

**At the Margins – Economic Geographies of Waste &  
Recycling**

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## Articles and Contributions

This cumulative dissertation is comprised of the following articles:

No.	Title	Journal	Status	Co-Authors	Contribution	Notation <sup>1</sup>
1.	Globalization and the Water-Energy-Food Nexus – Using the Global Production Networks Approach to analyze Society-Environment Relations.	<i>Environmental Science &amp; Policy</i>	Published 2018, Vol. 90 (Dec.), 201-212.	Martin Franz (33%), Kim Philip Schumacher (33%)	Co-author with significant contribution (33%)	ESP-Article (Section 5.1)
2.	Recycling economies and the use-value of waste: scrap shops in Kolkata, India.	<i>Journal für Entwicklungspolitik</i>	Published 2019, Vol. XXXV (2/3), 60-94.	/	Author (100%)	JEP-Article (Section 6.1)
3.	Environmental change and the informal plastic recycling networks of Kolkata.	<i>Singapore Journal of Tropical Geography</i>	Published 2020, Vol. 41 (3), 450-467.	/	Author (100%)	SJTG-Article (Section 6.2)

**Table 1:** Articles included in this cumulative dissertation.

The following publications were not incorporated into this cumulative dissertation, but contributed also to the research fields and scholarly debates addressed in it:

Laser, Stefan/Schlitz, Nicolas (2019): Facing Frictions: Waste and Globalised Inequalities. In: *Journal für Entwicklungspolitik*, XXXV(2/3), 5-32.

Schlitz, Nicolas (2016): Kreislaufstörungen. In Bangalore zeigt sich das Für und Wider von Recycling. In: *iz3w - Informationszentrum Dritte Welt*, 354(Mai/Juni), D18-D20.

<sup>1</sup> These short forms will be used to refer to the respective articles throughout the cumulative dissertation. If page references are given with these short forms, then they refer to page numbers in this dissertation.

## Preliminary Notes

The cumulative form of this dissertation has some implications with regard to formal requirements, which are briefly highlighted here:

1. The cumulative structure necessarily involves the repetition of some information that appears in the dissertation framework as well as in the compiled articles. This is the case, for example, with some elements of the literature review as well as the theoretical and methodical approach.
2. The literature references of the compiled articles have been transferred into the main reference section of this dissertation and harmonized according to the citation style used in this dissertation.
3. The empirical references, however, remain at the end of the compiled articles (where applicable) and are supplemented by a detailed empirical sample in the appendix.
4. The variation of in-text citation styles has been maintained to account for the original publications. These leads to some variation of citation styles.
5. The variation between American and British English has been also maintained to account for the original publications. This also leads to some variation in the English language style. This dissertation itself uses British English.

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## List of Abbreviations

BMEL	– Federal Ministry of Food and Agriculture in Germany
CDM	– Clean Development Mechanism
CIPET	– Central Institute of Plastic Engineering & Technology in India
EC	– European Commission
EEG	– Environmental Economic Geography
GCC	– Global Commodity Chains
GDN	– Global Destruction Networks
GPN	– Global Production Networks
GRN	– Global Recycling Networks
GVC	– Global Value Chains
IPCC	– Intergovernmental Panel on Climate Change
JNNURM	– Jawaharlal Nehru National Urban Renewal Mission
KMC	– Kolkata Municipal Corporation
KMDA	– Kolkata Metropolitan Development Authority
KSWMIP	– Kolkata Solid Waste Management Improvement Project
MoEFCC	– Ministry of Environment, Forest and Climate Change (formerly MoEF)
MSW	– Municipal Solid Waste
MSWM	– Municipal Solid Waste Management
OECD	– Organization for Economic Cooperation and Development
RDF	– Refuse-derived Fuel
SME	– Small- and Medium-sized Enterprises
SWM	– Solid Waste Management
WBCSD	– World Business Council for Sustainable Development
WBPCB	– West Bengal Pollution Control Board
WEF	– Water-Energy-Food Nexus
WtE	– Waste to Energy

## **1. Introduction**

This cumulative dissertation introduces an environmental economic geography approach to waste and recycling. It combines the analysis of two distinct case studies presented in three articles (see section 1.2 for an overview of the case studies and the articles on which they are based), namely the case of manure and digestate from intensive animal husbandry and bio-gas production in Lower Saxony, Germany, and the case of informal plastic recycling in Kolkata, India. The cumulative dissertation focuses on the analysis of economic and environmental change as entangled process, which is conceptualized in the context of waste and recycling as ‘waste economies’. As the discussion of the two respective case studies illustrates, waste economies represent an up-scaled analysis in terms of the entanglement of economic and environmental change at the analytical level of the capitalist production, societal handling and valorisation of waste. In this way, the cumulative dissertation contributes to a better understanding of the challenges posed to economic geography by global environmental change and touches upon some of the most pressing environmental issues related to globalised economic activities.

### **1.1. Putting the Global Waste Problem into Perspective**

In the course of the last five decades, overwhelming evidence for the unsustainability of human’s impact on earth has been gathered and directly related to the predominant ways in which economic systems are organised in modern, industrial societies (e.g. Haberl et al. 2011) – to their modes of production. This causal connection has referred in particular to the growth-orientation (e.g. Meadows et al. 1972) as well as increasing global integration of economic activities, which pose specific challenges to the economic feasibility and spatial scope of predominant environmental governance. The longstanding evidence of the increasing global scale of environmental problems like the depletion of ozone layers, acid rain and deforestation (amongst many others), and lately especially anthropogenic climate change (IPCC 2014) has figured prominently in public debates and policy forums. Economic geography is well equipped to address and analyse the globally integrated economic dimension of these changes (Dicken 2004) but has been lacking a thorough engagement with its environmental implications. This has changed in the last two decades with the emergence of the sub-disciplinary field of environmental economic geography (EEG; e.g. Braun et al. 2003; Gibbs 2006).

Waste has also figured prominently as pressing environmental problem. But it has been mostly framed as ‘post-consumption waste’ (Rogers 2006; Liboiron 2016a) and treated as a local, regional and particularly urban issue that reaches global scales only through aggregation of local incidences or global trade in hazardous waste (giving rise to the Basel Convention on the Transboundary Movement of Hazardous Waste; cf. Lepawsky/Connolly 2016) – in contrast to the ‘natural’ flows and proliferations engendered by other global environmental problems. In effect, such a framing affirms the governability of waste – and its resolvability as an environmental problem (Gourlay 1998) – through established regulatory mechanisms and technologies of environmental management. As a result, the crisis tendencies evoked by a steadily growing volume and complexity of waste have apparently been mitigated in the Global North since the 1980s by the systematic implementation of ‘secure’ waste management technologies like controlled landfilling, incineration and recycling.

In view of a perceived global scarcity of resources as well as adverse environmental impacts associated with resource extraction or waste disposal, however, awareness for the ‘waste problem’ and the wastage of resources is rising again within the OECD member states (OECD 2015). In recent years, this new problem awareness has made its way into various economic and political forums and the broad public debate under the notion of ‘circular economy’ (EC 2015). Moreover, this shift in public perception and policy orientation signals also a broadened scope of wasting processes beyond post-consumption waste that warrant attention, like in the case of the strong emphasis on agricultural waste in the concerted efforts to implement the concept of a ‘bio-economy’ (BMEL 2014). The broadened scope of waste and wasting processes under consideration reflects the results of an increasing number of studies that have focused on environmental implications of the changing material and energy flows, or “social metabolism” (Haberl et al. 2011: 3) of human societies on earth – especially studies that attended to the whole spectrum of ‘outflows’ from human economic, and particularly industrial activities (e.g. Moriguchi 1999; Matthews et al. 2000). Such an appraisal of the “system of materials flows and balances” (Coe et al. 2008: 378) has been also invoked as a promising approach for the integrated analysis of economic and environmental change in EEG (cf. Hudson 2001, 2008; Bridge 2008b, 2009). But little attention has been paid so far to “the outputs to the natural environment in the form of pollution/waste” (Coe et al. 2008: 379) in EEG. The

articles compiled in this cumulative dissertation address this research gap and connect the thrust of EEG to the existing economic geography scholarship on waste and recycling across North-South divides (e.g. Lepawsky/Billah 2011; Crang et al. 2013; Herod et al. 2013).

Since the mid-1990s, the steadily growing volumes of waste, the global trade in waste and recycling materials, and the associated environmental pollution in countries of the Global South have led to increasing environmental concern (World Bank 1999; UN-HABITAT 2010; UNEP 2015) as well as public controversy and socio-environmental conflict (e.g. Moore 2008; Chaturvedi/Gidwani 2011; Demaria et al. 2012; Schlitz 2014b). These articulations of the ‘waste problem’ in the Global South revealed also the limited transferability of environmental regulatory and waste management concepts and technologies from the North. In emerging economies of the Global South – such as India – the close connection between economic growth, integration into global production networks, changing and rising resource consumption (Singh 2012), and intensified waste generation illustrates the socio-environmental ambiguity of globalisation processes – epitomized in the abundance of plastic wastes in public space (Gasser et al. 2018). At the same time, informal recycling economies represent an important economic factor in many countries of the Global South and supply entire production networks with resources, often in conjunction with global trade in waste and recycling materials (Gregson et al. 2010; Bomhauer-Beins/Strüver 2014; WBCSB 2016).

On the one hand, these developments illustrate the close link that exists between the unabated crisis-ridden character of waste generation and its societal handling in the Global North and South. On the other hand, the economic significance of recycling economies and the global trade in waste and recycling materials makes the connection between the production of waste and its political governance and economic valorisation tangible. Waste is therefore not only an environmental problem that renders the sustainability of a global, growth-oriented capitalist economy questionable. Rather, the management and valorisation of waste – especially in the form of waste management, recycling and waste-to-energy industries – has opened up new fields of accumulation and is construed as critical component of future green circular economies, including its more rural version of a bio-economy. As will be shown throughout this dissertation, industrial patterns of waste production do not necessarily delegitimise capitalist economic systems for environmental

reasons, but also contribute to the reproduction of the internal and external limits of capitalist dynamics of accumulation, which are invariably based on growth. This economic valorisation of different forms of waste is at the centre of the conceptualisation of ‘waste economies’ elaborated in the following chapters of the cumulative framework and addressed in the research questions.

## 1.2. Interrogating Waste Economies – The Research Object

The analytical starting point of this dissertation is the seemingly banal observation that the growth-oriented global economy is producing substantial amounts and diverse forms of waste, and that this production of waste is constitutive of some of the most pressing environmental challenges of our times. This observation is the basic premise for the main assumption of this thesis, which is that in the course of the 20<sup>th</sup> century the production of waste has been integrated through diverse means (like concepts, technologies, forms of governance as well as valorisation strategies – as in the case of ‘waste-to-energy’) into the ways our economic and political systems function. Moreover, this production of waste is by now conducive for the growth and future development of the actual economic and political systems that produce substantial amounts and diverse forms of waste in the first place. Thus, the basic assumption of this thesis is that *capitalist patterns of waste production have become conducive for the reproduction of the internal and external limits that ensure further rounds of capitalist accumulation.*<sup>2</sup> This cumulative dissertation is subsequently guided by the following research question: *What is the role of waste in the expanded reproduction of capitalist (social and economic) relations and their spatial articulations?* This research question is further subdivided into the following two sub-questions:

a.) *What correlations, intersections and contradictions can be established between different patterns and dynamics of waste production and those of the societal handling and valorisation of waste, and how can these be conceptualised?* This sub-question pertains to the role of waste in the main research question. It aims at establishing and elaborating the

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<sup>2</sup> This assumption draws on a longstanding debate that has characterised academic ‘eco-Marxism’ (Marxist political-economy approaches to the analysis of society-nature relations) for the last decades of the 20<sup>th</sup> century (e.g. Benton 1989; Altvater 1993; Grundmann 1991; Castree 2000). While it is not possible to present this debate in detail here (see section 3.3 for some implications), it is necessary to clarify that the basic assumption of this thesis implies a doubtful stance towards positions that the ecological crisis tendencies of capitalist modes of production will eventually cause the ‘self-destruction’, and thus ‘the end of capitalism’ - history has refuted such a teleological position.

notion of ‘waste economy’ as the historical coincidence of the ways in which waste is produced in a particular society, and how it is handled in this society – how these two processes fit together and constitute a functional coherency, or if they do not fit together, what such a dysfunctionality then means for the stability and sustainability of the respective society (cf. Gille 2007).

b.) *How are waste economies – as the interplay of waste production, handling and valorisation – related to the expanded reproduction of capitalist social and economic relations and its spatial articulations?* This sub-question is relating the conceptualisation of waste economies back to the expanded reproduction of capitalist modes of productions – to the conditions that allow capitalist economies to continually grow and expand.

These research questions guide the up-scaled analysis of the case of manure and digestate from intensive animal husbandry and bio-gas production in Lower Saxony, Germany, and the case of informal plastic recycling in Kolkata, India. The first case study investigates the valorisation of surplus manure from intensive animal husbandry through biogas production in a highly industrialized rural region in north-western Germany – the example of manure and biogas plants in the Oldenburger Münsterland. This case study is presented in the article entitled “*Globalization and the Water-Energy-Food Nexus – Using the Global Production Networks Approach to analyse Society-Environment Relations*”, published 2018 in *Environmental Science & Policy* in co-authorship with Martin Franz and Kim Philip Schumacher (see section 5.1). The second case study focuses on plastic waste and used plastic materials that are revalorised through urban informal economies in India – the example of informal plastic recycling networks in Kolkata. This case study is based on two articles. The first is entitled “*Recycling economies and the use-value of waste: scrap shops in Kolkata, India*”, published 2019 in the *Journal für Entwicklungspolitik* (see section 6.1). The second article with the title “*Environmental change and the informal plastic recycling networks of Kolkata*” has been submitted to the *Singapore Journal of Tropical Geography*. It was published after the completion of this dissertation (see section 6.2).

These two case studies exhibit a number of differences, see table 2. The first case is situated in the Global North, in a rural region, while the second case is situated in an intensely urban agglomeration in the Global South. The two cases differ also substantially with regard to the types of waste and processes of wasting involved. The first case is concerned with agricultural waste – of intensive animal farming in particular – and the



aggravation of its environmental impact in the course of a successful valorisation strategy that uses surplus manure as resource input into bioenergy production, leading in turn to a surplus of digestate that needs to be handled. The second case, in contrast, is concerned with plastic waste, as one of the most paradigmatic forms of waste produced and proliferated by globalized economic activities. The recuperated and recycled plastics are derived from all possible kinds of plastic applications in India and are remanufactured into a whole range of recycling plastic products that serve mainly the needs of socio-economically disadvantaged groups. Yet, the most important difference between these two cases is the economic form that the handling and valorisation of waste has taken. On the one hand, we have a formal and highly industrialised rural economy that is also well integrated into global production networks. On the other hand, we have an urban and overwhelmingly informal economy that exhibits a number of (often indirect) relations and interdependencies with global production networks, but which produce mainly for regional low-value markets.

<b>Caste Study</b>	<b>Manure and digestate from meat and biogas production in Lower Saxony<sup>3</sup></b>	<b>Informal plastic recycling networks in Kolkata<sup>4,5</sup></b>
<b>Regional Context</b>	Rural Germany (Oldenburger Münsterland)	Urban India (Kolkata Metropolitan Area)
<b>Type of Waste</b>	Manure and digestate (organic waste)	Plastic wastes (polymers; synthetic wastes)
<b>Context of Revalorisation</b>	Industrial agriculture (formal)	Informal production (recycling and remanufacturing)
<b>Scope of Network Embeddedness</b>	Globally embedded production	Regionally embedded production

**Table 2:** Characterisation of the presented case studies

The substantial differences between these two case studies notwithstanding, they both also show a number of parallels that serve to illustrate important dimensions of waste economies. They point to the double character of waste, which always carries with it positive and negative framings or potentialities, laying the ground for their valorisation. In this way, they also reflect the confluence of ‘input’ and ‘output’, which points to the close

<sup>3</sup> Franz, Martin/Schlitz, Nicolas/Schumacher, Kim Philip (2018): Globalization and the Water-Energy-Food Nexus – Using the Global Production Networks Approach to analyze Society-Environment Relations. In: *Environmental Science & Policy* 90(Dec), 201-212. (See section 5.1)

<sup>4</sup> Schlitz, Nicolas (2019): Recycling economies and the use-value of waste: scrap shops in Kolkata, India. In: *Journal für Entwicklungspolitik* XXXV(2/3), 60-94. (See section 6.1)

<sup>5</sup> Schlitz, Nicolas (2020): Environmental change and the informal plastic recycling networks of Kolkata. In: *Singapore Journal of Tropical Geography* 41(3), 450-467. (See section 6.2)

entanglement of economic and environmental change, and subsequently helps to carve out the relationships between waste production and its societal handling. Moreover, even though the utilisation of manure as fertilizer in agriculture is probably one of the oldest practices of recycling in human history (Winiwarter 2002), both case studies provide particular insight into the dynamics of waste economies associated with globalised economic activities. They reveal how different forms of waste as well as processes of wasting and valorisation are enshrined in the uneven geographies of today's capitalist modes of production. Drawing on these two case studies, the overarching research question of what potential role waste – its production, handling and valorisation – has for the expanded reproduction of capitalist social and economic relations is addressed with respect to the uneven geographies of capitalism.

### **1.3. Outline**

The core of this cumulative dissertation is constituted by the three articles, which present the two case studies for the cumulative analysis. The cumulative framework is arranged around these core pieces and structured in the following way:

The next (2.) chapter introduces the relevant fields of literature, within which the environmental economic geography of waste and recycling is situated. It first introduces the sub-disciplinary field of environmental economic geography (EEG) along with the chain and network approaches characterising economic geography today, particularly the global production networks (GPN) approach. This is followed by an introduction to the interdisciplinary field of waste studies and the economic geography engagement with waste and recycling through global recycling networks (GRNs) and global destruction networks (GDNs). The chapter is closed with a short synthesising section that highlights identified research gaps and the contribution of this cumulative dissertation to the scholarly debates.

Chapter 3 presents the conceptualisation as well as operationalisation of the notion of waste economies on which this dissertation is based. This chapter, first, underscores waste economies through a critical discussion of the conceptual scope of the terms 'economy', 'waste' and 'expanded reproduction capitalist modes of production'. It subsequently conceptualises waste economies with reference to the production, handling and valorisation of waste, and further elaborates their operationalisation with regard to

processes of externalisation as well as dynamics of intensification and expansion.

Chapter 4 presents the empirical basis of the two case studies and elaborates their research approaches and methods used in data generation and analysis. It then goes on to the analytical integration of both case studies towards the appraisal of waste economies.

Chapter 5 contains the case study of manure and digestate from meat and biogas production in the Oldenburger Münsterland. It introduces this case and the relevant literature, followed by the first article of this cumulative dissertation. The chapter is closed by a brief discussion of this case and the corresponding article with regard to the specific articulation of waste economies entailed in it.

Chapter 6 presents the case study of informal plastic recycling in Kolkata. The case is first introduced and elaborated along the relevant literature, before it leads over to the second and third article of this cumulative dissertation. This chapter is also closed by a brief discussion of this case and the corresponding articles with regard to the specific articulation of waste economies entailed in it.

The next (7.) chapter discusses the analytical insights gained from the two case studies with regard to environmental economic geography of waste and recycling. It presents the combined analysis of waste economies – as the production, societal handling and valorisation of waste – of these two case studies. This is followed by the conclusion.

## 2. Waste and Recycling in Economic Geography

The engagement with waste and recycling has intensified across social science disciplines during the last two decades (Laser/Schlitz 2019), including human geography (e.g. Moore 2012). However, waste and recycling has not figured prominently within the subdiscipline of economic geography until the end of the 2000s (e.g. Lepwasky/Billah 2011; Gidwani/Reddy 2011), which can be explained to some extent with the general lack of attention paid to environmental issues, critically noted by a number of scholars (Dicken 2004; Braun et al. 2003; Coe et al. 2008). This chapter deals with the theoretical approaches that underpin the appraisal of waste and recycling in this cumulative dissertation. The case-specific literature and state of the art will be presented and discussed in the case study introductions (see section 5.1 and 6.1) and in the compiled articles (see section 5.2.5, 6.2.4 and 6.3.3).

This cumulative dissertation is situated in the field of economic geography of waste and recycling. I will hence in the following illustrate the current debates and outline which gap this dissertation aims to fill, namely contribute to the understanding of the economic function of waste in growth-oriented capitalist economies. More precisely, this dissertation aims to clarify how “economic and environmental processes intersect” (Aoyama et al. 2011: 116) in the production, societal handling and economic valorisation of waste, and how this intersection is conducive for capital accumulation. The economic geography of waste and recycling is linked to two sub-disciplinary, respectively interdisciplinary fields of studies: First, the burgeoning field of environmental economic geography (EEG; eg. Braun et al. 2003), which is firmly situated within the predominant chain and network approaches characterizing economic geography but also draws on other intellectual traditions (see section 2.1). Second, the emerging interdisciplinary field of waste studies (e.g. Moore 2012), which brings together several disciplinary and theoretical paradigms (see section 2.2). In addition, the conceptualization of waste economies outlined in this dissertation draws on four particular strands of literature, which either connect economic geography with waste studies or reverberate in both of these fields of studies, although often not very prominently. This includes the works on global recycling networks (GRNs; e.g. Crang et al. 2013; Lepawsky/Billah 2011), which constitute until now the main bridge between waste studies and economic geography. This also includes the works on global destruction networks (GDNs; e.g. Herod et al. 2013). GDNs have the potential to link

economic geography with waste studies. However, until now works on GDNs are confined to Marxist labour geography within economic geography and have taken only very limited notice of the dynamic development of waste studies (for GRN and GDN see section 2.3). Moreover, this includes two distinct but sometimes related approaches to the study of society-environment relationships that transcend both, (environmental) economic geography and waste studies. On the one hand, Marxist political economy approaches to the study of society-nature relations (e.g. Smith 1984, 2006; Harvey 1996, 2003; see also Castree 1995; Swyngedouw 1999; Bakker/Bridge 2006; Barnes/Christophers 2018) and the relation of waste and value in particular (e.g. Gidwani 2012; Gidwani/Reddy 2011; Samson 2015, 2017). And on the other hand, the conceptualization of society-environment interactions in terms of a social metabolism, that sheds a particular light on the production, handling and valorisation of waste (Winiwarter 2002; Demaria/Schindler 2016). Social metabolism and Marxist approaches will be highlighted throughout this chapter, wherever applicable, and will figure more prominently in the following chapter concerned with the theoretical conceptualisation of waste economies. This overview of the relevant strands of literature (see figure 1. for a depiction) will be completed with a short synthesis that carves out how this cumulative dissertation at the intersections of EEG and waste studies contributes to scholarly debates and economic-geographical understandings of the role of waste for the continued growth of capitalist economies (see section 2.4).

### **2.1. Chain and Network Approaches in Environmental Economic Geography**

The engagement with environmental concerns within economic geography has a relatively long but discontinuous history. Its origins lie mainly in resource geography as distinct geographic sub-discipline (Bridge 2008b, 2009; Hanink 2000) but include also several Marxist works on the relationships between capitalism and ‘nature’ that have been influential beyond the boundaries of the discipline (e.g. Smith 1984; see also Bakker/Bridge 2006). However, in its current outfit as EEG, it is strongly shaped by the conceptual terrain offered by the predominant chain and network approaches in economic geography, particularly the global commodity chain (GCC; e.g. Gereffi/Korzeniewicz 1994), global value chain (GVC; e.g. Gereffi et al. 2005) and global production network (GPN; e.g. Henderson et al. 2002) approaches, which will therefore be introduced in the following.

### **2.1.1. Chains and Networks of Global Production in Economic Geography**

Economic geography is today strongly shaped by chain and network approaches to the study of globalised economic activities. The notions of ‘networks’ and ‘embeddedness’ entailed in these approaches signal a general effort to acknowledge “the impact of social structure on economic activity” (Bair 2008: 340) and organisation beyond the ‘market’ and ‘hierarchy’ (Bair 2008; see also Hess 2004). Basically, these chain and network approaches have been developed out of unease with the limited explanatory power as well as reduced spatial and analytical scope of preceding conceptual approaches in face of the intense global integration of economic activities which came to be known as ‘globalisation’ since the 1990s (Dicken 2004). The chain heuristic on which these approaches draw originates from the notion of ‘commodity chains’ developed by world system theory (Hopkins/Wallerstein 1986). As Bair (2008: 348) points out, “in this tradition commodity chain analysis is a means to the end of understanding the evolution of the world capitalist economy – the true unit of analysis in world-systems research”. But the scope and scale of analysis has changed drastically in the course of the development of different chain and network approaches. According to Bair (2008: 340), it “has progressively narrowed across these approaches”, as she explains, starting with the most recent approach of GVC:

In essence, it is an effort to scale down the concept of governance from a characterization of the chain in its entirety to a description of the mode of coordination prevailing at a particular link in the chain, just as Gereffi’s global commodity chain represented a different kind of scaling down from the holistic chain construct of world-systems theory. [... In contrast,] the GPN paradigm within economic geography [...] advocates a scaling up and out of the network construct to enable a more macroscopic understanding of global production networks as a set of relational processes. (Bair 2008: 354)

The last mentioned GPN approach, because it aims again at a more up-scaled analysis and incorporates also ‘non-chain’ actors, allows for the appraisal of social and political – and as argued here: ‘material’ and ‘natural’ – environments of economic activities. Departing from GVC and preceding chain approaches, the GPN approach is drawing on a network heuristic in order to conceptualise global economic activities. The resulting networked constellations of globalised production are analysed through three analytical categories

(Henderson et al. 2002): value (divided into value creation, enhancement and capture), power (in the form of corporate, institutional and collective power) and embeddedness.

From its outset, the analytical category of 'value' included "both Marxian notions of surplus value and more orthodox ones associated with economic rent" (Henderson et al. 2002: 448). In addition, recent works on the under-researched 'dark sides' of, as well as processes of 'disarticulation' (Bair/Werner 2011; McGrath 2018; Werner 2018) from networks of globalised production have also pointed out that "value can be seen as socially, politically, historically, geographically, and discursively determined" (McGrath 2018: 513). This has implications for our understanding of value creation, enhancement and capture by different actors, as such processes can also "involve the destruction of resources, the (enforced) transfer of value from one set of actors to another, or even the re-valuing of that which was considered without value" (McGrath 2018: 513). Accordingly, the creation, enhancement and capture of value is imbued with power relations.

This is particularly relevant for the GPN approach, because in contrast to the GVC approach it does not only consider economic actors directly involved in "transforming 'inputs' into 'outputs'" (Coe et al. 2008: 274). Instead, global production networks can be understood as "contested fields" (Levy 2008: 948) which are also shaped by the institutional and collective power of a number of other actors like government agencies and state authorities, trade unions and civil society organizations. The political-economic reading of GPNs offered by Levy (2008), for example, underscores that international organisations, government institutions and state authorities often actively enable economically powerful actors to obtain and maintain economic rents in a process which is as much a "transfer" (Levy 2008: 947) of value as efforts by corporate capital to reduce wages. Moreover, Pauls and Franz (2013) have drawn our attention to power struggles beyond the entrenched triad of state, trade union and corporate actors. They highlight that also "struggles between state institutions [...] and local social and cultural institutions determine the capacity of the different actors to create value" (Pauls and Franz, 2013: 240). This already points to the unabated relevance that the spatial articulations of social, cultural and political structures play in shaping globally integrated production networks. In addition to the network relations of globally integrated economic actors, such place-based societal structures are taken into account in the GPN approach through an enhanced notion of embeddedness, particularly through societal and territorial embeddedness (Hess 2004).

Societal embeddedness pertains to the shared social and cultural background of actors – their common origin – while territorial embeddedness describes the place-based-ness of economic actors in particular territories. For the purpose of this cumulative dissertation the notion of societal and territorial embeddedness is partly extended in order to emphasize the social, cultural and in fact political contexts of economic activities (cf. Bair 2005; Crang et al. 2013). Following McGrath's (2018: 514) argument that “[a]ccounting for the inherently spatial nature of embeddedness grounds economic activity in social, cultural and political processes”, I aim at including all “non-economic, social relations in and through which firms operate” (Crang et al. 2013) into the analysis.

The strength of the GPN approach is the broad scope of its meso-level analysis, which allows for the appraisal of globalised economic activities across several scales. But the lacking up-scaled theoretical conclusions and theorizations about “the causal mechanisms linking these elements [of value, embeddedness, and power] to the dynamic configurations of global production networks” (Yeung et al. 2015: 32) – which in fact is the dynamic of a global capitalist economy – in GPN contributions has been subject to critique (e.g. Hudson 2008; Starosta 2010). Yeung et al. (2015: 53) have therefore proposed “[a] more dynamic GPN theory” which they call “GPN 2.0”. This cumulative dissertation also constitutes an effort for an up-scaled theorisation, although with a much smaller scope and focused primarily on the particular case of capitalist waste economies. But this effort deviates from the direction that GPN 2.0 has taken in Yeung et al. (2015: 53), in as far as the “peculiar combination of territorial outcomes arising from these processes [of (de/re)coupling]” do not remain an “empirical question” (Yeung et al. 2015: 53), but are considered central avenues for the theorisation of uneven capitalist development that is as much characterised by externalisations, exclusions and “disarticulations” (Bair/Werner 2011; McGrath 2018; Werner 2018) as it is by global integration.

### **2.1.2. Environmental Economic Geography**

As indicated above, there is a long tradition of research on environmental issues in economic geography, maintained largely under the rubric of resource geographies. But relatedly, and until recently (cf. Hanink 2000), environmental issues within economic geography were often confined to a narrow conceptualisation of resources as primary commodities and production factors for single industries (Bakker 2012). This factors were



analysed with regard to locational decisions and resulting global and regional economic imbalances – like the much debated “resource curse” (Bridge 2008b). These considerations did not include vital, although at times more indirect ‘inputs’ and conditions of economic activity related to basic ecosystem services and functions, on which various livelihoods thrive upon. As Bakker (2012: 105) points out, “they were treated as exogenous inputs to locational calculus. In line with mainstream economics, resources were defined in utilitarian terms – as economic inputs”. Resource geographies, thus, treated the environment and ‘nature’ as something external to society and the economy. The emerging field of studies that can be loosely described as environmental economic geography (EEG) is intended to partly correct this reductionist perspective on resources and the environment within economic geography (Bakker/Bridge 2006; Bridge 2009; Aoyama et al. 2011; Schmitt/Schulz 2016), and reclaim competence in face of other discipline’s advancing social-environmental explanations in what is considered to be one of geographies core competences (Braun et al. 2003; Gibbs 2006; Soyeux/Schulz 2008).

Contributions to EEG draw on a range of different concepts that mostly exhibited a certain theoretical proximity to the economic mainstream, like ecological modernisation (Gibbs 2006), institutional economics (Hayter 2008) or multi-level environmental governance, but included references to interdisciplinary fields of studies like political ecology (Braun et al. 2003; cf. Robbins 2012). Bridge (2008a: 76) describes EEG accordingly as a “topical contrivance” – a heterodox field mainly united by a common object of studies:

One *modus operandi* for EEG is to apply to contemporary ‘green’ phenomena the conceptual tools and methodological techniques developed in other areas of economic geography: in effect, to extend economic geography’s franchise by rolling out a well-honed set of tools. (Bridge 2008a: 77; italics in original)

A number of GVC and GPN contributions to EEG for example focus on the environmental upgrading of economic actors (e.g. De Marchi et al. 2013a) or they attend to the ‘greening’ of value chains (e.g. Bolwig et al. 2010; Reps/Braun 2012; De Marchi et al. 2013b) including environmental governance through eco-labelling (e.g. Ponte 2008). In his ‘sympathetic critique’, Bridge (2008a: 76) consequently describes EEG as “a loose grouping of grounded research activities that address the reciprocal relationships between economic organization and environmental outcomes” – but one which lacks a shared “distinctive intellectual project out of the encounter between economic geography and

environment” (Bridge 2008a: 76).

However, there is indeed a strong bias towards the paradigm of ecological modernisation in much of the EEG literature. This bias is problematic because of its one-sided emphasis on eco-efficiency, technological innovation and market mechanisms to address the environmental destructiveness of the current growth-based global economy, thus implicitly affirming the status quo. The “Gospel of Eco-Efficiency” (Haberl et al. 2011: 8) and the paradigm of ecological modernisation have received much critique because of its adherence to economic growth since the famous “Limits to Growth” report of the Club of Rome (Meadows et al. 1972). Proceeding from this early critique, Kosoy et al. (2012: 75) – drawing on the Javons Paradox – highlight that “efficiency increases accruing from technological innovations can become perverse incentives to consume more”. Moreover the promotion of “technological solutions to economic-socio-ecological problems” (Kosoy et al. 2012: 75) has depoliticising effects and distracts from the inherent entanglements of environmental and economic (as well as social and political) processes (Robbins 2012). In effect, the paradigm of ecological modernisation exhibits a strong tendency to treat ‘nature’ and the environment as something external to the economy. This reproduces a dichotomous view of society and its ‘natural’ environments that has spurred much critical engagement with social-environmental relations throughout the last decades, particularly within human geography (Smith 1984; Swyngedouw 1999; Castree/Braun 2001; Bakker/Bridge 2006). Bridge (2008a:77) proposes therefore to “use the encounter between economic geography and nature to question – and potentially to transform – some of the concepts which comprise economic geography”. He maintains that “the objective of an EEG should be to understand the difference that ‘environment’ makes to processes we have traditionally considered to be (purely) economic” (Bridge 2008a: 78-79). This again points to the merits of analysing “the environmental impacts of economic activity and the economic impacts of environmental mitigation” (Bakker 2012:104). One example for a process that has often been considered as ‘purely economic’ within economic geography is economic growth, the engagement with which has given EEG at least two new possible directions.

First, the assessment of the material and energy use of human societies – in terms of inputs, flows, transformations, stocks and outputs – at the intersection of industrial ecology and ecological economics has led to a number of critical accounts of the impossibility to

‘decouple’ economic growth from intensified material and energy use (e.g. Haberl et al. 2011). This adaptation of (social, or urban) metabolism as metaphor and methodology to investigate social-environment relations (see section 3.1) has been influential in human geography (Newell/Cousins 2015) and has not remained unnoticed in economic geography too (Hudson 2001, 2008; Bridge 2008b, 2009; Bolwig et al. 2010; Braun/Schulz 2012). Coe et al. (2008: 378) argue that “[c]onceiving of production chains/networks as a system of materials flows and balances [...] is a potentially valuable way of integrating GPNs with the fundamental environmental interaction that occurs at every point in the network”. Second, the unsustainability of a growth-based global economy has sparked a curious engagement with debates about post- and degrowth (e.g. D’Alisa et al. 2014) in economic geography (e.g. Schulz/Bailey 2014; Schmitt/Schulz 2016). Aoyama et al. (2011: 117) consider ‘growth’ therefore as an ‘excellent example’ for the new directions that EEG could take:

Long a fundamental concept in economic geography and in economic thought and practice more broadly, we can no longer assume that growth is good, or even that we know what growth is. [...] An important implication is that growth-oriented policies are not purely technical or objective but are inherently normative and political, which then suggests that growth should be decentered as a central goal of economic (and economic-environmental) activity.

These are just two (most relevant for this dissertation) of several possible directions invoked for an EEG (cf. Bridge 2008a; Aoyama et al. 2011; Braun et al. 2018) that take full theoretical and empirical advantage of the “mutual constitutiveness of economic and environmental change, with particular attention to the social dimensions of economic activity” (Bakker 2012: 109). This involves a fundamental reconfiguration of the “society—nature nexus” (Castree/Braun 2001: 13). Accordingly, as Aoyama et al. (2011: 116; italics in original) highlight, “global environmental change is not something that humans *do to* nature but rather refers to 21st-century postindustrial ‘socio**natures**’ that *emerge from* the intersection (or ‘coupling’) of numerous social and natural processes”. This co-constitutive understanding of “socio**nature**” (Swyngedouw 1999: 445; cf. Castree/Braun 2001) that is arising from the entanglement of economic and environmental change serves a double purpose. First, it puts a stronger emphasis on the ‘materiality’ of nature, thereby transgressing the society-environment binaries that have structured much of

the scholarship on society-environment relations. Second, it opens up an opportunity to critically re-engage Marxist works on the relationship between ‘nature’ and capitalist political economies, which have been partly disconnected from EEG and the economic geography mainstream (Bakker/Bridge 2006; Bridge 2009; see also Castree 1995, 2000) – like Smith’s (1984) “production of nature” thesis or Swyngedouws (1999: 447) notion of *socionature*, that recognises the ‘world’ as:

a process of perpetual metabolism in which social and natural processes combine in a historical-geographical production process of *socionature*, whose outcome (historical nature) embodies chemical, physical, social, economic, political, and cultural processes in highly contradictory but inseparable manners.

This cumulative dissertation contributes to such efforts to carve out the close entanglements of economic and environmental change within EEG through the focus on one very particular form of *socionature* – waste. As paradigmatic example for the externalised ‘output’ of societies and economies, waste potentially re-evolves towards a form of environment again, but will (in many cases) also never really lose its social imprint. Moreover, the deep interrelation between the production, societal handling and valorisation of waste points to manifold and contradictory ways in which material and environmental process impinge back upon economic processes.

## 2.2. Waste Studies

In the last two decades, the scientific engagement with waste has gained importance. It is an interdisciplinary field of research linking natural and social sciences (for an overview see Evans 2011; Moore 2012; Gregson/Crang 2015; Reno 2015; Alexander/Sanchez 2018; Dines 2018; Millington/Lawhon 2018; Corvellec 2019). Research that can be attributed to these Waste and Discard Studies<sup>6</sup> has highlighted that the ‘waste problem’ cannot be confined to a separate sector of technocratic environmental management, as Liboiron (2018a) explains:

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<sup>6</sup> The designation of this interdisciplinary field of research as Discard Studies was essentially coined by scholars affiliated to the blog [www.discardstudies.com](http://www.discardstudies.com), which has established itself as one of the most important publication platforms for social science work on waste and environmental pollution. While sympathetic to the arguments put forward for the deviating designation, the notion of Waste Studies is maintained in this dissertation due to its broader scope.

We tend to think that we are familiar with waste because we deal with it every day. Yet, this is not the case – most aspects of waste are entirely hidden from view and understanding. Waste and wasting includes social, economic, political, cultural, and material systems that shape materials, practices, infrastructures, and norms. [... But,] waste seems like a technical problem rather than a social, cultural, economic, and political problem.

The ‘waste problem’ is, in contrast to this predominant technical framing, inherently linked to fundamental societal orders (e.g. Douglas 2001 [1966]; Thompson 2017 [1979]), industrial patterns of production (e.g. Gille 2007), politics and technologies of disposability (e.g. Gregson/Crang 2010; Schlitz 2014b), economies of recycling (e.g. Alexander/Reno 2012; Crang et al. 2013), as well as consumer (e.g. Bulkeley/Gregson 2009) and repair cultures (e.g. Jackson 2014). It is linked to the ways in which societies, different social groups and their cultures are normatively ordered and organised and how they relate to their environments. What waste *is*, is therefore hard to define and strongly depending on the historically and geographically specific socio-economic, cultural and political context. Inspired by Actor Network Theory (ANT; e.g. Latour 2005) and Science and Technology Studies (STS; e.g. Coole/Frost 2010), these studies have therefore focused on the processes of wasting (e.g. Gourlay 1992), the materiality of waste and pollution (e.g. Gille 2007; Gregson/Crang 2010; Gabrys et al. 2013; Liboiron 2016b) and – following from the insight that waste’s materiality is often hard to ‘fix’ – on the hybridity and indeterminacy of waste (Hird 2012, 2013; Gille 2013). The latter pertains to the context-specificity of waste and processes of wasting, and emphasises the material and discursive transformations that occur when waste moves through space, time as well as through different social categories of things. Moreover, pointing to the ‘posthuman’ and ‘material turn’ signalled by ANT and STS, waste studies have highlighted the ‘material agency’ of wasted things throughout such transformation processes. Waste also affects and often changes the social, economic and political systems that created it in the first place. It is ‘acting’ back on society and its normative orders, potentially destabilising or also stabilising them. In tracing how different wastes and forms of wasting constantly translate into each other across time, space and scale (Gille 2007), waste studies have been able to show that “all waste and pollution are about power by maintaining structures that designate what is valuable and what is not” (Liboiron 2018b).

Globalised economic activities have drastically changed the power relations and inequalities related to waste and processes of wasting, and have accelerated the politico-economic dynamics through which they unfold. According to Laser and Schlitz (2019), waste studies have contributed to our understanding of the close entanglement of waste and globalised inequalities in three distinct ways. First, they have drawn our attention to the governance of waste, which generally ascertains the resolvability of the ‘waste problem’ – affirming that it is possible to get rid of things in the first place – through technological solutions. Gille’s (2007, 2010) concept of waste regimes has elaborated how the underlying politics of waste are always intertwined with predominant modes of waste production in a society as well its discursive representations. The resultant de-materialising effects of the governance of waste have been highlighted by Gregson and Crang (2010). Framed as technocratic management, this governance of waste is characterised by an imperative of disposability that translates either into ‘end-of-pipe’ technologies – “principally the established ones of incineration and landfill” (Gregson/Crang 2010: 1026) – or it is “reconfigured as resource recovery” (Gregson/Crang 2010: 1026) under the guise of the circular economy, which is also based on specific forms of dematerialisation and exclusion (Gregson et al. 2016). This is connected to the second aspect, the materiality of waste: the material “consequences of waste and pollution are shared unequally, laying the ground for vast injustices” (Laser/Schlitz 2019: 5) that are further complicated by the hybridity and indeterminacy of waste outlined above. Third, this field has engaged intensively with the relationship between waste and value (Gidwani/Reddy 2011; Gidwani 2012; Samson 2017), unveiling the dynamic relationship between the uneven geographies of capitalist accumulation and the reproduction of social inequalities. However, there is a peculiar (and partly self-chosen) disconnection of Marxist contributions that sets this third aspect apart from other works in the field of waste studies. In this regard, the environmental economic geography perspective on waste and recycling envisioned in this dissertation calls for – and to some extent also offers – a bridge between these at times disparate research strands within the interdisciplinary field of waste studies.

The social theory of waste developed by Gille (2007; see also section 3.2) has been one of the most influential contributions to the burgeoning field of waste studies (c.f. Cooper 2009; Evens 2011; Moore 2012; Reno 2015). It is particularly useful for the integration of Marxist approaches into the wider canon of waste studies and EEG because it links a

Marxist political economy perspective with ANT. Through this theoretical integration, Gille (2007, 2010) arrives at a conceptualisation of waste-society relations and of waste as a “hybrid entity” (Gille 2007: 27) that is very similar to the notion of socionature proposed by Swyngedouw (1999) and Castree (1995, 2001, 2002) for the analysis of society-environment relations within human geography. For Gille (2007: 28), hybridity “is the acknowledgement that the material and the social do not exist apart from one another; rather, they constantly create and reconstitute each other”. This is much in line with the notion of socionature suggested by Aoyama et al. (2011: 116-117) for a reconfigured EEG:

economic relations do not lead to ‘destruction’, ‘protection’, or ‘restoration’ of nature per se; instead, economic and environmental processes intersect to produce new socionatures, which then reshape possibilities for future economic and environmental relations.

Accordingly, this dissertation draws on a procedural (hybrid) understanding of wasting as co-constitutive process, considers the materiality of waste and highlights the inextricable interrelations between waste and value in order to analyse waste economies. In this vein, it combines both Marxist and ‘new materialist’ perspectives within EEG and waste studies. It contributes to a better understanding of the fragmented and disparate articulations of socionatures through the way in which waste economies – as the entangled production, handling and valorisation of waste – are shaped by and also shape the uneven geographies of capitalism.

### **2.3. Waste and Recycling in Economic Geography**

Recent contributions to the study of waste and recycling within economic geography are to varying degrees related to the interdisciplinary field of waste studies. Their waste-specific criticism and expansion of chain and network approaches, such as the GVC and GPN, has been undertaken primarily under the labels global recycling networks (GRNs; e.g. Gregson et al. 2010; Lepawsky/Billah 2011; Lepawsky/Mather 2011; Crang et al. 2013; Gregson/Crang 2015) and global destruction networks (GDNs; e.g. Herod et al. 2013, 2014; McGrath-Champ et al. 2015). But it includes also different combinations of both approaches in studies that focus preliminary on labour relations and informality entailed in recycling and destruction networks (e.g. Laha 2014; Wong 2015; Samson 2017). These works have centered mostly on e-waste as empirical examples (e.g. Lepawsky/Billah 2011;

Lepawsky/Mather 2011; Laha 2014; Wong 2015; Lepawsky 2019), but included also studies of end-of-life ships (Gregson et al. 2010), used garments (Norris 2015) and used cars (Brooks 2012) or a combination of several of these types of waste (Crang et al. 2013; Herod et al. 2013, 2014; McGrath-Champ et al. 2015).

The works on GRNs have provided an unprecedented consolidation of waste studies and economic geography scholarship, although with only limited references to EEG. They criticise the unidirectional orientation of previous analyses of global value chains and production networks towards consumption as the end point of the realisation of value. In contrast, they emphasise the supply-orientation of recycling networks as well as their multiple trajectories across several production sectors and strands and regulatory regimes which are enabled through “brokered forms of governance” (Crang et al. 2013: 13) by agents and intermediaries:

it is crossing value regimes that creates the opportunity to capture value by creating markets in recovered materials, which offer cheap supplies and thus cheap products that would not otherwise exist. These flows across value regimes connect and entwine different sectors and networks in ways that confound assumptions about linear processes. (Crang et al. 2013: 22)

Thus, reflecting the insights from waste studies, Crang et al. (2013: 15) point to “the often unintentional effects of environmental regulatory regimes [... and highlight that the] classifications of what is a waste and what is a resource enable value to be created when the former can be transformed into the latter”. This also means that “power may be evinced more in the expulsion of certain materials; wastes may be costs to be externalised onto other actors and/or the environment” (Crang et al. 2013: 15). Moreover, and in congruence with the main thrust of waste studies, GRNs emphasize the importance of concrete material properties for the recovery of value from waste (Lepawsky/Billah 2011), which depends first and foremost on the assessment of the quality and management of the heterogeneity and complexity of used goods (Gregson et al. 2010). This also serves to explain the important role of relational forms of governance in recycling networks through intermediaries, which is based on long-term relations of trust.

The works on GDNs reintroduce a Marxist political economy perspective into the analysis of the global trajectories of waste and recycling, but at the same time cut most connections



to waste studies scholarship<sup>7</sup> established by GRNs. In principle, the GRN critique of “the neat sequencing of inputs to outputs implied by GVC, GCC and much of GPN analysis” is welcomed by Herod et al. (2014: 422). At the same time, they adopt a skeptical position towards the ‘posthuman’ and ‘material’ turn signalled by the ANT and STS scholarship imbuing waste studies. Herod et al. (2014: 425) subsequently criticize GRNs for their „tendency to ignore the political economy of the passage of value/congealed labour from one product to the next in the recycling process and to focus, instead, on the transformation of commodities’ physical form and their discursive transition from ‘commodity’ to ‘waste’”. In contrast, GDNs emphasise that there are “very real beginnings and endings” to the material and discursive recovery, reuse and recycling of wasted things, which are determined by “processes of capitalist accumulation” (Herod et al. 2013: 378). They propose, instead, the notion of destruction networks, which are “networks of places where products are disassembled and their constituent parts are extracted for processing and re-use” (Herod et al. 2014: 427). To capture the political economy of the passage of value from and through waste – as well as its endings – they differentiate (drawing on an unpublished manuscript by Smith [1981]) between processes of devalorisation and devaluation. Devalorisation describes the general process of wear and tear through which commodities slowly lose their value/congealed labour, while devaluation describes the “‘wastage’ of commodities before they have actually reached their ‘end-of-life’” (Laser/Schlitz 2019: 11), like in the case of planned obsolescence (see section 3.4.1). This distinction has proved useful for the analysis of present day patterns of capitalist wasting and formal recycling economies in the Global North and has inspired several studies (e.g. Laha 2014; Wong 2015; Samson 2017). But according to Samson (2017), it has a very limited scope to explain the political economy of informal recycling in post-colonial context, and it remains largely disconnected from other works in waste studies and EEG.

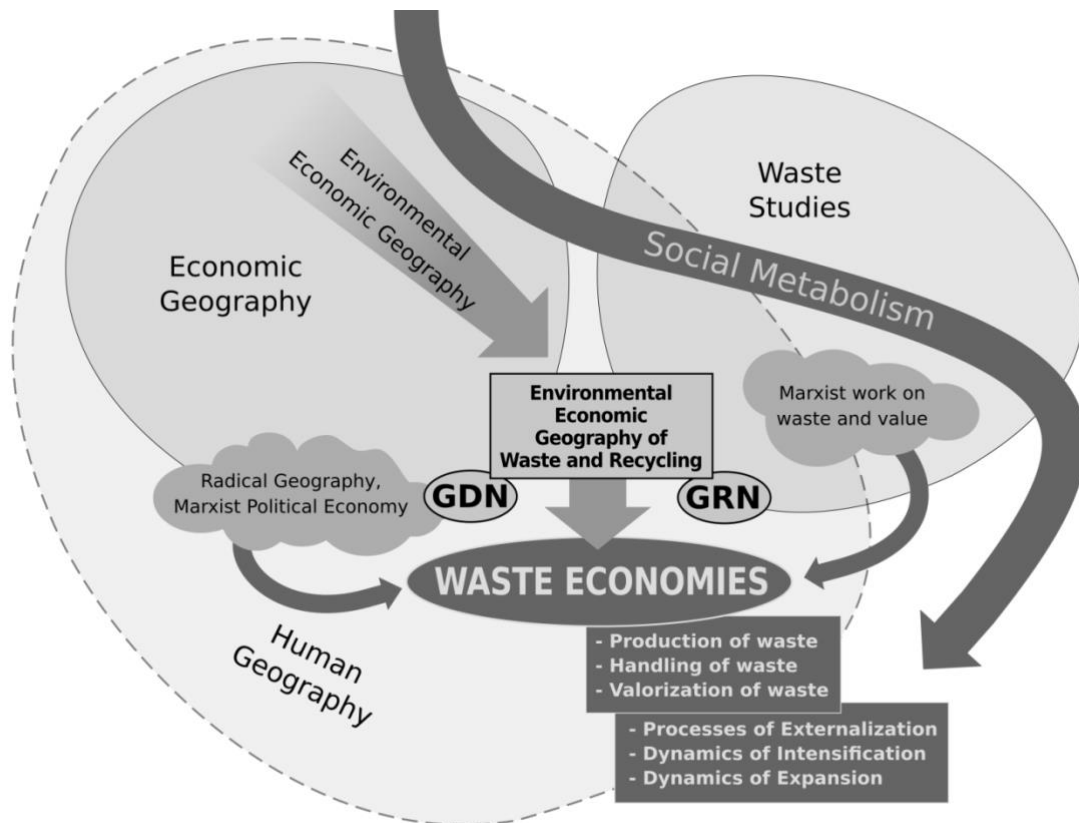
#### **2.4. Positioning Environmental Economic Geographies of Waste and Recycling**

The preceding sections have introduced the theoretical approaches that underpin the appraisal of waste and recycling in this cumulative dissertation. This appraisal of waste

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<sup>7</sup> With the exception of some in part critical references to Marxist works on the relationship between waste and value (Gidwani/Reddy 2011) in the heterogeneous field of Waste Studies (cf. Herod et al. 2015; McGrath-Champ et al. 2015). This reflects again the peculiar (and partly self-chosen) disconnection of Marxist inspired works within both EEG and Waste Studies, which is also addressed in this dissertation.

economies (elaborated in the next chapter) is positioned at the crossroads of EEG and waste studies, inspired by social metabolism and Marxist political economy approaches to socio-natures, and firmly located at the interstices between GRNs and GDNs – as illustrated in figure 1.



**Figure 1:** Scholarly Position of Environmental Economic Geography of Waste and Recycling (own figure, prepared by Tobias Stadler)

Many important social science oriented contributions to waste studies are situated within human geography (e.g. Bulkeley/Gregson 2009; Gidwani/Reddy 2011; Gidwani 2015; Graham/Thrift 2007; Gutberlet 2008; Millington/Lawhon 2018; Moore 2011, 2012; Reddy 2015; Samson 2015, 2017; Whitson 2011). But this human geography engagement with waste is often detached from debates within the mainstream of economic geography or situated only at its margins. The works on GRNs have filled the resultant research gap through its direct reference to both the established economic geography approaches of GVC and GPN, and the state of the art in waste studies. Although GRN entails only limited references to EEG, its emphasis on the materiality of waste strongly resembles the conceptualization of waste as hybrid socio-nature within waste studies, which coincides

with calls to attune to entangled economic and environmental change in a reconfigured EEG (Bridge 2008a; Aoyama et al. 2011). The works on GDNs, in contrast, recast a Marxist political economy perspective on waste and recycling and open up important theoretical insights into the relationship between value and waste. But GDNs fall again behind GRNs' bridging function between economic geography and waste studies and also lack any serious engagement with EEG. This reflects a still existing cleavage between waste studies and environmental economic geography as well as the marginal position of Marxist approaches to the environment and the relationship of waste and value within both fields. In this respect, the present cumulative dissertation pursues a threefold objective:

1. To strengthen the integration of waste studies into environmental economic geography with a specific emphasis on Marxist works on GDNs and waste-value relationships in both fields. Thereby, this dissertation aims to contribute to an improved and up-scaled theoretical understanding of entangled economic and environmental change entailed in the production, societal handling and valorisation as waste as hybrid socionature.
2. To bring economic geographies' privileged relational perspective on global production and its uneven geographies into conversation with waste studies, in order to facilitate a spatio-temporally nuanced understanding of the economic function of waste in globally integrated as well as disarticulated growth-oriented capitalist economies.
3. To utilise this synthesis of thematically, theoretically, and (sub-)disciplinarily distinct bodies of knowledge for the analysis of two different case studies. It aims at an improved theoretical apparatus to investigate the material (environmental) processes and economic dynamics that underpin the capitalist valorisation of waste – namely, processes of externalisation as well as dynamics of intensification and expansion (see section 3.4.2).

Following this threefold objective, this cumulative dissertation constitutes an effort to engage in up-scaled theorization that builds on, but to a certain degree also departs from the predominant chain and network approaches in economic geography. The following chapter introduces the theoretical concept of waste economies, respectively the interplay of waste production, handling and valorisation, which is operationalised via processes of externalisation as well as dynamics of intensification and expansion. This concept will be used for the combined analysis of the two case studies presented here from an environmental economic geography perspective. The relevant literature and state of the art for the two case studies will be presented and discussed in chapter 5 and 6.

### 3. Theorising Waste Economies

This chapter outlines the theoretical conception of waste economies. It establishes the analytical dimensions that underpin the combined analysis of the case of manure and digestate from intensive animal husbandry and bio-gas production in Lower Saxony, Germany, and the case of informal plastic recycling in Kolkata, India. For that purpose, it is necessary to first critically engage with the notions ‘economy’ (section 3.1) and ‘waste’ (section 3.2) and discuss their interrelations, particularly with respect to capitalist modes of productions and their expanded reproduction (section 3.3). Based on these clarifications and elaborations, I will introduce the concept of waste economies as the conjunction of the production, the societal handling and the valorisation of waste (section 3.4.1). Three different economic processes and dynamics serve as central analytical dimensions to delineate the characteristics of waste economies with regard to the expanded reproduction of capital accumulation, that is, the continued growth of capitalist economies: processes of externalisation as well as dynamics of expansion and intensification (section 3.4.2). While processes of externalisation describe the economic causes for the inadequate (economic) valuation of social and ecological costs and services (cf. Huber 2017), dynamics of expansion explain the (often violent) appropriation of capital and incorporation of new fields of accumulation based on the preceding productions of waste (cf. Gidwani/Reddy 2011; Reddy 2015). Situated in between these two are dynamics of intensification that refer to the valorisation of waste through efficiency increases and ecological modernisation within existing fields of accumulation.

#### 3.1. Economy, its Environment and Social Metabolism

What exactly is the ‘economy’ with regard to economic geographies of waste and recycling – and waste economies more generally? The etymology of the term ‘economy’ reveals that its original meaning is distinct from the currently prevailing understandings and definitions of the economy. Barnes and Christophers (2018) critically discuss the bias of currently widespread definitions of the ‘economy’ towards national, profit-oriented monetary economies. Drawing on the Oxford English Dictionary (OED), they point out that the ‘economy’ nowadays refers primarily to the “production and consumption of goods and services and the supply of money” (OED 2019a), which is “maintained for the sake of profit” or at least related to “the generation of income” (OED 2019b). According to Barnes

and Christophers (2018), this definition is the result of historical processes that led to the sharpening of economic representations – from early political economy that identified the ‘economy’ as a separate societal sphere with distinct logics and objects, to neoclassical economics that further abstracted this sphere from the rest of society, and finally to the territorial demarcation of this separate sphere of society in the form of the ‘national economy’ (Barnes/Christophers 2018: 29-30).

In contrast to this designation of a national, monetary, growth-oriented capitalist economy, the historical meaning of the term ‘economy’ goes back to the Greek *oikos*, “house”, and *némos*, “managing”, combined to *oikonomía* (Hoad 1996). It denotes housekeeping, or the “management of a household or family, husbandry, thrift, arrangement” as well as “administration” (OED 2019a), particularly in terms of the allocation and distribution of material resources. This peculiar etymology of the ‘economy’ points to very different economic processes, subjects, rationalities as well as social and socio-ecological relations. Moreover, it reveals two interrelated developments that are of importance to economic geography: first, the socio-spatial or symbolic (figurative) and discursive reconfiguration of the confined space that is designated as the ‘economy’ – with very material effects in physical space (where does the economy begin, and where does it end?). As well as, second, the scalar tensions involved in the demarcation of a specific, self-contained societal realm as ‘economy’ and the changing relationship with its ‘outside’ and ‘other’ (are we talking about the kinship-, city-, or national- as well as regional-‘household’, or do we even refer to the global scale of the economy and/or the environment?).

On a more substantial level, the difference between the frugal ‘management of a household’ and the ‘national growth economy’ is pointing towards the dynamics of inclusion and exclusion at stake in (any) definition of the ‘economy’ – who and what and which processes are part of the economy, or who and what is not? Such questions are particularly important if we are concerned with waste as paradigmatic form of that which is externalised from the economy. Moreover, such demarcations of the ‘economy’ as specific self-contained realm also touch upon the central question of the relationship between human societies and their environments. The latter are still often conceived as external, non-human, ‘natural’ environments – even if they would need to include all kinds of ‘second nature’ (Smith 1984) and not only pristine wilderness, as nowadays more than half of all humans on earth are living “in the nature of cities” (Heynen/Kaika/Swyngedouw

2006). In his conceptualization of economies and their geographies in terms of “spaces, circuits and flows”, economic geographer Hudson (2004: 466) points therefore to the multiple interrelations between the economies of capitalism and their ‘outside’ and ‘other within’<sup>8</sup> – including their ‘natural’ environments:

commodity production and consumption are also often complex processes of material transformations. The resultant ‘environmental footprint’ of these activities emphasizes the critical grounding of ‘economies’ in nature. Elements of ‘first nature’ become increasingly commodified while a ‘second nature’ is also increasingly produced from within the social relations of capital. (Hudson 2004: 460)

One specific understanding of the ‘economy’ as ‘grounded in nature’ has emerged from the conjuncture of industrial ecology and ecological economics: social metabolism (e.g. Fischer-Kowalski/Weisz 1999). This intellectual tradition is concerned with the “mutual dependencies” (Fischer-Kowalski/Weisz 1999: 215) of society and nature, which it considers in terms of “the entire flows of materials and energy that are required to sustain all human economic activities” (Haberl et.al. 2011: 3). Social metabolism understands the economy as a metabolic process of material and energy exchange, transformation and throughput, which takes characteristic forms depending on the modes of production, and this sheds a particular light on waste:

Seen from a material viewpoint, waste is the final output of social metabolism; its composition and amount depend on the quality and quantity of input. Changes in social metabolism, hence, are reflected in changes in waste, and thus determine how dangerous wastes will be. (Winiwarter 2002: 38)

Through its distinct perspective on social-environmental interactions and rigorous empirical research, contributions to social metabolism as school of thought were able to mark out the historical development of “characteristic metabolic profile[s]” (Fischer-Kowalski/Weisz 1999: 230) or “socio-metabolic regimes” (Haberl et al. 2011:1) ranging from ‘hunter and gatherer societies’ to ‘agrarian societies’ and finally to ‘industrial societies’ (Fischer- Kowalski/Weisz 1999: 230-236; Haberl et al. 2011: 2-4). As Haberl et

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<sup>8</sup> In Hudson’s (2004: 453) terms, the „formal capitalist economy and its spaces” overlap in complex ways with “noncapitalist economies and their spaces ‘outside’ the social relations of capital”, “noncapitalist economies and their spaces ‘within’ the social relations of capital” as well as “informal and illegal capitalist economies and their spaces”.

al. (2011: 1) explain, “[t]ransitions between these regimes fundamentally change socio-ecological interactions, whereas changes and variations within each regime are gradual” (Haberl et al. 2011:1). The first of these transitions from ‘hunter and gatherer societies’ to ‘agrarian societies’ marks the Neolithic revolution, which fundamentally changed society-environment relationships in a way that is described by social metabolism as the “colonization of nature” (Haberl et al 2011: 2). This refers “to the intended and sustained transformation of natural processes, by means of organized social interventions, for the purpose of improving their utility for society” (Fischer-Kowalski/Weisz 1999: 234). However, such organized social interventions like agriculture have to be continually maintained in order to sustain “the preferred features of the colonized systems“ (Fischer-Kowalski/Weisz 1999: 236). This, in turn, has strongly shaped the social and economic organization of societies and involves “a process of mutual conditionality” between “societies and their natural environments” (Fischer-Kowalski/Weisz 1999: 236).

The metabolic rift between agrarian and industrial societies marks another “rapid transition that continues today and has enabled humankind for the first time to trigger processes of environmental change on a global scale” (Haberl et al. 2011: 4). Besides an exponential increase of energy use in industrial societies, this ongoing metabolic transition is typically marked by a fivefold growth of material use as well as by the reversal of the relative proportions of biomass consumption against minerals used in industry and construction (Fischer-Kowalski/Weisz 1999: 232; Singh et al. 2012). Inevitably, such a metabolic transition involves a quantitative growth and qualitative change of ‘output’, which highlights the correlations between economic modes of production and patterns of wasting:

... the amount and composition of wastes are characteristic of the specific mode of production of a society. [...] Using the concept of social metabolism, and coupling this idea with the notion of modes of production (or subsistence), gives a useful concept to describe waste systematically and to understand its change over time. (Winiwarter 2002: 40)

A social-metabolic understanding of the economy, therefore, points to the inextricable coupling of the material and the monetary economy (Haberl et al. 2011). And it substantiates Bridge’s (2008: 77) call for an EEG that conceives “production not as value creation but as a process of materials transformation in which environmental change and the organization/disorganization of matter and energy are integral rather than incidental to

economic activity”. In the following, this cumulative dissertation adopts such a “wider view of ‘the’ economy” (Braun et al. 2018: 122) as social metabolism, and focuses particularly on the societal relationships with waste under capitalist modes of production.

### **3.2. Waste: Normative Orders and Environmental Governance**

Following a social metabolic framing of the economy, waste is first and foremost – and very broadly – defined as “final output of social metabolism” (Winiwarter 2002: 38), the concrete form of which is highly dependent on the specific historical and cultural context and the metabolic profile of concerned societies. Scholars across disciplines agree that there is no intrinsic definition of waste, and as Reno (2009: 29) puts it: “Your trash is someone’s treasure”. Waste constitutes not only a highly relational (and, in the perception of social-science scholars, social) category, but there are intense debates among waste scholars if the ‘indeterminacy’ of waste is one of its key features (Hird 2012, 2013; Gille 2013). As Sarah Moore (2011: 135) puts it, “whether or not something is considered trash depends on time and place more than any inherent characteristics of the object itself”. In order to cope with the resulting problems and pitfalls in defining waste, sociologist Gille proposes a first broad and operative definition of waste as “any material we have failed to use” (Gille 2007: 18) – which posits waste as “surplus material” (Gille 2010: 1050) – and subsequently focuses on “the act of wasting” (Gille 2007: 18). This emphasis on the processes through which waste accrues draws attention to the “material and social consequences of one type of waste material metamorphosing into another as it traverses the circuits of production, distribution, consumption, reclamation, and ‘annihilation’” (Gille 2010: 1050). The structure of the following section is reflecting Gille’s (2007: 11-38) dimensions of a “social theory of waste” that differentiates between the (liminal) spatiality, (hybrid) materiality and (socially co-constitutive) temporality of such processes of wasting.

#### **3.2.1. The Spatiality of Waste**

The spatiality of waste describes not only the trajectories of waste materials through physical space and their territorialization, but refers also to the social and cultural circumstances and implications of waste’s spatialization. Waste designates “the opposite of some concept or quality [...], order and value” (Gille 2007: 20). Processes of wasting are therefore based on the assessment of the utility and value we ascribe to certain things –



they are based on social classifications:

The act of wasting always involves some classification and displacement, and this is where the figurative spatiality of waste (that is, classification) transitions into its physical spatiality. The reclassification of the object implies placing it not only into a different category of things but also into a physically different place [...]. (Gille 2007: 21)

Accordingly, it is no surprise that the pioneers of contemporary Waste Studies, Mary Douglas (2001 [1966]) and Michael Thompson (2017 [1979]), espoused a social-constructivist approach to study waste. Douglas' (2001 [1966]: 48) influential spatial definition of waste as “matter out of place” indicates that there normally is a ‘correct’ place for waste, which is defined by cultural and social orders and their spatial articulations – take the example of the sanitary landfill (Winiwarter 2002; Reno 2009; Gill 2013). However, designated places for waste “quickly became ‘banned’ and functioned as the perilous living spaces of liminal or outcast individuals and groups” (Winiwarter 2002: 48). Thus, “places for waste are usually marginal spaces – marginal to whatever mainstream activity is taking place in a particular location” (Gille 2007: 22). From this follows that waste turns into pollution and is becoming a threat to cultural and social order once it is found in the ‘wrong place’. This is what Moore (2012: 792) coined “waste as abject”:

Waste as abject posits waste as something that is expelled from the social body in order to shore up the boundaries that divide that which belongs from that which does not [...], created not through identification, but rather through its always incomplete exclusion. (Moore 2012: 792)

Waste constitutes a “boundary object between inside and outside” (Gille 2007: 23). This liminality of waste explains its relevance for “key dichotomies: efficiency/inefficiency; usefulness/uselessness; order/disorder; gain/loss; clean/dirty; alive/dead” (Gille 2013: 1). It indicates that waste has a lot to do with normative orders, and that waste carries with it both threatening and stabilising potential for such orders. In fact, waste demarcates the boundaries of normative orders – particularly the boundary line between society and nature – but it does so in an unstable and ambiguous manner. As Winiwarter (2002: 45-46) emphasises: “Dealing with waste is an epitome of our dealing with nature as the ‘other’ of society in general.”

### 3.2.2. The Materiality of Waste

The materiality of waste constitutes another important analytical dimension of a social theory of waste. It pertains amongst others to the bio-physical and chemical properties as well as the mobility of wasted materials through space and across different media. This materiality of waste has been highlighted also by early social metabolic accounts of waste, that identified processes of wasting as “disservice” (Fischer-Kowalski 1998: 71) and emphasised that “there is a primary interdependency among all waste streams that evades treatment by separate media” (Fischer-Kowalski 1998: 72). Yet, it is important to acknowledge, beyond a strict natural science perspective, the reverberation of this ‘disservice’ and its translations across ‘separate media’ into the production and societal handling of waste. To account for such a socially entangled materiality, Gille (2007: 27) refines her definition towards an understanding of waste as “a hybrid entity, that is, it is simultaneously social and material” (see section 2.2). This notion helps to understand waste as something that is simultaneously entangled with and inextricably distinct from society; waste is a product of society, of its social and economic orders, but it is not following the rules laid down by normative orders of society. It has become some sort of unruly socionature:

[T]he materiality of waste places a limit on how it may be classified or, as referred to above, spatialized. To put it simple, the materiality of waste has important implications for how we can go about safely dealing with it. [... D]ifferent societies ignore or misunderstand the nature of their material foundations and thus ‘mis-spatialize’ wastes in unique ways. Waste’s materiality is usually clouded by culture: by insufficient knowledge of the materials in use and/or by the ideologies, metaphors, norms, and values that blind us to one or another aspect of material agency. (Gille 2007: 27)

This mistreatment of the materiality of waste often has “unintended consequences [...], resulting in a constant ‘back-and-forth’ between society and waste” (Gille 2007: 27-28). This ‘back-and-forth’ is exactly what is at stake in the entanglement of economic and environmental change in a reconfigured EEG.

### 3.2.3. The Temporality of Waste

In order to understand the social and environmental implications of waste as hybrid

socionature, it is necessary to develop a processual heuristic of the transformations and translations between different waste materials and forms of wasteing – between social and material processes. For that purpose, Gille focuses on the circulations and metamorphoses of waste in time. By attending to the temporality of waste, it is possible to gain insights into the reciprocal interactions, translations and transformations that lead to the hybridity of the social and the material. “[B]esides the circulation of value, we also find in any economy a circulation of waste. This is no simple circulation of the same waste. Rather, it is a circulation in which one form of waste metamorphoses into another form.” (Gille 2007: 29) To elaborate this point, and the difference between forms and materials of waste, Gille explains:

However, the circulation of waste doesn’t simply mean the transformation of *one waste material into another* (for example, when waste incineration generates toxic ashes). It also, and even more fundamentally, implies that *different forms of waste* are continually transformed into each other. Waste as excess turns into waste as material, as in the environmental consequences of overconsumption. Waste as inefficiency can change into waste as material and vice versa. (Gille 2007: 29, italics in original)

The social theory of waste developed by Gille serves to expose the causal chain of previously disconnected social and material circumstances, which carve out the co-constitution of economic and environmental processes in the case of waste. These causal patterns are summarised in the following depiction:

What appears to be unique in different time periods and different societies are the types of waste produced (their material composition); the key sources of waste production (for example, unutilized surplus or insufficient inputs) and the dominant mode of waste circulation and metamorphosis; the socially and culturally determined ways of misperceiving waste’s materiality; the ways in which, as a result, waste tends to ‘bite back’; the cultural, political, and moral inclination to resolve waste’s liminality (inscribed negativity or positivity); and, finally, key struggles around waste (in the sphere of production and in the sphere of distribution). (Gille 2007: 34)

The (historically) changing socio-material and metabolic dynamics of inclusion and exclusion exposed by this understanding of the ‘economy’ and ‘waste’ have a lot to do

with the normative orders, rationalities and techniques of controlling what enters and what leaves the ‘household’ (economy). As Winiwarter (2002: 43) puts it: “A society’s ways of dealing with waste should be considered a central attribute, because the creation of order is a central aim of all cultures and waste is the inevitable by-product of order”. Although waste pertains more to the output – to devaluation and rationalities and techniques of externalisation and expulsion – it is intrinsically linked with the rationalities that govern the input into, and the allocation and distribution within the ‘household’, and thus, with one of its major dimensions: value, and in the case of capitalist formations, the production of surplus value. Normative orders and the valuation practices that underlie specific forms of wasting as well as waste handling are strongly intertwined with the economic organisation of societies; with the modes of production that determine the allocation, transformation and distribution of resources in the ‘household’. But the materiality of waste and its environmental implications also impinge back upon the modes of production and normative orders in particular ways. Waste – as form of hybrid socionature – offers a privileged perspective to study the co-constitution the economies and environments in economic geography. This process of co-constitution in which the production of waste, its materiality and environmental implications, and its societal handling constantly merge into each other, marks the confluence of social and material forms. And as “the production and management of waste under capitalism is quite different than it is under other systems of economic organisation” (Herod et al. 2013: 377) it is important to attend to this specific social-environmental relationship entailed in capitalist modes of productions.

### **3.3. Frontiers and Expanded Reproduction of Capitalist Modes of Production**

‘Capitalism’ designates modes of production<sup>9</sup> that are based on particular social relations, exhibit a specific socio-metabolic profile and involve distinct relationships with ‘nature’ – and subsequently produces particular forms of waste, of which plastics are one of the most

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<sup>9</sup> There have been intense debates if capitalism can be described as singular systemic phenomenon, how the multiple articulations of capitalism as (supposedly uniform) mode of production throughout history and across geographical space and scale can be explained (cf. Hudson 2004), and if it is more accurate to talk about ‘varieties of capitalism’. The notion of uneven capitalist development (initially coined by Leon Trotsky, taken up by Rosa Luxemburg and advanced by economic geographers like David Harvey [1975] and others), together with the concept of primitive accumulations (De Angelis 2001; Federici 2004) by dispossession (Harvey 2003) and the French regulation approach (Aglietta 1984) allows for sufficient differentiation without renouncing capitalism as specific historical formation that is based on definite social and economic relations. Nevertheless, I prefer to use the plural to indicate the spatio-temporal contingency of capitalist development.

paradigmatic ones. The historical development of capitalist modes of production is accompanied by the (still on-going) transition towards the metabolic profile of industrial societies (Haberl et al. 2011) and has led to an unprecedented impact of human societies on earth. From an environmental perspective, the most indicative (and currently also most contentious) characteristic of capitalist modes of production is that they are based on exponential economic growth – in the conventional (monetary) sense of national economies as well as in the material and energetic sense advocated by ecological economics and social metabolism. Recent debates about the ‘Anthropocene’ – a notion that announces a new geological age – point to the magnitude of change inflicted on ecosystems and the environment by capitalist modes of production on a planetary scale (Waters et al. 2016; Castree 2015). Increased nitrogen and phosphorus cycles due to intensified use of fertilizers in industrial agriculture as well as combustion of fossil fuels have been established as important markers of the ‘Anthropocene’ (Waters et al. 2016)

As a mode of production, capitalism is based on particular social relations. These are most importantly capitalist (wage) labour relations and private ownership of the means of production, which coalesce in the capitalist production of commodities<sup>10</sup> for exchange on markets with the sole purpose of accumulating more capital than initially spent in production. This accumulation of capital is predicated on the exploitation of surplus value from labour. The capitalist production process is at the same time a labour process in which useful labour transforms nature to produce concrete use-values, and a valorisation process, in which abstract labour – or ‘labour power’ – produces (exchange) value in the form of commodities for capitalist markets. Marx explains the capitalist production process as follows:

The transformation of a sum of money into means of production and labour-power is the first phase of the movement undergone by the quantum of value which is going to function as capital. It takes place in the market, within the sphere of circulation. The second phase of the movement, the process of production, is complete as soon as the means of production have been converted into commodities whose value exceeds that of their component parts, and

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<sup>10</sup> It is important to note that commodity exchange is preceding capitalist modes production by far, as the commodity form is a much older form of economic exchange that has been present already in many and also much older societies. But the way commodities are produced, that is, exclusively for the accumulation of value, and the all-encompassing character of the commodity form in capitalist societies are unique features of capitalist modes of production.

therefore contains the capital originally advanced plus a surplus value. (Marx 1990[1867]: 709)

Finally, “[t]he employment of surplus value as capital, or its reconversion into capital, is called accumulation of capital” (Marx 1990[1867]: 725). The surplus value is then invested again into production, to expand and improve production, to produce more and increase productivity, e.g. through enhanced technology, etc.<sup>11</sup> This imperative to accumulate value (in contrast to the individual consumption of the surplus value by property owning classes, as it was the case in feudal societies), is what characterises capitalist modes of production and constitutes their dynamic character. It translates into the disastrous patterns of growth much noticed by environmental scholarship across the disciplines and reflected by recent post- and degrowth debates: “Capitalist production, therefore, only develops the techniques and the degree of combination of the social process of production by simultaneously undermining the original sources of all wealth – the soil and the worker” (Marx 1990[1867]: 638). The growth imperative inscribed into capitalist modes of production is, thus, predicated on the valorisation process that commands the perpetual accumulation of capital from surplus value – irrespective of its material basis.

Put differently, capitalist production as a *labour* process is premised upon precisely those socio-ecological conditions which it continuously undermines as a *valorization (Inwertsetzung)* process. The immanent limits of the capitalist mode of production do not lie in the reproductive necessities of human and non-human nature, but in the crises of the valorization process. (Brand/Wissen 2013: 692; italics in original)

This crucial disjuncture between the social and environmental destructiveness of capitalist modes of production on the one hand, and its (potential) simultaneous stability as valorisation process on the other hand, has spurred decades of fierce debates among Marxist scholars. These debates revolved around the question if there are ‘natural limits’ of capitalism (e.g. Benton 1989; Altvater 1991; Grundmann 1991; Castree 2000) – thus, in how far its social and ecological destructiveness is also undermining the general conditions for capital accumulation in the long run. The production of waste, most often considered in terms of ‘polluting output’, thus over-exploiting natural sinks (Winiwarter 2002), has

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<sup>11</sup> The different forms of upgrading and value enhancement identified in the GVC and GPN literature represent a timely overview of these strategies.

figured prominently in these debates. Yet, historically, the global ‘garbage crisis’ (Griffin 1992; Gourlay 1992) appears to have not seriously threatened the continuance of capitalist modes of production, even though waste generation has been constantly growing.

A slightly different investigation of the environmental implications (and limits) of capitalist modes of production has emerged around the ‘internal’ limits and crisis tendencies of capitalist accumulation – as valorisation process – instead of focussing on the ‘external’ barriers to growth set by its social and environmental destructiveness. As Marx (1990[1867]: 711) emphasises,

[w]hatever the social form of the production process, it has to be continuous, it must periodically repeat the same phases. A society can no more cease to produce than it can cease to consume. When viewed, therefore, as a connected whole, and in the constant flux of its incessant renewal, every social process of production is at the same time a process of reproduction.

Recurring economic crises on a global and regional scale throughout the history of capitalist modes of production provide plenty of empirical evidence that the expanded reproduction of capitalist accumulation is far from granted. Particularly big crises of over-accumulation – like the Great Depression or the more recent financial crisis – in which existing markets cannot absorb the over-production, have indeed threatened the reproduction of the general conditions for capital accumulation. This internal crisis-proneness of capitalist modes of production have led to intense scholarly engagements with the question why and how capitalist modes of production not only prevail, but continue to permeate more and more geographical spaces, spheres of life, and environments. Two lines of explanation that have evolved from these debates are particularly relevant for an analysis of the contradictory relationship between waste and capitalist modes of production in environmental economic geography.

One explanatory framework has been provided by the French regulation approach (Aglietta 1987) and its analysis of the historical conjuncture “of a mode of production and distribution, on the one hand, and a mode of consumption on the other [...], safeguarded by a range of institutional forms that together constitute a mode of regulation” (Brand/Wissen 2012: 548). The seminal work of Aglietta (1987) has analysed such a historical conjuncture for the case of the United States. He has carved out how the ‘frontier’ concept that characterized early capitalist extensive accumulation there during the expansion towards

the West Coast gave rise to an ‘intensive’ form of accumulation based in mass consumption: Fordism. Harnessed for the analysis of the combined social and environmental crisis tendencies of capitalist modes of production, this regulationist understanding of the social, political and institutional mediatedness of capitalist accumulation was developed into the concept of the regulation of societal nature relations (Brand/Wissen 2012, 2013). It describes “the ways in which structures of domination organise and shape the management of the ecological destructiveness that is inherent to the capitalist mode of production” (Brand/Wissen 2013: 692). This mediation is comparable with the conjuncture of a mode of production and distribution and a mode of consumption:

It takes place, firstly, via temporally- and spatially-varied strategies of capital valorisation. Environmental crisis phenomena can be the starting point for the development of new technologies by shifting the power relations between capital fractions and creating capacities for crisis management without overcoming the fundamental ecological contradiction of capitalism. [...] More recently, the debates on a ‘green economy’ may indicate the emergence of a new regime of accumulation, which creates economic opportunities for ‘green’ capital fractions [...]. Secondly, the regulation of society-nature relationships takes place via institutions, norms, values, processes of subjectivation, and normalised practices that often bring to the fore new strategies of capital valorisation. Conceptions of (and ways of appropriating) nature are hegemonically produced and thus necessarily selective. Regulation may prevent destructive forms of appropriating nature from becoming a politically relevant problem. In this case, the destructive character of society-nature relationships remains latent and is seen as manageable and, therefore, acceptable and/or it remains limited to socially marginalised groups. Most of all, its costs are both spatially and temporally externalised. (Brand/Wissen 2013: 692-693)

Another explanatory framework to understand the continued expansion of capitalist modes of production, irrespective of their social and environmental contradictions and crisis-proneness, has focused more on the dynamics of inclusion and exclusion of capitalist economies – in terms of the seizures, appropriations and expulsions that mark the historical formation of capitalism. As outlined above, capitalist modes of production are based on wage labour and private ownership of the means of production in the hands of capital. But



these are social forms that first had to emerge in a violent historical process that Marx (1990[1867]: 873) described as “primitive accumulation”. This process was characterised by the expropriation of the rural populations from their ‘common’ land (in order to deprive them of their means of production, or subsistence, and turn them into wage labourers under the command of capital). Moreover, it involved the subjugation and expropriation of the population in the colonies of European imperial powers, whose wrested possessions enlarged the capital stock available for the production of surplus value: “The treasures captured outside Europe by undisguised looting, enslavement and murder flowed back to the mother-country and were turned into capital there” (Marx1990[1867]: 918).

Recent scholarship has emphasised that this original form of accumulation, is far from over but continues to form an essential part of capitalist accumulation strategies (De Angelis 2001; Federici 2004), particularly in times of crisis (Harvey 2003). As Bair and Werner (2011: 990) summarise, the “intensification of market forces worldwide, and the rolling back of the commons in the broadest sense of noncommodified social relations, has foregrounded a rethinking of these processes and their historical and geographical connections”. To highlight this “continuous character of capital’s ‘enclosure’” (De Angelis 2001) in times neoliberalism, Harvey (2003: 74) has introduced the notion of “accumulation by dispossession”. He emphasises that such “accumulation by other means” (Harvey 2003: 72) becomes particularly important during time of crises of over-accumulation and that “the power of the state is frequently used to force such processes through even against the popular will” (Harvey 2003: 75). Moreover, and as ‘nature’ itself has become an accumulation strategy for example for ‘green’ capital fractions, the privatisation and commodification of this ‘nature’ by extra-economic means like in the case of land grabbing has also gained in importance:

The escalating depletion of the global environmental commons (land, air, water) and proliferating habitat degradations that preclude anything but capital-intensive modes of agricultural production have likewise resulted from the wholesale commodification of nature in all its forms. (Harvey 2003: 75)

One central aspect of Harvey’s notion of accumulation by dispossession is that it is less focused on the transformation of independent producers into wage labourers and more directed towards the ways in which “capital values the resources to be enclosed, but not the people who must be dispossessed of them” (Samson 2015: 815). As a result,

“accumulation by dispossession creates surplus populations who must sustain themselves outside wage labor, often through informal work” (Samson 2015: 813), thus constituting the vast informal economic spaces in cities of the Global South. These informal economies often become targets for another round of accumulations by dispossession, as Samson (2015: 813) shows for the case of informal recycling in South Africa: “the state and capital seek to capture new spheres of accumulation created by informal workers”. However, Bair and Werner (2011: 990) maintain that, while Harvey is “linking dispossession to moments of crisis, the contours of capital accumulation and those people and places provisionally externalised from its relations are best understood through everyday practices and struggles over value”.

The preceding elaborations were meant to clarify the contradictory ways in which capitalist accumulation is on the one hand prone to crisis tendencies that, on the other hand, simultaneously inflict and enable the expanded reproduction of capitalist modes of production (through the contingent reconfigurations of environments, social relations and institutional settings in space and time). Two notions appear particularly useful to analytically harness the intrinsic necessity of capitalist modes of production to grow and expand (in monetary as well as material and energetic terms) in a way suitable for the following appraisal of waste economies: the supposed (natural) *limits* to capital accumulation discussed by Marxist approaches to ‘nature’ (Harvey 1996; Benton 1989; Grundmann 1991, Castree 2000) and the notion of *frontier* of extensive capital accumulation deployed by Aglietta’s (1987) analysis of the historical development of capitalism in the United States. Both notions point to the crucial role that the changing spatial and temporal dynamics of inclusion into and exclusion from the normative orders that underpin capitalist social formations (most of all value) have for the recurring adaptation and expanded reproduction of capitalist modes of production – and thus, for their unhampered growth and expansion.

### **3.4. Towards a Conceptualisation of Waste Economies**

This section introduces and operationalises the concept of ‘waste economies’ on which the combined analysis of the two empirical case studies is based. Waste economies are conceptualised with regard to the production, societal handling and the valorisation of waste. This conceptualisation offers a political economy perspective that considers the

societal handling of waste and the underlying politics of waste (Gille 2007, 2010; Moore 2011) as integral part waste economies and closely intertwined with the production and valorisation of waste under capitalist modes of production. Accordingly, the intersecting, correlating and conflicting patterns and dynamics between these three aspects of waste economies are discussed with regard to the first subsidiary research question (see the following section 3.4.1). This is followed by the elaboration of the three main analytical dimension of waste economies – externalisation, intensification and expansion – which are pertaining to the second subsidiary research question (see section 3.4.2).

### **3.4.1. Conjuncture of the Production, Handling and Valorisation of Waste**

This section addresses the first subsidiary research question: *What correlations, intersections and contradictions can be established between different patterns and dynamics of waste production and those of the societal handling and valorisation of waste, and how can these be conceptualised?* This sub-question pertains to the role of waste in the main research question. It first aims to establish and elaborate the notion of ‘waste economy’ as the historical coincidence of the ways in which waste is produced in a particular society, and how it is handled in this society – how these two processes fit together and constitute a functional coherency, or if they do not fit together, what such a dysfunctionality then means for the stability and sustainability of the respective society (cf. Gille 2007). Second, the relationships between the production and handling of waste are detailed as correlation, contradiction and *intersection*. Intersection is situated in between correlation and contradiction because it points to the historically contingent conjunctures and coincidences of waste production and handling, which are not predetermined and can involve a lot of friction that reverberates on both production and handling, thus, retaining the open and co-constitutive character of relationship. From this view, the politics of waste constitute an integral part of waste economies, thus, highlighting a political economy perspective on the economic geography of waste. Third, this research question differentiates between the general societal handling of waste, which is like the production of waste a trans-historical component of any human society (cf. Winiwarter 2002), and the valorisation of waste, which qualifies capitalist forms of waste handling in particular. Moreover, valorisation is a very special form of waste handling that directly feeds back to the production of waste because it is itself already organised as a form of capitalist

production based on private property, marketisation and commoditisation,<sup>12</sup> thus necessarily producing specifically capitalist forms of waste itself.

#### 3.4.1.1. *The Production of Waste in Capitalist Societies*

The production of waste in a society is a direct outcome of its predominant mode of production and the specific social metabolism this involves. From a socio-metabolic perspective, the most salient feature of waste under capitalist modes of production is the massively intensified scale, scope and complexity of wastes produced, which means that “[t]he quality and quantity of wastes we experience today is unparalleled in history” (Winiwarter 2002: 39). Besides a mere focus on quantities, this points to the increasingly complex and entangled spatial and material patterns of wasting under capitalist modes of production, which are predicated on the ‘input’ and on what happens ‘inside’ the economy as ‘household’. It points to the spatial trajectories and material transformations entailed in extraction, allocation, production, circulation, distribution and consumption and how they affect recovery, reuse, recycling and disposal. Capitalist waste production is also a production of space. It involves the spatial dispersal (Trettin 2002) as well as re-concentration and proliferation (Crang et al. 2013; Gregson/Crang 2015) of increasingly complex and intricate material compositions (Gille 2007; Liboiron 2016b) through global recycling and destruction networks that often imply the transgression of scales. Gille (2007: 27) concludes that “it is the complexity of linkages, both among different scales and among different materials in circulation, that renders today’s waste problem so much more daunting”. But in order to move from such a more descriptive account to an analytical account, we have to explore the systemic causes of waste production under capitalist modes of production: “In considering waste’s production under capitalism, then, we must recognise that capitalism departs from other forms of social organisation in its relationship to Nature and society” (Herod et al. 2013: 380).

The systemic causes for the specific forms of capitalist waste production lie on a downscaled level in the abstraction from concrete use-values of the social and material world (leading to what is often described as ‘externalisation’; cf. Huber 2017) that the realization of (exchange) value through capitalist commodity production involves. Under

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<sup>12</sup> This is, of course, only applicable to the predominantly privatised formal waste management, recycling and waste-to-energy industry. Informal waste handling exhibits at times very different relationships to capitalist modes of production.

industrial capitalism, waste can therefore be described as the result of “the priority of exchange value over use-value” (Horton 1997: 132): “... it is only under commodity production that useful things are thrown away” (Horton 1997: 130).

Yet, this down-scaled but theoretically complex explanation of waste through the specifically capitalist form of value is only explaining the general economic possibility of capitalist processes of wasting (based on the neglect of concrete use-values of the social and material world). The works to GDNs (Herod et al. 2013, 2014; McGrath-Champ et al. 2015) in economic geography have provided an intermediate level explication of capitalist waste production that relates its theoretical complex depiction as abstraction from concrete use-values (externalisation) with its up-scaled description as surplus material resulting from over-accumulation (see below). To analyse the specific processes of wasting that result from the material translation of over-accumulation into waste, the works on GDNs propose to differentiate between processes of devalorisation and devaluation:

When a commodity literally wears out and its constituent elements cannot be used for anything else, then we might think of it as having been devalorised and the value incorporated within it and its constituent parts used up, with none left to be passed on to new products. However, when a commodity is replaced with a newer model and yet it is either still functioning and/or its constituent parts may be reused (either by taking them out and putting them unchanged into another commodity or by processing them and turning them into raw materials for new products), then we might think of it as having been devalued. (Herod et al. 2013: 379)

The devalorisation of commodities does not necessarily wreck things of all their possible concrete use-value, but it affects its “utility” (Schmitt/Schulz 2016) under historically and geographically specific societal conditions and relates to the “proto-concept of capitalist waste” identified by Horton (1997: 130; see above). But processes of devaluation describe particular forms of capitalist wasting, which are characteristic for the ecological destructiveness of capitalist modes of production since the post-war period, as Herod et al. (2013: 380) explain:

Profit is the ultimate goal of production, so from collective capital’s point of view the generation of waste and pollution on the one hand and use values on the other only matter in so far as they pertain to facilitating surplus value extraction.

Creating more use values for people or creating less waste comes second to the need to accumulate. The result is that waste is endemic to the system and has become ever more so over the past half century. Indeed, the post-Depression economic system developed in the Atlantic economies was fundamentally structured around the very necessity of producing waste as twin to accumulation. (Herod et al. 2013: 380)

This points to an up-scaled level of analysis, where the systemic causes of waste under capitalist modes of production are best explained through its growth imperative (pertaining to its expansive character), which inevitably leads to overproduction. Markets inability to absorb this surplus production has historically resulted in very abrupt and tremendous processes of wasting caused by the sudden devaluation happening during big crises of over-accumulation (cf. Harvey 1975, 2003; Bair/Werner 2011). But the Fordist accumulation regime and mode of regulation that evolved in the United States and Europe during the post-war years has given rise to a different, less abrupt and more continuous form of capitalist wasting, characteristic of what we conceive of as post-consumption waste today (cf. Rogers 2006): “The consumer goods revolution that followed involved the restructuring of industry towards mass production/consumption, design changes that decreased the lifespan of commodities, and the meteoric rise of the packaging and advertising industries” (Herod et al. 2013: 380). Since then, waste is produced “by the objective necessity of absorbing surplus through planned obsolescence and accelerated need creation” (Gille 2007: 32) including an enormous range of packaging waste and single-use, ‘throw-away’ goods. As Baran and Sweezy (1966) have argued, this waste production by design is meant to generate continuous demand in order to safeguard constantly rising consumption, exactly with the aim of preventing big crises of over-accumulation during which not so much consumer goods but rather also a lot of capital is devalued in historical ruptures often described as ‘creative destruction’. The “growing practice of manufacturers devaluing commodities through planned obsolescence rather than allowing them to be devalorised as they wear out through normal wear and tear” (Herod et al. 2013: 380) represents the replacement of one form of creative destruction (crises of over-accumulation) with another. Either way, the growth imperative of capitalist modes of production leads to processes of over-accumulation that materialise in the form of waste. As Gille (2007: 32) explains,

... one form of waste, that of surplus materializing as unnecessary and unproductive goods, will turn into actual waste, thus immensely increasing the burden on nature. The chief waste circulation pattern of capitalism is thus the metamorphosis of waste as unutilized excess into waste as pollution.

#### 3.4.1.2. *The Societal Handling of Waste*

The societal handling of waste – as integral aspect of waste economies – denotes much more than the management of waste. Following from the complex mechanisms of social conflict and coordination involved in the regulation of societal nature relations (Brand/Wissen 2013), the societal handling of waste involves the entire ensemble of social, cultural, institutional, political and economic processes necessary to cope with the ‘waste problem’. Related forms of the governance of waste – as part of the politics of waste (Gille 2007) involved in its societal handling – are in a way always predicated on and co-constituted by the prevailing modes of production. Crucially, such a conceptualisation of the societal handling of wastes involves two dialectical moments that pertain to the double character of waste and its articulation under capitalist modes of production: On the one hand, the externalised environmental and social impacts and implications of capitalist waste production, particularly the “negative use-value” (Gille 2007: 25) of wastes, have to be managed to maintain the legitimacy of the economic system – depending on the social constructions of environmental risk and political legitimacy (cf. Moore 2008; Gutberlet 2008). But, on the other hand, this management or governance of waste has to take forms that do not seriously jeopardise further rounds of capitalist accumulation either – which are, as elaborated, necessarily premised on the production of waste.

There is quite a peculiar interplay along several lines necessary to reconcile the production and the societal handling of waste. This entrenched nature of environmental politics and governance of waste has given rise to a whole industrial complex that intertwines several actors: state authorities and government institutions from the municipal to the national level, big private waste management companies active in several countries, an abundance of SMEs engaged in activities ranging from service provision to ‘recycling’ (as production, including bio-gas production) and consultancy, academic institutions (involved research and development activities), as well as international financial institutions and international organisations. It is not possible – within the limited frame of this cumulative dissertation –

to elaborate this waste management industrial complex in greater detail. Yet, it is integral to establish this waste management industrial complex as a backdrop against which the explication of the societal handling of waste can unfold in terms of the valorisation of waste – as particular capitalist, and specifically neoliberal mode of waste governance.

#### 3.4.1.3. *The Valorisation of Waste*

The long history of the reuse of waste products by human societies, like for example the application of excreta and manure as fertilizers in agriculture, indicates that the revaluation of wastes is much older than the perception of waste as a sanitary and environmental problem (Winiwarter 2002). This dialectic between waste and value points to the long legacy of the double character of waste and its foundational character for any waste economy. But the revaluation of the previously devalued takes a specific form under capitalist modes of production. It is predicated on the specific form that (exchange/surplus) value takes in capitalist economies and the peculiar relationship with nature and the environment involved in this value form, which is characterised by process of externalisation due to the abstraction from concrete use-values (Huber 2017). As a consequence, the revaluation of waste under capitalist formations takes the form of valorisation. This means that waste, as “any material we have failed to use” (Gille 2007: 18), can only be re-used in socially acceptable ways<sup>13</sup> if it is re-inscribed as a commodity and does not seriously undermine existing valorisation processes.

Waste management evolved in a historical process as the specialised and socially accepted branch of private and public services entrusted with the implementation of the governance of waste. Environmental historians like Winiwarter (2002) relate this process to the tertiarisation of the economy and describe it in terms of the partial internalisation of previously externalised economic effects. This means that the externalised social costs of

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<sup>13</sup> The formulation ‘socially acceptable’ refers to the hegemonic conditions that structure political-economic power relations in a way that renders ‘social acceptability’ subject to the imperative of capital accumulation and its societal regulation. This does not mean, of course, that e.g. more sustainable economic and technological options not conducive for capital accumulation (particularly of the dominant capital fractions) are not pursued by different social actors. However, it means that the proliferation and generalization of such options will be met, on the one hand, with resistance and will involve (sometimes fierce) social struggles. On the other hand, this means that the social relations structuring capitalist formations (including labour relations, the commodity form and private property) and the rationalities that govern the capitalist valorisation process (the pursuit of surplus value for the sake of capital accumulation) are very likely to be reinstalled again into these options, simply because they are hegemonic and permeate everyday social, political and economic life (cf. Hudson 2004).



societal waste handling where partially integrated into capitalist production processes as service industry, thereby providing a profitable field for the investment of over-accumulated capital on its own. Authors like Lindemann (1992), Reith (1998) and Winiwarter (2002) have highlighted the intense struggles between proponents of recycling and those of incineration in the early history of capitalism – struggles that were entangled in contentious urban-rural relations and gave rise to landfilling as third technological option and infrastructure. These struggles appear, at first sight, simply as struggles between revaluation in terms of recycling technologies and externalisation in terms of ‘end-of-pipe’ technologies. However, the historically contingent development of different waste management options can also be interpreted in terms of different valorisation strategies that are predicated on the uneven development of capitalist modes of production and the coupled change of social metabolism, particularly also in terms of urbanisation as a process that involves specific rural-urban relations.

Following up on the earlier history of the waste management industry, the urge for large-scale investments into incineration in the post-war period can be interpreted as a new accumulation strategy that was predicated on the social metabolism of the post-war Fordist growth period and its forms of waste production. This pertains particularly to planned obsolescence, single-use commodities, packaging and the general rise of synthetic wastes (like plastics) with high calorific value suitable for energy recovery (Winiwarter 2002; see also Gille 2007; Herod et al. 2013). Yet, this new accumulation strategy was also met with fierce local resistance against large-scale waste management infrastructures like incinerators (and landfills).

In the wake of the environmental movements in the Global North, there was a shift in the governance of waste that led to environmental policies in favour of recycling. Recycling, in the historically distinct form it took from the post-war period onwards, can be understood as waste handling in the form of valorisation that does not undermine further rounds of production and subsequent capital accumulation (Schlitz 2016). In turn, this rise of recycling led to an interesting technological, but especially also discursive reinvention of incineration as waste management technology and infrastructure by the capital fractions involved in it.

This was once again predicated on the changing social metabolism of advanced capitalist societies and their enormous demand for energy: incineration was recast as ‘waste to

energy' (WtE). It included a whole new set of technologies (like refuse-derived fuel – RDF) that arguable deviated (in part substantially) from the former depiction of incineration as simple 'burning' of wastes and targeted particularly also energy recovery from organic matter, like in the case of bioenergy strategies. These new and intensified strategies of capital fractions invested in incineration developed an especially contradictory impetus in the times of anthropogenic climate change. Related market-based climate change mitigation mechanism like carbon trading released enormous funds for clean development mechanisms (CDM), which also registered a number of WtE-technologies as CDMs and served to intensify the drive for the installation of WtE-technologies in metropolitan cities of the Global South (e.g. Demaria/Schindler 2016).

The historically evolving waste management industrial complex is based on valorisation strategies that mediated the capitalist production of waste with its societal handling – mainly through service provision and resource mining: “private management of waste and the transformation of waste into new commodities create new spheres of accumulation for capital” (Samson 2017: 41). The shape that the 'circular economy' takes, for example, is also strongly imbued with this imperative for valorisation and opens up a wholly new chapter of the infamously glorious history of the waste management industrial complex (cf. Gregson et al. 2016).

### **3.4.2. Analytical Dimensions of Waste Economies**

This section addresses the second subsidiary research question: *How are waste economies – as the interplay of waste production, handling and valorisation – related to the expanded reproduction of capitalist social and economic relations and its spatial articulations?* This sub-question is relating the conceptualisation of waste economies back to the expanded reproduction of capitalist modes of productions – to the conditions that allow capitalist economies to continually grow and expand. The valorisation of waste, as specifically capitalist confluence of the production and handling of waste, engenders distinct (and divergent) geographies that generally reflect the uneven development of capitalist modes of production (cf. Smith 1984; Barnes/Christophers 2018). In order to maintain capital accumulation over long periods of time and within confined space (of the 'final' planet), the 'limits to growth' have to be constantly recreated and reinterpreted into 'frontiers for capital accumulation'. On the one hand, this is achieved by digging and drilling deeper or

by commodifying ever-new realms of social life and the environment. On the other hand, and this is the linchpin of the notion of waste economies elaborated in this cumulative dissertation, capitalist production of waste potentially also serves to “create its own exteriority as a means to guarantee the reproduction of accumulation” (Bair/Werner 2011: 990) – if the societal handling of waste succeeds in transforming externalised limits (as waste, or output more generally) into future ‘frontiers for growth’. This second sub-question investigates if, how and why the different articulations of capitalist waste production and its societal handling at distinct space-times contribute to the expanded reproduction of capitalist modes of productions. Three different economic processes and dynamics serve to delineate major features of waste economies in relation to expanded capitalist reproduction: processes of externalisation as well as dynamics of intensification and expansion. The case of manure and digestate from intensive animal husbandry and bio-gas production in Lower Saxony, Germany, and the case of informal plastic recycling in Kolkata, India later illustrate the difference that the uneven geographies of capitalism make for the specific articulations of waste economies – in terms of dynamics of intensification and expansion.

#### *3.4.2.1. Processes of Externalisation*

Processes of externalisation generally pertain to “how capital relates to nature, particularly how nature is [...] not valued” (Kenney-Lazar/Kay 2017: 33). This notion overlaps with the classical concept in ecological economics (and even neoclassical economics) in as far as the externalisation of (non-commodified) social and ecological costs and services from economic calculus is concerned (Gille 2007). But, in the context of this cumulative dissertation, externalisation transcends its classical meaning and highlights instead the abstract rationality at work in the governance of what ‘leaves’ the confined space of the capitalist accumulation economy - and how this is related to society (the ‘household’) and its social metabolism at large. This process of externalisation is, with regard to capitalist production of waste, caused on a very general level by the abstraction from concrete use-values that commodity production involves (Horton 1997; Herod 2013). Under the growth imperative of capitalist modes of production, it results in surplus production that has historically led to the large scale destruction caused by the sudden devaluation happening during crises of over-accumulation. Yet, As Bair/Werner (2011) argue, it is important to

focus not only on the moments of capitalist crisis and the “assets” released, or wasted during it “at close to zero cost” (Bair/Werner 2011: 990) – as Harvey (2003) would have it – but to attend also to “the contours of capital accumulation and those people and places provisionally externalised from its relations” (Bair/Werner 2011: 990) during the normal run of things. This focus on the ‘disarticulations’ of globalised economic activities reveals that “processes of devaluation, for example, are an inherent dynamic of capitalism” (Bair/Werner 2011: 990). Subsequently, externalisation is also related to what Herod et al. (2013) have elaborated as processes of devaluation, which pertains to planned obsolescence, “accelerated need creation” (Gille 2007: 32) and the pervasiveness of ‘throw-away’ consumption goods, that externalise the destructiveness of over-accumulation on environments. Moreover, as Bair and Werner suggest above, devaluation concerns not only commodity ‘things’ but also places and people externalised from capitalist modes of production. Accordingly, ‘waste’ can be interpreted as “the political other of capitalist ‘value’, repeated with difference as part of capital’s spatial histories of surplus accumulation” (Gidwani/Reddy 2011:1625). However, this entanglement of waste economies with the governance of what ‘enters’ and what ‘leaves’ the ‘household’ reveals itself also in the impetus of ‘end-of-pipe’ technologies (disposal and incineration) and the imperative of ‘disposability’ at work in much of the waste management industry (Schlitz 2014b). It is, moreover, elucidated by the global trade in waste and debates about “pollution heavens” (Gregson/Crang 2015) that articulate through the uneven geographies of capitalism. Externalisation is generally related to mechanisms of devaluation and their fragmented spatial character. To differentiate this whole range of capitalist forms of wasting related to processes of externalisation on multiple scales, and to elucidate their relevance for the expanded reproduction of capitalist modes of production, it is necessary to distinguish between two dynamics that describe how the entangled production and societal handling of waste has been conducive for capitalist development and the valorisation of waste: Intensification and Expansion, elaborated in the following sections.

#### 3.4.2.2. *Dynamics of Intensification*

Dynamics of intensification are conceptually situated in-between processes of externalisation and dynamics of expansion characterising waste economies. This intermediate dimension of waste economies serves to explain their abstract relation and

historical co-development. It describes the mechanism through which capitalist modes of production are to a certain extent able to incorporate and reconcile the social and environmental contradictions that result from its processes of externalisation. In established fields of accumulation and below prolonged dynamics of primitive accumulation (by dispossession), this dimension pertains to the impetus derived from waste production, handling and valuation for:

- a.) efficiency increases in the form of reduced production waste, which has historically also been a major driver of technological progress and productivity increases, and thus contributes to continued accumulation on a higher level;
- b.) resulting competitive advantages and their combined effects with increasing eco-efficiency on demand that have been described as the Javon's Paradox according to which "efficiency increases accruing from technological innovations can become perverse incentives to consume more" (Kosoy et al. 2012: 75);
- c.) the (underlying) paradigm of ecological modernisation and its ideological function in thwarting or influencing environmental regulation and governance in a way conducive for capital accumulation. This aspect is strongly related to concepts like the 'green economy', 'circular economy' or 'bioeconomy'.

All of these three aspects reverberate in the prevailing conceptualisations of environmental governance and environmental upgrading within EEG. Moreover, dynamics of intensification serve to explain the complex interplay between the emergence of the waste management service industry and the intensified devaluation (Herod et al. 2013) of consumer goods through planned obsolescence, the creation of needs and 'throw-away' cultures that characterised the 'golden years' of Fordist growth in the Global North during the post-war period. In this regard, Herod et al.'s (2013) notion of devaluation improves our understanding of the political economy of formal recycling in the global North as recycling schemes mitigate environmental costs of capitalist over-accumulation and at the same time produce new spheres of accumulation for capital without jeopardising demand for new products (Samson 2017). As Herod et al. (2013: 381) elaborate:

In short, devaluing working products rather than letting them be devalorised by wearing out paves the way for further accumulation, giving rise to conditions in which ongoingness is possible on the scale that it exists today. The point, then, is that a resource-intensive, 'throwaway' society was not some 'natural' socio-

economic evolution but has instead been a necessity to a system of production and consumption constantly in crisis, one that only incidentally meets human needs. Developed as a way to avoid overaccumulation, paradoxically the expansion of domestic and international markets for consumer goods through ‘forced consumption’ has actually allowed the systematic tendency towards overproduction to continue, with waste generation acting as a kind of safety valve that has kept the treadmill of production going.

Thus, dynamics of intensification substantiate the peculiar relationship of ecological modernisation (as paradigm and ‘actually existing’ green capitalism) with processes of externalisation (e.g. devaluation) and dynamics of expansion (e.g. recycling as new field of capital accumulation) within waste economies.

#### 3.4.2.3. *Dynamics of Expansion*

Dynamics of expansion pertain to the way in which the production of waste (and related processes of externalisation inherent to capitalist accumulation) has been serving to reproduce general conditions for expanded reproduction of capitalist social and economic relations. Following Bair and Werner (2011: 990), this can be described as a “play of forces, between what is constituted as within capitalist relations of production and what is positioned as their interior limit” - strongly related to the governance of what ‘leaves’ and what might ‘enter’ again the household (of capitalist accumulation). This dynamic of waste economies illustrates how new frontiers of appropriation and valorisation (as in the case of continuous primitive accumulation by dispossession, cf. De Angelis 2001; Harvey 2003) and subsequent fields of capital accumulation are reproduced through the production of waste as externalised socio-nature. It includes all kinds of “more-than-capitalist” (Gibson-Graham 2014; cf. Braun et al. 2018) economic spaces that develop around such externalised socio-nature at the fringes of capitalist accumulation, like in the case of informal recycling networks in cities of the Global South (Sanyal 2007). Accordingly, the production of waste also serves to reproduce future limits of capital accumulation, like in the case of ‘waste lands’ appropriated again for real estate development (e.g. Gidwani/Reddy 2011), or the seizure and formalisation of ‘informal’ economic spaces in cities of the Global South, including informal recycling economies (e.g. Reddy 2015). Dynamics of expansion, therefore, “emphasizes capital’s imperative to create its own

exteriority as a means to guarantee the reproduction of accumulation” (Bair/Werner 2011: 990).

Based on a conceptualisation of the economy as social metabolism that is predicated on distinct modes of production, I have proposed to understand waste as paramount example of a 'hybrid' socio-nature that reveals the dynamics of inclusion and exclusion between the social and the material, thus exposing the demarcations between the (capitalist accumulation) economy and its 'outside' environment. Moreover, the proposed focus on processes of wasting (as classification and displacement) reveals not only the entanglement of “the environmental impacts of economic activity and the economic impacts of environmental mitigation” (Bakker 2012:104) but points to various ways in which different waste materials and different forms of wasting are translated and transformed into each other (Gille 2007). This enhanced understanding of the co-constitution of economic and environmental processes opens up new perspectives on the peculiar ways in which capitalist waste production stands at once for the social and environmental destructiveness of capitalist modes of production, while at the same time enabling the shifting and adjustment of the 'natural limits' as well as the reproduction of the economic 'frontiers' that are crucial for the expanded reproduction of capitalist accumulation (Harvey 2003; Bair/Werner 2011). To analyse this (contradictory) dynamic, I have presented a conceptual notion of waste economies that emphasis the (historically and socio-metabolically contingent) entanglements of the production, societal handling and valorisation of waste. Based on this conceptualisation of waste economies, I have identified processes of externalisation as well as dynamics of intensification and expansion as interlocking mechanisms that potentially (but not necessarily, and only under specific circumstances) facilitate the reconciliation of the social and environmental contradictions involved in the production of waste, and thus conceivably contribute to the expanded reproduction of capitalist accumulation.

### **3.5. Cross-cutting Lines of Difference**

The different waste materials addressed in the following two case studies draw attention to two types of waste that are exemplary for historically changing social metabolisms, the modes of production on which they are based, and the specific production of waste they

involve. Excreta and manure, on the one hand, constitute the most original form of waste produced by societies, as it is directly related to the biological metabolisms of humans and their ‘colonized’ (livestock) nature (Winiwarter 2002). Yet, with the changing shape of colonized nature, the shape of its waste also changed. Plastics, on the other hand, are probably the most paradigmatic types of waste ever produced by capitalist modes of production and constitute an unprecedented material composition that is truly anthropogenic, and thus involve an enormous potential for ‘unintended consequences’ (Liboiron 2016b).



## **4. Researching Waste Economies – Methodical Approach**

This dissertation is comprised of two distinct case studies in two different regions. The first case study investigates the valorisation of surplus manure from intensive animal husbandry through biogas production in a highly industrialized rural region in northwestern Germany – the example of manure and biogas plants in the Oldenburger Münsterland. The second case study focuses on the recovery and revalorisation of wasted plastic materials through informal plastic recycling in the metropolitan area of Kolkata, India. In this cumulative dissertation a combined, up-scaled analysis of these two cases is provided on a higher level of theoretical abstraction. In this vein, the two case studies serve to illustrate different aspects of waste economies – of the production, handling and valorisation of waste.

This chapter first briefly elaborates on the research context and process of the two case studies, putting an emphasis on the empirical research in Kolkata. The case study of the Oldenburger-Münsterland draws on a research project carried out by Kim Philip Schumacher, co-author of the ESP-article, and is not based on empirical data I have generated myself. The case study of Kolkata draws on my own empirical research on recycling economies in India and is based on empirical data I have generated myself. The chapter then moves on to the analytical integration of the empirical case studies into the theoretical framework of waste economies: It discusses the conjuncture of the analytical categories used in the three articles with the conceptualization of processes of externalisation and dynamics of intensification and expansion.

### **4.1. The Case Study of the Oldenburger Münsterland**

The empirical basis of the case study on manure and digestate based biogas production in the Oldenburger Münsterland is derived from a sub-project of the “Bioenergie Region Südoldenburg 2.0” consortium project, conducted by Kim Philip Schumacher between 2012 and 2015. This project was part of a nation-wide initiative of the German Federal Ministry of Food and Agriculture. The project in Südoldenburg brought together researchers with agribusiness stakeholders, farmers' associations and local politicians to find new ways to address the manure problem in connection with bioenergy production. It combined a stakeholder analysis with the analysis of material flows and regional added-value from bioenergy production as part of an applied research agenda. It also included an assessment of the legal and regulatory context as well as of the knowledge transfer and

communication strategies between different groups of actors (stakeholders). A mixed methods approach including semi-structured problem-centred interviews (Witzel 2000) and participant observations (Hammersley/Atkinson 2007) was used according to the particular research setting and context and supplemented by a secondary data material and media analysis.

#### **4.1.1. Research Process and Analysis of the Oldenburger Münsterland Case Study**

The empirical data consists of 40 interviews with actors of the regional agri-business network and includes 28 semi-structured interviews with owners and operators of biogas plants in the region. These interviews with owners and operators of biogas plants served to record interactions and conflicts between energy production and intensive livestock farming. This was supplemented by findings from 12 informal discussions in the form of ero-epic dialogues (Novy et al. 2008: 20f) and participant observations at various meetings within the project and other events of agricultural stakeholders in the region. The method of qualitative content analysis (Lamnek 2010) has been used for the analysis of this set of empirical data. Moreover, this case study also draws on a secondary data materials analysis (Flick 2009: 129) of existing statistical data and studies on agribusiness and bioenergy in the region including an analysis of the regional agricultural press and local media articles on the issue.

#### **4.2. The Case Study of Kolkata**

The empirical research for the case of plastic recycling in Kolkata, India, was conducted from September 2016 to February 2017. It was designed as explorative single-case study (cf. Baxter 2010) of plastic recycling networks at the level of Kolkata's urban (mainly informal) economic, political and socio-metabolic system. The research design deployed a process and flow heuristic to account for spatial and material (socio-metabolic) and economic processes of plastic recycling and (re)manufacturing on the one hand. This was combined on the other hand with a hierarchically structured network heuristic to consider the functional position of recycling actors within the economic organisation of the recycling network (see figure 7. and 8.). An emphasis was put on the multi-scalar entanglement of informal as well as formal actors directly involved in plastic recycling and (re)manufacturing as well as their relations to formal MSWM, state authorities, government agencies and civil society organizations including business associations (see

section 4.2.1.2). The research focused particularly on the social, economic and political context of plastic recycling networks in Kolkata, loosely drawing on the “extended case method” (Burawoy 1998) for reflexive social science that points to intersubjectivity and the role of power relations in research (see also Forsyth 2008). The triangulation of qualitative methods of empirical social science (Flick 2009) was used to adopt and adjust the methods according to the particular research setting and context. This methodical set (see section 4.2.1.1) included a variation of (a.) specifically adapted participant observations (Hammersley/Atkinson 2007), (b.) ero-epic dialogues (Novy et al. 2008: 20f) and receptive interviews (Lamnek 2010), depending on the research phase and context, as well as (c.) guideline-based interviews with standardised elements in the form of expert interviews (Lamnek 2010) or problem-centred interviews (Witzel 2000).

#### **4.2.1. Research Process and Analysis of the Kolkata Case Study**

The empirical fieldwork in Kolkata was conducted in the course of a six-month research stay at the Centre for Studies in Social Science Calcutta (CSSSC). The empirical fieldwork was conducted with the support of two research assistants, Deborshi Chakraborty and Subhasish Bandyopadhyay,<sup>14</sup> who assisted with interpretation during field research as well as translation and transcription of recorded interviews or audio records taken during event observations (see below).

##### *4.2.1.1. Methods of Data Generation*

The methodical approach used to analyse plastic recycling networks in Kolkata was mainly shaped by the triangulation of qualitative methods of empirical social science (Flick 2009). It combined (a.) three specific types of (a total of 35) participant observations with (b. and c.) four distinct types of (a total of 71) interviews.

The (a.) three types of participant observations (Hammersley/Atkinson 2007; Charmaz 2006) included context specific adaptations in the form of waste walks (Schlitz 2014a) and event observations (Fritsch 2018). Waste walks are explorative walks through urban space and were used as initial method to access the research field. They combine participatory observation with moving through the city, in order to systematically explore the societal handling of waste, identify spaces for waste and recycling, the actors involved, as well as

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<sup>14</sup> During the first three weeks of the main research phase, the empirical fieldwork was also supported by a third research assistant, Srijan Banerjee, who later resigned due to other obligations.

the trajectories of wasted plastic materials through urban space. This method was particularly useful to understand spatial patterns of dispersal and concentration of recycling activities: While reclaimers and scrap shops are found in every neighbourhood, the downstream actors of the recycling network are often – though not always – clustered in and confined to marginalised parts of the city. The tracing of these spatial patterns through waste walks offered a way to comprehend the functional differentiation and scalar structure of the plastic recycling networks (including economies of scale) and revealed two very specific actors: cleaner & cutters and dana traders. Moreover, waste walks became especially resourceful as method in a later research stage as they marked out movements between different research encounters, traversing contrasting waste scapes and fragmented parts of the city.

Owing to the explorative character of this empirical research, my own situatedness as white male researcher (of European descent) in post-colonial context, and the conditions of informality that shape much of Kolkata's recycling network, access to informants was a major challenge throughout the research process. It was a difficult task to get in touch with recycling agents and get the permission to interview them. A flexible set of guideline-based interviews with adjustable standardized elements proved viable in this situation. It ranged from (b.) very open formats like ero-epic talks (a low-threshold form of open interviews, mostly used to access an unacquainted research field; Novy et al. 2008) and receptive interviews (Lamnek 2010) to (c.) semi-structured ones like problem-centred interviews (Witzel 2000) and expert interviews (Lamnek 2010). This set of interviews helped to investigate the passage of (monetary) value and material (socio-metabolic) circuits as well as the concrete social and economic relations that make up Kolkata's recycling networks. It enabled the flexible integration of different formats depending on what was possible. The adjustable standardized elements focused on key figures of plastic waste trading, processing and recycling, including traded items, exchange prices, wage levels as well as the overall economic performance (loosely orientate towards the interview guidelines of Trettin 2002). They turned out to be of major importance because they enabled some degree of comparability amongst the very different research interactions (especially because they made it possible to gather some basic data, even if full-length interviews have been rejected). Moreover, and not less important, they provided a basic and translatable structure to simplify the interaction with my research assistants.

#### 4.2.1.2. *Empirical Sample – Two Data Sets*

The empirical research entailed two parallel processes of qualitative data generation. The first focused on economic actors directly involved in the recycling value chain (see sections 6.2.5 and 6.3.6.1 for detailed descriptions of the involved actors) as well as on the spatial patterns and trajectories of recycling networks (and SWM more generally). The second process of data generation focused on the broad spectrum of non-chain actors that shape plastic recycling networks in Kolkata, particularly those involved in public and private MSWM, but also including relevant state authorities, government agencies and civil society organisations. These two processes of data generation followed different logics but entailed also a number of important overlaps that enriched the overall sample and provided contextual insights. The following description of the empirical sample (see Appendix 1 for a detailed register of the generated empirical data) is therefore divided into actors directly involved in the recuperation, recycling and (re)manufacturing of used plastics, and other actors involved in the recycling networks as well as those entangled (in relevant ways) in its wider social, political and environmental context. Table 3 gives an overview of actor groups and methods comprised in the empirical sample.<sup>15</sup>

The first set of data is comprised of eight research interactions with reclaimers (waste pickers),<sup>16</sup> three research interactions with mobile hawkers (itinerant waste buyers), and 20 research interactions with scrap shop owners and workers in the up-stream segments of the plastic recycling network<sup>17</sup>. The intermediate trade and downstream segments of Kolkata's plastic recycling networks were covered by six research interactions with wholesalers, three research interactions with cleaners and cutters (intermediary, preprocessing actors), eight research interactions with plastic recyclers, four research interactions with specialised traders of intermediate and final plastic recycling products (like recycling plastic granules or resin, also called 'dana')<sup>18</sup>, as well as three research interactions with plastic (re)processors and (re)manufacturers<sup>19</sup>. Finally, this set of data included also 26 'waste walks', with the aim to systematically explore the spatial articulations of waste

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<sup>15</sup> Waste walks are not enlisted in table 3 because they framed the combination of different methods and usually included several actors groups. For a detailed list of all waste walks see Appendix 1.

<sup>16</sup> The research interactions with reclaimers often involved several people at the same time.

<sup>17</sup> The JEP-article presents a distinction of scrap shops according to their source of wasted plastic, which turned out to be crucial to understand the role of concrete use-values and the passage of value during the process of analysis. For this purpose, wholesalers were also included in the analysis (as 'big' scrap shops).

<sup>18</sup> Of which one is also a recycler and thus already listed as recycler.

<sup>19</sup> Of which two are also recyclers and thus already listed as recyclers.

management systems and recycling networks.

Data Set	Actors	Ero-Epic Talks	Interviews	Participant Observation	Event Observation
First Set	Reclaimers	EroEpic. 8, 9, 16, 17	Int. 12, 23, 24, 27		PartOb. 6
	Hawkers	EroEpic. 1, 12	Int. 30 <sup>20</sup>		
	Scrap Shops	EroEpic. 3,4,6, 10, 11, 13, 14, 15, 18, 19	Int. 2, 7, 8, 9, 13, 14, 25, 28, 29, 30		
	Wholesale	EroEpic. 7	Int. 5, 6, 17, 22, 26		
	Cleaner & Cutter		Int. 19, 20, 21		
	Recyclers	EroEpic. 26 <sup>21</sup>	Int. 10 <sup>22</sup> , 33, 38, 40, 41, 42 <sup>23</sup>	PartOb. 4	
	Dana Traders	EroEpic. 5	Int. 10, 11, 15		
	Manufacturers	EroEpic. 26	Int. 10, 42		
Second Set	KMC-MSWM	EroEpic. 25, 28	Int. 3, 31, 39	PartOb. 2a, 2b, 7	
	Civil Society	EroEpic. 2, 20, 21, 22, 23, 24, 27	Int. 32, 34		PartOb. 1
	State/Gov. Authorities		Int. 35, 36, 37, 43	PartOb. 9	PartOb. 8a, 8b
	Others		Int. 1, 4, 16, 18	PartOb. 5	PartOb. 3a, 3b, 3c

**Table 3:** Overview of types of research interactions per actor groups of the empirical sample

The second set of data is comprised of seven research interactions with actors engaged on different levels in the formal MSWM of the Kolkata Municipal Corporation (KMC), including two SWM Assistant Directors at the Borough Level, the Director General and the Chief Engineer at the SMW department of the KMC, and a participant observation at Dhapa, the major dumpsite of Kolkata. Moreover, it included nine research interactions with civil society organisations – especially the two social-environmentally oriented NGO's *DISHA* and *Tiljala Shed*, as well as the *Indian Plastic Federation* (a business association of plastic industries in East India). This set of data also encompasses five research interactions with relevant state authorities and government agencies, namely the *Central Institute of Plastic Engineering & Technology* (CIPET), the *West Bengal Pollution Control Board* (WBPCB) and the *Kolkata Solid Waste Management Improvement Project*

<sup>20</sup> This interview was conducted with a scrap shop owner as well as with three mobile hawkers who are supplying his scrap shop.

<sup>21</sup> The interviewee is running a business involved in plastic recycling and manufacturing of PVC-pipes.

<sup>22</sup> The interviewee is running a business involved in dana trade, plastic recycling as well as the processing of fresh plastic material for a transnational corporation.

<sup>23</sup> The interviewee is running a business involved in plastic recycling and plastic furniture manufacturing.

(KSWMIP) of the *Kolkata Metropolitan Development Authority* (KMDA). It also includes five research interactions with private companies involved in SWM as well as committed engineers and scientists. Finally, this set of data is enriched by four event observations (cf. Fritsch 2018: 46-72) that constitute a specific form of participant observation, which is very well suited to analyse the interactive dynamics, distinct perspectives and public negotiations (along multiple power relations) between these different groups of actors.

This concatenation of research interactions with multiple actors involved in Kolkata's plastic recycling networks provided for a comprehensive sample that enabled the analysis of a number of different aspects of plastic recycling networks as well as their interrelations. However, this diversity and complexity of research settings required the flexible set of adapted methods.

#### 4.2.1.3. *Analysis*

The empirical data generated in this way was analysed using the method of qualitative content analysis following Lamnek (2010) and Flick (2009; see also Gläser/Laudel 2006). Drawing on chain and network approaches within EEG as well as the works on GRNs and GDNs, initial analytical categories like value creation and capture, labour relations, material properties of waste as well as organisational forms within the recycling sector guided the empirical research. Processes of de/revaluation through destruction and recycling networks – pertaining to value production, enhancement, and capture (Henderson et al. 2002) as well as its determination and transfer (Bair/Werner 2011; McGrath 2018) in the GPN approach – were related to organisational forms within recycling networks (including forms of power and governance as well the embeddedness of respective actors). Moreover, the materiality (Crang et al. (2013) of wasted plastics – framed in terms of physical and chemical properties and transformations – was related to concrete working conditions and labour relations (Herod et al. 2013) within recycling networks, in order to better explain the societal handling of plastic waste. This combination aimed at the integrated analysis of spatial, material, economic and socio-political dimensions of informal plastic recycling along intersectional power relations.

However, following the principles of a circular research process (Novy et al. 2008) and reflexive social research (Burawoy 1998), the process of analysis involved also an inductive phase of theoretical reconstruction that integrated some aspects of grounded theory coding (Charmaz 2006) before proceeding with qualitative content analysis. In

reflection of the empirical realities encountered during the research process, the preliminary analytical categories were subsequently adapted and transformed: the materiality of waste was reframed and coded on the one hand in terms of the ‘tangible use-values’ of wasted plastics and their economic articulations through ‘languages of valuation’<sup>24</sup> in order to better account for their relevance in the recuperation and passage of value during the recycling process. This made possible the ‘source-wise differentiation’ of plastic recycling networks along different strands according to plastic types, colours and different qualities. On the other hand, the different material transformations entailed in the recycling process were reframed as a social metabolism in order to carve out the strong imprint that recycling as concrete production process – involving material flows and transformations – had on the economic organization of plastic recycling networks in Kolkata. To account for these entangled processes, working conditions and labour relation were additionally more strongly considered as concrete labour process, emphasising also the specific work tasks and machinery involved – with codes like ‘activities’ or ‘work tasks’. Moreover, the economic relations, interactions and forms of organisation were also reframed in accordance with the specific empirical realities encountered in Kolkata, to emphasis for example the crucial allocative role of ‘agents’ or the importance of long term ‘relations of trust’ for the economic functioning of recycling networks.

### **4.3. Analysing Waste Economies – Analytical Integration**

The two distinct case studies on which this cumulative dissertation is based, served to carve out different aspects of waste economies and their respective relevance for the expanded reproduction of capitalist accumulation, that is, for the continued growth of capitalist economies. As a consequence, the analysis of the two case studies with regard to the notion of waste economies elaborated in the proceeding chapter meant first and foremost to ground the cases into the general political-economic (as well as social-environmental and cultural) context in which waste is produced, handled and valorised. In revisiting the analytical categories of the GPN approach, such a grounding was based in particular on extended notions of the societal and territorial embeddedness as well as economic and institutional power relations (see section 2.1.1.) that strongly shape the

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<sup>24</sup> These ‘languages of valuation’ were carriers of ‘tacit recycling knowledge’ and included a number of “codes of participants’ special terms as *in-vivo* codes“ (Charmaz 2006: 55; italics in original) to describe specific types of plastics, like ‘*guria*’, ‘*kalo*’, ‘*krystal*’ or ‘*dairy*’ in their economic relevance.



possibilities and capabilities for value production, enhancement and capture (as well as its determination and transfer). With respect to the entangled economic and environmental change entailed in waste economies, this also meant to attend to the materiality of concerned wastes types and their material transformations throughout the socio-metabolic processes underpinning their production, handling and valorisation. This points to the ways in which “different societies ignore or misunderstand the nature of their material foundations and thus ‘mis-spatialize’ wastes in unique ways” (Gille 2007: 27) – and to the resultant ‘unintended’ consequences and externalising effects, as well as the implications this has for the societal handling and valorisation of waste. The analytical integration of the two case studies of this cumulative dissertation has carved out to what extent distinct types of waste and processes of wasting in different geographical contexts exhibit parallels and differences with regard to the ways in which waste is handled, transformed and revalorised economically; how the production and handling of waste relate to each other; which environmental implications arise from both processes (how the materiality of waste is ‘misunderstood’); and under which economic, political and social-environmental conditions the valorisation of waste takes place.

The identification of such parallels and differences contributed to a better understanding of the relationship between the production of waste and its societal handling and economic valorisation, summarised under the notion of waste economies. This concept of waste economies has been operationalized in terms of processes of externalisation, as well as dynamics of intensification and expansion. Processes of externalisation pertain to the ‘misrecognition’ of a society’s material basis and relate the production and societal handling of waste to each other. Dynamics of intensification and expansion pertain to the valorisation of waste as specifically capitalist form of societal waste handling and relate this handling of waste back to processes of capital accumulation as well as the uneven geographies it gives rise to. Table 4 shows which aspects of externalisation, intensification and expansion are addressed in the respective articles.

Both cases provided important insights into the processes of externalisation that are entailed in the production of waste and forms of wasting and further impinge upon its societal handling. In the ESP-article (the case of the Oldenburger Münsterland), processes of externalisation pertain to the environmental impact implied by the concrete materiality of manure and digestate, which is analysed through the concept of trade-offs (in the water-

energy-food nexus literature) and risks (in the GPN-Literature) – particularly environmental risks and their diverging perception by different actors. Moreover, it is also captured through the global material flows and labour migration implied by the role of the regional agribusiness cluster as “external resource transformer” (Smetana et al. 2016: 404) and the uneven geographies they reflect. In the JEP-article (the case of Kolkata), processes of externalisation are addressed through the distinction of concrete use-values and different social use-values of wasted plastics, which are further elaborated with respect to spatial and material patterns of capitalist forms of wasting as well as processes of primitive accumulations that underpin informal economies in India. The respective processes of externalisation in the case of Kolkata are refined in the SJTG-article through the analytical distinction of socio-metabolic functions of wasted plastic in the recycling process on the one hand, and environmental implications and risks associated with the material transformation of plastics on the other.

Case	Article (Notation)	Processes of Externalisation	Dynamics of Intensification	Dynamics of Expansion
1. Case	ESP-Article	Trade-offs and (env.) risks; distant externalising effects through imported inputs	Value enhancement/capture (bioenergy strategies) based on embeddedness	Imported inputs and labour (only indirectly applying)
2. Case	JEP-Article	Distinction of concrete and social use-value; spatial and material wasting patterns	Social upward mobility of marginalised actors (only indirectly applying)	Relation of informal need economies and capitalist accumulation economies
	SJTG-Article	Differentiation of plastics socio-metabolic function and environmental risks	Limited capabilities for env. upgrading/improved env. management	Transfer of value; effects of formalization schemes for recycling

**Table 4:** Operationalisation of waste economies per article.

Dynamics of intensification are strongly related to the embeddedness of economic actors and production networks. Especially their network embeddedness is offering important insights into the specific economic spaces (Hudson 2004) in which waste economies unfold. In the ESP-article, dynamics of intensification have been analysed through the interplay of network embeddedness in global production networks with the societal and territorial embeddedness as well as economic and institutional power relations that strongly shaped the opportunities for value enhancement and capture through biogas production. Such dynamics are much less obvious and straightforward in the case of Kolkata, where

waste is handled and revalued primarily within informal need economies (Sanyal 2007) that offer limited scope for capital accumulation (Gidwani/Baviskar 2011). Accordingly, dynamics of intensification are only indirectly addressed in the JEP-article with references to social upward mobility amongst marginalized actors in the labour-intensive up-stream segments of Kolkata's recycling networks and the interrelation and entanglement of formal and informal economic spaces through the intermediary role of scrap shops. In the SJTG-article, this very absence of dynamics of intensification constitutes the starting point for the investigation of the potential for improved environmental management and environmental upgrading in the intermediate and downstream segments of plastic recycling networks with respect to conditions of informality and the economic inequalities entailed in it.

Dynamics of expansion pertain to the multiple ways in which process of externalisation are laying the ground for further rounds of capital accumulation, even if state and private capital are not able or willing to valorise waste through dynamics of intensification 'inside' the accumulation economy. Such dynamics are only indirectly addressed in the ESP-article with respect to imported material inputs and the exploitation of cheap migrant labour. However, dynamics of expansion are particularly relevant to understand the valorisation of waste in the case of plastic recycling networks in Kolkata. In the JEP-article, such dynamics are addressed through the description of recycling networks as informal need economies that are the result of processes of primitive accumulation (by dispossession) and "subsidise and supplement capital accumulation" (Gidwani/Baviskar 2011: 143) through their revalorisation of wasted plastics which would otherwise be lost to capitalist production. In the SJTG-article, this contradictory relationship between informal and formal economic spaces is refined with reference to the "transfer of value" (McGrath 2018: 513) entailed in conditions of informality and the social stigmatisation of waste-related works – as well as the displacements and dispossessions often involved in the modernisation and formalisation of recycling in India.

The following two chapters will introduce the two case studies and present the three articles in which they are elaborated. In these case-study chapters, the relevant literature will be also introduced. Based on the scholarly debates and the specific contributions of the three articles, the implications of these two cases for the analysis of waste economies will be discussed.

## 5. The Case Study of Manure and Digestate in the Oldenburger Münsterland

The case of biogas production from manure in the Oldenburger Münsterland in the north-western state of Lower Saxony in Germany provides a pertinent perspective on agricultural waste production, handling and valorisation, which is deeply entrenched in a particularly contested form of agricultural production – intensive livestock farming. Manure is a prime example for agricultural waste, which is defined by the United Nations (1997: 3) Department for Economic and Social Information and Policy Analysis as follows:

Waste produced as a result of various agricultural operations. It includes manure and other wastes from farms, poultry houses and slaughterhouses; harvest waste; fertilizer run-off from fields; pesticides that enter into water, air or soils; and salt and silt drained from fields.

While this definition puts manure on the same level as biotechnologically engineered and substances like pesticides, it is noteworthy to briefly revisit the peculiar waste-history of manure. Human and animal excreta form a nearly trans-historical chapter in the long story of waste and human societies. As Winiwarter (2002) has emphasised, the specific way in which societies have dealt with excreta and manure is instructive for understanding the close entanglements of modes of production and waste generation and treatment, as well as of changing rural-urban relations. She draws our attention to the different hygienic conditions found in cities in medieval Europa and Asia, which are related to different modes of production that translated into distinct societal metabolisms and related patterns of waste production:

European agricultural economies conceptualized (urban) waste as a problem rather than a resource, because of the relative abundance of animal manure. [...] The dung they produced was as valuable a resource as the other products that could be extracted from them. In such circumstances, human excrement from the cities was not considered a prime resource for agriculture. Japanese and Chinese towns, in contrast, relied on the supply of human excrement [...] due to the very limited supply of animal manure in their agricultural systems [...]. The European solution came at a cost, because the production of manure via animals is an expansive solution in energetic terms. In solar based societies, energy means

area, so the area needed in Europe to feed one person was much higher than in Asia, due to the extra area needed to produce animal fodder. [...] Cities in Asia were far more hygienic places than most European ones and water pollution due to faecal matter, one of the recurrent European problems, was almost unknown. Excrement was waste in Europe but recyclable in Asia. (Winiwarter2002: 41-42)

However, the green revolution, industrial agriculture and the “livestock revolution” (Emel/Neo 2011: 68) has drastically changed the mode of agricultural production, and with it also the mode of manure production towards a specifically capitalist form of wasting. These “changes in the intensity of the livestock sector reflect the economic logic of a Fordist regime and produce significant social-political and environmental ramifications” (Emel/Neo 2011: 69). Intensive livestock farming, as a crucial component of conventional industrial agriculture, is characterised by “its unceasing concentration and intensification – fewer but bigger farms or factories, with more specialization of feed and other inputs, and fewer farm workers” (Emel/Neo 2011: 68). Tamasy (2013: 385) explains this intensification, concentration and specialisation of production in detail:

Intensification refers to the introduction of factory-style farming, including the mechanization and automation of production processes in agriculture, the increased use of energy resources and chemicals, and the creation of new types of stock-breeding. Concentration describes the amalgamation of farms and fields, the increasing dependence on contract farming, and the expansion of the agribusiness model of production. Specialization relates to a transformation of labour and management structures, in which individual farms and regions specialize in particular products. Areas of intensive agriculture are seen as spatial outcomes of these principles.

The Oldenburger Münsterland is the prime example of such spatial outcomes in Germany and constitutes a particularly instructive case to comprehend industrial modes of agricultural production, the development of the intensive livestock industry and related forms of agricultural waste production. Tamasy (2013: 389) describes the Oldenburger Münsterland as “the area of the most intensive livestock farming in Germany”. It is a particularly instructive case of economic globalisation in the countryside because the Oldenburger Münsterland turned historically from a peripheral region that was characterised by unfavourable agricultural conditions and subsistence farming into “an

economically successful rural region in which many globally operating agri-businesses are based” (Tamasy 2013: 386). This development was spurred by railway and motorway connections as well as the entrepreneurial impetus of long-established trade capital, and it got additional impetus in the post-war period. According to Tamasy (2013: 387), from the 1960s onwards, this development involved

... the complete automation of the production process, new breeding methods and the introduction of factory farming to reduce costs as the primary goal of agricultural production. Under the cost dictate, farms grew and merged while vertically integrated agri-businesses developed in the poultry industry, controlling and streamlining the whole food commodity chain.

Moreover, “a recent boost” to this development trajectory of intensive livestock farming “has come from the extensive construction and use of biogas systems” (Tamasy 2013: 386). However, this development trajectory has also serious drawbacks:

The Oldenburger Münsterland is known as a ‘hotspot’ for environmental vulnerabilities, resulting from the very high number of livestock (not necessarily officially registered), the over-supply of manure, ordure nuisance and related health issues, and – recently again – groundwater deterioration. (Tamasy 2013: 386)

Such negative environmental implications – often downplayed as ‘externalities’ – of agri-industrial development trajectories are, however, not limited to local scales. Rather, they constitute one of daunting dimensions of global environmental change, as the following concluding quotation of Emel and Neo (2011: 69) elucidates:

Industrial livestock production is one of the most significant generators of ecological impacts at the global, regional, and local scales. Flooding the global markets with cheap meat, milk, and eggs has huge implications for biogeochemical cycles and land cover change. [...] Counting grazing lands, as well as lands in feed crop production, the livestock sector occupies 30 percent of the ice-free terrestrial surface of the planet. Transformation of forest and grassland into range lands and fodder or grain crops is occurring at alarming rates, especially in South America. [...] These land use changes generate carbon dioxide emissions, alter biodiversity and hydrologic cycles, and produce new pollutants. Concentrated livestock production produces its own set of hazards to

people and the environment, including serious nitrogen and phosphorous pollution of water resources, new viruses, and exotic new drug-laced pollutants.

## 5.1 Globalization and the Water-Energy-Food Nexus – Using the Global Production Networks Approach to Analyze Society-Environment Relations

**The following chapter contains the print version of the article detailed below:**

Franz, Martin/Schlitz, Nicolas/Schumacher, Kim Philip (2018): Globalization and the Water-Energy-Food Nexus – Using the Global Production Networks Approach to analyze Society-Environment Relations. In: *Environmental Science & Policy* 90(Dec), 201-212.

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### **Abstract:**

The interrelation of the water-energy-food nexus and processes of globalization has to be understood thoroughly in order to address socio-economic inequalities and environmental change. However, unravelling the complexities of the water-energy-food nexus in the context of globalization poses conceptual and empirical difficulties. Economic globalization, e.g. through transnational trade and foreign direct investment, results in a global conjunction of actors, interests and impacts, strongly affecting patterns of resource extraction and environmental degradation, and local capabilities for its governance. In environmental economic geography, the global value chain and global production networks approaches have proved useful for the analysis of interrelations between governance structures, value, institutional contexts, and modes of resource consumption. In this paper, we discuss the potential of the global production networks approach to analyze society-environment relations in the context of the water-energy-food nexus and processes of globalization. To make our argument, we will use the case of manure and digestate, which results from meat and bioenergy production in the Oldenburger Münsterland, the center of livestock farming in Germany. The region is Germany's best developed agribusiness cluster, which is integrated into a transnational network of animal producers, feedstuff producers and meat processors. And it is also home to many biogas plants and several market leaders in bioenergy technology, strongly related to the livestock husbandry business. The case is an example of the three-way-mutual interactions among food, energy and water. The analysis will combine the perspective of the water-energy-food nexus with the analytical categories of the global production networks approach to provide a nuanced understanding of the socio-environmental implications of the global integration of a regional agri-food production cluster.

**Keywords:** Global Production Network, Water-Energy-Food Nexus, Globalization, Agriculture, Manure, Risk



### 5.1.1 Introduction

Economic globalization results in a global conjunction of actors, interests and impacts, strongly affecting patterns of resource extraction, environmental degradation and local capabilities for environmental governance. In order to address socio-economic inequalities and environmental change that are caused by these processes, the interdependency of the water-energy-food (WEF) nexus and processes of globalization have to be understood thoroughly. Unraveling the complexities of these interrelations poses conceptual and empirical difficulties, which have not been adequately addressed by the WEF literature up to now. However, a number of analytical frameworks have been developed for understanding the relations between globalized production, trade, consumption and its interlinked stakeholders that can be harnessed to address these shortcomings. Such so called value chain or network approaches include commodity chains, filière, commodity circuits, global commodity chains, global value chains and global production networks (for an overview see Neilson and Pritchard, 2009). Network and chain approaches were initially developed as an explicit response to the failure of previous explanatory paradigms to cope with the changing geographies of production as they were trapped in a container view of space – a perspective bound territorially to the regional or national level.

The global value chains (GVC, e.g. Gereffi et al., 2005) and global production networks (GPN, e.g. Henderson et al., 2002)<sup>25</sup> approaches have proved useful for analyzing the interrelations between economic networks and environmental change. While GVC is used primarily for linear analyses of the power relationships between companies and their institutional context, the GPN framework is meant “to go beyond such linearity to incorporate all kinds of network configuration” (Coe et al., 2008: 272) and to put more emphasis on spatial aspects by using the concept of embeddedness. This broad understanding allows for the integration of actors like consumers, non-governmental organizations (NGOs) and trade unions into the analysis.

In this paper, we will discuss using the analytical categories of the GPN approach for analyzing society-environment relations in the context of the WEF Nexus and processes of globalization. We argue that a combination of the WEF Nexus perspective with the GPN approach offers a nuanced understanding of the environmental impacts and global interrelations of production networks. Most of the existing studies use the GVC approach,

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<sup>25</sup> In the following we use the acronym “GPN” to refer to the GPN approach, and “global production networks” to refer to the empirical phenomenon (see Yeung and Coe, 2015: 42).

but we focus on the GPN approach because of its broader analytical scope, which enables us to account for the societal environments of production processes. To illustrate our argument, we will use the case of manure and digestate that results from intensive meat and biogas production in the Oldenburger Münsterland (c.f. Pahl-Wostl, 2017). The region is the center of livestock farming in Germany and is well-integrated into a transnational network of animal and feedstuff producers, meat processors and other actors. The production of manure and digestate in this region exceeds the ecologically justifiable deployment for the available agrarian land, thereby endangering the groundwater quality. This has led to the establishment of an energy-intensive inter-regional export system that transports the surplus manure for deployment at farms without or with very limited livestock keeping in other regions.

The article is divided into six sections. Following the introduction, we will present the WEF Nexus perspective. In section 3, first, we will discuss the analysis of social-environmental relations within GPNs. Subsequently, we will discuss the conjunction of GPNs and the WEF Nexus. In section 4, we will present our methods. The findings of section 3 will be used in section 5 to analyze the case study. Finally, we will conclude that the GPN approach could help to explain trade-offs and provide a nuanced understanding of resource governance through the analysis of the underlying power asymmetries, risk dispersions and value allocations. Based on our empirical analysis we emphasize the relevance of the analytical category of risk for a better understanding of socio-environmental relations within the WEF Nexus. The proposed combination of aspects of GPN and WEF Nexus has the potential to be a basis to overcome shortcomings in both strands of research.

### **5.1.2 The Water-Energy-Food Nexus**

The nexus perspective first gained prominence at the World Economic Forum 2011, with the aim of promoting the indivisible relations between water, energy and food from a securities perspective (water-energy-food security) (Biggs et al., 2015). Following this event, the WEF Nexus increasingly attracted the attention of politicians and researchers (Leese and Meisch, 2015), and a variety of modified versions of the WEF Nexus have been developed by different authors (Biggs et al., 2015). All versions share the goal of advocating nexus thinking “as an advance on current and often sector-specific governance

of natural resource use” (Biggs et al., 2015: 390). The multiple possible linkages and interrelations within nexus thinking are generally structured by the notion of “security as the crucial link in the nexus approach” (Leese and Meisch, 2015: 696). We understand the WEF Nexus to be an integrated perspective for the analysis of the three-way interdependencies between water, energy and food for decision-making processes (Scott et al., 2015). The global crisis dynamics of society-environment relations exceed the simple causations (of environmental economics) of the depletion of resources and sink. Yet, to “date, nexus framings and applications of the nexus approach have tended towards technical assessments to enhance productivity, optimize synergies and identify trade-offs across nexus sectors to inform natural resource governance” (Biggs et al., 2015: 391). Furthermore, “current nexus framings are often focused on macro-level drivers of resource consumption patterns” (Biggs et al., 2015: 390). But on an overall scale, “there is no fixed concept of nexus, and the nexus is internationally interpreted as a process to link ideas and actions of different stakeholders under different sectors and levels for achieving sustainable development” (Endo et al., 2015: 3). However, WEF scholars have introduced different categories to analyze the challenges in the interrelations within the WEF Nexus. For instance, Scott et al. (2015) use the categories 1) security – analysis of the “human and ecosystem dependence dimensions of resource security” (Scott et al. 2015: 23); 2) institutions – analysis of the role of institutional structures and functions for resource management; and 3) resources – analysis of “multiple resource-use practices [...] to understand interrelations among such practices that were previously considered in isolation” (Scott et al. 2015: 16).

There are only limited analytical and conceptual tools for analyzing the driving forces of globalization within the WEF debate. Furthermore, WEF Nexus analyses have the tendency to reproduce territorially bound spatial categories – e.g. the nation state – within their appraisal of adaptive management and multi-level governance. Network and chain approaches like GPN and GVC were initially developed to enable the analysis of transnational networks of flows of products, value, and the underlying governance structures that transcend state boundaries. Therefore, these approaches could deliver the analytical and conceptual tools needed for the integrated analysis of driving forces of globalization and their effects on the WEF Nexus. Moreover, with its focus on the spatial

organization and governance of production, it could help transcend the persistent recourse to nation-state bound analysis.

### **5.1.3 The Global Production Networks Approach and the Water-Energy-Food Nexus**

#### *5.1.3.1 Society-Environment Relations in the Global Production Networks Approach*

The GPN approach is a framework for exploring the complex network of stakeholders who perform “functions, operations and transactions through which a specific product or service is produced, distributed and consumed” (Coe et al., 2008: 274) transnationally. The GPN approach targets the interrelations between governance structures, value and knowledge flows, institutional contexts, and territorial arrangements of the networks. In doing so, it understands production networks not only as an economic but also as a social, cultural and political (Coe et al., 2008) – and as we are arguing here: socio-environmental – phenomena. Production networks “may affect environmental processes that have impacts well beyond their area of origin [...]” (Bolwig et al., 2010: 183). To address such environmental impacts on a local, regional or national level, the transnational interrelations have to be understood thoroughly.

Case studies that use the GPN or the GVC approach to analyze the interrelations between economic networks and environmental concerns or impacts include the trade in endangered plant species (Pauls and Franz, 2013), ecological upgrading in car production (Reps and Braun, 2012), standards and eco-labels in food production and trade (e.g. Bernzen and Braun, 2014; Dannenberg and Nduru, 2013; Ponte, 2008), hydro-carbon (oil) production networks (Bridge, 2008) and e-waste (Lepawski and Billah, 2011) as well as the ship breaking and textile recycling industries (Crang et al., 2013). Most of these studies use the GVC approach, but – as already pointed out before – we focus on the GPN approach for the reason that it has a broader analytical scope. The GPN framework provides three analytical categories: value, power, and embeddedness. These categories and their subcategories (see figure 2) are used to analyze different analytical dimensions: The ownership architecture of involved firms, the governance structure of the networks between the involved actors, the role of different institutions and the different involved sectors (Henderson et al., 2002).

Dicken and Thrift (1992: 287) emphasize that “[b]usiness organizations are themselves 'produced' through a historical process of embedding which involves an interaction between the specific cognitive, cultural, social, political and economic characteristics of a firm's 'home territory' [...], those of its geographically dispersed operations and the competitive and technological pressures which impinge upon it.” Economic activities necessarily involve specific ways of relating to nature (Bakker, 2012). Political ecology scholarship provides rich examples of how historical processes of embedding of economic activities are deeply entangled with the production of locally specific but increasingly globalized society-nature relations (Robbins, 2012). According to Hess (2004: 176-177), embeddedness can be subdivided into societal (the origin of an economic actor including his cultural and political background), territorial (“the extent to which an actor is 'anchored' in particular territories or places”) and network embeddedness (the network relationships an organization or person is involved in). The results of Reps and Braun (2012) illustrate how network embeddedness influences the capacity for environmental upgrading processes. We will show for the case of the Oldenburger Münsterland how societal and territorial embeddedness determines the capacity to benefit from environmental policies, to influence environmental governance, as well as to thwart stricter environmental regulations. This relates to the politics in society-environment relations and the multiple power relations at work in conflicts about access to and control over the bio-physical environment and the distribution of environmental goods as much as environmental bads (Robbins, 2012).

The GPN framework differentiates between three categories of power for analyzing the distribution and exercise of power (Henderson et al., 2002, see figure 2): corporate power (the extent to which a firm can influence other actors in the global production network), institutional power (the exercise of power by the state, state agencies and international agencies) and collective power (the extent of power that collective agents like trade unions, associations or community based organizations can have to shape particular parts of a global production network). Pauls and Franz (2013) point out that clandestine practices can result in ineffective legal regulations or private standards and thus undermine institutional and corporate power in a global production network. In the case of endangered plant species in India, they show that state regulations can conflict with local social and cultural norms. While the trade in specific plants is legally forbidden, it can be widely socially

accepted in certain places or regions. “These struggles between state institutions [...] and local social and cultural institutions determine the capacity of the different actors to create value” (Pauls and Franz, 2013: 240).

This points to the fact that value is contested and closely tied up with the question of “how capital relates to nature, particularly how nature is or is not valued” (Kenney-Lazar and Kay, 2017: 33). The category of ‘value’ in GPNs is subdivided into value creation, enhancement and capture. From the outset, Henderson et al. (2002: 448) conceptualized value in GPNs with reference to “both Marxian notions of surplus value and more orthodox ones associated with economic rent”. Yet, according to McGrath (2017: 3), these two notions “imply irreconcilably different understandings of what value is”: one based on the differentiation of “use value, exchange value, abstract labour” in order to explain how “capital exploit labour”; the other based on “prices determined in markets (for goods and services as well as, crucially, labour)” (McGrath, 2017: 3). The resulting conceptual tension has strong implications for the analysis of society-environment relations:

- a) The process of value creation in GPNs is arguably the most contentious aspect. The formation of value in orthodox economic theory by price mechanisms on markets leads to the “central problem of environmental economics: Why is it that so many valuable processes in nature – ecosystem services like atmospheric circulation, hydrological flows, soil nutrient cycling – bear no monetary value under capitalism?” (Huber, 2017: 42). In response to this, many studies and approaches exist which try to internalize the costs of ‘externalities’ (Kosoy et al., 2012). In contrast, Huber (2017: 43) emphasizes that “Marx’s value theory allows for an ecological critique of capitalism by showing capital’s inability to value much of the natural processes that sustain life”. The reason is that under capitalism “[c]ommodities bear values [only] *if* it took some kind of labor to produce them”, with the effect that “much of the world of nature has immense use-value (in the sense of “social worth”), but no [exchange] value” (Huber, 2017: 42) in terms of monetary value.
- b) The value enhancement through technology and knowledge transfers is strongly related to popular accounts of ecological modernization and eco-efficiency (Robbins, 2012; Haberl et al., 2011). Yet, as Kosoy et al. (2012: 75) point out

“efficiency increases accruing from technological innovations can become perverse incentives to consume more”.

- c) The capture of value within organizations and territorially bound spaces is closely related to development issues at large. It influences the unequal global distribution of environmental goods and bads and affects instruments of global environmental governance like carbon trading (Haberl et al., 2011). While, on a downscaled level, it can be connected to eco-standards and eco-labeling, the cross-sectoral, trans-boundary and multi-scalar integration of such efforts poses largely unresolved challenges.

Some studies using value chain or network approaches provide important accounts of the materiality of specific resources and their repercussions on economic activity (Bridge, 2008), or the recurrent movement of things between the status of resource, commodity and waste as they traverse realms of de- and re-commodification (Crang et al., 2013; Lepawski and Billah, 2011). Yet, they analyze environmental implications of global production processes mostly in an isolated way: flowers are cut, water gets contaminated, food is produced organically or not, carbon sinks are identified and traded, electronics are disaggregated and reassembled (see e.g. Bernzen and Braun, 2014; Bridge, 2008; Lepawski and Billah, 2011; Pauls and Franz, 2013). Bolwig et al. (2010, 174) state that “research on the environmental implications of agro-food value chain dynamics generally lacks a deep analysis of the latter”. In the best case, environmental impacts and their reverberation on economic activity are identified along one singular dimension of ecosystems. An integrated analysis of environmental impacts and repercussions on multiple economic activities, as well as a real connection with a natural science perspective does not take place. Such an integrated analysis would need to consider the entanglement of economic activities with the production of locally specific but globally meaningful society-environment relations and their implications for the ecosystem functions vital for human livelihoods. Well established methodologies for the assessment of environmental implications of globalized production processes include material and energy flow accounting (MEFA) (Haberl et al., 2011), life-cycle assessment (LCA) for the analysis of particular products within industrial ecology (Hellweg and Canals, 2014) and regional sustainability assessment methodology (RSAM) based on resources, capital and transfers

(Smetana et al., 2016). Yet, “[although] a variety of methods exist for environmental appraisal of systems of production, they are not usually integrated within analyses of the value chains of which these systems are part” (Bolwig et al., 2010: 184). To integrate such methodologies for assessing the environmental implications of globalized production processes, a conceptual bridge is needed. In this vein, combining GPN with WEF Nexus thinking could be the basis for an interdisciplinary research framework.

### *5.1.3.2 The Conjunction of the Global Production Network Approach and the Water-Energy-Food Nexus*

What is interesting from the perspective of GPN is that the WEF literature provides a much more nuanced understanding of society-environment relations beyond the limited category of resources, which is biased towards direct production factors within value chain literature. At the same time, the WEF Nexus can reduce the complexity and multiplicity of society-environment relations to an extent suitable for outcome oriented analysis. The GPN approach draws on a network heuristic, which enables a nuanced analysis of the complex, multi-layered dynamics as well as variety of actors involved in globalizing economic activities. To combine it with the WEF Nexus, we draw on the categories put forward by Scott et al. (2015) and match it with general tendencies of the WEF literature to carve out analytical interactions:

1. We have to ask which relevance each of the nexus resources – water, energy and food – have for the creation, capture and enhancement of value in a production network. This will provide us with a concrete idea of the entanglement of globalized economic activities with nexus resource-use. But, in order to address the general mechanisms through which capitalism “ignores and ultimately destroys ecological systems“ (Huber, 2017: 41), it is helpful to ask as well whether, how and why nexus resources are valued economically.
2. This has tremendous implications for the understanding of trade-offs so prominently discussed in the WEF literature. Under the paradigm of economic growth and institutionally safeguarded by private property law, corporate power is able to determine the use of resources and influence the outcomes of natural resource governance as well. The notion of trade-offs can serve as a conceptual tool to analyze this influence and its effects. Because corporate power is compelled to

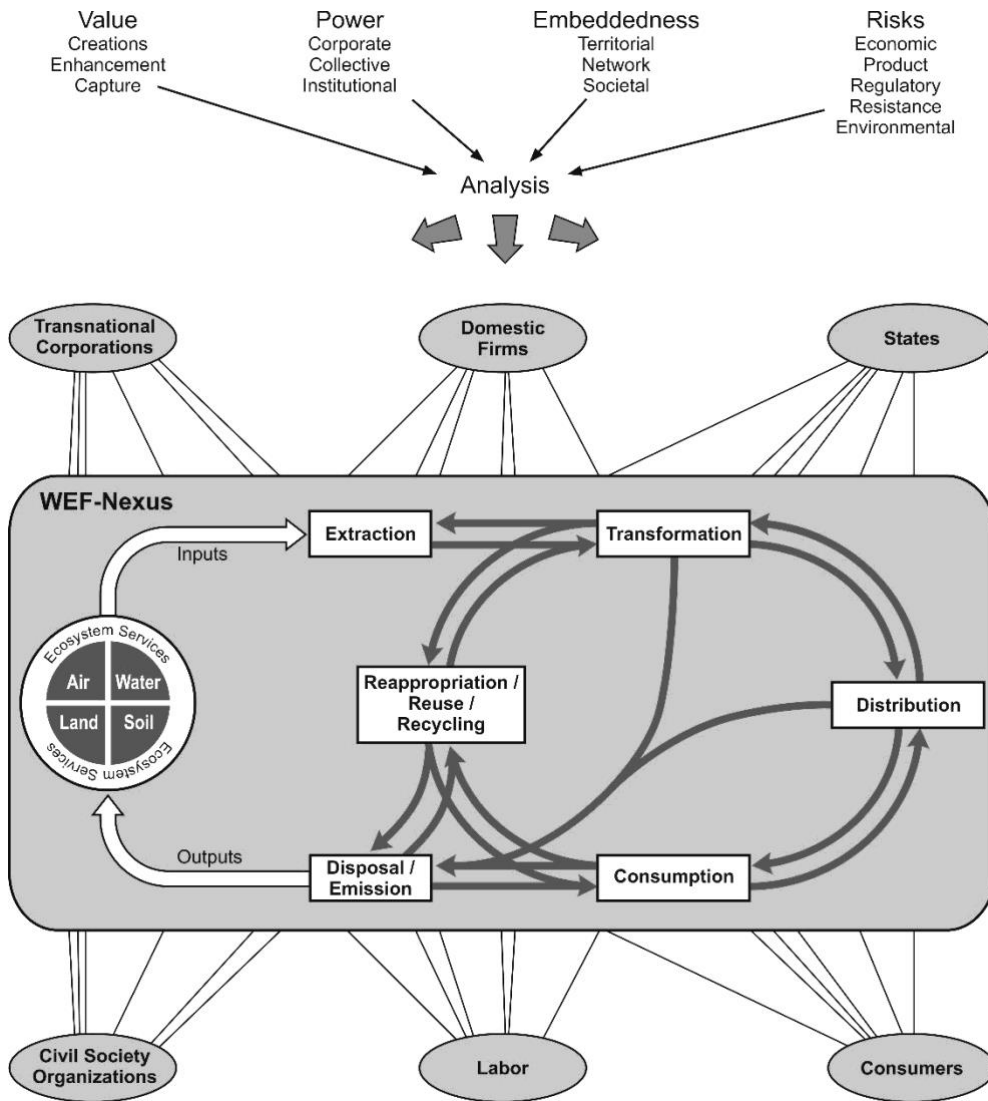


secure rents / extract surplus value within a competitive environment, the possible outcomes of trade-off situations are often predetermined, rendering environmentally sustainable yet less profitable options economically infeasible.

3. We consider the notion of institutions put forward by Scott et al. (2015) as a conceptual vehicle for the appreciation of natural resource governance in the WEF Nexus debate and relate it to questions of institutional and collective power as well as the embeddedness of the production network in question.

In order to meaningfully combine the WEF Nexus with the GPN approach, we have to extend the analytical categories of the GPN framework and include the category of risk. Yeung and Coe (2015) identify the risk environments of companies as one of the causal drivers of the development of global production networks. They differentiate between five kinds of risk: economic risk, product risk, regulatory risk, labor risk, and environmental risk. We will use this differentiation of risk environments as categories that have to be analyzed in relation to the other categories of the GPN approach. Yeung and Coe (2015) use the term labor risk for contestations of corporate strategies. However, resistance can also be exerted by other actors like NGOs, media and consumers (e.g. Gereffi et al. 2001). Thus, we have rechristened it “resistance risk” to indicate its broader scope (see Figure 2). Risk concerns all actors involved in production networks in distinct ways and enables us to relate to the notion of security in the WEF literature (Hoff, 2011; Leese and Meisch, 2015; Scott et al., 2015). In the WEF literature (e.g. Endo et al., 2015), maximizing security is sometimes used synonymously with minimizing risk, but a low risk can still be associated with a low level of security when vulnerability is high (Smith, 2013). An actor’s willingness to react to risks is strongly linked to their perception of these risks: Actors may assess risks in a different way based on their respective level of knowledge and sensitization and their distinct embeddedness. It is possible that the same circumstance is perceived as an environmental risk by one actor, as an economic risk by another one, and as not relevant at all by a third actor although they are all exposed to this circumstance in similar ways.

The scope of interrelations between the network architecture and analytical categories of the GPN approach – value, power, embeddedness and risk – with the WEF Nexus perspective is illustrated in Figure 2.



**Figure 2:** Analyzing the Water-Energy-Food Nexus with the analytical categories of the Global Production Networks approach (original figure based on Henderson et al., 2002, Yeung and Coe, 2015, Dicken, 2011: 60).

The following case study will be used to illustrate the special relevance of a differentiated analysis of risks. We will analyze risk in relation to the other analytical categories of the GPN approach without a comprehensive analysis of each of these analytical categories (due to the limitations of length in this article).

### 5.1.4 Material and methods

The empirical insights were compiled while one of the authors participated in the project “BioenergieRegion Südoldenburg 2.0” (2012-2015). The project was part of a nationwide initiative financed by the *Fachagentur Nachhaltende Rohstoffe* (FNR) on behalf of the

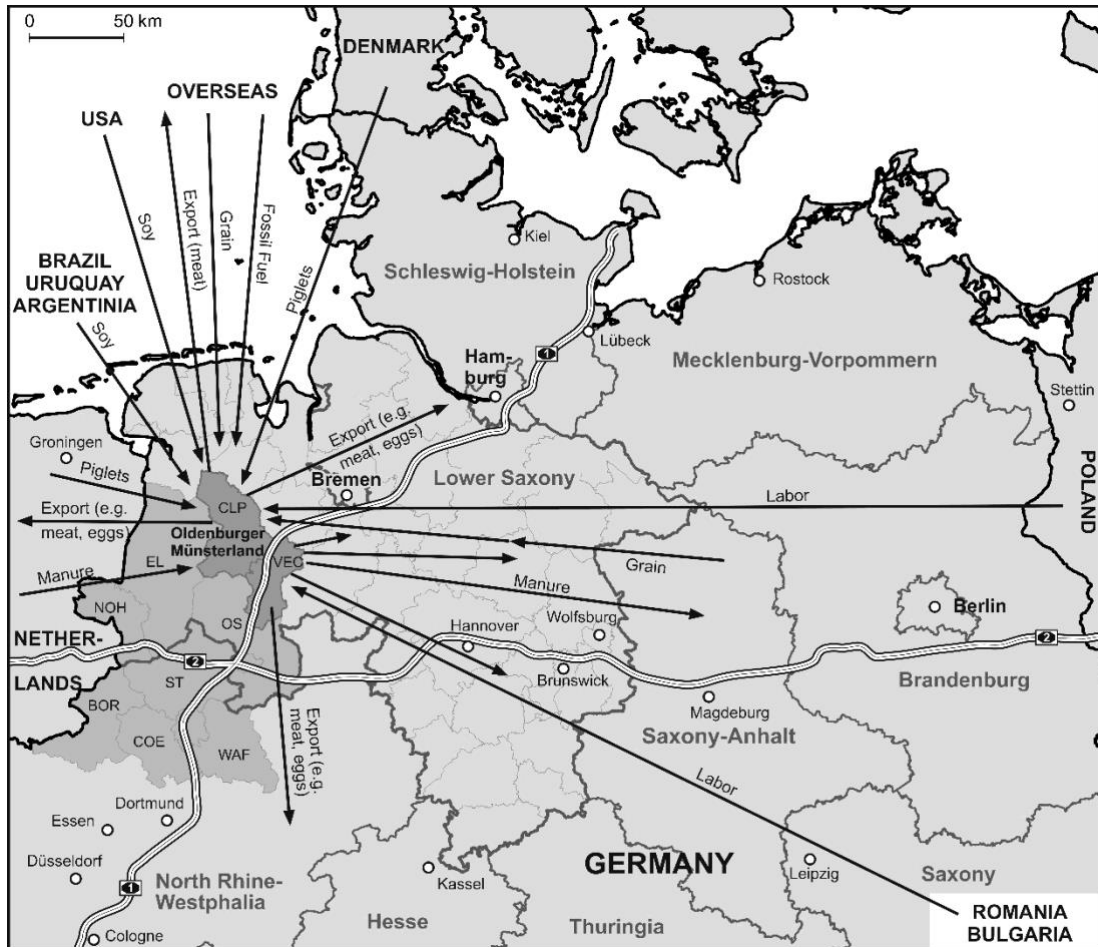
Federal Ministry of Food and Agriculture. It brought together researchers with stakeholders from agribusinesses, agricultural associations and local politicians to find new ways to tackle the manure problem related to bioenergy-production. The main materials are talks and interviews with the above-mentioned stakeholders. Additionally, participatory observations during various meetings within the project and results from 28 semi-structured interviews with owners and operators of biogas plants have been used. The interviews and insights (documented as field notes) have been analyzed using the method of qualitative content analysis. Furthermore, we draw on existing studies, statistics, the regional agricultural press and media articles.

### **5.1.5 Case Study Oldenburger Münsterland**

In Germany, the westernmost part of the federal state of Lower Saxony, the region Weser-Ems and the north-western parts of the federal state of North Rhine-Westphalia (NRW) constitute a region of highly industrialized agriculture and animal production and form the core of an agribusiness cluster (see figure 3).

In 2014, 2.9 million tons of meat were produced in Lower Saxony, representing 32.3 % of the pork and 59.1 % of the poultry production in Germany. NRW contributes another 34 % of the German pork production (LSN, 2016). The core of the agribusiness cluster is the Oldenburger Münsterland, consisting of the districts Vechta and Cloppenburg.

The cluster development is strongly linked to the “historical process of embedding” (Dicken and Thrift, 1992: 287) of the actors in the territory (see figure 4). Historically unfavorable agricultural production conditions were turned into comparative advantages when the region got railway (second half of the 19th century), allowing the import of barley from Russia (Windhorst 1975: 30), and motorway connections in the 1960s. This infrastructure enabled the import of fertilizers and feedstuff and increased the accessibility of markets – the production network scaled up its reach. Based on these new opportunities and cheap local labor, the farmers introduced intensive fattening of pigs and strongly increased animal production, driven by cattle dealers and their knowledge of emerging markets (e.g. Ruhr-Area), capital and networks (Windhorst 1975: 30). In the 1960s, layer hens, as well as chicken and calves fattening grew in importance (Klohn and Voth, 2008).



**Figure 3:** The Oldenburger Münsterland in Lower Saxony - destination for imports of grain, piglets, labor and manure and the origin of exports of food and manure (original figure).

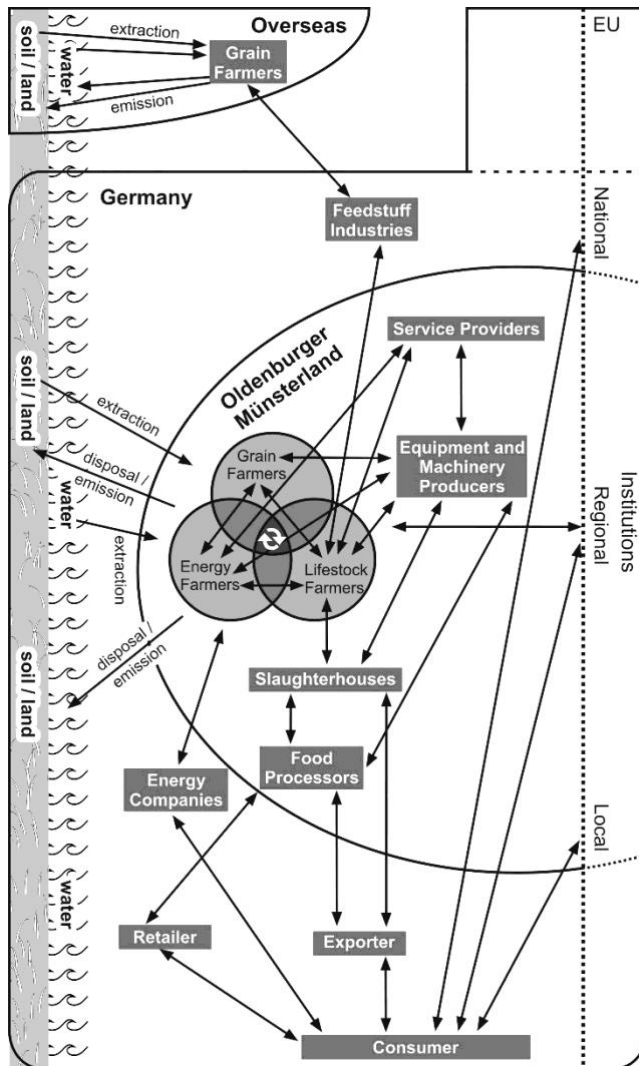
Today the region is characterized by a high degree of vertical and horizontal integration of agriculture and food production and related industries like machine building, stable technology, packaging industry, feed production, animal pharmaceuticals and food processing. A strong network embeddedness of the involved actors has evolved since the 1950s (Tamásy and Tepe, 2015). A lot of businesses are still family owned SMEs, meaning a high regional value capture. This creates a close network of local actors tied together by business and often family relations (Berlin Institut, 2009). Many of these actors are collectively organized in different associations and developed a strong collective power, which they use to influence political institutions on the local and regional level. The co-evolution of the economic structure of the region and the responsible state institutions has long ensured favorable conditions for the territorial embeddedness of all kinds of agri-

food businesses and limited the regulatory risks for the farmers and companies (interviews with lobby groups and agricultural associations).

The region is integrated into global production networks via inputs, and labor sourcing as well as exports of food and machinery (see figure 3 and 4), characterizing it as “external resources transformer” (Smetana et al., 2016: 404). Via the seaports, grain and oilseeds like soy for concentrated feed is imported, the latter mainly from the USA and Brazil. Germany imports 12 % of feedstuff (71.5 % of the concentrated feed) using 2.7 million hectares of land abroad (Destatis 2016). Importing resources which are extracted overseas (Smetana et al., 2016) means 1) that some of the emissions that result from meat production in the Oldenburger Münsterland are localized overseas (e.g. pesticides for soy production in Brazil), and 2) that nutrients that are extracted from soils overseas are disposed in Germany. Additionally, 1.5 million piglets are imported to the Oldenburger Münsterland per year from Denmark and the Netherlands in order to meet the high demand for pig fattening in Germany (Klein and Tamásy, 2015)<sup>26</sup>. Dutch agricultural business (farming, slaughtering etc.) and Danish food-processing companies are becoming increasingly important players in German agri-food networks. Germany has comparative advantages for slaughtering because of cheap migrant labor from Southeast Europe. In 2014 2.2 million pigs have been imported from abroad to Lower Saxony for slaughtering. This adds up to 19 million pigs (32 % of Germany) being slaughtered in Lower Saxony (LSN, 2016). Additionally, workers from Poland work in the agribusiness in Lower Saxony. Cheap labor from abroad increases locational advantages and a company’s value capture (Tamásy, 2013, see figure 3).

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<sup>26</sup> Farmers in Denmark and the Netherlands focus on piglet production to reduce the amount of manure they produce due to regulative pressure.



**Figure 4:** Actor-relations within the agri-food production network of the Oldenburger Münsterland (original figure)

In addition to high domestic market shares, Lower Saxony produced 30 % (1.3 million tons, 2.7 billion euros) of all German meat exports in 2014. The Netherlands, Italy and Denmark are the main markets, with exports to China strongly increasing (43,000 tons in 2014, LSN, 2016). China and South Korea are two of the new markets for high quality meat. Furthermore, animal parts not sought after in Europe are exported China. This gives animal producers the opportunity of enhancing the value of their produce (Klein and Tamásy, 2015).

The subsidies for renewable energies since 2000<sup>27</sup> and a bonus for the use of renewable primary products since 2004 and for manure as input since 2009 have added to the successful development of biogas production and related machine building and services to the regional economy. Before changes in the subsidizing schemes in 2012 and 2014, there was a building boom of biogas plants. 146 biogas plants in the Oldenburger Münsterland provide farmers with opportunities for value enhancement. The inventive talent and entrepreneurship as well as available technologies and financing opportunities within the region enabled this development and created a regional biogas production network, at least temporarily impinging on further investments into live-stock keeping. This development caused increases in land prices, land-rents and feedstuff, resulting in tensions between different actors within the agri-business (interviews with owners of biogas plants, see figure 4).

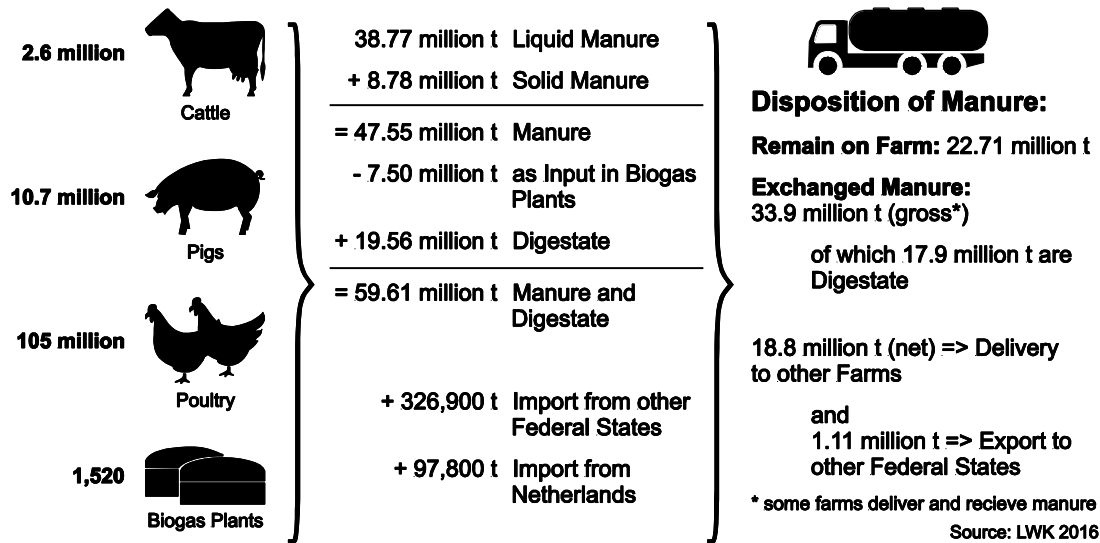
Since the 1970s, scholars have pointed out the environmental risks related to this vast intensification and high density of live-stock (e.g. Mose and Schaal, 2012; Windhorst, 1975):

- Surplus of animal excreta
- Emissions from animal housing systems and chemical fertilizers
- Potential hazards caused by animal diseases
- Potential conflicts regarding species-appropriate animal husbandry in relation to changing consumer demands and to sensitizing of the public

The biggest problem is the surplus of solid and liquid manure (see figure 5). In some districts the accumulated manure exceeds the amount that can be deployed on fields and grassland according to existing regulations. The problem has worsened due to the biogas plants, because the fermentation process turns the subsidized input of maize into digestate without reducing its volume. It has to be deployed like manure, accounting for 52.8 % of farm fertilizer that was passed on by farms (LWK, 2016: 9). This can be seen as a trade-off between the use of maize in the food-chain and its use in the energy production chain.

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<sup>27</sup> German Renewable Energy Law (2000) guarantying buy-off of gas and electrical energy at high fixed subsidized prices for a period of 20 years.



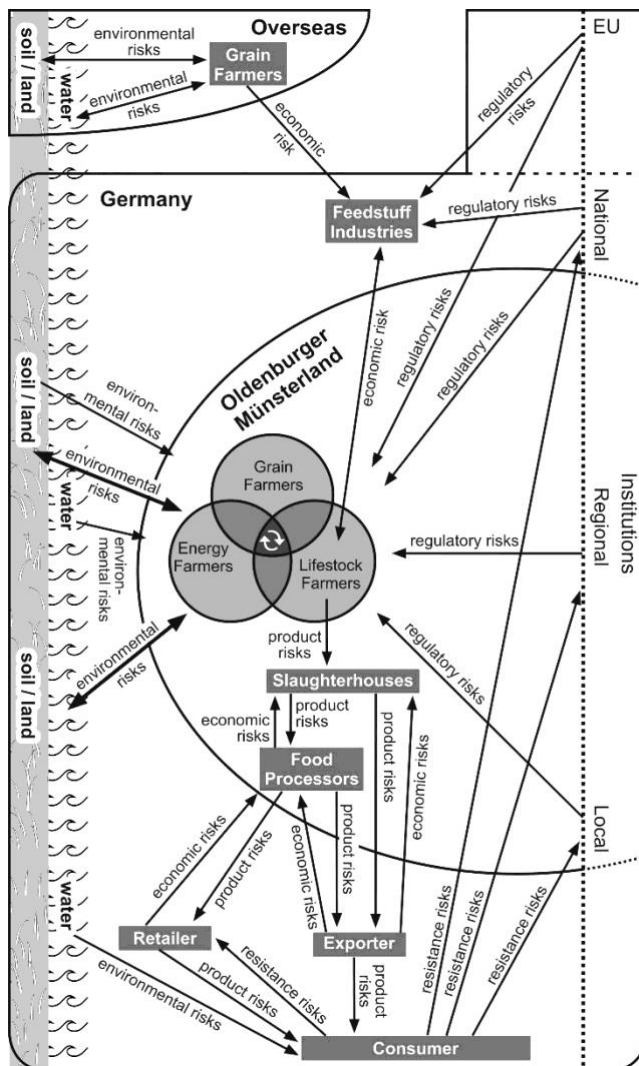
**Figure 5:** Production, import and export of manure and digestate in Lower Saxony 2014/15. Source: LWK 2016 (original figure)

Currently, the accumulated amount of nitrogen from organic manure exceeds the limit of 170kg/ha agricultural area in the district of Vechta (174kg/ha) and is close to it in Cloppenburg (163kg/ha) (LWK, 2016: 27). Phosphor limits are exceeded in the Oldenburger Münsterland, too (LWK, 2016: 26). In total, there is an annual surplus spread of mineral and organic fertilizer of 80,000 tons nitrogen in Lower Saxony, posing risks to soil and groundwater. Proposed changes to the regulatory framework like the stricter fertilizer regulation of 2017 require the inclusion of digestate and mineral fertilizer into the calculation of 170kg/ha agricultural area, aggravating the surplus in several more districts (LWK, 2016: 42), and thus will lead to more intra-regional exports. The high demand for water for the slaughterhouses is another issue.

These environmental impacts translate into environmental risks and have the potential to become economic risks for farmers and agribusiness (see table 5 and figure 6) and ultimately for regional development if the current mode of production is not altered (c.f. Tamásy, 2013). At the moment and in anticipation of environmental risks, the regulatory risks dominate the discussions in the regional agribusiness. Two developments have increased the regulatory risk: the increase in nitrates in the groundwater wells (BMU and BMEL, 2017) and regulations imposed by the EU, also influencing the national regulations on fertilizers use and agricultural codes of best practice. In April 2016, the European Commission referred Germany to the Court of Justice of the EU for failing to take



measures in accordance with the Water Framework Directive to combat water pollution caused by nitrate (European Commission, 2016). In contrast to Denmark or the Netherlands (where rather strict regulations have been imposed), in Germany no drastic measures have been taken so far, maybe because it is a rather regional problem concerning primarily Lower Saxony and NRW.



**Figure 6:** Risks relations among the actors within the agri-food production network of the Oldenburger Münsterland (original figure)

Regional actors aim at belittling the environmental problems (see table 5), e.g. by claiming that data from the manure reporting system started in 2012 is overvalued. An assessment based on the maximum possible number of animals in the stables according to the building

permits was demanded several times but was never compiled “because of the workload” (Protocol project-meeting). Also, there is a well-known discrepancy between the numbers of animals in the agrarian census of Lower Saxony and the amount of animals registered with the animal disease insurance agencies (Tamásy, 2013), which points to hidden practices that make the existing legal regulations ineffective and limit institutional power.

In Lower Saxony, agribusiness and food production is the second largest industry. It is extremely well embedded within all kinds of local institutions and political organizations (see figure 4), resulting in considerable bargaining power in the provincial government. The strategic influence of agri-businesses aims at lowering their regulatory risks, as it influences local and regional institutions. However, regulatory risks grow on international and national levels. In order to avoid stricter governmental regulations and to show that the region can solve its problems locally, quick fix solutions like a regional manure export system have been proposed. Logistics and the necessary technologies have been implemented quickly. The export system is governed particularly by animal feedstuff providers in cooperation with agricultural service providers and truck companies, due to their relations with farmers, capital and logistic knowledge. They have also established several exchange markets for manure (*Güllebörse*), where farmers can sell or buy liquid manure. Yet, the export of manure is costly, energy and traffic intensive (interviews with lobby organizations, service providers, and a feedmill).

Resistance by the population to the environmental risks of live-stock production – which has influenced regulation in many other fields in Germany – is rather low in this region (see figure 6). One reason might be the high proportion of the population that is directly (ca. 17 % of labor force in food industry and agriculture, Verbund OM, 2014) or indirectly connected to the agri-food business. The expansion of the agri-food cluster (Berlin Institut, 2009) is a local success story (Tamásy, 2013). It seems that the local social and cultural norms contradict international regulation. The strong network embeddedness in the region makes it easy to put considerable pressure on all actors opposing the prevalent development model and thus lower resistance risks for the companies (informal interviews, see figure 6). However, there is some local protest against the extensive ground water withdrawal by large slaughterhouses, which causes private water wells and ponds in the surrounding gardens and farms to dry up.

	Risks	Value	Power	Embeddedness
<b>Environmental Risks</b>	<ul style="list-style-type: none"> <li>Intensive agriculture results in emission of soils &amp; water</li> <li>Bioenergy production results in corn-monocultures production &amp; increases emission of soils &amp; water</li> </ul>	<ul style="list-style-type: none"> <li>Value creation is based on intensive agriculture</li> <li>Disposal of manure on farmland enables intensive agriculture</li> <li>Value enhancement through bioenergy production</li> <li>Value enhancement through manure-import from the Netherlands</li> </ul>	<ul style="list-style-type: none"> <li>Strong collective agency of farmers &amp; agribusiness based on strong network embeddedness &amp; importance of agricultural sector for regional value capture</li> </ul>	<ul style="list-style-type: none"> <li>Strong territorial embeddedness &amp; concentration of intensive agriculture in one region</li> <li>Strong network embeddedness of farmers &amp; agri-businesses</li> </ul>
Env. Risks cause <b>Product Risks</b>	<ul style="list-style-type: none"> <li>Polluted drinking water &amp; livestock watering</li> <li>Polluted products</li> <li>Bad image of meat products from the region</li> <li>Rising prices of land &amp; inputs</li> </ul>	<ul style="list-style-type: none"> <li>Product risks endanger reputational capital of producers. In the food industry, reputational capital is an important factor for the ability to create value</li> <li>As environmental &amp; product risks are unknown in other markets (like China) the export of products bear alternative value creation &amp; enhancement possibilities</li> </ul>	<ul style="list-style-type: none"> <li>Association of farmers &amp; agribusinesses try to belittle environmental &amp; products risks</li> </ul>	<ul style="list-style-type: none"> <li>Environmental &amp; product risks result in negative views of products from the region by consumers which potentially affects all actors which are territorially embedded in the region</li> </ul>
Env./Prod. Risks cause <b>Resistance Risks</b>	<ul style="list-style-type: none"> <li>Collective resistance by consumers</li> <li>Demand for stronger regulation</li> <li>Hindrance of building projects/ investments</li> <li>Changing patterns of consumption</li> </ul>	<ul style="list-style-type: none"> <li>Product &amp; environmental risks endanger the reputational capital of companies that do not benefit from intensive agriculture. Thus they may resist against the intensive agriculture business model</li> <li>Resistance risks endanger the sales of products from the region</li> </ul>	<ul style="list-style-type: none"> <li>Collective power of consumers can express itself in a boycott of products</li> <li>Collective power of consumers can influence the institutional power on national or supranational level</li> <li>Collective power of inhabitants of the region can influence institutional power on local or regional level</li> </ul>	<ul style="list-style-type: none"> <li>Strong embeddedness on a regional level lowers risk of resistance on the local/regional level as inhabitants identify themselves with the agricultural sector</li> </ul>
Env./Prod./Res. Risks cause <b>Regulatory Risks</b>	<ul style="list-style-type: none"> <li>Cessation of subsidies</li> <li>Prohibition of current practices</li> <li>Enforcement of existing regulations</li> </ul>	<ul style="list-style-type: none"> <li>Regulatory risks endanger intensive agriculture business model</li> <li>Regulatory risks can result in lower income for farmers &amp; agri-businesses</li> </ul>	<ul style="list-style-type: none"> <li>Institutional power can establish stricter enforcement of existing regulations</li> <li>Institutional power can establish stronger regulations</li> <li>Lobbying by collective agents of farmers &amp; agri-businesses lowers regulatory risks</li> </ul>	<ul style="list-style-type: none"> <li>Strong network embeddedness influences institutions on local &amp; regional level &amp; lowers regulatory risks</li> </ul>

Env./Prod./Res./Reg. Risks cause <b>Economic Risks</b>	<ul style="list-style-type: none"> <li>• Lower sells</li> <li>• Reduced productivity revenues</li> <li>• Investment necessary due to new regulations</li> <li>• Costly manure report</li> </ul>	<ul style="list-style-type: none"> <li>• Economic risks endanger intensive agriculture business model</li> <li>• Economic risks can result in lower income for farmers &amp; agri-businesses</li> </ul>	<ul style="list-style-type: none"> <li>• Lobbying by collective agents of farmers &amp; agri-businesses &amp; public relations activities to reduce economic risks</li> </ul>	<ul style="list-style-type: none"> <li>• Strong cluster structures lower economic risks due to knowledge transfer &amp; short-dated reactions</li> <li>• Potential risk of lock-in based on strong intraregional networks</li> </ul>
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**Table 5:** Risks in the agri-food production network of the Oldenburger Münsterland (own table based on interviews).

### 5.1.6 Conclusion

A growing body of literature has been discussing the interlinkages between water, energy and food security in overcoming the often sector-specific understanding and governance of environmental change (Biggs et al., 2015). While these studies have provided many interesting empirical insights – mainly on a macro level – they have not managed to develop an analytical framework that unravels the complexities of the interrelations between the WEF Nexus and processes of economic globalization, one of the main drivers of resource extraction and environmental degradation. The GPN approach could deliver the analytical and conceptual tools needed for the integrated analysis of driving forces of globalization and their effects on the WEF Nexus. By drawing on a differentiated notion of value, it helps to explain trade-offs with reference to the power of firms to determine resource use and governance. It also provides a nuanced understanding of resource governance (institutions) through the notions of power and embeddedness. In order to meaningfully combine the WEF Nexus with the GPN approach we have to extend the analytical categories of the GPN framework by a differentiated notion of risk (building on the differentiation of risk environments as causal drivers of the development of GPNs proposed by Yeung and Coe, 2015). Risk concerns all actors involved in production networks in distinct ways. Analyzing risks in a differentiated way – and in relation to the analytical categories value, power and embeddedness – provides us with a nuanced understanding of water-energy-food security. Such a combination of the GPN approach with the WEF Nexus has the potential to be a basis to overcome shortcomings in both strands of research.

The case study of the Oldenburger Münsterland illustrates the environmental implications of agro-food and bioenergy centered regional economic development. We have elaborated

how a combination of the WEF Nexus perspective with the GPN approach can leverage a more thorough understanding of the intertwined workings of environmental change with processes of economic globalization. The region is marked by a specific nexus of ground water use and contamination with intensified agricultural food and livestock production. This interrelation has been intensified by the dynamic integration of biogas production into the regional economic fabric. A supposed win-win situation in the form of the use of an environmentally unsustainable by-product of one production process (manure) as input into another production process (biogas production) turned – in the light of strong network embeddedness and the specific character of the region as “external resource transformer” (Smetana et al., 2016: 404) – into a situation where additional external inputs (e.g. maize) aggravated the overall environmental conditions (effects of manure and digestate surplus on ground water). The ground water contamination is a result of biogas production which is part of an effort to enhance value in line with state subsidies. This example illustrates the important role of corporate power in the creation of trade-off situations. Moreover, the conceptual integration of GPNs’ analytical categories reveal how the territorial and network embeddedness of the regional agri-food and biogas industry has enabled them not only to enhance value through imports. It also shows how these actors successfully thwart any regulatory consequences through the exertion of power on a local and regional scale.

In this regard, we identified the relevance of the analytical category of risk for a better understanding of socio-environmental relations within the WEF Nexus: The case study of the Oldenburger Münsterland shows that the perception of risk by all actors based on their embeddedness in “specific cognitive, cultural, social, political and economic characteristics of [their] ‘home territory’” (Dicken and Thrift, 1992: 287) and its relation to power structures needs to be understood thoroughly to develop effective strategies against environmental degradation. The importance of the food sector for the regional economy as well as its path dependency and interconnections of many businesses within a cluster make it difficult to have far reaching system transformations within a short time (cf. Tamásy, 2013). Nevertheless, the environmental problems especially the nitrate load of the ground water calls for immediate actions towards a sustainability transition.

But problems do not only exist on the local, regional and national level. As the region is integrated into global production networks farms and companies in the region transform grain and oilseeds from the USA and Brazil into relatively cheap meat that is partly

exported. This transformation of resources which are extracted in other parts of the world (Smetana et al., 2016) means on the one hand, that some of the emissions that result from German meat production are localized overseas (e.g. pesticides for soy production in Brazil) and on the other hand, that nutrients that are extracted from soils overseas are disposed in Germany. These and other interlinkages between the Oldenburger Münsterland and the global parts of the same production network have been illustrated. We argue that the analytical categories of the GPN approach are suitable tools to reveal the underlying power asymmetries, risk dispersions and value allocations.

## **5.2 Remarks on the Oldenburger Münsterland Case Study**

The ESP-article points towards a number of analytical possibilities and implications that contribute to the GPN approach, the WEF Nexus and scholarship in environmental economic geography, as has been outlined in the conclusion. There are, however, some aspects that need particular emphasis in the context of this cumulative dissertation.

First of all, processes of externalisation in the case of the Oldenburger Münsterland are directly linked to the intensive mode of agricultural (livestock) production, which translates directly into the patterns of intensification and concentration that characterises related modes of waste production – particularly the concentration of surplus manure. Tamasy (2013: 387) highlights that “environmental consequences of productivist agriculture were obfuscated, dismissed or constructed as ‘non-issue’ for most of the post-war period”. Accordingly, the rationality of agricultural waste production is predicated on the positive framing of manure as resource, which negates waste’s “negative use value, that can harm nature and human health” (Gille 2007: 25). However, the negative environmental impacts of intensive livestock farming are tremendous, from local to global scales (cf. Emel/Neo 2011), and Waters et al. (2016) consider the altered nitrogen and phosphorus cycles due to intensified use of fertilizers in industrial agriculture (beside fossil fuel combustion) as one of the prime markers of the ‘anthropocene’. Also Haberl et al. (2004: 202) name under the rubric “human-induced changes in ecosystems” that are characteristic of the unsustainability of industrial societies “global changes in biogeochemical cycles (carbon, nitrogen, etc.)”.

The valorisation of manure through biogas production not only perpetuates this logic of intensification in the Oldenburger Münsterland, but it does so through a form of upgrading that involves a higher level of capital concentration and commodification – which subsequently results in value enhancement – as well as an enlarged social metabolism through additional inputs. The accelerated intensification in production translates also into increased externalisation, particularly in terms of digestate, but also through other externalising effects. However, it is important to emphasise that this ‘unintended consequence’ of upgrading and value enhancement through bioenergy strategies is itself also a (presumably unintended) consequence of state policies and changing regulatory environments, particularly the ‘Energiewende’ (energy transition) heralded by the German Renewable Energy Law (BGBI 2000) and its subsidy and bonus schemes for renewable

primary as well as manure inputs. The ‘Energiewende’ in Germany has resulted in a decentralisation of energy production and related infrastructure that has weakened the economic and political power of big energy companies, but it has also led to a number of conflicts, particularly also spatial conflicts due to competing land use forms and rising land prices in rural areas (cf. Kanning et al. 2009; Bosch et al. 2016). Related scepticism towards biogas production can be ascribed to the general disillusion with intensive modes of industrial agricultural production. As Tamasy (2013: 387) highlights with regard to the Oldenburger Münsterland and the general situation in Germany, conventional agriculture is increasingly losing its legitimacy in public perception:

Growing concerns result from the dominant pathway of agricultural intensification, concentration and specialization. Major challenges are seen in a high animal disease risk, the overuse of antibiotics in factory-style livestock farming, emissions from livestock farming operations, soil and groundwater deterioration and ethical issues related to animal welfare.

Also Emel and Neo (2011: 67) reported for the United States that “pollution, animal cruelty, and worker abuse resulting from factory farming are increasingly covered by the popular press”. One paradigmatic answer to the contestations of dominant intensified forms of industrial agriculture, and the global ecological crisis more generally, are concerted efforts to envision new modern and high-tech forms of social-environmental relations and related modern rural economies. The “political project” (Goven/Pavone 2014) of the ‘bioeconomy’ (cf. BMEL 2014) can be interpreted as such a concerted strategy by state actors and dominant capital fractions invested in agri-business towards the ‘greening’ of intensive industrial agriculture without fundamentally changing its mode of production (cf. Birch et al. 2010; Goven/Pavone 2014). In fact, the bioeconomy is geared to open up new opportunities for further intensification in line with biotechnology and related capital, technology and knowledge intensive investments in order to ‘decouple’ economic and material growth (e.g. Sheppard et al. 2011). Bioenergy, and particularly biogas production amongst it, is a crucial component of the new accumulation strategies envisioned by the bioeconomy agenda (Bioökonomierat 2016: 14), which is supposed to also constitute some sort of functional rural counterpart to the ‘circular economy’.

Viewed in this light, the Oldenburger Münsterland represents a good case to “demonstrate the material and social consequences of one type of waste material metamorphosing into



another as it traverses the circuits of production” (Gille 2010: 1050). To be precise, it reflects the consequences of manure turned through bio-gas production – with additional imported biomass (especially corn) inputs, which also reflects an energy-food trade off – into surplus digestate that further aggravates the ‘negative use-value’ of waste in terms of water and soil pollution. And most importantly, it reveals how this material transformation of one form of waste into another is predicated on dynamics of intensification in the valorisation of waste, which are, in turn, based on new accumulation strategies in line with the ‘Energiewende’ and the ‘bioeconomy’ agenda.

## 6. The Case Study of Informal Plastic Recycling Networks in Kolkata

The case of plastic recycling in Kolkata, the capital of the state of West Bengal in Eastern India, provides an instructive example of the diverging and at times conflicting forms of societal waste handling in India. This chapter is concerned with one particular type of waste that has shaped and challenged the way in which Indian societies approach the waste of globalised economic activities: plastics. In contrast to manure, which is neatly categorised as typical form of agricultural waste, plastics do not fit any single technical and managerial category but form a part of several rubrics of waste and forms of wasting – from municipal solid waste (MSW) and commercial waste to industrial waste, hazardous waste<sup>28</sup> and electronic waste; plastics are found everywhere. This is because of the ubiquitousness of hydro-carbons (oil) and derived polymers (plastics) as crucial material base for capitalist modes of production since the post-war period (cf. Bridge 2008b; Huber 2013). While ‘plastic’ in itself (the main polymer compounds) is nontoxic, it can host all kinds of hazardous substances depending on its specific fashioning as well as later use (Liboiron 2016b). Even though certain applications would therefore suggest the segregation and separate treatment of some plastic waste streams, it can be complicated to trace the distinct biographies of wasted plastics (Gasser et al. 2018), particularly in most parts of the Global South where virtually all wasted plastics end up with public or municipal solid waste (MSW).

In India, like in many newly emerging economies of the Global South, economic development throughout the last decades was coupled with an increase in material and energy use (in terms of its social metabolism; Singh 2012) and a subsequent exponential growth as well as compositional change in waste generation (Zhu et al. 2008; Kaushal 2012). While India’s social metabolism has been growing slowly and has been marked by a large percentage of biomass (2/3 of the total resource use) until the 1980s, it increased by 60% in the following three decades (Singh et al. 2012: 62). Moreover, this increase was characterised by the accelerating use of fossil fuels, minerals for construction, and metals and minerals for industrial production, which already amounted to 60% of the total

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<sup>28</sup> The toxicants and toxic substances potentially contained in polymer compounds, for example due to their use in storing such substances, can necessitate the declaration of plastics as hazardous waste (Gasser et al. 2018).

resource consumption by 2008 (Singh et al. 2012: 65-67). This represents a complete reversal of the biomass ratio compared to other (industrial) material inputs in India's socio-metabolic profile since the 1980s. Such changing patterns in resource use have been interpreted as rapid socio-metabolic transition from the metabolic profile of agrarian societies to that of industrial societies (Singh et al. 2012; Haberl et al. 2011; Fischer-Kowalski/Weisz 1999) and illustrate the accelerated displacement of pre-capitalist and enforcement of capitalist modes of production – under post-colonial neoliberal conditions. Moreover, this metabolic transition clearly marks the period of political and economic liberalisation since the 1980s and 1990s as a watershed moment of entangled economic and environmental change in India. The strengthened integration of India into a global economy radically altered predominant modes of production and their relationship to the 'natural' environment, which clearly reflects a dynamic of capitalist expansion.

This change in the mode of production had strong repercussions on the production of waste in India. One of the most prominent aspects of this change was the phenomenal rise of plastic waste (for details see sections 6.2.1, 6.2.4 and 6.3.5). The increasing proportion of plastics and other synthetic materials in the urban waste stream posed significant challenges to predominant societal modes of waste handling, which were predicated on traditions of organic waste handling. These traditions were part of a specific set of rural-urban relations – similar to historical forms of excrements recycling in East Asia described by Winiwarter (2002) – and included natural composting of organic waste and the use of urban waste for soil enrichment in peri-urban and rural agriculture (Furedy 1994; Beukering et al. 1999; for the case of Kolkata see Ghosh 2017). Such "frugal habits" (Furedy 1994: 97) ceased in the 1990s, when farmers refused to take urban waste because of its high contamination with non-organic materials.

As a consequence, this concomitant feature of economic growth also posed serious challenges to urban local bodies, who are the legally designated responsible state authorities for solid waste management (SWM) in India. In the case of Kolkata City, the Kolkata Municipal Corporation (KMC) currently has to deal with more than 5000 tons of mixed solid waste per day (Das/Bhattacharyya 2013: 148)<sup>29</sup>. Burdened with expensive yet uncompleted efforts to collect the growing amounts of municipal solid waste, public bodies

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<sup>29</sup> Reliable and up-to-date data on solid waste streams is often not available or hard to access in India. The quoted data on solid waste generation in Kolkata represents a conservative calculation based on a survey conducted by the KMC. It is safe to say that the actual figures are most probably higher by now.

like the KMC hardly succeeded in establishing functioning municipal solid waste treatment systems and rely primarily on uncontrolled landfilling (Das/Bhattacharyya 2013: 147-148). They have often outsourced waste collection and disposal services to private ventures and willingly or not fostered the proliferation of open dumps (Chattopadhyay et al. 2009: 1452f; Hazra/Goel 2009: 477).

Drawing on Gregson and Crang's (2010) accounts of the de-materializing effects of the governance of waste, I have elsewhere described this predominant form of waste handling by public authorities in India as a form of "disposability" (Schlitz 2014a: 64): it is characterised by the negation of the materiality of waste due to the collection of only mixed wastes and their untreated disposal "in all kinds of marginal spaces [...] – especially along the city's periphery, where it revealed its 'negative use value' in the serious contamination of equally marginalized communities' environmental health" (Schlitz 2014a: 111). This description applies very well to the case of Kolkata and its main dumpsite Dhapa (cf. Ghosh 2017).

Already in the late 1990s, the subsequent pollution of urban and peri-urban environments spurred environmental protest and legal activism by middle and upper class civil society groups in India. It aimed at the efficient collection and disposal of urban waste, although often with a strong 'anti-poor' inclination towards cleanliness and hygiene that depreciates informal recycling activities (Baviskar 2002; Gill 2012: 191ff). This high-profile environmental activism successfully induced the Supreme Court *Committee on Solid Waste Management in Class I Cities in India* (Supreme Court 1999) and the enactment of the first solid waste legislation in India, the *Municipal Solid Waste (Management and Handling) Rules 2000* (MoEF 2000). The following decade saw multiple efforts to improve MSWM across Indian cities, including large scale investments into capital- and technology intensive waste management infrastructure in the course of nation-wide programs like the 2005 established *Jawaharlal Nehru National Urban Renewal Mission* (JNNURM) – geared mainly towards waste collection vehicles, landfills and incinerator projects. Moreover, and in line with neoliberal urban policies, these efforts were exclusively framed as public-private partnerships or privatisation schemes that did not substantially change the imperative of disposability in public waste management. They relied heavily on 'end-of-pipe' technologies, continued to negate the altered materiality of waste and asserted the negative perception of waste as pollution and as a development problem. This

situation triggered a second wave of middle and upper class environmental activism from the early 2010s onwards that demanded waste segregation at source, the implementation of formal recycling schemes and the incorporation of marginalised actors of informal recycling networks into formal waste management – particularly in cities like Bangalore (cf. Chengappa 2013; Schlitz 2014a, 2014b). Through a highly effective combination of legal activism, lobbying, advocacy and public relations, this second wave of civil society waste management activism gave rise to a second generation of solid waste legislation in India, particularly the *Solid Waste Management Rules 2016* (MoEFCC 2016), the *E-Waste (Management) Amendment Rules 2018* (MoEFCC 2018a) and the *Plastic Waste Management (Amendment) Rules 2018* (MoEFCC 2018b). Besides environmental concerns, this civil society activism and the ensuing new legislation strongly reflected an emerging interest by formal private and state actors in the valorisation of waste, which was based on a growing awareness of waste as economic potential and valuable resource (Chaturvedi/Gidwani 2011).

This positive perception of waste as resource by formal actors has been provoked by the omnipresence and economic vividness of informal recycling activities in India, which account for the recovery of 15 - 59 % of the total urban waste stream (Sharholly et al. 2008: 465; Wilson et al. 2009: 631) and are responsible for exceptionally high plastic recycling rates estimated between 48 % (Mutha et al. 2006: 222) and 60 % (WBCSD 2016: 4). Informal recycling economies operate beyond and beneath formal waste management and constitute a socio-metabolically crucial parallel and supplementary form of societal waste handling in India, which has absorbed much of the negative social and environmental consequences associated with the imperative of disposability in formal waste handling. These informal recycling networks have contributed substantially to the mitigation of the unequally distributed and externalised social and environmental cost of economic liberalisation in India: they provide an environmental service through the recovery of wasted materials, they create income opportunities and support the livelihoods of socio-economically disadvantaged and excluded groups, and they reduce the pressure on public budgets by reducing the expenditures for municipal solid waste management through the diversion of wastes from municipal solid waste streams and disposal (cf. Chaturvedi/Gidwani 2011; Chengappa 2013; Reddy 2015). These informal recycling networks constitute a largely under-researched and complex set of social relationships (for

a noteworthy exception see Gill 2012), which is delineated spatially throughout various cityscapes and across multiple scales, and furthermore shaped by a number of social differences as well as economic hierarchies.

There is a longstanding literature on SWM as well as on informal recycling activities in India (e.g. Furedy 1994; Baud/Schenk 1994; Huysman 1996; Beukering et al. 1999; Trettin 2002; see section 6.2.3). While the latter has been mainly focused on health concerns (e.g. Hunt 1996; Binon/Gutberlet 2012) and social and economic deprivations as well as the potential integration of marginalised recycling actors into formal waste management (e.g. Baud et al. 2001; Ahmed/Ali 2004; Wilson et al. 2009), the former was mainly concerned with the implementation of efficient municipal solid waste (MSW) collection and disposal schemes following blueprints from the Global North (e.g. Sharholly et al. 2008; Kumar et al. 2009; Kaushal et al. 2012). The intense economic interrelations between formal waste management, informal recycling networks and the increasingly formal manufacturing of goods from recycled material in conventional production networks are, however, largely under-researched with the exception of comprehensive studies by Kulke and Staffeld (2009) for the case of Dhaka (Bangladesh) and Gill (2012) for the case of Delhi.

The study by Kulke and Staffeld illustrates that an environmental economic geography approach is suitable to address this research gap. The case of Kolkata is particularly telling, because the interest of formal actors in the valorisation of waste is still much less pronounced compared to other metropolitan cities in India, like Delhi (Chaturvedi/Gidwani 2011; Demaria/Schindler 2016) and Bangalore (Chengappa 2013; Schlitz 2014a; Reddy 2015). As a consequence, Kolkata is distinctly marked by the divide between disposability in formal waste handling and the positive framing of waste as resource in informal waste handling. The main feature of the following case study of informal plastic recycling networks in Kolkata is its broad and multi-scalar approach that takes into account the often messy and socially and economically complex empirical realities in the up-stream segments of informal recycling networks as well as the 'passage of value' towards and through the down-stream segments of recycling plastic processing and (re)manufacturing. Moreover, it points to the close entanglement of economic and environmental processes throughout the revaluation and valorisation of wasted plastics and emphasises the various actors that directly and indirectly shape plastic recycling networks in Kolkata.

## 6.1 Recycling economies and the use-value of waste: scrap shops in Kolkata, India

**The following chapter contains the print version of the article detailed below:**

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**Abstract:**

Informal recycling networks in the Global South have stimulated debates about political economies of recycling in post-colonial contexts. This article retrieves the underrated Marxian notion of use-value to explore how used plastic materials are revalued in the plastic recycling networks of Kolkata, India. Focusing on the role of scrap shops within recycling networks, the relation between informal and formal economic spaces is discussed with reference to Sanyal's (2007) distinction between needs-based and accumulation economies. It is argued that scrap shops perform the crucial role of translating concrete use-value of wasted plastics into new potential social use-value. Thereby, the analysis contributes to understanding the transformation of value between informal and formal economic space in post-colonial political economy of recycling in India.

**Keywords:** Informal recycling; scrap shops; Kolkata; use-value; global destruction networks; post-colonial political economy

We must be careful also to distinguish between forms of capital that travel in circuits of expanded reproduction and those that strive primarily for simple reproduction or acutely modest accumulation (petty or simple commodity production). And we must acknowledge frequent scenarios where commons (and the communities that sustain them) are relay points in the social life of commodities, and as such may subsidise and supplement capital accumulation. (Gidwani/Baviskar 2011: 143)

### **6.1.1 Introduction**

In India, as in many countries of the Global South, economic development throughout the last decades was coupled with an exponential growth as well as compositional change in waste generation (Zhu et al. 2008: 10). Notably, the plastic proportion of the total Municipal Solid Waste (MSW) generation in India has been increasing from 0.7% to 4% between 1971 and 1995 (Mutha et al. 2006: 223). Moreover, the average per capita plastic consumption rose further from 0.8 kg in 1990/91 to 3.2 kg in 2000/01 (Mutha et al. 2006: 223) and increased sharply to around 13 kg in 2014 (WBCSD 2016: 7).

This concomitant feature of economic growth has posed serious challenges to urban local bodies charged with the public responsibility for solid waste management. It laid the groundwork for the formation of vast informal economic networks geared toward the recovery of value from used plastic materials, wherever the local state and private corporations proved incapable of handling and valorising wasted plastics. These informal recycling networks<sup>30</sup> created income opportunities for economically deprived urban populations in times of ‘jobless growth’ (as the post-reform period in India is often characterised), particularly for marginalised social groups. The waste generated as a result of neoliberal globalisation in urban India advanced to a form of urban commons (cf. *Gidwani/Baviskar 2011*) and as a result, India has been able to reach exceptionally high plastic recycling rates (compared to most OECD countries) of around 60% (WBCSD 2016: 8).

This article places an empirical focus on scrap shops in Kolkata, in an effort to contribute to the theoretical understanding of the political economy of recycling. My empirical

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<sup>30</sup> I am using ‘recycling networks’ interchangeably with ‘recycling economies’. Yet, the former is pertaining more to geographically situated spatial relations, while the latter is highlighting economic relations.



research was geared toward a multi-scalar analysis of plastic recycling networks in Kolkata ranging from *reclaimers*<sup>31</sup> and small scrap shops to recycling workshops and plastic processing industries (see section 5). This research focus is aligned with the burgeoning social science literature on waste (Gille 2007; Gregson/Crang 2010, 2015), and is ascribed in particular to the works concerned with recycling economies (Alexander/Reno 2012; Gill 2012; Gregson/Crang 2015; Samson 2017). As part of this literature, recent contributions within economic geography have described the ‘ongoingness’ of wasted materials’ economic life (Lepawsky/Mather 2011; Gregson et al. 2010; Crang et al. 2013) through *global recycling networks* (GRN) as well as their “very real beginnings and endings” determined by “processes of capitalist accumulation” (Herod et al. 2013: 378) in *global destruction networks* (GDN).

While these approaches have provided a number of analytical avenues for the appraisal of economies of waste and recycling, I contend that the analytical framework provided by the GDN approach falls short of explanations of why, how and under which conditions these recycling economies function in countries within the Global South. Moreover, they miss the implications that spatial and material patterns of wasting have for our understanding of the post-colonial political economy of recycling.

I argue, thus, for a resituating of recycling economies within uneven capitalist development and its prolonged dynamics of primitive accumulation (by dispossession [Harvey 2003] increasingly of urban commons; cf. Gidwani/Baviskar 2011). Such a reconceptualization goes hand in hand with a theoretical reframing of waste and recycling under (post-colonial) capitalism. In this regard, I emphasize the Marxian notion of use-value as an analytical tool to understand the passage of value from waste through the dispersed and fragmented economic geographies created by uneven capitalist development. I consider these fragmented economic geographies in terms of Sanyal’s (2007: 209) analysis of urban informal spaces as “needs-based” economies.

The deployment of the notions of ‘use-value’ and ‘needs-based economy’ is the result of an empirically grounded search for theoretical concepts that are consistent with the relevance of plastic waste’s materiality for the passage of value between informal and formal economic spaces that my research has indicated. In this article I intend to shed light on the question of how and why the interrelation between informal and formal realms of

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<sup>31</sup> The term ‘reclaimers’ is less prone to reproduce the stigmatization of waste work, compared to ‘waste pickers’, see Samson (2017).

recycling functions economically. I will show this interrelation with regard to the intermediary role of scrap shops in recuperating value from plastic waste in the recycling economies of Kolkata.

In what follows, I will first engage in a theoretical elaboration of waste and recycling that emphasizes the Marxian notion of use-value against the background of uneven capitalist development. I will also critically discuss established works on GDNs within economic geography. Then, I briefly outline my methodological approach. This is followed by an introduction of (informal) plastic recycling economies in Kolkata, and India in general. The remaining parts of this article take the scrap shop as a vantage point for the empirical analysis of the politico-economic significance of wasted plastics' use-values in the recuperation of value in Kolkata's recycling networks and of the social and economic conditions this is predicated on. These delineations give way to the suggestion that recycling economies in Kolkata ought to be understood in terms of their situatedness within the needs-based economies of post-colonial capitalism (Sanyal 2007).

### **6.1.2 Theorising economies of waste and recycling**

Although the burgeoning social science literature on waste has focused much attention on informal recycling activities and the role of reclaimers, Samson (2017: 41) notes that “there is little engagement with literature on value theory or interrogation of *how* reclaimers contribute to the generation of new value” in recycling economies. While the sub-discipline of environmental economic geography (cf. Braun et al. 2018) appears well equipped to address this research gap, it has been silent on the relation of waste and value (with the exception of Franz et al. 2018). Two important exceptions have emerged from other fields of economic geography and were both posed as critics of *global value chain* (GVC, see Gereffi et al. 2005) and *global production network* (GPN, see Henderson et al. 2002) approaches: the works on *global recycling networks* (GRN, see Gregson et al. 2010; Lepawsky/Mather 2011; Crang et al. 2013) and *global destruction networks* (GDN, see Herod et al. 2013, 2014).

The works on GRNs have pointed out that recycling economies pose fundamental challenges to the conceptual frameworks of GVC and GPN approaches. They have argued that the presupposed linearity of value chains (which continue to structure also GPN research, see Crang et al. 2013: 14)—from production to consumption—is at odds with the

trajectories of recycling value chains. Instead, they have shown how recycling networks follow multiple trajectories, crosscutting “different product and sectoral chains” (Crang et al. 2013: 14), while being oriented to the supply of eminently heterogeneous ‘goods’. The production and capture of value in these recycling networks, therefore, depends upon the ability to assess the quality of complex and heterogeneous materials, and the capabilities to connect and mediate different production networks, value regimes and regulatory environments. Crang et al. (2013:22), thus, “demonstrate the central importance of materiality to the governance of value capture and extraction”. Lepawsky and Mather (2011) align with this principal direction of inquiry but focus more on the practices, actions and processes of wasting and recycling. They emphasize the “‘on-going-ness’ of economic activity” (2011: 243).

Herod et al. (2014) welcome this GRN critique of the orderly succession of production steps from input to output in GVC and GPN analysis. They however identify a “tendency to ignore the political economy of the passage of value/congealed labour from one product to the next in the recycling process and to focus, instead, on the transformation of commodities’ physical form and their discursive transition from ‘commodity’ to ‘waste’” (Herod et al. 2014: 425). To correct this tendency, they introduce the notion of GDNs “as networks of places where products are disassembled and their constituent parts are extracted for processing and re-use.” (Herod et al. 2014: 427) They also develop the insightful differentiation of devalorisation and devaluation:

When a commodity literally wears out and its constituent elements cannot be used for anything else, then we might think of it as having been devalorised and the value incorporated within it and its constituent parts used up, with none left to be passed on to new products. However, when a commodity is replaced with a newer model and yet it is either still functioning and/or its constituent parts may be reused (either by taking them out and putting them unchanged into another commodity or by processing them and turning them into raw materials for new products), then we might think of it as having been devalued (Herod et al. 2013: 379).

This differentiation of devalorisation and devaluation provides important insights into the economic processes at work in the global trade in waste and recyclables. Moreover, it also improves our understanding of the political economy of formal recycling, especially in the

global North. Recycling schemes mitigate environmental costs of capitalist over-accumulation and “create new spheres of accumulation for capital” (Samson 2017: 41), without jeopardizing demand for new products—a logic epitomised in disposable items and planned obsolescence (Herod et al. 2013).

There are, nevertheless, three interlinked problems in the contributions on GDNs. According to Samson (2017), the first problem concerns the labour process emphasised by Herod et al. (2013, 2014) and their inability to properly account for the supposedly “unproductive labour” (Herod et al. 2014: 439) of informal recycling agents not directly linked to GPNs. The invocation of the term ‘unproductive’ to designate labour draws on the classical Marxian differentiation of ‘useful’ labour on the one hand, which is all labour producing some sort of use-value, and ‘productive’ labour on the other hand, which refers only to that ‘useful’ labour that also creates surplus value and is characteristic for capitalist production. This differentiation runs the risk of economic reductionism (Gough 1972: 72) as it assigns economic and political relevance to workers more or less exclusively according to their position within the production process. Such a position deprives the masses of informal workers of political and economic agency (particularly if they labour outside classical wage-relations). Instead, Samson (2017: 57) emphasises that “it is crucially important to recognise the role of informal workers in determining the conditions for the de- and re-valuation of waste”. For decades, the differentiation of unproductive and productive labour has been subject to considerable critique, particularly by feminist scholars like Federici (2004) who argue that capitalist accumulation is based on the constant exploitation of women’s unpaid reproductive labour thereby producing the most important of all commodities for capitalism: labour power. It is no surprise that these feminist critics have also been at the forefront of a renewed engagement with the “continuous character of capital’s ‘enclosure’” (DeAngelis 2001; Federici 2004; Harvey 2003). This highlights the unabated relevance that the dispossession, exclusion and exploitation of women, nature and the (post-)colonial ‘Other’ has “as a structural and periodically repeating process that is integral to the *longue durée* of the capitalist world economy” (Gidwani 2015: 590).

The second problem identified by Samson (2017) is related to a general tendency within the GPN literature to focus predominantly on the global nature of big capital (Bair/Werner 2011)—epitomized in the transnational corporation—and a subsequent disregard of “the

specific nature of the capitalist economy in postcolonial contexts” (Samson 2017: 39). Herod et al. (2014: 427) claim that GDNs are “indelibly imbricated with, and an indispensable Other to, GPNs”, but they interpret this entanglement of different economies solely in terms of a hierarchy (and thus, implicitly denigrate the supposedly ‘unproductive’ labour within informal recycling circuits). Samson (2017: 43) observes that “all of their examples focus simply on how differing labour costs and health and safety regulations in the global North and global South lead GDNs to take different forms in these locations”. She argues instead that informal recyclers not only “shape conditions for the de- and re-valuation of waste”, but “that the choices they make about how to revalue waste reveal important insights into the deep inner-relations between formal and informal, and local and global aspects of the economy in postcolonial contexts” (Samson 2017: 43).

Moreover, and in addition to this critique, I contend that the works on GDNs underestimate the role of material characteristics of waste, processes of wasting and the social metabolism<sup>32</sup> of waste flows in the post-colonial political economy of recycling. The Marxian notion of ‘use-value’ (often neglected by Marxist economists; cf. Rosdolsky 1977) offers a theoretical avenue to attend to the materiality of waste (e.g. bio-physical properties) and processes of wasting, which can be directly related to the Marxian concept of value as congealed labour, deployed by Herod et al. (2013, 2014). In the remainder of this article, I discuss how this notion of use-value enables me to relate the abstract political economy of capitalist production to the material realities of plastic recycling in India. In this way, it is possible to analyse the entanglements between informal and formal economic spaces, which I consider in terms of Sanyal’s (2007) differentiation of needs-based and accumulation economies.

#### *6.1.2.1 Capitalist patterns of wasting*

In order to understand how the ongoingness of wasted things is connected with the political economy of capitalism, it is vital to take a detailed look at the ‘endings’ of commodities. That implies analysing the spatial and material patterns of wasting and the social processes embroiled in it. This section investigates such spatial and material patterns of wasting

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<sup>32</sup> The notion of social metabolism is used here to denote waste flows in terms of the co-constitution of politico-economic processes and “biophysical processes that result as resources are assembled and transformed, and waste is produced” (Demaria/Schindler 2016: 3).

beyond and below the differentiation of devaluation and devalorisation put forward by Herod et al. (2013, 2014).

First, the production of (particularly post-consumption) waste under capitalism follows specific spatial patterns, namely spatial dispersion (Trettin 2002: 4-5), for the sake of value realisation through household consumption. This is why those things that could become waste (e.g. plastic waste) and might evolve into recyclable plastic, first and foremost have to be reclaimed from displacement. They have to be collected, differentiated, gathered and compiled before anything else could be done with them—they have to be recognized. This explains the important status of and enormous expenditure for (separate) waste collection schemes within formal waste management efforts in the global North and South alike.

Second, processes of wasting under capitalism do not produce plastic waste per se, but hybrid forms of waste composed of complex and intricate combinations of different materials (Gille 2007: 29). This is why they have to be appraised as things—potentially use-full things—long before they can become recycling plastic, and partly even before they become plastic waste. The Marxian notion of ‘use-value’ offers a useful way to analyse the role of wastes’ materiality within the political economy of capitalism. Horton (1997: 132) identifies the structural source of waste under industrial capitalism as “the priority of exchange value over use-value”.<sup>33</sup> In this vein, he offers an instructive “proto-concept of capitalist waste” (Horton 1997: 130), drawing on the explication of the commodity form in the opening chapters of Marx’s *Capital*. The single commodity, as Marx elaborates, appears as the elementary form of wealth in capitalist societies. He explains, “as use-values, commodities differ above all in quality, while as exchange-values they can only differ in quantity” (Marx 1990[1867]: 128). Marx emphasises that “the exchange relation of commodities is characterized precisely by its abstraction from their use-values” (1990[1867]: 127).

Consequently, Horton (1997: 130) argues that,

... it is only under commodity production that useful things are thrown away.

The social separation that commodity production introduces between production and consumption provokes the possibility of waste in the historically pure form of the discard of human use-value.

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<sup>33</sup> This is much in line with Herod et al.’s (2013) differentiation of devaluation and devalorization, but located on a different level of abstraction.

The reason for this is that the “value of a commodity is finally dependent not on its (individual) use but its (social) ability to be sold” (Horton 1997: 129-130), which pertains to its (abstract) social<sup>34</sup> use-value: “Waste under commodity production, therefore, assumes the conceptual form of the discard of abstract [social] use-value” (Horton 1997: 130), which is itself highly dependent on markets and societal conditions. This points to Marx own explication that “use-value itself – as the [social] use-value of a ‘commodity’ – possesses an historically specific character” (Marx [1881] in Rosdolsky 1977: 76).

While Herod et al. (2013, 2014) are right to claim that there are very real ends to a commodity’s life, this differentiation of concrete and social use-value is integral to understand capitalist processes of wasting in general. It implies that the devalorisation of commodities put forward by Herod et al. (2013) does not necessarily wreck things of all their concrete use-value, but largely affects its social use-value moulded by societal conditions across space and time. To quote Moore: “whether or not something is considered trash depends on time and place more than any inherent characteristics of the object itself” (2011: 135). Thus, what is not, and can never really be lost in processes of wasting, is the concrete use-value of a thing (it can only be changed). Also Marx ascertains that such a concrete thing “is a whole composed of many properties; it can therefore be useful in various ways” (1990[1867]: 125).

Gille (2007: 25) has forcefully argued that we also have to consider “negative use value, that can harm nature and human health”. Gille (2007: 29) goes on to highlight “the complexity of linkages, both among different scales and among different materials in circulation”, which constitutes “waste itself is a hybrid entity, [...] simultaneously social and material”. To understand how recycling networks function economically, we have to pay attention to the relation of the social and the material embroiled in waste, the difference and margin between concrete use-value and social use-value, and the potential abstraction into quantitative exchange value this involves. The Marxian notion of use-value constitutes a useful conceptual tool to analyse how the material and discursive transformation as well as spatial trajectories of waste are related to the passage of (exchange) value in the political economy of recycling. My empirical analysis of scrap shops in Kolkata illustrates this difference and margin between concrete use-value and social use-value, and exposes its relevance for the passage of value—particularly in post-

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<sup>34</sup> The notions ‘social use-value’ and ‘abstract use-value’ are both used in the Marxist literature. While their distinction makes sense in specific cases, I use ‘social use-value’ for reasons of comprehensibility.

colonial contexts, where the contentious expansion of capitalist social relations exhibits its exclusionary and often violent character.

#### *6.1.2.2 Informal recycling as need economy within post-colonial capitalism*

A focus on on-going processes of primitive accumulation<sup>35</sup> provides a good vantage point to attend to “the specific nature of the capitalist economy in postcolonial contexts” (Samson 2017: 39). Gidwani and Reddy (2011) emphasize that our understanding of ‘waste’ is deeply entrenched in the early history of capitalist development and associated processes of primitive accumulation and the enclosure of the commons. They show how the concept of waste evolved to “designate the unenclosed common, the external frontier, and the ethical horizon of civil society” (2011: 1626), which ought to be organized properly and used productively. Thus, they consider ‘waste’ to be “the political other of capitalist ‘value’, repeated with difference as part of capital’s spatial histories of surplus accumulation” (Gidwani/Reddy 2011: 1625).

In present-day urban India, “‘waste’ has become society’s internal and mobile limit [...] a fiercely contested frontier of surplus value production” (Gidwani/Reddy 2011: 1625). Moreover, critically drawing on Sanyal’s (2007: 208) notion of the “need economy”, Gidwani (2015: 2) argues that this makes it necessary to consider informal recycling as an “infra-economy [...] that is denied recognition [but] that is conducive for capitalist accumulation”.

Sanyal’s (2007: 209) elaboration of the “post-colonial economic formation” exposes the historically specific character of use-value in the relations of production implied by informal economies, which are geared towards the satisfaction of needs. Far from being remnants of pre-capitalist petty commodity production, informal economies should be understood as products of uneven capitalist development: “The most important aspect of the informal sector is that its producers are estranged from the means of production as a result of primitive accumulation” (Sanyal 2007: 209). They are also not able to find work in the formal sector.

In order to survive, they have to engage in some kind of productive activity in “the space of the dispossessed, of those who are excluded from the space of capital, a wasteland

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<sup>35</sup> The term “primitive accumulation” is used instead of “original accumulation” in this article for reasons of conformity with the quoted literature (from post-colonial perspective).



created by capitalist development” (Sanyal 2007: 193). The inhabitants of this wasteland “engage in a variety of economic activities for their survival” (Sanyal 2007: 194). This involves different forms of labour, from self-employment and family labour to wage labour, “where in most cases the employer himself is a worker who uses hired labor as a supplement” (Sanyal 2007: 214), but the main “purpose of production is consumption for the satisfaction of need” (Sanyal 2007: 212):

[T]he need economy is the space of all consumption driven production activities irrespective of their modes of labor, relations of production and organizational forms. These activities are entirely embedded in the circuit of money and exchange. They can generate a surplus for ploughing back and therefore are capable of self-expansion. In contradistinction, the accumulation-economy refers to the space of production activities that are driven by the logic of accumulation and are based on capitalist production relations with strict separation between capital and labor. (Sanyal 2007: 215)

With the help of Sanyal’s differentiation between needs-based and accumulation-centred economies, it is possible to think of more than one social use-value in the post-colonial political economy of India, specifically to conceive of the existence of different economic spaces with different social use values. Yet, and in line with Gidwani (2015), I would contend that the need economy is not exactly located “outside” of capitalist accumulation, as Sanyal (2007: 209) argues, but rather describes the manifold corridors through which “workers are thrown out and drawn back into [capital’s] embrace” (Gidwani 2015: 590). Recycling economies demarcate one of these corridors and a particularly vibrant one, which also marks the flux of concrete and social use-values in relation with capitalist patterns of wasting. As outlined above, capitalist processes of wasting deprive wasted commodities of their abstract (social, and historically specific) use-value (Horton 1997) within the space of the accumulation economy, which potentially also foregrounds the reversal of the abstraction from concrete use-values entailed in the exchange relation of commodities.

Therefore, it is necessary to consider the use-value of waste, and “the transformation of commodities’ physical form and their discursive transition” (the latter is important to assess the social use-value inscribed in things) in order to understand “the passage of value/congealed labour from one product to the next in the recycling process” (Herod et al.

2014: 425). I argue that the economic function of informal recycling economies (as need economies), lies in the recognition of the remaining concrete use-values and subsequent recuperation and rehabilitation of (abstract) social use-values for both need and accumulation economies. In what follows, I will illustrate how recycling agents within the labour-intensive realms of Kolkata's informal recycling networks are translating wasted plastics' concrete use-value into social use-value within both, informal needs-based and accumulation-centred economies.

### **6.1.3 Researching Recycling Economies in Kolkata**

The previous sections have argued for a more comprehensive theoretical perspective on informal recycling economies in the context of post-colonial capitalism, and emphasised the significance of spatial and material patterns of wasting for the ongoingness of economic life. This implies considering wasted (devalorised and devalued) plastic materials in Kolkata as urban commons/end-of-life commodities with multiple remaining use-values. Moreover, this requires framing the collection, sorting and processing of wasted plastics as well as their reinjection into commodity circuits in terms of a "need economy" (Sanyal 2007: 208.). This section introduces the methods and sample of my empirical research to prepare the empirical analysis.

The empirical research was conducted in Kolkata, India, from September 2016 to February 2017 and was designed as a multi-scalar case study of plastic recycling networks. The analysis is mainly based on research interactions with recycling agents directly involved in the plastic recycling process and focuses on thirteen interviews with scrap shop owners. These thirteen interviews are part of a larger qualitative methodical set of 43 semi-structured interviews and ethnographic accounts in the form of 26 waste walks (participatory observations while moving through public space, with the aim to systematically explore the spatial articulations of waste management systems and recycling networks) and eight participant observations. I worked with two research assistants, Deborshi Chakraborty (PhD candidate at Jadavpur University) and Subhasish Bandyopadhyay (post-grad student at Jadavpur University), who supported me in establishing relationships with recycling agents, interpreting during research interactions and translating and transcribing interviews.

#### **6.1.4 Setting the Scene – Situating plastic recycling networks in Kolkata**

Kolkata is the capital of West Bengal and one of the three major metropolitan regions in India along with Delhi and Mumbai. Once the prosperous industrial hub of Eastern India, this metropolitan region has experienced extensive divestment following the period of intensified integration into globalized production since liberalisation. Nevertheless, in 2011, Kolkata City generated above 5000 tonnes of municipal solid waste per day (Das/Bhattacharyya 2013: 147-48). The plastic fraction of Kolkata's municipal solid waste has been rising from 1970 to 1995 from 0.64% to 3.22% and reached close to 5% in 2005 (Chattopadhyay et al. 2009: 1450), thus, constituting the second largest recycling fraction after paper. Despite this, the predominant mode of formal waste management by the municipal authorities is disposal (Bagchi/Mitra 2017; Das/Bhattacharyya 2013). As there is only one official and registered (apparently unoperative) plastic recycling plant (Int34) and, compared to other metropolitan areas like Delhi (Chaturvedi/Gidwani 2011) or Bangalore (Reddy 2015), hardly any effort by big capital or NGOs to profit from the formalisation of recycling collection schemes and valorisation of wasted plastics, virtually all plastic recycling in Kolkata is taking place in the so called 'informal sector'.

Kolkata's plastic recycling networks branch out into specific recycling areas that are entangled with the spatial history of the city. Kolkata is bound by the Hoogly River in the West and by vast wetlands in the East. Thus, urban sprawl was long confined to the South, where most of Kolkata's emerging affluent middle and upper class settled, and the North, where significant industrial development took place. Interestingly, big pockets of the central and northern parts of old Kolkata were taken over by bustling merchandise and labouring classes. This partly explains the peculiarity that one of the oldest recycling hubs of the city is located very centrally, in and around an area called Kolabagan, and right next to some of the oldest and most renowned academic institutions of West Bengal and India.

The eastern Wetlands have only recently become the frontier of urban development. Kolkata's main dumping site 'Dhapa' (Das/Bhattacharyya 2013) has been marking out the eastern frontier like an arrowhead into the wetlands. With the reclamation of the wetlands, Dhapa has also moved eastwards over the course of the 20<sup>th</sup> century, making way for poor neighbourhoods and small industries, including the plastic recycling hubs of Tangra, Topsia and VIP, which are now surrounded by real estate development (Int34).

Such plastic recycling hubs and their networks are spread throughout urban India and constitute a complex societal coherency. They are shaped by differences and hierarchies related to gender, caste and class as well as communal belonging and religion (Gill 2012; Bagchi/Mitra 2017). Furthermore, they are highly specialized with respect to different waste fractions and their value chains (Gill 2012). Recycling value chains are characterised by a large number of intermediaries on different scales. The profit margins of recycling agents depend on a complex interplay of access to high-quality supply, tacit recycling knowledge, and economies of scale and trade contacts. All of these dimensions are permeated by social difference, resulting in highly unequal terms of trade for the biggest and most marginalized proportion of recycling agents (Gill 2012; Gidwani 2015) in the labour-intensive realms.

### **6.1.5 Wasted plastics' use-value in Kolkata's needs-based recycling economies**

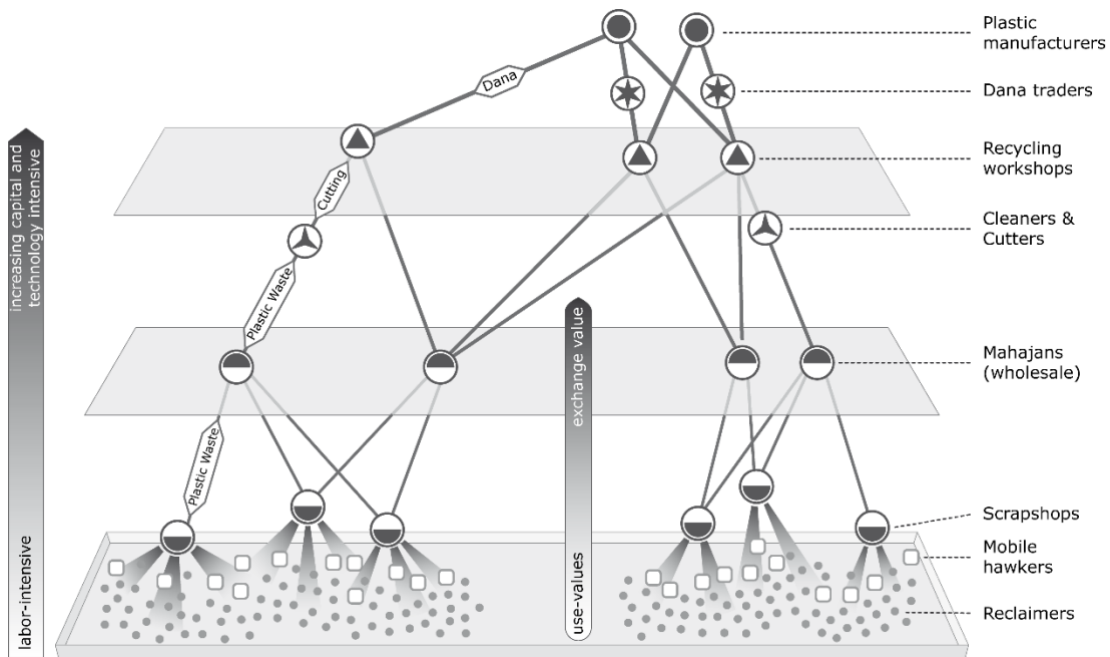
Kolkata's recycling networks are composed of a number of different hierarchically integrated recycling agents directly involved in the recovery and recuperation of value from used plastic materials. Their relative position within the plastic recycling value chain is depicted as a structural heuristic in Figure 7. The actors directly involved in plastic recycling include first of all *reclaimers*, who retrieve recycling-materials in public space and at dumping sites. Then there are mobile *hawkers* (*Kabbadi Walas*, often also referred to as *itinerant waste buyers*), who buy recycling materials directly from households and shops to resell them to scrap shops. They constitute, together with *workers* in scrap shops and recycling workshops, the basic workforce of plastic recycling networks.

The next up-scaled actors are *scrap shops*, which buy, sort and store recycling materials in order to sell them afterwards in bigger quantities of more homogeneous plastic materials to *wholesalers*. As an essential part of the recycling system the scrap shop represents an "engine of arbitrage: the node where 'raw' waste is purchased, segregated, and stored, before being channelled into secondary circuits of value" (Chaturvedi/Gidwani 2011: 132). Scrap shops are of crucial importance for the reversal of capitalist patterns of wasting. Accordingly, the rehabilitation of social use-value from concrete use-value arises during the passage of wasted plastics from scrap shops and wholesalers (who are engaged in intense sorting, thus homogenizing the wasted plastic materials into type-wise plastic input fractions) to cleaners and cutters. Wholesalers (also called *Mahajans* or *apex traders*), who

are basically bigger scrap shops, function as gatekeepers for plastic wastes' passage into secondary circuits of value. These are characterised by the comparably technology- and capital-intensive processing of recycling plastic.

The recycling agents in the more capital-intensive realms of plastic recycling value chains are, to a varying extent able to make profits, and (in pursuit of surplus value) to invest into their businesses, while still being (to different degrees) subject to conditions of informality (regarding land titles, legal status and labour relations). *Cleaners and cutters* are intermediate up-scaled actors for the pre-processing of homogeneous plastic recyclables, and they seem to have emerged in the last decade from bigger wholesalers. They are cleaning and cutting the plastic waste to produce flakes, which is a tradable intermediate plastic recycling product (called *cutting*) that later serves as main input into the actual recycling process in *recycling workshops*, where *dana* is produced. *Dana* is plastic granulate and the final product of the recycling process, which is traded by *dana traders* afterwards, or directly sold for further processing to plastic manufacturers.

The final transition from concrete use-value to social use-value within the “accumulation-economy” (Sanyal 2007: 215) appears to be performed in the processing of *cutting* into *dana*. While cleaned and chopped plastic *cutting* still bears the marks of the wasted plastics it was derived from (in terms of colour and texture, and wear and tear), *dana* is already processed (dyed and melted) to an extent that it's qualities only reflect the aggregated properties of a whole tonnage of *cutting* (which was already a mix of particular wasted plastics). This is a form of abstraction also reflected in increasing scientific denotations and related quality grading.



**Figure 7:** Structural heuristic of plastic recycling networks (own figure, prepared by Christoph Reichel)

Trettin (2002: 69-86) has argued that the economically most relevant recycling agents in Kolkata are hawkers and neighbourhood-based scrap shops, because they supply enormous quantities of relatively clean and homogenous recyclables sourced directly from households. My interrogation of the ‘ongoingness’ of the economic life of used plastics in the recycling networks of Kolkata, therefore, centres on those recycling agents who are spread throughout the city and who do not necessarily collect and compile plastic waste *per se*, but all kinds of potentially useful materials. This includes reclaimers, hawkers, and especially the scrap shops, where useful materials accumulate. These actors in the labour-intensive realms of recycling networks are often differentiated according to their hierarchical position along recycling value chains. This is usually reasoned in the interconnection of value capture and economies of scale (see figure 7), thus distinguishing, for example, scrap shops and wholesalers due to the higher turnover of the latter. Alternatively, they can be analysed according to the “difference in potential rents to be extracted from particular locations”, or territories of collection, as proposed by Bagchi and

Mitra (2017: 158). Such an approach already points to the economically crucial aspect of supply and sourcing (see Crang et al. 2013) in recycling networks.

In a slightly related manner, I am going to analyse scrap shops with regard to the spatial, material and discursive trajectories and transformations of wasted plastics implied by capitalist patterns of wasting. That way it is possible to identify three (ecological) economic functions of the labour-intensive realms of recycling networks—epitomized in the role of scrap shops—and foreground the implications of distinct sources of wasted plastics for the recuperation of social use-value through the appraisal of their concrete use-value:

1. The collection and spatial agglomeration of dispersed waste that accrues along different nodes of production, distribution and consumption. This pertains to distinct socio-metabolic points as well as social-institutional frames of access.
2. The appraisal of concrete use-values (predicated on socio-metabolic points of access) and subsequent anticipation of potential social use-values of used material.
3. The segregation and allocation of sufficient amounts of recyclables according to their suitability for further processing and remanufacturing (which pertains to the interconnection of value capture and economies of scale).

These functions indicate how scrap shops in Kolkata facilitate the actual plastic recycling processes, and thus enable the passage of value from wasted plastics into secondary circuits of value in the accumulation economy. The next sections first offer a detailed analysis of the distinct ways in which three different types of scrap shops attend to capitalist patterns of wasting. Second, the social and economic conditions of recycling economies in Kolkata are analysed in line with the characteristics of Sanyal's (2007) need economy.

#### *6.1.5.1 Looking, touching, feeling – scrap shops' translation of plastics' concrete use-values*

In what follows, I will first attend in detail to the appraisal of concrete and social use-values in Kolkata's plastic recycling networks. Then I will turn to the reversal of spatial and material patterns of capitalist wasting in the agglomeration of dispersed and hybrid wastes that accrue along different nodes of production, distribution and consumption, in order to differentiate between three types of scrap shops according to their source of

wasted plastics. This differentiation serves to illustrate the intermediary role of scrap shops and relevance of wasted plastics' use-value for the passage of value between needs-based and accumulation driven recycling realms.

The presence of concrete use-values in recycling networks reveals itself in mundane practices, namely in the way recycling agents in Kolkata attend to the different wasted items available to them. Concrete use-values are contained in the labour of sorting, dismantling, segregating and compiling, which involves a lot of 'sensing'. They sort according to the physical forms they encounter and differentiate between types and colours of plastics. They meticulously distinguish plastics just by seeing the reflections of light in them (Int6), by crushing and hearing their sound (Int14) and by feeling their texture, or, in case of uncertainty, by tearing (Int6) and breaking (Int30) them, by plunging them in water (Int22) or by burning them (Int13). This practice, the differentiation of types of plastics, is performed through the ordering capacities of a vernacular language of valuation (Martinez-Alier 2008) and the tacit recycling knowledge encoded in it. The discursive order of things in this language is necessarily in conversation with, but never reducible to, the scientific denominations aligned with recycling commodities' exchange value.

Scrap shops translate concrete use-values into social use-values with the help of this language of valuation, which draws on the colour (like in the case of "*kalo*", which means black, to describe black plastics), the utility (like in the case of the "*delivery*" function of water pipes) or sensible attributes (like in the case of "*hard*" or "*krystal*") of things, or on specific products that shape the perception of these things (like in the case of "*mother*" or "*dairy*" derived from the milk pouches of the dairy company *Mother Dairy*). Yet, the concrete use-values contained in this practice and performed through this language don't appear from nothing but are predicated on capitalist processes of wasting.

Scrap shops in Kolkata do not only process street and household waste but also all kinds of production and commercial wastes. The material and discursive transformations and spatial trajectories of wasted plastics in Kolkata differ according to the respective nodes along conduits of production, distribution and consumption where they accrue. This has implications for the potential recuperation of value by scrap shops. In the following, I introduce and distinguish three types of scrap shops (see table 6), differentiated according to their source of recyclables.



1. *Reclaimer-sourced scrap shops* (Int2; Int5; Int7; Int9; Int17; Int25; Int26) attend to the most dispersed and hybrid source of wasted plastics. The recovery of recyclables from mixed municipal solid wastes by reclaimers (c.f. Trettin 2002; Ghosh 2017; Bagchi/Mitra 2017) is a particularly clear example of the reversal of spatial and material patterns of capitalist wasting. Plastics are recovered in an often decomposed or ‘dirty’ state, which has implications for their concrete use-values and for further processing. Muhammad Aziz<sup>36</sup> (Int5) runs a reclaimer-sourced scrap shop in Kolabagan in Old Kolkata. He inherited this business from his father and grandfather. Reclaimer-sourced scrap shops buy all kinds of scrap materials, compile them and sell them for further segregation to *Mahajans*. These scrap shops are often located in and around recycling hubs (Seabrook/Siddiqui 2011) or low-income neighbourhoods where reclaimers live.

2. *Household-sourced scrap shops* (Int8, Int13, Int22, Int30; c.f. Trettin 2002) also draw on highly dispersed, mostly post-consumption waste, but bypass its trajectories of wasting (often with the help of mobile hawkers) before it enters municipal solid waste streams. Amita Ray (Int8) runs a typical neighbourhood-based scrap shop with her family in the South-East of Kolkata and explains their supply base:

We buy waste from different places. The sellers sometimes come down to sell them or as we have our own van, my brother goes to their respective places and collects the material [...] from households mainly. We rarely deal with offices, only if they come and ask us to collect. Most of the sellers live in the nearby locality.

The area covered by Farhan Laskar (Int30) and his mobile hawkers is much larger and stretches throughout the vast middle-class neighbourhoods of southern Kolkata, although their suppliers are also households. Farhan Laskar explains that “every kind of material comes here” (Int30), like paper, plastics, glass bottles and metals. By virtue of their source of waste, household-sourced scrap shops receive already pre-sorted and comparably clean recyclables and their variety of reclaimed materials is much greater compared to reclaimer-sourced scrap shops.

3. *Commercially-sourced scrap shops* (Int6, Int14) draw on plastic wasted in the circuits of production and distribution. The small shop of Jabbar Rafiq (Int14), who runs a family business in third generation as well, also located in Kolabagan, stands in stark contrast to

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<sup>36</sup> All names of interviewees are synonyms.

reclaimer- and household-sourced scrap shops. He is specialised solely in plastics and his business is built on a privileged source: he purchases relatively unspoiled and homogenous discarded plastic packaging materials in bigger quantities from commercial areas. He also already sorts plastics according to scientific denominations of plastic types. He deals mainly in polypropylene (PP); three different types of low-density polyethylene (LD) differentiated into white, coloured and soft; high-modulus polyethylene (HM); and *dairy* (milk packets). There is a lot of ‘sensing’ involved in the process. During our interview, he was cutting out the printed parts of plastic packaging foils to separate them from the untainted transparent main parts. He was meticulously differentiating between hard, soft and colour types of plastics and explained how to distinguish plastics just by seeing, crushing and hearing their sound and feeling their texture.

The social-institutional frames of access to wasted plastics, particularly the extent to which a property status is ascribed to them, further elucidates this three-fold differentiation of scrap shops. Commercially-sourced and household-sourced scrap shops generally access waste plastics as a form of private property, although households sometimes also give away recyclables for free as reward for the collection service or as a gift. In contrast, reclaimer-sourced scrap shops deal with waste plastics that have been obtained by reclaimers as urban commons.

<b>Types of scrap shops</b>	<b>Spatial patterns and socio-metabolic points of recovery</b>	<b>Material properties, compositions and hybridity of source</b>	<b>Social-institutional character of supply</b>
<b>Reclaimer-sourced</b>	Highly dispersed in public space and at MSW disposal sites	All kinds of mixed, often dirty and partly decomposed wastes	Wastes recovered by reclaimers as urban commons
<b>Household-sourced</b>	Highly dispersed, generally derived at place of consumption	All kinds pre-sorted and comparably clean recyclable waste	Waste accessed as private property, exchanged as commodity or received as gift
<b>Commercially-sourced</b>	Less dispersed and derived at different points of production and distribution	Only comparably clean and homogeneous plastics materials	Waste accessed as private property, exchanged as commodity

**Table 6:** Source-wise differentiation of scrap shops.

The different economic position of scrap shops is always also related to economies of scale (the third of the above-mentioned functions of labor-intensive recycling realms).

Nevertheless, this threefold differentiation of scrap shops in Kolkata reveals a general tendency. The reversal of capitalist patterns of wasting and the appraisal of concrete and social use-values of waste plastics by scrap shops intersect in a way that exposes their intermediary role in the passage of value between informal and formal, between needs-based and accumulation economies. Recyclers in the labour-intensive realms of Kolkata's plastic recycling networks are not only anticipating the social need for recycling *dana* in the accumulation economy. On the contrary, they are always also anticipating the social need for reusable and repairable plastic things in the needs-based economy. However, they do so differently with respect to the specific access-point to capitalist patterns of wasting they can draw on, as exemplified by the household-sourced scrap shop of Farhan Laskar (Int30) and his hawkers. They acquire not only recyclables like paper, plastics, glass bottles and metals, but also collect all kinds of things that could be refurbished, repaired and used again in one way or another. As Farhan Laskar clarifies: "We do not sell them, we take them ourselves. [But,] nothing fixed. If someone comes and asks for them against a good price, we sometimes sell them" (Int30). Like Farhan Laskar and his hawkers, Amita Ray and her family are taking "almost everything" (Int8), including all kinds of useful things that could be repaired, refurbished and passed on against remuneration. Muhammad Aziz (Int5) recounts that "there are things which can be reused" and that reclaimers "get them [and] directly sell them" (Int5) on the market for reusable items (WasteWalk3).

Recycling agents in Kolkata recover value starting from the most direct and concrete way and proceed with the recuperation of value through aggregation and segregation, which makes used plastic materials valuable for accumulation-centred manufacturing again. Kolkata's recyclers are highly skilled translators of different material worlds and they translate differently according to the source of wasted plastics they can draw on and the concrete use-values they obtain from it. The general premise of the appraisal of concrete use-values of plastics remains the same. This clarifies scrap shop's intermediary role in the passage of value from wasted plastics between needs-based economies and the accumulation-centred processing and remanufacturing of recycling *dana*.

The closer wasted plastics accrue to the spheres of capitalist production and circulation of commodities, the easier the re-establishment of social use-value for the accumulation economy, and the higher the value captured by scrap shops. Jabbar Rafiq's (Int14) commercially-sourced scrap shop illustrates the economic relevance of different sources of

recyclables. This is also always related to the homogeneity, quality, colour and contamination-level of waste supply as crucial factors for further processing. While being firmly situated within the need economy (as typical example of an “owner worker” [Sanyal 2007: 238] with one employee in a rented place), his source of recyclables ascribes him a privileged economic position. This is demonstrated by the difference in profit margins. With the sale of their plastic items, reclaimer-sourced scrap traders like Tanveer Sayed (Int2) are making a marginal profit of 0.50 to maximum 2 Rupees (Rs.)<sup>37</sup> per kg. This is less than the profit made by household-sourced scrap shops like the ones run by Farhan Laskar (Int30) and the Family of Amita Ray (Int8), which amounts to an average of 2 to 3 Rs. per kg of plastic material. Jabbar Rafiq (Int14), in contrast, is making an average 5 to 7 Rs. profit per kg of sold plastic. His profit margins are up to five times that of reclaimer-sourced scrap shops and more than double compared to those of household-sourced scrap shops. The resulting capability for “acutely modest accumulation” (Gidwani/Baviskar 2011: 143) gives him hope for social upward mobility, at least in the next generation, as he pledges that his children “will be educated and will do better jobs” in the formal realms of the accumulation economy.

While the analytical distinction of devalorisation and devaluation of Herod et al. (2013) does reverberate in the differential (exchange) value recuperated from used plastics according to their source, this distinction does not serve to explain the passage of value from informal to formal economies of plastic recycling and remanufacturing. It does not explain why, how and under which conditions these recycling economies function in countries of the Global South. I contend that the passage of value in the post-colonial political economy of plastic recycling in Kolkata is predicated first and foremost on scrap shops’ reversal of capitalist pattern of wasting through their appraisal of use values *within needs-based economies*.

#### *6.1.5.2 Social and economic conditions of the retrieval of wasted plastics in Kolkata*

The appraisal of concrete use-value and anticipation of the potential social use-value of used plastic materials by scrap shops (for both reuse within the need-economy and recycling for the accumulation economy) is enabling the achievement of exceptionally high plastic recycling rates of up to 60% (WBCSD 2016: 8) in India. However, the

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<sup>37</sup> During the research period, 1 € has been exchanged for approximately 73 Rs.

appreciation of concrete use-values of wasted plastics is economically only feasible at the needs-based informal fringes of capitalist relations of production, as it is particularly labour intensive. It is built on the extreme exploitation of informal labour, and Kolkata's plastic traders and manufacturers are well aware of this fact and of the 'competitive advantage' they gain from it within global recycling networks (Int42; Int37; cf. WBCSD 2016). In this section I discuss how Sanyal's (2007) depiction of the need economy is reflected in the social relations governing labour-intensive realms of recycling economies in Kolkata.

Tanveer Sayed (Int2) runs a "relay point" (Gidwani/Baviskar 2011: 143) in the social (after-)life of commodities: a small scrap shop on a backstreet sidewalk in Old Kolkata, where he is channelling the concrete use-value of wasted materials into potential future social use-values. He came to Kolkata from the countryside (a village, where he still has his household and family) and since the mid-1980s he has been in this profession. Coming from a village, he found work in a scrap shop with the help of friends. Once he understood the business, he opened his own small scrap shop. He remembers: "our business was more or less mundane and constant and the prices were more or less stable" (Int2). However, during the last years, "all the prices of the daily needs are inflating, all the materials of the scrap dealers [...] have drastically gone down in price, but the prices of new goods remain the same" (Int2). Against the backdrop of this economic downturn<sup>38</sup> he makes clear that his livelihood is under constant threat. There is now no way to save or invest in his business: "We are poor people, little entrepreneurs, there is no capital for us. Whatever income is there, it's difficult to even run a household with it [...], we earn and spend on a daily basis" (Int2).

In line with Sanyal's (2007) description of the need economy, most recycling agents in the labour intensive realms of Kolkata's recycling networks are not oriented toward capital accumulation, but toward consumption for the simple satisfaction of needs. Additionally, the labour relations that are characteristic for capitalist modes of production are not the norm within Kolkata's plastic recycling economies. Tanveer Sayed is (like Int14), a typical example of an "owner worker" (Sanyal 2007: 238) with one employee who basically

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<sup>38</sup> The local prices of recyclables are directly related to the prices of fresh plastic (Int37; Int42), and thus, bound up with the global oil price. Virtually all of my informants were aware about this connection, but an overwhelming majority of them attribute their economic hardship since 2015 to the economic policies of the BJP-lead government of Narendra Modi.

performs the same kind of work as he does. The reclaimer-sourced scrap shop of Muhammad Aziz (Int5), on the contrary, reflects (like Int13) typical capitalist labour relations: he employs four workers in two shifts for sorting and packaging tasks, while he manages the shop. He employs no family labour. The scrap shop of Amita Ray (Int8) is again a different case, based solely on family labour (like Int22). Whenever her father is out to work as a driver (in order to meet the children's educational costs), she runs the shop with the help of her mother and younger brother.

The need economy, which Sanyal (2007) conceptualises to characterise urban informal economies like Kolkata's plastic recycling networks, is the result of primitive accumulation. It constitutes a "wasteland" that is the "the space of the dispossessed" (Sanyal 2007: 194) and excluded. As such, it is predicated on contested, contradictory and often violent histories of rural-(peri)-urban relations and migrations. This is as in a classical neoliberal example of the expropriation of subsistence farmers and fishers around Kolkata for state-sponsored land speculations in the name of a urban development project called *Rajarhat New Town Project*: "Most of [the fishers and farmers] now collect, sort and sell garbage for their living" (Seppälä 2014: 95). However, these rural-(peri)-urban relations includes also commuting stories, occupational mobility and diversification of income for better livelihood options (Int8; Int22; Int30; cf. Trettin 2002).

Processes of primitive accumulation by dispossession are bound up with and always draw upon existing power relations (DeAngelis 2001; Federici 2004) especially social categorizations along gender, caste and religion in the case of Kolkata, and India in general. In line with previous studies (Trettin 2002; Bagchi/Mitra 2017), my research shows that, while more than half of all reclaimers are women, the share of female workers in scrap shops is already much lower (and confined to sorting activities), and only very few women are found to run scrap shops (and there are virtually no female hawkers and no women among up-chain actors of the recycling value chain). Only two of the scrap shops included in my sample were run by women (Int25, Int8), and one of them, Amita Ray (Int8), did so only in the absence of her father. Amita adds another crucial layer to the interwoven power relations that structure the political economy of plastic recycling in Kolkata when she explains: "Actually, most of the buyers are Beharis and Muslims. [...] Very few Bengalis like us are associated with this trade" (Int8). Waste and recycling works are done mainly by low-status Muslim (Seabrook/Siddiqui 2011) and low-caste, *Dalit*

groups (Bagchi/Mitra 2017; see also Iyer in this issue) who are often considered as “intruding” migrant populations by the dominant social groups in Kolkata, even if they migrated from neighbouring states or rural Bengal generations ago. The low status ascribed by dominant social groups to everything and everybody related to waste and recycling is also reflected in the political negation of recycling economies in Kolkata. This negation by state authorities, government institution and parts of the civil society—for whom local plastic recycling economies either do not exist (Int43) or are to be held responsible for urban pollution (Int31)—has considerable implications for the social, political and economic vulnerability of recyclers (particularly in public space) and the devaluation of recycling labour, as it affirms its societal stigmatization. Amita Ray (Int8) also speaks about the close-knit relationship between sources of recyclable materials and the longstanding stigmatisation of waste and dirt related works. She points out that “all the works are done by the family members only” and that they “do not deal with the waste pickers [...]. The neighbours object to dealing with the waste pickers as they collect things from unhygienic places” (Int8). She affirms that “*kabbadi walas* [mobile hawkers] collect many things from dustbins, which we do not allow them to sell here” (Int8).

Labour-intensive realms of recycling networks in Kolkata reflect how social power relations (particularly along social categories of gender, religion and caste), the stigmatisation of recycling labour and its political negation are entangled with the economic deprivation implied by prolonged processes of primitive accumulation by dispossession. They coincide with the economic inequalities produced by the hierarchical division of labour and economics of scale that structure recycling networks, and are aggravated by the divergent access to differently wasted plastic materials. The result of this is the extreme devaluation of all works related to the collection, sorting, agglomeration, segregation, compiling and purification of waste materials (see also Vallin/Dias in this issue). This has to be taken into account in order to understand the “passage of value/congealed labour” (Herod et al. 2014: 425) in the post-colonial political economy of recycling. The devaluation of recycling labour conditions, enables and confines the appraisal of wasted plastics’ concrete and social use-value, and the interactions between need and accumulation economies configured by it.

### 6.1.6 Conclusion

In this article, I have focused on scrap shops' intermediary role in the retrieval of wasted plastics' use-value through informal recycling economies in Kolkata, India. Based on a critical engagement with recent economic geography scholarship on GDNs (Herod et al. 2013), I have argued with Samson (2017) for a theoretical reframing of the political economy of recycling in post-colonial context. Ensuing from a multi-scalar empirical analysis of plastic recycling networks in Kolkata, I have deployed the Marxian notion of use-value as an analytical tool to account for the relevance of spatial and material patterns of wasting in the recuperation of value by scrap shops in the labour-intensive realms of needs-based (Sanyal 2007) recycling economies. This approach foregrounds the interrelations and entanglements of informal and formal and of needs-based and accumulation-centred spaces in the post-colonial political economy of recycling.

I have analysed scrap shops' intermediary role in the retrieval of wasted plastics' use-value with respect to their supply. The source-wise differentiation of scrap shops in Kolkata elucidates how economies of recycling begin with the reversal of capitalism's spatial and material patterns of waste production. They aggregate dispersed hybrid discarded materials, acquired either as waste-commodity (within the confines of private property) or obtained as urban commons (by reclaimers). They distinguish and disassemble the constituent parts of their purchase according to concrete material characteristics that indicate physical and chemical properties, sensible texture, form and colour, that is, the concrete use-value of wasted things. This is a process that involves a lot of looking, touching and feeling, as well as a lot of knowledge about relative exchange values (premised on potential social use value) of recyclables. However, in this process, they also measure out the re-use-value of things against their potential exchange value in recycling value chains (c.f. Samson 2017). They take the reusable items for themselves, or re-sell them at second-hand markets. In the case of all three types of scrap shops, the material properties of wasted plastics are the only reliable indicator to assess their potential value, to be either fed as resource inputs into the "secondary circuits of value" (Chaturvedi/Gidwani 2011: 132) in the accumulation economy, or to be kept or sold for direct reuse or repair in the need economy. However, they are translating the material properties of wasted plastics differently according to the waste-source they can draw on and the concrete use-values they obtain from it, thereby extending the "useful life" (Reddy



2015: 168) of things. This differential capability to translate concrete use-values into social use-values designates their abstract economic function as “relay points” (Gidwani/Baviskar 2011: 143) in the interactions between informal and formal, between needs-based and accumulation economies. It elucidates how they “subsidise and supplement capital accumulation” (Gidwani/Baviskar 2011: 143).

This appraisal of use-values of wasted plastics is only economically feasible within the informal sub-economies of India’s post-colonial capitalist formation (Sanyal 2007). It is based on the extreme exploitation of devalued labour at the fringes of capitalist accumulation and deeply entrenched in on-going processes of primitive accumulation by dispossession. In Kolkata, these processes are particularly clear along power relations related to social categorizations of caste, gender and religion that translate into the social stigmatisation of work with waste and its political negation by government institutions, state authorities and the general public. The entanglement of recycling economies within the interlocking power relations that structure needs-based economies in India results in the stark devaluation of recycling labour. Ironically, it is exactly this useful labour of collecting, sorting, aggregating and compiling—the metabolizing labour “inside India’s infra-economy” (Gidwani 2015)—that is absolutely central for the reversal of capitalism’s spatial and material patterns of wasting, and thus, the indispensable premise of any recycling economy. This has implications for the Marxian understanding of value (as congealed labour) put forward by Herod et al. (2013, 2014), because the recuperation of exchange value is not organised solely within the confines of capitalist production but mediated through diverse societal relations that might be partly aligned to, but in any case exceed capitalist social relations. Thus, from a value standpoint, the congealed labour of waste plastics has been (to varying degrees) already lost *within* capitalist primary circuits of accumulation (be it through devaluation or devalorisation) and is only reincarnated in an accumulation-by-dispossession like manner.

The transfer of value from waste between informal and formal economic spaces of recycling discussed in this article could provide new impetus for the engagement with “socio-economic inequalities and environmental change” (Franz et al. 2018: 201) within environmental economic geography (cf. Braun et al. 2018). The Marxian notion of use-value, particularly the differentiation between concrete and social (or abstract) use-value, might also provide a missing link to the recent, and extremely productive, engagement

with the materiality of waste and recyclables from the perspective of new materialism, which is drawing on actor network theory (cf. Gille 2010), and science and technology studies (cf. Lepawsky/Mather 2011). Moreover, it might offer fertile ground for further engagement with the research agenda set by the explicitly political Marxist readings of recycler's "abstract and concrete labour in the age of informality" (Gidwani 2018) and their agency (Samson 2017) within the uneven geographies of post-colonial capitalism.

**Empirical Sources**

Interview (Int2; small-size scrap shop) conducted in Old Kolkata on Nov. 19<sup>th</sup> 2016

Interview (Int5; middle-size scrap shop) conducted in Old Kolkata on Nov. 25<sup>th</sup> 2016

Interview (Int6; middle-size scrap shop) conducted in North Kolkata on Dec. 3<sup>rd</sup> 2016

Interview (Int7; small-size scrap shop) conducted in East Kolkata on Dec. 4<sup>th</sup> 2016

Interview (Int8; small-size scrap shop) conducted in East Kolkata on Dec. 4<sup>th</sup> 2016

Interview (Int9; middle-size scrap shop) conducted in East Kolkata on Dec. 4<sup>th</sup> 2016

Interview (Int13; middle-size scrap shop) conducted in Old Kolkata on Dec. 10<sup>th</sup> 2016

Interview (Int14; small-size scrap shop) conducted in Old Kolkata on Dec. 10<sup>th</sup> 2016

Interview (Int17; big-size scrap shop) conducted in East Kolkata on Dec. 15<sup>th</sup> 2016

Interview (Int22; middle-size scrap shop) conducted in East Kolkata on Jan. 19<sup>th</sup> 2017

Interview (Int25; middle-size scrap shop) conducted in East Kolkata on Jan. 24<sup>th</sup> 2017

Interview (Int26; big-size scrap shop) conducted in East Kolkata on Jan. 24<sup>th</sup> 2017

Interview (Int30; small-size scrap shop) conducted in South Kolkata on Jan. 26<sup>th</sup> 2017

Interview (Int31; Kolkata Municipal Corporation) conducted on Jan. 30<sup>th</sup> 2017

Interview (Int34; NGO representative) conducted in East Kolkata on Feb. 6<sup>th</sup> 2017

Interview (Int37; Central Institute of Plastics Engineering & Technology) in Haldia on Feb. 8<sup>th</sup> 2017

Interview (Int42; plastic manufacturer) conducted in Old Kolkata on Feb. 14<sup>th</sup> 2017

Interview (Int43; West Bengal Pollution Control Board) conducted on Feb. 17<sup>th</sup> 2017

Waste Walk (WasteWalk3) conducted in Old Kolkata on November 2<sup>nd</sup> 2016

## 6.2 Environmental Change and the Informal Plastic Recycling Networks of Kolkata

**The following chapter contains the pre-peer reviewed version of the article detailed below:**

Schlitz, Nicolas (2020): Environmental change and the informal plastic recycling networks of Kolkata. In: *Singapore Journal of Tropical Geography*, 41(3), 450-467.

This article has been published in final form by Wiley in the Singapore Journal of Tropical Geography – **Link:** <https://doi.org/10.1111/sjtg.12324>

### **Abstract:**

This article introduces plastic recycling networks in Kolkata, India, as a case to illustrate the contradictory entanglement of economic and environmental change in urban informal contexts of the Global South. In light of the prevailing environmental critique of informal plastic recycling in India, this article discusses plastic recyclers' environmental impact and contribution as well as the potential to enhance the environmental and economic performance of their business. Network and chain approaches in the emerging field of Environmental Economic Geography are combined with the notion of social metabolism to conceptualize the entanglement of environmental and economic processes as well as socio-environmental inequalities entailed in recycling networks. The analysis reveals the impact that the heterogeneity and fluctuation of plastic waste supply has on the economic organization of recycling networks, giving rise to distinct forms of governance in its intermediate and down-stream segments. Such an integrated perspective also serves to explain why environmental upgrading is hard to achieve under prevailing circumstances by plastic recyclers in Kolkata. Based on an assessment of the social and political conditions of informality under which plastic recyclers operate, the adoption of common assumptions about ecological modernization imbuing parts of Environmental Economic Geography is called into question.

**Keywords:** Recycling, Plastic, Informal Recycling Networks, Environmental Change, Environmental Economic Geography, India

### 6.2.1 Introduction

The appraisal of recycling has been ambivalent in recent years: while being praised as crucial component of the ‘circular economy’ in the Global North, recycling activities in the Global South have partly fallen into disgrace under the guise of the ‘pollution heaven thesis’, which refers to the globally unequal distribution of environmental pollution in a ‘race-to-the-bottom’ (Gregson & Crang 2015; Gasser et al. 2018). This ambivalence points to the intricate relationship between economic activities, material transformations and the governance of associated environmental implications. And it raises the general question how processes of economic and environmental change are entangled with each other.

This paper takes plastic recycling economies in Kolkata, India, as a case to illustrate the contradictory entanglement of economic and environmental change in urban informal contexts of the Global South. In India, informal plastic recycling networks provide employment and livelihoods to at least 0.25 Million workers (Mutha 2006: 242) and are responsible for the country’s exceptionally high plastic recycling rates, estimated between 48% (Mutha et al. 2006: 222) and 60% (WBCSD 2016: 4). India’s informal recycling economies however, are still sometimes exclusively depicted as dirty, small-scale backyard businesses that pollute urban environments, subvert government regulations and neglect any environmental and labour-safety standards (WBPCB 2017). Such accusations are often aligned with justifications for the modernization of municipal solid waste management (MSWM) and the formalization of recycling (Reddy 2015). In light of such contradictory appraisals, I discuss informal plastic recyclers’ environmental impact and contribution as well as the potential to enhance the environmental and economic performance of their business. I particularly focus on actors directly involved in the increasingly capital- and technology-intensive down-stream segments of plastic recycling networks. These actors strongly influence the environmental and economic processes and dynamics of change that shape recycling economies beyond the predominant and often narrow focus on MSWM, which has characterized the literature on informal waste handling in India for a long time.

Drawing on contributions to the emerging field of Environmental Economic Geography (EEG; e.g. Braun et al. 2003, 2018) and its “sympathetic critique” (Bridge 2008) and extension (Bakker 2012), I argue for an integrated analysis of economic and environmental change. This involves both the perpetual entanglement of material transformations and economic transactions, as well as co-constituted structural change of environments and

economies. Such an integrated perspective serves to explain why formalized environmental upgrading is hard to achieve under prevailing circumstances by plastic recyclers in Kolkata. Based on an assessment of the social and political conditions and economic inequalities characterizing informal plastic recycling, I call for caution in the adoption of common assumptions about ecological modernization often implicated in concepts of environmental governance and upgrading in the EEG literature.

The next section discusses network and chain approaches, potentials and limitations for the analysis of entangled economic and environmental change within EEG. This is followed by a review of relevant sources on informal waste management and recycling in India. The fourth section introduces the empirical sample and methods used, followed by the contextualization of the waste and plastic recycling in Kolkata. The remainder of the article presents the empirical analysis of the case study, leading to the conclusion.

### **6.2.2 Environmental Change in Economic Geography**

Throughout the last decade, economic geography scholarship has contributed substantially to social science studies of waste and recycling (e.g. Lepawsky & Billah 2011; Crang et al. 2013). Surprisingly, these contributions are largely disconnected from the engagement with environmental concerns within economic geography (e.g. Bridge 2008; Schmitt & Schulz 2016; Braun et al. 2018). Both strands of research draw on two predominant approaches in economic geography that conceptualize globalized economic activities through chain or network heuristics: the Global Value Chain (GVC; e.g. Gereffi et al. 2005) and Global Production Network (GPN; e.g. Henderson et al. 2002) approaches. In introducing these fields and approaches and their possible convergence, this section proposes to envisage the entanglement of environmental and economic change entailed in recycling economies in terms of a social metabolism that involves particular socio-environmental inequalities.

The GVC approach is following a linear scalar ('vertical') heuristic of economic processes of value adding "where 'upstream' signals flow towards production, and 'downstream' towards consumption", while a "segment is a 'vertical chunk' of a value chain between two nodes [and a] value chain can have different strands, due to different product characteristics" (Bolwig et al. 2010: 175). GVC is focusing on the hierarchies and power relations that structure the global integration of economic actors into value chains, which are conceptualized through five forms of governance (Gereffi et al. 2005): market,

modular, relational, captive and hierarchy. Changes in these structures are captured through the notion of upgrading or downgrading of economic actors already integrated in the value chain, or through their integration or exclusion (Bolwig et al. 2010).

The GPN approach, departing from GVC and preceding chain approaches, conceptualizes global economic activities as networked constellations captured through three analytical categories (Henderson et al. 2002): value (divided into value creation, enhancement and capture), power (in the form of corporate, institutional and collective power) and embeddedness. While the network heuristic is particularly useful, the forms of governance and upgrading developed in the GVC literature are often integrated into GPN analysis and applied to all kinds of value accumulating production processes – including more regionally integrated ones (Pauls & Franz 2013), similar to the case of plastic recycling networks in Kolkata. Big corporations and “lead firm-driven modes of governance are not apparent in the South Asian centred [recycling] networks” (Crang et al. 2013: 22) analyzed here, which is why I refer to ‘economic power’ instead of ‘corporate power’.

GPNs consider not only economic actors directly involved in “transforming ‘inputs’ into ‘outputs’” (Coe et al. 2008: 274). Rather, production networks are “contested fields” (Levy 2008: 948) also shaped by the institutional and collective power of other actors like government agencies and state authorities, trade unions and civil society organizations. The ‘grounding’ of economic networks – as inherently social relations – is achieved in the GPN approach through an enhanced notion of embeddedness, particularly through societal and territorial embeddedness (Hess 2004). In this article, I draw on a broader notion of ‘societal embeddedness’ (cf. McGrath 2018), that is, “the non-economic, social relations in and through which firms operate” (Crang et al. 2013) in recycling networks. This differs from the notion commonly used in the GPN literature (Hess 2004), in that it puts an emphasis on the social, cultural and in fact political contexts (cf. Bair 2005).

A waste-specific criticism and expansion of chain and network approaches has been undertaken primarily under the notions of Global Recycling Networks (GRNs, e.g. Crang et al. 2013) and Global Destruction Networks (GDNs, e.g. Herod et al. 2013). The works on GRNs emphasize the importance of materiality for the recovery of value from waste (Lepawsky & Billah 2011), which depends heavily on the assessment of the quality and management of the heterogeneity and complexity of used goods. Thus they criticize the unidirectional orientation of previous analyses of GVCs and GPNs towards consumption

as the end point of the realization of value and in return emphasize the multiple trajectories, supply-orientation and “brokered forms of governance” (Crang et al. 2013: 13) in recycling networks.

As noted earlier, the works on GRNs are relatively disconnected from the Environmental Economic Geography (EEG) literature. EEG “describes a loose grouping of grounded research activities that address the reciprocal relationships between economic organization and environmental outcomes” (Bridge 2008: 76). From its outset (Braun et al. 2003) it invoked a range of different conceptual frameworks like ecological modernization, multi-level environmental governance and political ecology that have since been extended to (sustainability) transition studies and post-growth (Schmitt & Schulz 2016), or the water-energy-food nexus (Franz et al. 2018), amongst others (c.f. Braun et al. 2018). Network and chain approaches within EEG have proved useful to analyze the environmental concerns related to globalized economic activities, and their mitigation (Schmitt & Schulz 2016; Franz et al. 2018). Most GPN/GVC contributions to EEG focus on the environmental upgrading of specific economic actors and the ‘greening’ of value chains (e.g. Bolwig et al. 2010) or environmental governance through eco-labelling. Parts of these works are implicitly biased or explicitly related towards paradigms of ecological modernization, which are based on the logic of eco-efficiency and prioritize technological solutions and market mechanisms to promote environmental sustainability. The paradigm of ecological modernization has faced considerable critique because of its adherence to economic growth and the promotion of “technological solutions to economic-socio-ecological problems” (Kosoy et al. 2012: 75), which misses the fundamental entanglement of environmental and economic as well as social and political processes. Bridge (2008: 76-77) calls in his “sympathetic critique” of EEG for the uncovering of the fields potential to emerge as an “epistemic project” that entails a rethinking of economic processes. This involves “thinking about production not as value creation but as a process of materials transformation in which environmental change and the organization/disorganization of matter and energy are integral rather than incidental to economic activity” (Bridge 2008: 77). According to such a framing, not only environmental upgrading, but every form of economic activity will entail some environmental change. Improved environmental management and enhanced environmental performance (e.g. upgrading) are but two of many relevant dimensions of environmental change. The constant flow of material input



and output, and the “the biophysical processes that result as resources are assembled and transformed, and waste is produced” (Demaria & Schindler 2016: 3) through economic activities, constitute the other, underlying dimensions. Both of these dimensions of environmental change are best captured through the concept of social metabolism, “at the core of which is a complex relationship between its materiality (e.g. volume, composition, density and its biophysical transformation) and political economy (e.g. ownership, access and value struggles)” (Demaria & Schindler 2016: 5). To address this contested nature of environmental change, the social metabolism of plastic recycling in Kolkata is analyzed with respect to “the manifold interrelationships between economic, social, and environmental disadvantage” (Braun et al. 2018).

### **6.2.3 Informal Waste Management and Recycling in India**

There is a long tradition of literature focusing on informal recycling activities in the context of MSWM in India (Furedy 1994; Trettin 2002). These contributions were often concerned with the role of reclaimers (waste pickers) and have correspondingly focused on the social aspects of informal recycling, related health issues and the pertinence of small-scale “appropriate technology” (Furedy 1994: 88) for MSWM in India. In stark contrast, the similarly long history of environmental management and urban planning literature on MSWM in India has often completely ignored informal recycling and its contribution to waste management. It depicted reclaimers as nuisance, or argued for their incorporation into municipal street-sweeping staff. Instead, this literature has focused on challenges of municipal solid waste (MSW) collection and disposal as well as technology- and capital-intensive infrastructures following western blue-prints (Furedy 1994; Demaria & Schindler 2016).

Informal recycling economies contribute in at least three distinct ways to sustainable urban development (Chaturvedi & Gidwani 2011; Chengappa 2013; Reddy 2015): First, they provide an ecological service through remarkable efficiency in the recovery and segregation of urban waste. Second, they “offer important economic services” as “they create significant employment opportunities and ameliorate the livelihood insecurities of marginalized groups” (Reddy 2015: 168). Third, they offer an “ecological subsidy to the city” (Chengappa 2013: 1) by diverting waste from the public waste stream, which results in reduced public expenditures (Reddy 2015). Nevertheless, informal recycling has been

largely negated by state authorities and the general public and has continued to operate mostly beneath and beyond government regulations and municipal waste management systems (Furedy 1994; Gidwani 2015). The intricate relationship between formal MSWM and informal plastic recycling in India has been studied by Gill (2012) in the case of Delhi. Another contribution on plastic recycling economies is the study by Kulke and Staffeld (2009) on the informal-formal linkages in the plastic recycling industry of Dhaka, Bangladesh. This is “divided into a survival economy [...] and a growth-oriented informal economy” and exhibits “a broad spectrum of [...] different degrees of formality” (Kulke & Staffeld 2009: 40).

More recent investigations of informal plastic recycling economies in India and their environmental implications have been conducted as part of the *Sustainable Recycling Industries* program<sup>39</sup> (WBCSD 2016), including a *Feasibility Study for a Certification of Sustainably Recycled Plastics in India* (Gasser et al. 2018). This study has revealed that potentially hazardous chemicals in recycled plastics are stemming from catalysts used during polymerization in the petro-chemical industry (e.g. phthalates used as plasticizers) as well as from common additives like pigments, stabilizers and flame retardants mixed with polymers during processing of plastics. They also include hazardous chemical residues absorbed through contact during use, thus pointing to the central concern of traceability of recycling plastics, particularly hard to achieve within informal networks (Gasser et al. 2018: 16-21). Yet, this study also highlights that the list of hazardous substances in recycled plastics is “remarkably short and their occurrence in the waste stream is relatively well known” (Gasser et al. 2018: 24). It proposes the implementation of a local traceability (certification) scheme to aid formal and more advanced recycling units – which are often not profitable (Gasser et al. 2018) – to build up a market for high-value, sustainably recycled plastics and thereby promote integration into global production networks. Its stance towards the “pervasive presence of informal actors” (Gasser et al. 2018: 20) within India’s plastic recycling networks is contradictory: On the one hand they “complicate the implementation of a traceability scheme” and are “the source of many of the traceability concerns” (Gasser et al. 2018: 20). On the other, they need to participate because they are construed as main beneficiaries of sustainable plastic recycling schemes (Gasser et al. 2018). These recent studies however, do not sufficiently take into account the

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<sup>39</sup> See [www.sustainable-recycling.org](http://www.sustainable-recycling.org)

critical social science literature on informal waste handling and recycling in India (Gidwani 2015; Reddy 2015). As a consequence, they appear to grapple with understanding the economic, political and social intricacies of the informality of recycling in India and its often messy, dispersed informal settings and relationships.

#### **6.2.4 Methods – Researching Plastic Recycling**

This article draws on empirical research conducted in Kolkata, India, from September 2016 to February 2017 that was designed as a multi-scalar case study of plastic recycling networks. The underlying research design combined a process (and flow) heuristic with a (hierarchically structured) network heuristic in order to account for spatial and material processes of plastic waste recovery and recycling and the functional position of actors within Kolkata's recycling network. The analysis is mainly based on research interactions with actors directly involved in the plastic recycling process and focuses particularly on interviews with actors in the intermediate and down-stream segments of the recycling network. These interviews are part of a larger qualitative methodical set of 43 semi-structured interviews and ethnographic accounts, in the form of 26 waste walks (participatory observations while moving through public space, with the aim to systematically explore the spatial articulations of waste management systems and recycling networks) and eight participant observations, which are selectively brought into the analysis.

#### **6.2.5 Kolkata's Waste and Recycling Scapes**

Kolkata is the capital of West Bengal with an estimated population of 10 Million (Paul et al. 2014: 846). It was once the prosperous industrial hub of Eastern India. But since the reform period of the 1990s, Kolkata has experienced India's intensified integration into globalized production mainly in terms of disinvestments. Yet, this economic downturn was in fact a dramatic shift towards informal production and employment: "West Bengal tops the chart with respect to the number of unorganized manufacturing enterprises and workers in the country" (Thomas 2014: 84).

The plastic industry in and around Kolkata Metropolitan Area is today comparably small and insignificant, as petrochemical-chemical industries are now concentrated in West India (Thomas 2014). Yet, historically, Kolkata appears to be one of the incubators of plastic

processing and recycling in the country, with pioneering plastic processing companies (like *Synthetic Moulders Ltd*) still being based in the city and one of the largest petrochemical companies of India – *Haldia Petrochemicals Ltd.* – located in the close-by port-area of Haldia. These regional imbalances in macro economic trends are strongly reflected in the accounts of my informants: virtually all actors directly involved in Kolkata's plastic recycling networks report declining prices and a significant downturn in business, particularly since 2013, and highlight the business opportunities and economic developments in Mumbai and Delhi. Particularly economically powerful actors in the down-stream segments of the plastic recycling networks point to the lacking opportunities for value enhancement through integration into (formal) high-value supply chains of (increasingly global) production networks in Kolkata.

Irrespective of the macro-economic trends of disinvestment and informalization, Kolkata is still a metropolitan region that produces considerably high amounts of urban waste. In 2011, Kolkata City generated above 5000 tons of MSW per day (Das & Bhattacharyya 2013: 147-48). The plastic fraction of Kolkata's MSW has been constantly rising from 1970 to 1995 from 0,64% to 3,22% and reached close to 5% in 2005 (Chattopadhyay et al. 2009: 1450). It constitutes the second largest recycling fraction after paper. Until now, formal MSWM by the Kolkata Municipal Corporation (KMC) is mainly composed of the (unsorted) collection and disposal of mixed wastes at uncontrolled landfills (Das & Bhattacharyya 2013). In contrast to other metropolitan areas like Delhi (Chaturvedi/Gidwani 2011) or Bangalore (Reddy 2015), corporate capital or civil society organizations show little interest in investing into the formalization of recycling collection schemes and valorization of wasted plastics. Virtually all plastic recycling in Kolkata is taking place in the informal economy. One of the oldest recycling hubs of the city is located very centrally, in and around an area called Kolabagan in old Kolkata, which is home to bustling merchandise and labouring classes. From there, a number of specialized plastic recycling hubs stretch through the neighbourhoods of Narkeldanga, Tangra, Topsia and VIP towards the East, where the city's main dumping site 'Dhapa' is located – which is marking out the eastern urban frontier towards vast wetlands (AUTHORS).

### **6.2.6 The Contested Social Metabolism of Plastic Recycling Networks in Kolkata**

Informal plastic recycling networks in Kolkata produce a variety of different types, qualities and colours of plastic granules, which are called ‘dana’. Dana is a production good that serves as material input in plastic manufacturing. At first sight, and for the untrained eye, recycling dana is indistinguishable from ‘fresh’ dana (also called 1<sup>st</sup> grade) – the plastic granules (resin), which are produced through polymerization of hydrocarbons in the petrochemical industry.

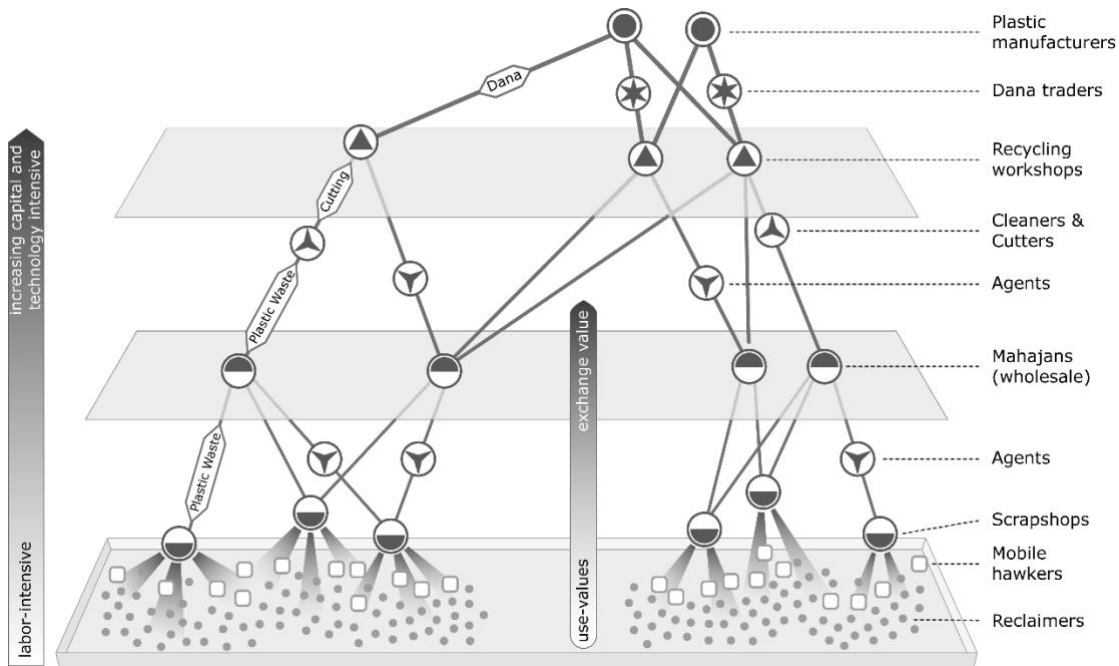
In order to produce recycling dana, informal plastic recycling networks in Kolkata are drawing on an extremely heterogeneous variety of sources for wasted plastics. These source materials of plastic recycling networks – its ‘staple’ – is, as resource flow, particularly hard to predict: it is fluctuating a lot in terms of quantities, composition and qualities, depending on the particular nodes of production networks (from production to distribution and consumption), where plastics are wasted. One of the biggest challenges of plastic recycling networks, as material production process, is to cope with these uncertainties of supply and allocate the fluctuating quantities and qualities of wasted plastics available for recycling.

For the analysis of the entanglement of environmental and economic processes in informal plastic recycling, I distinguish between two aspects of the material qualities of plastic waste sources and their processing: First, the socio-metabolic functions and transformations of wasted materials involved in recycling as a production process. Second, the environmental risks, implied by different waste materials and their processing. Both aspects are strongly intertwined with the economic organization and with social and political conditions of plastic recycling.

#### *6.2.6.1 Social Metabolism of Plastic Recycling*

Informal plastic recycling networks can take multiple forms (Crang et al. 2013): the nodes, segments and strands of recycling networks can vary significantly between different plastic types, from place to place, and even within a city. Nevertheless, Kolkata’s recycling networks show some clear patterns depicted as a stylized heuristic in Figure 8. These patterns are predicated mainly on plastic recycling as a material production procedure that “requires relatively simple technological and resides on a few basic processes” (Gasser et al. 2018: 24), thereby linking differently sourced plastic waste flows with plastic

manufacturing. This social metabolism of plastic recycling, the work tasks, machinery involved, the material transformations and environmental risks implied, are described in this section.



**Figure 8:** Structural heuristic of plastic recycling networks (own figure, prepared by Christoph Reichel)

The basic pillar of any informal plastic recycling network is the up-stream segments of sourcing: the collection, pre-sorting and aggregation of plastic waste materials from different places. This is performed by *reclaimers* (waste pickers) who retrieve recyclable wastes from public spaces and MSW-streams including dump sites, as well as *hawkers* (itinerant waste buyers) who purchase segregated recyclables from households and all kinds of commercial entities. Both actors sell their recyclables to a vast, decentralized network of *scrap shops*, which are often specialized either on retriever-, household- or commercially-sourced wastes (AUTHORS). Here, recycling materials are sorted and stored in order to sell them afterwards in bigger quantities of more homogeneous plastic materials to *wholesalers*.

The actors of the up-stream segments of recycling networks<sup>40</sup> obtain recyclables from an extremely heterogeneous set of sources that generally reflect all possible applications of plastics in India (as there are no separate streams of municipal or production or hazardous wastes), and channel them into specialized trade networks. This describes their metabolizing function: they reinsert processable batches of recyclable waste materials into the material stocks and flows of society. The environmental implications in these segments of the recycling network are mainly related to traceability concerns (indication of original applications and former use) and health risks associated with waste handling, like respiratory diseases (Binon & Gutberlet 2012). The widespread sourcing of recyclable plastics from medical waste in Kolkata constitutes a particularly virulent problem.

The social and material transformation from plastic waste to recycling material starts in-between scrap dealers and wholesalers, who are engaged in intense sorting, thus homogenizing the wasted plastic materials into refined type-wise plastic input fractions. Wholesalers (*Mahajans*) function as gatekeepers (in terms of homogeneity and volume) for plastic wastes' passage into down-stream segments of the recycling network, which are characterized by the increasingly technology- and capital-intensive processing of recycling plastic.

*Cleaners and cutters* are intermediate up-scaled actors for the pre-processing of recycling plastic. They are engaged in refined segregation according to plastic types and colours, employ shredders to cut the refined plastics into small pieces and clean them afterwards with chemical detergents in mechanised water ponds to produce purified flakes called *cutting*. Cutting is a tradable intermediate plastic recycling product that later serves as main input into the actual recycling process in recycling workshops. Recycling cutting is not only differentiated into 2<sup>nd</sup> grade and 3<sup>rd</sup> grade – the latter being composed of street waste derived from MSW streams. Moreover, there are also a number of quality differences within each grade – more than four in the case of 2<sup>nd</sup> grade, each again distinguished into different colours – which imply significant price differences. These quality differences point to an already existing traceability mechanism based on tacit recycling knowledge, although more geared towards the use-value of recycling plastics than to environmental risks. In addition to traceability concerns, other relevant environmental impacts at this node

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<sup>40</sup> With the exception of big amounts of homogenous plastic production wastes, which are often directly sold to bigger down-stream (up-chain) actors of recycling networks.

of recycling networks are: waste water from the cleaning process containing chemicals for cleaning, pollutants attached to the used plastic, as well as dust and fine particles released into the air during the cutting process.

*Plastic recyclers* are normally specialized on one or two types of plastics and employ extruder machines, where cutting is first melted in a heater and then passed through a barrel with several filters that refine the melted plastic until it is released by pressure into strings, which are cooled in water and cut into granules – constituting *dana* (literally meaning ‘small pieces’). The final social-metabolic transition from wasted plastic with concrete, tangible (and traceable) material properties to abstract recycling plastic commodity for plastic manufacturing appears to be performed in the processing of cutting into *dana*: while cleaned and chopped plastic cutting still bears the marks of the wasted plastics it was derived from (in terms of colour and texture, and wear and tear), *dana* is already processed to an extent that its qualities only reflect the aggregated material properties of a whole batch of cutting. This appears to be the social-metabolic reason why cutting exists as intermediate product in the first place: its’ tangible use-value in terms of texture and physical properties still enables a thorough quality-assessment by the expert eye of qualified recycling labour. As a recycler (interview, 9 February 2017) explains, “recycling is all about filtering” of wasted plastic materials depending on the purity and homogeneity of input, suitable melting temperature and filter nets. Environmental concerns at this node involve the treatment of production waste (rejects of the filtering and filter nets) and waste water, as well as traceability concerns related to “cross-contamination” if recyclers “use the same machinery for several polymer types for different applications” (Gasser et al. 2018: 20).

As final product, *dana* is either sold directly to *plastic manufacturers* for further processing or traded by *dana traders* on specialized markets. As Gasser et al (2018) emphasise, traceability concerns with respect to potentially hazardous chemicals contained in polymers, depend on the secondary application of recycled plastics. In India the use of recycled plastics is thus prohibited for any application that involves contact with food (Gov. of WB 2018). Kolkata’s plastic recycling networks supply a variety of different quality recycling plastic for the production of all kinds of goods. These include footwear, furniture, buckets, cable coatings, tubes and telephone covers, but also a number of households items like jars, mugs, jugs, toys, in which contaminated polymers could



definitely pose a health risk. Moreover, my research confirms the findings of Mutha et al. (2006: 233): “While [products from fresh plastics] are preferred by the middle and upper classes, the cheaper recycled products certainly serve the markets of the low-income classes of Indian society.”

Informal recycling networks in Kolkata exhibit an enormous capacity to recover, segregate, aggregate and allocate extremely heterogeneous flows of wasted plastics according to their material properties and source. A number of informants explicitly refer to the environmental contribution of their business by diverting wasted plastics from landfills and substituting fresh plastic materials, as a recycler exemplifies:

From my personal experience, [...] recycling is a good thing. If recycling does not happen, where would this scrap be dumped? What has government done for this? I believe recycling is like serving the country, [but the] government sometimes hinders our work. (interview, 9 February 2017)

The capacities of recycling actors in Kolkata, however, are focused primarily on those material qualities of wasted plastics that determine further processing – like colour, type of plastic (resin) and purity – and not on toxicants contained in different qualities of plastics (although there are overlaps between these dimensions of material quality) and environmental pollution related to their processing.

#### *6.2.6.2 Plastic Recycling Networks*

The multiple sources, temporal fluctuations, spatial dispersal and heterogeneous composition of plastic waste supply pose a significant allocative challenge to the economic organization of recycling networks. This challenge has had a strong impact on the specific form plastic recycling networks have taken in terms of the network architecture and governance forms characterizing economic interactions and exchange. In agreement with Kulke and Staffeld’s (2009: 40) division of plastic recycling economies in Dhaka into “a survival economy” and “a growth-oriented informal economy”, Kolkata’s recycling networks can be divided into a labour intensive realm comprised of the up-stream segments of sourcing, and an increasingly technology- and capital-intensive realm composed of down-stream segments of processing. These realms are connected by an intermediary trade level (see figure 8.) that is built on refined segregation, the realization of economies of scale, and intensive coordination for allocation.

In slight contrast to the findings of Crang et al. (2013), my research indicates that on this intermediate level between scrap shops and wholesale as well as cleaners and cutters, the recycling network is governed also by forms of market-coordination. The coordination on this intermediate level is aided by codified tacit recycling knowledge allowing the determination of economic exchange through price mechanisms – even though this is maintained to a considerable extent by middlemen (‘agents’). This is a common feature of economic organization in South Asia, particularly within informal economic spaces (Pauls & Franz 2013), as a cleaner and cutter puts it: “Our country is run by middlemen” (interview, 19 December 2016). Accordingly, agents serve to broker the evident allocation difficulties predicated on the multiplicity of sources and heterogeneity of wasted plastics and navigate supply and demand insecurities.

The form of governance changes in the down-stream segments of the recycling network – partly conditioned by the material implications of these segments: As outlined in the previous section, cutting – as intermediary recycling product – already implies a considerable abstraction from the original applications shaping the material properties contained in a whole batch of chopped plastics. A recycler (interview, 13 February 2017) emphasizes: “we do not have the luxury of having sealed company materials [...], we have to check the materials ourselves, the quality, the colour, everything”. Recyclers however can assess the material qualities including the associated environmental risks of their supply only to a limited degree. Therefore, recyclers build up long time relationships with their supplying wholesalers, and cleaners and cutters to mitigate uncertainties and ensure the material quality as well as steadiness of input – particularly in the high-value strands of the recycling network that produce high-quality 2<sup>nd</sup> grade dana. In some cases these supply relationships last for generations and involve strong mutual dependencies. Thus, particularly in the down-stream segments, plastic recycling networks in Kolkata exhibit highly relational forms of coordination based on long-term relationships of trust. These “network[s] of trust” (WBCSD 2016: 11) serve to mitigate the insecurities in material quality and homogeneity of input, which are integral for smooth and efficient recycling operations as well as desired quality of dana output.

The governance of intermediate (mediated market-coordination) and down-stream segments (increasingly relational coordination) of Kolkata’s plastic recycling networks varies in accordance with the specific social-metabolic processes involved. These direct

entanglements of recycling as material and economic process reflect the “mutual constitutiveness of economic and environmental change” (Bakker 2012: 109). Moreover, my research indicates that the allocative capacities entailed in prevailing forms of governance serve to translate the supply-orientation imposed by the nature of plastic waste flows (Crang et al.’s 2013) into the demand-orientation imperative to plastic product manufacturing. The successful navigation of such discrepancies between material supply and demand also requires a lot of flexibility, which is largely predicated on economic inequalities and conditions of informality.

Informal recycling networks are marked by economic inequalities and entail extreme socio-economic vulnerabilities for the large majority of actors in the up-stream sourcing segments. Most reclaimers, mobile hawkers, and also some scrap shop owners and their workers lack official land titles, any entitlements to social security and sometimes also a legal residence status, which makes them vulnerable in public space and open dispute situations. Actors at the intermediary wholesale trade level and in the down-stream segments of the recycling network are able to capture by far the biggest share of value. However, this often hides the fact, that most of these actors are small- and middle-size economic entities, which are only to a limited degree able to make profit, invest and expand their business. They are also sometimes confronted with significant economic insecurities linked to the informal setup of their business (e.g. land titles). This explains what Gasser et al. (2018: 9) describe with respect to the astonishing valorisation of low-quality plastic wastes as “race to the bottom”. As a dynamic and highly competitive field – even though more than price mechanisms on the market mediate this competition – plastic recycling networks in Kolkata nevertheless display signs of structural change and economic development in the “growth-oriented” (Kulke & Staffeld 2009: 40) down-stream segments.

An example for upgrading processes and entangled economic and social-environmental change in the down-stream segments of Kolkata’s plastic recycling networks are cleaners and cutters. They appear to have emerged as a distinct node in the recycling network between wholesalers and recyclers in the early 2000s,<sup>41</sup> resulting from the functional upgrading of wholesalers and the outsourcing of this particular production step by recyclers. In Kolkata, their appearance along the ‘eastern waste frontier’ around Dhapa is

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<sup>41</sup> Kulke and Staffeld (2009: 36) list “shredding enterprises” in Dhaka, but they are not mentioned in the study of informal waste management in Kolkata by Trettin (2002) in the late 1990s.

related to gentrification processes and increased population density in traditional recycling hubs like Tangra, Topsia and VIP, as a cleaner and cutter explains: “First we were in Tangra. Then the population there has gone up. We had to shift here” (interview, 12 December 2016). The displacement of this production step to more marginal spaces along the eastern periphery happened mainly due to the sound pollution, but also due to its perceived dirtiness and smell.

Recyclers constitute, in the majority of cases, family enterprises in second or third generation that evolved from plastic scrap trading, or other trade sectors. Most of them are small- and medium-size enterprises that employ around eight to twelve workers in one workshop, housing one or two extruder machines specialized on one or two types of plastics. The cutting is mostly sourced locally or regionally,<sup>42</sup> because imported plastic wastes are more expensive and hard to access due to bureaucratic restrictions. The variety of types and qualities of recyclable plastics leads to a number of different strands in Kolkata’s plastic recycling networks. In some specialized cases of high-quality plastic recycling or integration into GPNs, there is also scope for upgrading and value enhancement. One such case was based on a successful strategy of inter-chain as well as product upgrading, related value capture and value enhancement. This company has evolved from ancestral furniture trade, and is a well-established distributor of imported furniture that has additionally ventured into large-scale production of one particular type of high-quality furniture from recycled plastic, for the regional markets in West Bengal and North-east India – making use of the already existing distribution network (interview, 14 February 2017). Another case represents a successful strategy of functional upgrading and value capture through GPN integration. In addition to plastic recycling, this company is the licensed supplier of processed fresh dana for the production units of a transnational corporation manufacturing electric appliances (interview, 8 December 2016). These examples of powerful economic actors in the down-stream segments of the recycling network illustrate that there is potential for upgrading and value enhancement. These are, however, exceptional cases. Most actors, also in the down-stream segments, operate on limited margins that allow only for investments necessary to stay in business. There appears to be very little economic scope for upgrading. The involved actors do not have (by and large) the resources, knowledge and incentives – and capabilities in general – to

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<sup>42</sup> Recyclers often have specific knowledge about the exact plastic waste source of their input material due to the long-term relationships of trust with supplying cleaners & cutters or wholesalers indicated above.

engage in processes of environmental upgrading.

This can be ascribed to a confluence of unfavourable conditions that shape Kolkata's recycling networks, which pertain to the political-economic conditions of informality (Gidwani 2015), and the prevalent social stigmatization of waste related works (Bagchi & Mitra 2017) in Kolkata. While conditions of informality point to the complicated territorial embeddedness of recycling networks in the face of institutional power of the state and the regulatory environment it constitutes, the social stigmatization of waste related works articulates mainly through the societal embeddedness of actors directly engaged in the recycling network. Formal state actors and also parts of the civil society still have a very ambivalent relationship with and position towards informal recycling networks. The West Bengal Pollution Control Board, for example, states that in West Bengal "[o]rganized recycling is not practiced and as a result the present system of salvaging and recycling causes health hazards and environmental pollution" (WBPCB 2017: 296). Such widely held positions do often translate into policies that are implicitly designed to impede or actively thwart informal recycling activities. The linchpin of recent efforts to modernize MSWM under the 'Clean City' campaign in Kolkata – the introduction of compactor stations instead of open vats – was explicitly aimed at the "stoppage of rag picking" (AITC 2014) and has impeded the access of reclaimers to low-quality plastic recyclables from MSW. The introduction of new MSWM and plastic waste management laws in India has partly changed this situation and has stipulated the official recognition and inclusion of reclaimers. However the subsequent *Plastic Waste Management (PWM) Policy & Strategy of Urban West Bengal* exhibits a strong tendency towards the establishment of new, formally registered "plastic waste recycling plants of excellence" (Gov. of WB 2018: 22) and strongly underestimates the existing informal plastic recycling capacities.

The potentially exclusionary effects of the regulatory environment also reflect the general stigmatization of waste and dirt related (informal) works in India. Many low-status Muslim and Dalit groups are engaged in the up-stream sourcing segments of Kolkata's recycling networks, while its intermediary trade and also some parts of the down-stream segments are dominated by actors who migrated from neighbouring states or from rural West Bengal and Bangladesh, who are also often Muslims. Most of these groups are considered "intruding" migrant populations by the dominant social groups in Kolkata (Bagchi & Mitra 2017). These communal boundaries that characterize the societal embeddedness of the

majority of recycling actors find their spatial articulation in the locations of plastic recycling hubs – reaching from Old Kolkata via Tangra and Topsia to Dhapa – which are mostly poor, working-class and traditionally Muslim neighbourhoods.

Overall, this situation can be interpreted as a form of territorial dis-embeddedness associated with the societal embeddedness of recycling actors as ‘outsiders’ and/or low-status Muslims or Dalits. This implies that the environmental, economic and societal contribution of recyclers is not acknowledged by the state or general public. The lack of trust in the quality of recycled plastics observed by Gasser et al. (2018) is deeply entrenched in the social stigmatization as well as informalization that characterize recycling networks in India. As McGrath (2018: 513) has pointed out, “value can be seen as socially, politically, historically, geographically, and discursively determined”, which has implications for the potential to create, enhance and capture value. The confluence of unfavourable social, cultural and political conditions shaping Kolkata’s recycling networks is conducive to the “transfer” (McGrath 2018: 513) of value from marginalized actors in the up-stream sourcing segments of the recycling network, who lack social recognition and subsequently obtain a weaker position in price negotiations compared to already powerful economic actors, thus safeguarding the economic supremacy of the latter. This also negatively affects the value capture of economically powerful actors in the down-stream segments, which highlights the social, cultural and political context of entangled economic and environmental change.

### **6.2.7 Conclusion**

In this article, I have combined the analytical categories of network and chain approaches used in EEG with the notion of social metabolism in order to carve out the entanglement of economic and environmental processes in the case of Kolkata’s plastic recycling networks. Such an emphasis on the “environmentally-embedded character of economic activity” (Bridge 2008: 79) illustrates how plastic recycling networks cope with the material and allocational challenges posed by the social metabolism of plastic in Kolkata. These networks exhibit an enormous capacity to allocate extremely heterogeneous flows of wasted plastics according to their material properties and sources, giving rise to a whole array of recycling plastic qualities. Yet, until now, these capacities are mainly geared towards those material qualities that determine further processing and not to the

traceability of potential toxicants contained in differently sourced plastics and environmental pollution related to their processing. My analysis shows that these multiple sources, temporal fluctuations, spatial dispersal and heterogeneous composition of plastic waste supply are giving rise to distinct forms of governance in the intermediate and downstream segments of recycling networks. On the one hand, this confirms Crang et al.'s (2013: 15) view that “supply comes before demand” and that plastic wastes’ “[m]aterial heterogeneity [...] pushes towards a relational governance structure” (Crang et al. 2013: 19). While this is true for the down-stream segments of recycling networks – particularly its high-quality strands – the intermediate trade segments also exhibit forms of market-coordination based on the codification of tacit recycling knowledge, even though aided by intermediaries. This confirms not only the “versatility of the modes of governance, even within a single chain or network” observed by Blažek (2016: 850), but indicates also one more – in this case environmental, respectively social-metabolic – factor causing such varieties.

Moreover, and in line with recent calls for greater context sensitivity in GPN, my analysis has highlighted the negative impact of “larger social, cultural and political-economic environments” (Bair 2005: 168; cf. Schmitt & Schulz 2016; McGrath 2018) on recycling networks in Kolkata. I have described this situation as a form of territorial dis-embeddedness associated with the societal embeddedness of recycling actors as ‘outsiders’ and/or low-status Muslims or Dalits. It finds its articulation through the mutually enforcing conditions of informality and waste-related social stigmatization, and it is reflected in formal state actors’ ambivalent relationship with and position towards informal recycling networks. This confluence of unfavourable social, cultural and political conditions shaping Kolkata’s recycling networks is conducive for the transfer of value from marginalized to economically powerful recycling, but also negatively affects the value capture and capabilities for upgrading of the latter. Plastic recycling networks in Kolkata illustrate the close entanglement of environmental, economic as well as social and political processes. This also calls for caution in the adoption of assumptions about ecological modernization imbuing parts of EEG. My empirical analysis indicates that a formal transition towards sustainable, high-quality and high-value plastic recycling envisioned in the literature (Gasser et al. 2018) is a very unlikely scenario under current circumstances, although substantial change might be underway with the changing policy framework.

### 6.3 Remarks on the Kolkata Case Study

The two articles that represent the case study of informal plastic recycling in Kolkata contribute to several areas of scholarship in environmental economic geography and waste studies, as has been outlined in the respective conclusions. There are, however, some aspects that need particular emphasis in the context of this cumulative dissertation. This case study reflects processes of externalisation that form an integral part of waste economies in at least two distinct ways.

On the one hand, the rise in wasted plastic materials in India is directly related to the integration of India's economy into global production networks since the reform period and its economic and political liberalisation policies. The changing socio-metabolic profile of India's economy (Sing et al. 2012) and the available data on plastic consumption and plastic waste generation (e.g. Mutha et al. 2006) leave no doubt about this correlation. Accordingly, the emergence of plastic waste in India can be interpreted as an "unintended consequence" (Gille 2007: 27) and can thus be seen as an externalising effect of capitalist dynamics of expansion<sup>43</sup>. My informants confirm that plastic recycling in Kolkata goes back to the late 1980s and early 1990s (e.g. Int10, Int33, Int38, Int41; see Appendix 1), which coincides roughly with the reform period. This illustrates how the negation of waste's materiality – reflected in the imperative of disposability in formal waste management that is still clearly recognisable in the case of Kolkata – was confronted by the affirmation of plastics concrete materiality and positive use-value by informal recycling networks. Thus, informal recycling represents a parallel form of societal waste handling, beyond and beneath official MSWM.

On the other hand, the informal recycling networks, which thrive on the material remnants that the globally integrated formal accumulation economy and the state "failed to use" (Gille 2007: 18), cannot be interpreted in terms of dynamics of intensification, exactly because these networks are themselves constituted at the informal fringes of formal economic spaces. Informal recycling networks are intensely entangled with the formal accumulation economy, but to a large degree characterised by social and economic relations that exceed capitalist social relations. They are constituted themselves within

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<sup>43</sup> This period does not reflect a dynamic of intensification as the 'jobless growth' character and the forms of financial rent seeking through investment entailed in this dynamic illustrate.



economic spaces that are historically the result of a different but strongly related process of externalisation, namely the process of primitive accumulation constitutive for the post-colonial political economy of capitalism in countries like India (Sanyal 2007; Gidwani 2015).

Before proceeding to the discussion of the two presented case studies, it is important to point out one more implication that the combined insights from both articles on informal plastic recycling in Kolkata have for the understanding of dynamics of expansion entailed in waste economies. The different social use-values of wasted plastics within the informal need economy and the capitalist accumulation economy analysed by Sanyal (2007) as well as the economic inequalities and the limited scope for environmental upgrading of recyclers in Kolkata has to be situated in and understood against the background of general tendencies of waste economies in India. Several studies have elaborated the adverse effect that processes of MSWM modernization and the formalisation of recycling has had on informal recycling agents in India. Particularly the contributions by Chaturvedi and Gidwani (2011), Gidwani and Reddy (2011), Gidwani (2013, 2015), Reddy (2015) as well as Demaria and Schindler (2016) have unequivocally depicted these processes as expulsion and exclusion of already marginalised social groups in Delhi and Bangalore and framed them as processes of (primitive) accumulation by dispossession (Harvey 2003) in which the combined interests of political and economic elites expropriate urban commons that sustain subaltern social groups. One distinct feature of informal recycling networks in Kolkata is that this particular form of accumulation by dispossession is still largely absent, with the exception of the introduction of compactor stations by the KMC, which strongly impeded reclaimers access to the municipal solid waste stream. Recent policy documents, however, clearly state the intention of the government of West Bengal to take hold of this fallow resource of waste in order to generate public revenue, especially through public-private partnerships (Gov. of WB 2019). The processes of accumulation by dispossession through the modernised and formalised valorisation of waste described for the cases of Delhi and Bangalore constitute an imminent threat for informal recycling networks in Kolkata, and thus, have to be considered as crucial backdrop in the analysis of this case.

## **7. Discussion – Waste Economies and the Uneven Geographies of Capitalism**

This cumulative dissertation has developed an environmental economic geography (EEG) approach to the analysis of waste and recycling. In reflection of recent calls for a reconfigured EEG that focuses on the entanglement of economic and environmental processes – on their co-constitution as socionature – this approach has been framed as ‘waste economies’. Waste economies describe the historically contingent and often conflicting confluence of the production, societal handling and valorisation of waste under capitalist modes of production. It describes how “economic and environmental processes intersect to produce new socionatures, which then reshape possibilities for future economic and environmental relations” (Aoyama et al. 2011: 116). Two distinct case studies served to illustrate how the historically and geographically specific articulations of waste economies are predicated on uneven capitalist development. The differentiation of processes of externalisation as well as dynamics of intensification and expansion has been introduced in order to account for these specific articulations of the production and societal handling of waste across space and time, and the implications such variability has for the potential valorisation of waste.

The preceding two chapters 5 and 6 have presented the case of manure and digestate from intensive livestock farming and biogas production in Lower Saxony, Germany, and the case of informal plastic recycling in Kolkata, India. They have been positioned as two specific cases of waste economies within distinct economic spaces that appear to be marked first and foremost by difference. The first case is grounded in a highly industrialised rural economy in North-western Germany, in the Global North. This agribusiness cluster is strongly integrated into global meat production networks and involves substantial cross-border movements of capital, commodities, labour as well as waste-commodities – as the “Güllebörsen” (ESP-Article: 88), an exchange market for manure illustrates. In contrast, the second case is entangled in the urban informal economy of the biggest metropolitan agglomeration of eastern India. It is strongly linked to the regional economy, draws on a range of different sources for wasted plastics, supplies mostly local plastic production networks with second and third grade input material and is firmly situated in the informal economic spaces that characterise “the capitalist economy in post-colonial context” (Samson 2017: 39) in the Global South.

The obvious differences notwithstanding, both cases point – through their commonalities as well as their dissimilarities – to some general features of capitalist waste economies. This chapter carves out the analytical insights and implications entailed in these correlations and differences for a more general understanding of the entanglement of the production, societal handling and valorisation of waste in environmental economic geography. The next section discusses the analytical understanding of the economic processes at work in both cases, gained through the conceptual framework of the GPN approach. The following section attends to the entanglement of environmental and economic processes as described in both case studies and carves out the specific articulations of manure, digestate and plastic waste as forms of ‘hybrid’ socationature. This gives rise to the elaboration of the processes of externalisation implied by the distinct forms of wasting entailed in surplus manure and digestate as well as plastic waste, and how this in turn impinges on their potential valorisation through dynamics of intensification and expansion.

### **7.1. Two Case Studies from the Perspective of GPN**

The analytical categories and dimension of the GPN approach provide important insights into the economic organisation as well as the political and social context of waste economies and their specific articulations in the distinct cases of the Oldenburger Münsterland, Germany, and Kolkata, India.

The case of manure and digestate from intensive meat and biogas production in the Oldenburger Münsterland “illustrates the important role of corporate [respectively economic, see section 2.1.1] power in the creation of trade-off situations” (ESP-article: 91) between food and energy, which entail also the intensified production and valorisation of waste. The analytical apparatus of the GPN approach helps to carve out how the economic power of the regional agri-food industry is intertwined with its strong network as well as territorial embeddedness. This leads on the one hand to a high regional value capture and serves on the other hand to influence, subvert and weaken institutional power of local and regional state institutions. Moreover, the interplay of economic power with strong network and territorial embeddedness in turn enabled the regional agri-food industry to capitalize on the new regulatory framework provided by the German Renewable Energy Law (BGBI 2000) on a national level and its subsequent bonus schemes for renewable primary inputs

as well as manure inputs. It made available the capital as well as the international trade contacts for additional biomass (corn) and manure imports (drawing on already established global production network links) that was necessary to profit from investments into biogas production. And it established fertile ground for related machine building and service business development in the regional economy, leading to a “regional biogas production network” (ESP-article: 85).

The case of informal plastic recycling in Kolkata also illustrates the coupling of power and embeddedness as important factors influencing the capabilities and opportunities of different actors to produce, capture and the transfer value, but in the opposite way. Informal recycling economies are marked by stark economic inequalities that are strongly intertwined with other societal power relations including class, caste, gender and religious belonging as well as communal background – particularly also the portrayal of recyclers as ‘outsiders’ (Bagchi/Mitra 2017). These power relations articulate through conditions of informality and the social stigmatization of waste-related works. They intersect with the societal embeddedness (in its extended meaning, see section 2.1.1) of recycling networks and lead to complicated arrangements of territorial embeddedness, respectively to a situation described in the SJTG-article as territorial dis-embeddedness that is based on the ‘negation’ of informal recycling by state authorities and government institutions described in the JEP-article. While the JEP-article is concerned mainly with labour-intensive upstream segments of recycling networks, the SJTG-article is focusing on the intermediary trade and (increasingly technology and capital-intensive) down-stream segments. This explains the different theoretical angles chosen for the analysis of Kolkata’s informal plastic recycling networks, which are nevertheless both related to the GPN approach, particularly with regard to value as its central analytical category.

Economic geography has been at the disciplinary forefront of studies that address the relationship between waste and value (e.g. Gidwani/Reddy 2011; Gidwani 2012; Samson 2017) – also with regard to the GPN approach (Crang et al. 2013; Herod et al. 2013). As emphasised in the ESP-article, the GPN category of value draws on “both Marxian notions of surplus value and more orthodox ones associated with economic rent” (Henderson et al. 2002: 448). Large parts of this cumulative dissertation and particularly the JEP-article focus on the relation of Marxian notions of value with waste and its economic valorisation. However, the orthodox meaning of value as economic rent also reverberates in the

analytical application of GPNs value creation, enhancement and capture throughout this dissertation and the articles compiled in it. The ESP-article points to the value enhancement and capture made possible through biogas production as additional, integrated production strand (extrapolated from the recycling segment of the initial production networks plus additional inputs and new infrastructural investments). The JEP-article and the SJTG-article also discuss the determination and transfer of value (cf. Levy 2008; McGrath 2018) caused by societal power relations. In addition to the two classical meanings of value as surplus value and economic rent, and in line with the works on GRNs, this cumulative dissertation highlights the materiality of value and its entanglement with environmental processes. The JEP-article points to the ‘creation’ of value through the translation of concrete use-values of used plastics into new exchange value entailed in different social use-values, as well as the diverging capabilities for value capture determined by the specific sources of plastic waste. Moreover all three articles attend to entanglements of environmental and economic processes reflected in material and energy flows, drawing either on the water-energy-food nexus or the concept of social metabolism. In this way, they foreground “how the environmentally-embedded character of economic activity is significant for the functioning of economic systems” (Bridge 2008a: 79). This is inherently related to the production as well as de- and reconstruction of value in capitalist modes of production, which is elaborated in the next section with regard to waste.

To sum up, both case studies reveal the interplay of economic power and different forms of embeddedness with the institutional power of state actors reflected in policies, regulations and implementation practices on multiple scales. They point to the relevance of this interplay for the variegated capabilities and opportunities of different actors to produce, enhance and capture, or also transfer value. Moreover, both case studies carve out how this interplay impinges on the entanglement of economic and environmental processes and advance the integrated analysis of GPNs and global environmental change.

## **7.2. Waste, Recycling and the Entanglement of Economic and Environmental Processes**

The interdisciplinary field of waste studies (see section 2.2 and 3.2) has provided important insights into the specific forms that the entanglement of economic and environmental change takes in the case of waste. These insights have been (implicitly and explicitly)

discussed and further elaborated from an economic geography perspective by the GRN and GDN approaches (see section 2.3). On an abstract theoretical level, a substantial part of the contributions to the diverse field of waste studies has emphasized the (1.) spatiality and (2.) materiality of waste as well as waste's (3.) material and discursive transformations (e.g. Gille 2007) throughout the socio-metabolic processes underpinning its production (Winiwarter 2002), handling and valorisation. In revisiting these three dimensions of waste as 'hybrid' socationature for both case studies, this section foregrounds the production of waste as process of externalisation that reverberates in the societal handling of waste – and its valorisation.

### **7.2.1. Spatiality of Waste**

The spatiality of waste pertains to the normative orders and socio-cultural and economic practices of classification as well as the resultant spatial patterns of displacement and territorialization involved in processes of wasting. It signifies “where the figurative spatiality of waste [...] transitions into its physical spatiality” (Gille 2007: 21). In this way, it also points to the double character of waste: “it always carries with it potentially ‘negative’ as well as ‘positive’ framings“ (Laser/Schlitz 2019: 8) that articulate in the spatial patterns of wasting.

Manure constitutes historically one of the most paradigmatic cases of waste turned into resource, as it has served as fertilizer in agricultural production for ages. This form of the societal handling and revaluation of waste often involved specific spatial and socio-metabolic articulations of rural-urban relations. However, the green revolution, intensified agriculture and industrial meat production under capitalist modes of production have drastically changed the patterns of wasting represented by the production of manure. This also challenges the historically evolved modes of societal handling of this type of waste in terms of its extensive deployment as fertilizer on fields and grassland. The case of the Oldenburger Münsterland is an illustrative example for these changing patterns of wasting and subsequent challenges to historically evolved modes of societal waste handling:

Historically unfavourable agricultural production conditions were turned into competitive advantages when the region got railway (second half of the 19th century) [...], and motorway connections in the 1960s. This infrastructure enabled the import of fertilizers and feedstuff and increased the accessibility of markets [...]. Based on

these new opportunities and cheap local labour, the farmers introduced intensive fattening of pigs and strongly increased animal production [...]. (ESP-Article: 82)

From the very beginning, the development of the regional agri-business cluster in the Oldenburger Münsterland was based on large-scale imports of ‘external’ inputs, including fertilizers to enrich “the region’s unfavourable soils” (Tamasy 2013: 387). Moreover, based on these external inputs, the region followed “a unique pathway of intensification, concentration and specialization” (Tamasy 2013: 387) in livestock farming geared towards minimising cost while maxing outputs of meat and food products for sale outside of the region. Following this mode of intensive agricultural production in livestock farming, the regional economy has been described by Smetana et al. (2016: 404) as “external resource transformer” that is increasingly disconnected from its local social and ‘natural’ environment – a logic which is also reflected in its patterns of wasting and waste handling:

The high density of livestock results in a massive over-supply of manure, as crop plants can only absorb limited nutrients. In addition, the region produces digestive output resulting from the increasing use of biogas systems and receives much manure imports from the Netherlands as nearby neighbouring country. (Tamasy 2013: 387)

The prevailing resource character of manure as agricultural fertilizer (thus, the overemphasis of the ‘positive’ framing of waste as useful input) has led under conditions of intensified meat production to spatial patterns of intensive and concentrated manure deployment on disproportionately small areas of agricultural land – which drastically changed the nutrient cycles and turned into soil and water pollution.

Plastic, in comparison to manure, is a very recent waste phenomenon. However, it stands paradigmatically for the material and discursive formation of capitalist waste production since the Fordist post-war period. This also has to do with its predominant framing as post-consumption waste, which involves particular spatial patterns of wasting: the spatial dispersal (Trettin 2002) for the sake of (capitalist) value realisation through household consumption. However, the prevalent emphasis on ‘post-consumption’ waste in public discourse is problematic, because it obfuscates the vast majority of waste quantities (Liboiron 2016a). This justifies claims to focus more on wastes accruing during production and distribution as well as the general environmental effects and implications of production processes. But both categories have to be treated with caution. This is because the

categories of ‘production waste’ and ‘post-consumption waste’ – though important to understand capitalist production as a valorisation process – tend to reproduce the “neat sequencing of inputs to outputs implied by GVC, GCC and much GPN analysis” (Herod et al. 2014: 422) that has been called into question by Hudson (2004) and the works on GRNs (e.g. Lepawsky/Billah 2011; Crang et al. 2013).

In India, the emergence of plastics in noteworthy quantities is inextricably linked to the post-reform era of economic and political liberalisation since the 1980s and 1990s. This historical transition was marked by the pervasive diffusion of “styles of globalized consumption” (Nair 2008: 81) and materialised as accelerated socio-metabolic transition towards the metabolic profile of industrial societies (Singh et al. 2012) – reflected also in a phenomenal rise in domestic plastic production. The rapidly increasing application and use of this comparably new material resulted in drastically changing qualitative and quantitative patterns of solid waste production: wasted plastics emerged as a new form of particularly urban waste in enormous quantities within a comparably short period of time. The case of plastic recycling networks in Kolkata illustrates that the distinction of processes of wasting related to production and commercial activities (including distribution) and those related to consumption does have strong spatial, material and economic implications for subsequent recycling operations. But at the same time, Kolkata’s plastic recycling networks also thrive on the constant transgressions of such conceptual boundaries (cf. Lepawsky/Billah 2011): their allocative (socio-metabolic) efficiency is to a large extent founded on the relational capability to connect material economic flows across such boundaries (cf. Crang et al. 2013). As Bagchi/Mitra (2017) emphasise, this capability is also predicated on the incapability of waste governance efforts in Kolkata (and many other cities in India) to successfully implement and maintain source-wise segregation and separate treatment of waste flows, which they claim is in turn related to the (often) deliberate ineffectiveness of zoning laws. The spatial articulations of processes of wasting as well as processes of waste recuperation in India are, thus, predicated on the more general spatial articulations of urban informality in the Global South (Roy 2005; Nair 2008).



### 7.2.2. Materiality of Waste

The materiality of waste points towards central dichotomies and frictions in the way societies and their economies relate to nature, respectively their ‘natural’ environments. This friction is revealed in the way societies ignore the material basis of their economies – its social metabolism. Under capitalist modes of production it pertains particularly to the abstraction from concrete use value – including “negative use-value” (Gille 2007: 25) – in commodity production. It is based on the imperative of growth (as the pursuit of surplus value for the sole purpose of capital accumulation) propelling capitalist development as well as to the subsequent externalisation of waste as “surplus material” (Gille 2010: 1050) and of the social and environmental cost of production more generally. Moreover, this friction is reflected in the misinterpretation of the materiality of waste, which has unintended consequences that impinge back upon society, its modes of production, and its dominant ways of handling waste. This points to the entanglement of environmental and economic processes (Bridge 2008a; Bakker 2012; Aoyama et al. 2011), which gives rise to waste as a form of socionature that is at the same time social and material.

In pursuit of surplus value, respectively, of value enhancement and capture from industrial meat production in the Oldenburger Münsterland, the (mis-)interpretation of the materiality of manure solely in terms of its ‘positive use-value’ as agricultural fertilizer input implied the neglect of its potential ‘negative use-value’ – in terms of soil and groundwater pollution. The following ‘mis-spatialisation’ of manure-as-pollution in terms of concentrated deployment of surplus manure on fields and grasslands caused nitrate and phosphorus pollution of soils and water bodies in the Oldenburger Münsterland.

In the case of Kolkata, the ‘mis-spatialisation’ of plastic wastes due to the misinterpretation of its materiality applies in a twofold way. On the one hand, the negative framing of waste as dirt and pollution coincides with the imperative of disposability in municipal solid waste management (MSWM). This ‘negative attitude’ towards waste translates into the societal impetus to get rid of waste, but waste, as any form of matter, cannot be made disappear (Gille 2007). On the other hand, the mis-spatialisation of the wastes of neoliberal globalisation towards all kinds of marginal spaces and the negation of mixed wastes’ materiality (which is itself caused by the imperative of disposability in formal MSWM) is leading to heavily contaminated soils and water bodies around landfills along the urban periphery. Moreover, it gives rise to the enormous material heterogeneity, spatial dispersal

and temporal fluctuation of plastic waste supply, which poses significant allocative challenges to plastic recycling and determines the economic organisation and network architecture of informal recycling economies in Kolkata. However, Kolkata's plastic recycling networks also misinterpreted the materiality of used plastic with regard to the positive framing of its socio-metabolic functionality, while neglecting potential environmental health risks associated with toxicants contained in plastics (SJTG-article).

The divide between formal and informal societal waste handling in India has enormous implications for the societal capacity to reconcile and adjust (capitalist) modes of production and its inherent patterns of wasting with the societal handling of waste.

### **7.2.3. Material and Discursive Transformations**

The spatial and material patterns of waste production point already to the respective repercussions in the societal handling of waste: the historically contingent coincidences or inconsistencies of the production and societal handling of waste are most clearly recognised in the way different wastes and different forms of wasting perpetuate, transform and translate into each other (Gille 2007). Such 'metamorphoses' of forms of waste and processes of wasting pertain to the translation of different logics of externalisation at work in capitalist waste economies.

The case of manure and digestate from industrial meat and biogas production in the Oldenburger Münsterland is an illustrative example of how waste "metamorphoses from one form to another" (Gille 2007: 28): the logic of intensified agricultural production is replicated in the societal handling of manure in terms of its revaluation and valorisation as (partly commodified) fertilizer that is extensively deployed on fields and grasslands – predicated on the 'positive' framing of waste as resource. Under conditions of state subsidies to leverage a transition towards sustainable energy production, this mode of societal handling of waste is replicated further in the valorisation of manure in biogas production, drawing on additional inputs of imported biomass (especially corn), which leads to aggravated trade-offs (between food and energy) and externalising effects in terms of the over-accumulation of nitrate and phosphorus in soils and water bodies in the Oldenburger Münsterland. A quote from the ESP-article gets the metamorphosis of one form of waste into another – in terms of perpetuating logics of externalisation – right to the point:

The region is marked by a specific nexus of ground water use and contamination with intensified agricultural food and livestock production. This interrelation has been intensified by the dynamic integration of biogas production into the regional economic fabric. A supposed win-win situation in the form of the use of an environmentally unsustainable by-product of one production process (manure) as input into another production process (biogas production) turned – in the light of strong network embeddedness and the specific character of the region as ‘external resource transformer’ – into a situation where additional external inputs (e.g. maize) aggravated the overall environmental conditions (effects of manure and digestate surplus on ground water). The ground water contamination is a result of biogas production which is part of an effort to enhance value in line with state subsidies. (ESP-article: 91)

In the case of Kolkata, the imperative of disposability (Schlitz 2014b) – a rather pure form of externalisation that dominates waste production and formal MSWM in India – translates into the negation of the concrete materiality of wastes. It subsequently takes the form of indiscriminate dumping and uncontrolled landfilling of mixed wastes in a double sense: the waste stream is neither separated into waste fractions (e.g. metals, paper, glass, plastics, etc.) nor is it successfully divided into sources with respect to the specific economic sectors and nodes of production networks where waste accrues (e.g. production waste, commercial and market waste, post-consumption waste, which often necessitate separate treatment for environmental safety reasons).

This has enormous implications for the informal societal handling and revaluation of waste in India, as the case of informal plastic recycling networks in Kolkata exemplifies. The sources of wasted plastics determine to a significant extent the possible value to be extracted and captured by informal scrap shops (JEP-article). The spatial and material patterns of capitalist processes of wasting in India, which are reflected in the imperative of disposability in formal waste management, determine the material qualities and characteristics of wasted plastics – particularly with regard to homogeneity and contamination levels. The closer wasted plastic accrue to the realms of production and distribution, the higher are the volumes as well as material homogeneity and the purity received by scrap shops. Vice versa, the recovery of plastics from the municipal solid waste stream involves not only significant vulnerability and social stigmatization in public

space. Moreover, in most cases it provides only access to highly heterogeneous and dirty plastic wastes that bear little value in the recycling chain and are processed as ‘third grade’ recycling plastic (SJTG-article). In short, the crude logic of externalisation prevailing in India’s expansive mode of accumulation leads to the production of waste in the form of disposability, negation and expulsion that turns into excess material which ends up with excess populations that share the same marginal registers and spaces.

### **7.3. Waste Economies between Dynamics of Intensification and Expansion**

The specific articulations of the societal handling and valorisation of the outlined processes of wasting are varying according to the economic, political and social context. In effect, such variation in the entanglement of the production, societal handling and capitalist valorisation of waste is strongly predicated on the uneven geographies of capitalist development. The differentiation of processes of externalisation as well as dynamics of intensification and expansion (see section 3.4.2) has been introduced to account for some of the variations in the way societies produce and handle waste in the Global North and South alike. At the same time, it enables some degree of generalisation of potential capitalist accumulation strategies arising in face of such manifold patterns of wasting – regarding the forms that the valorisation of waste can possibly take. The examination of dynamics of intensification and expansion in the case of the Oldenburger Münsterland and the case of Kolkata gives rise to a nuanced notion of waste economies and a refined description of their role in the expanded reproduction of capitalist social and economic relations against the backdrop of uneven development. While the valorisation of manure through biogas production in the Oldenburger Münsterland can be described – by and large – as a dynamic of intensification, the case of informal plastic recycling networks in Kolkata, in contrast, is best understood with reference to dynamics of expansion that tend to seize upon materials, spaces, capitals and people previously externalised from the realms of the capitalist accumulation economy. However, both cases point to the relevance of state actors and government regulations in shaping the economic spaces in and through which the revaluation and capitalist valorisation of waste can unfold.

#### **7.3.1. The Valorisation of Waste through Dynamics of Intensification**

The agri-business cluster in and around the Oldenburger Münsterland is vertically and

horizontally integrated into global animal and food (meat) production networks and “related industries like machine building, stable technology, packaging industry, feed production, animal pharmaceuticals and food processing” (ESP-article: 82). It is thoroughly implicated in the regional and global circuits of capital accumulation, which is reflected in the intense transnational links (via commodities, capital and technologies), economic power, network embeddedness and high value capture of its main economic actors. Because of their privileged position within the economic spaces of capital accumulation, economic actors in the Oldenburger Münsterland were able to capitalise on regulatory changes evoked by the German Renewable Energy Law (BGBI 2000) on a national level and its subsequent bonus schemes: they provided opportunities for the valorisation of previously externalised environmental impact from extensive local deployment of manure. The successful large-scale introduction of biogas production can be identified as typical case of value enhancement and capture, and as a form of environmental upgrading (as analysed in EEG), which clearly pertains to an intensification dynamic under the rubric of ecological modernization. Moreover, the environmental problems that gave rise to biogas as mitigation technology (which finally developed a momentum of its own) in the first place, were itself already the result of similar intensification dynamic: the excessive production of meat resulted in excessive application of an age-old agricultural technology – the application of manure from animal husbandry as fertilizer. This illustrates the recurrence of forms of externalisation already reflected in the initial production of waste, although strongly related to the capabilities for participation in globalised production that are predicated on the network embeddedness and economic power of involve actors. The valorisation of waste, as specifically capitalist form of waste handling, necessarily involves further externalising effects due to the abstraction from concrete use-values involved in commodity production (Horton 1997), which materialise again as waste production – thus, constituting a “metamorphosis of waste as unutilized excess into waste as pollution” (Gille 2007: 32). Excess manure and energy-food trade-offs in the form of imported biomass input into biogas production are transformed into surplus digestate in a processes that can be described as “accumulation by contamination” (Demaria/D’Alisa 2013: 38).

Such capital and technology-intensive trajectories of ecological modernisation are inconceivable for most actors directly involved in the informal plastic recycling networks of Kolkata. These networks are operating outside or at the fringes of formal realms of

capitalist accumulation and largely beyond the scope of formal waste management efforts – even though these separate economic spheres are entangled through an abundance of links with each other. The case of Kolkata reveals on the one hand a lacking capability of (particularly also up-scaled) recycling agents to engage in classical dynamics of environmental upgrading. But this designated ‘absence’ of enhanced environmental performance is firmly rooted in societal conditions. It is related to the informality of plastic recycling networks, contingent on the negation and obstruction of informal recycling activities by state authorities, government institutions and the general public. And it is intertwined with the spatial articulations of recycling economies along marginal spaces of the city as well as predicated on their particular macro-regional economic embeddedness, e.g. the lack of a high-value market for plastic recycling products.

### **7.3.2. The Valorisation of Waste through Dynamics of Expansion**

Informal plastic recycling networks in Kolkata are firmly based in what Sanyal (2007) has characterised as needs-based economies. Informal need economies in India constitute hybrid economic spaces, which are simultaneously organized as capitalist and non-capitalist, or “more-than-capitalist” (Gibson-Graham 2014: 76) economies – much in the same way as waste, as a form of hybrid socionature, “is simultaneously social and material” (Gille 2007: 27). According to Sanyal (2007), they are the result of uneven capitalist development and processes of primitive accumulation that imbue the post-colonial political economy in India. Informal economic actors in needs-based economies have (historically) been deprived of the means of production to sustain a living ‘outside’ or at the rural fringes of capitalist modes of production, but are at the same time repudiated by capitalist labour markets. Samson (2015) has highlighted that the contemporary processes of accumulation by dispossession described by Harvey (2003) often reflect capitals’ interest in the resources and means of production of dispossessed groups, but not in their labour power. They are expelled into a state of disposability. In order to survive, they have to engage in some kind of productive activity within the vibrant informal spaces of the need economy, which are “entirely embedded in the circuit of money and exchange” (Sanyal 2007: 215)<sup>44</sup>. However, these informal economic spaces are structured by social

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<sup>44</sup> This is a crucial qualification because it means, first and foremost, that informal need economies are not really located outside the capitalist accumulation economy, but rather fill its interstices as well as marginal and void spaces. The notion of uneven geographical development signifies exactly such faultlines,

and economic relations and forms of economic organisation that can deviate substantially from capitalist labour relations and its relations of production (see section 6.2.5.2). By and large, the “purpose of production is consumption for the satisfaction of need” (Sanyal 2007: 212) and not the accumulation of capital through surplus value extraction.

The case study of informal recycling networks in Kolkata suggests that there are two contradictory modes of the societal handling of plastic waste at work in India, which strongly reflect the distinction of needs-based and accumulation-centred economies. The formal mode of waste handling by municipalities, state actors and big private companies (like SWM service contractors) is marked by the externalisation of waste as dirt and public nuisance. It translates into specific spatial and material patterns of wasting that are characterized by the displacement of waste along marginal spaces and the negation of the materiality of mixed wastes, which I have described elsewhere as an imperative of disposability (Schlitz 2014a, 2014b). The resulting mis-interpretation and mis-spatialisation of waste’s concrete materiality leads to substantial frictions between the production of waste and its societal handling in the form of environmental pollution, rising public expenditures and significant opposition and resistance by different social groups. However, this desperate dysfunctionality in the formal production and handling of waste was partly mitigated by another, informal mode of societal waste handling beyond and below formal waste management, which is firmly rooted in the need economy. In a situation where the state and formal capital fractions proved unwilling or incapable to handle the waste produced by its own economic policies and globalised economic activities – this means, to incorporate, manage and valorise it – the usefulness and potential value of wasted plastics was recognised and harnessed only by informal economic actors, out of basic needs.

This raises the question how informal and formal societal modes of plastic waste handling are related to each other; how the needs-based and accumulation-centred waste economies

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disturbances and disruptions of the normative orders of centralized constitutional states and capitalist social and economic relations, which are very pronounced in many parts of the Global South. A simplified contra-position serves to clarify this point: Dynamics of intensification are generally geared to the (always incomplete) efforts to patch up, fill and integrate such interstices and faultlines through processes of privatisation and commodification. In contrast, dynamics of expansion come into play and unfold in situations where the grip of the state and capitalist social and economic relations is much less tight and comprehensive. In this situations capitalist accumulation strategies rather take the form of breaching into the sometimes vast spaces and encompassing social relations that are positioned as its ‘outside’ frontier or “interior limit” (Bair/Werner 2011: 990), thus revealing capitalism’s ‘original’ predatory traits. The point is, however, that both dynamics are just two sides of the very same coin - they are inextricably entangled.

in India are interacting with each other. This question pertains to the economic functioning of informal recycling economies, which essentially points to the recovery, recuperation and passage of value from wasted plastics through the conduits of both informal and formal economic spaces. Moreover, this has enormous implications for the potential capitalist valorisation of plastic wastes. Both aspects, the economic possibility of revaluation and the potential and actual forms of capitalist valorisation of plastic waste have been addressed and thoroughly discussed in the JEP-article and the SJTG-article.

Drawing on the Marxian notion of 'use-value' and focusing on the economic function of scrap shops, I have argued in the JEP-article that the recuperation and revaluation of heterogeneous plastic wastes from diverse sources is comprehensible through the differentiation between the concrete and social use-value of wasted plastics. The intermediary role of scrap shops "in the passage of value between informal and formal, between needs-based and accumulation economies" (JEP-article: 121) is predicated on the appraisal of "concrete material characteristics that indicate physical and chemical properties, sensible texture, form and colour, that is, the concrete use-value of wasted things" (JEP-article: 126). This appraisal of concrete use-value constitutes a reversal of capitalist patterns of wasting and it is taking different forms according to the distinct nodes along the conduits of production, distribution and consumption where waste accrues – the different sources of and access-points to wasted plastics. Scrap shops are translating the concrete use-value of wasted plastics into social use-value, which basically describes the historically and geographically specific "ability to be sold" (Horton 1997: 130). However, the post-colonial political economy of capitalism in India implies that there are different social use-values in distinct economic spaces. Accordingly, scrap shops "within the labour-intensive realms of Kolkata's informal recycling networks are translating wasted plastics' concrete use-value into social use-value within both, informal needs-based and accumulation centred economies" (JEP-article: 112).

The SJTG-article has focused instead on the allocational capacities of economic actors in the intermediate trade and down-stream segments of Kolkata's recycling networks to further convey and process the fluctuating quantities and qualities of wasted plastics from diverse sources, which are supplied by scrap shops. This is based on brokered forms of governance, which are well adjusted to the social metabolism of used plastics and leveraged by the ordering capacities of intermediaries, and strongly reflects the



entanglement of economic and environmental processes.

The analysis of the economic organisation and functioning of plastic recycling in Kolkata confirms the stark contrasts between the formal handling of waste and its informal revaluation. At the same time, recycling networks in Kolkata also reveal intense links and interrelations between the informal economic spaces of the need economy and the capitalist accumulation economy as well as the formal handling of waste embroiled in the latter. Overall, the case study of Kolkata elucidates, in contrast to Sanyal's (2007) depiction, that informal need economies are not exactly located 'outside' capitalist modes of production, but are rather "positioned as their interior limit" (Bair/Werner 2011: 990), at their margins. In a situation where the economically feasible and socio-metabolically attuned societal handling of plastic waste is taking place predominantly in the informal economic spaces of the need economy – at the (unruly) fringes of the capitalist accumulation economy – the potential and actual forms of capitalist valorisation of waste deviate substantially from dynamics of intensification. In this situations, valorisation works instead through dynamics of expansion, which generally articulate in two distinct ways. Both ways of expansive valorisation can be framed in terms of processes of accumulation by dispossession, but with different spatio-temporal horizons – reflecting the diverging focus on moments of crisis as ruptures (Harvey 2003) on the one hand, and everyday practices of disarticulation, devaluation, and value transfer (Bair/Werner 2011; McGrath 2018) on the other.

Regarding the latter, the case study of Kolkata confirms that informal recycling networks function as an "infra-economy [...] that is denied recognition [but] that is conducive for capitalist accumulation" (Gidwani 2015: 576). Irrespective of the negation by state authorities, government institutions and the general public, Kolkata's plastic recycling networks contribute on an everyday basis in at least three ways to sustainable urban development (see section 6.3.3). They provide a socio-metabolic (ecological) service through remarkable efficiency in the recovery, segregation and recycling of wasted plastic. Informal plastic recycling networks also "offer important economic services" because "they create significant employment opportunities and ameliorate the livelihood insecurities of marginalized groups" (Reddy 2015: 168). And they offer an (uncompensated) "ecological subsidy to the city" (Chengappa 2013: 1) by diverting waste from the public waste stream, which results in a substantial reduction of public expenditure

for MSWM. All of these contributions serve to mitigate the social and environmental contradictions entailed in the capitalist production and formal societal handling of plastic waste in India. However, the case study of Kolkata confirms that “value can be seen as socially, politically, historically, geographically, and discursively determined” (McGrath 2018: 513), which is reflected in the misrecognition of this vital societal contributions of informal recycling networks and translates directly into the devaluation of recycling labour. Conditions of informality (as a result of primitive accumulation; Sanyal 2007), the blunt negation and thwarting of informal recycling activities by state actors, and waste-related social stigmatizations all contribute to the stark debasement and extreme exploitation of informal recyclers, particularly in the labour-intensive upstream segments of recycling networks. This indicates the “transfer” (McGrath 2018: 513; cf. Levy 2008) of value from labour-intensive up-stream segments to economically powerful actors in the down-stream segments of plastic recycling networks, but it explains also the limited value capture and capabilities for upgrading in the down-stream segments. Moreover, this illustrates how informal plastic recycling networks “subsidise and supplement capital accumulation” (Gidwani/Baviskar 2011: 143) through processes that can very well be described as slow but steady accumulation by dispossession.

Regarding the former, the privatisation of MSWM (Chaturvedi/Gidwani 2011), the modernization of waste management through capital- and technology-intensive infrastructures and technologies like compactors or incinerators (Furedy 1994; Forsyth 2006; Demaria/Schindler 2016), or the formalisation of recycling (Reddy 2015) as well as evictions and displacements to seize control over informally claimed urban spaces in the name of development (Baviskar 2002) all constitute (more or less sudden) ruptures in the course of the everyday practices and processes of value transfer in India. They possibly deprive – sometimes literally overnight, sometime within a few weeks or months – whole urban informal populations of their shelter and livelihood. Accordingly, Gidwani and Reddy (2011: 1625) observe that “‘waste’ has become society’s internal and mobile limit [...] a fiercely contested frontier of surplus production” (Gidwani/Reddy 2011: 1625) in present-day urban India. Such processes are very much in line with what Harvey (2003) has described as accumulation by dispossession.

In contrast, the case of the Oldeburger Münsterland appears to be marked by the absence of such expansionary forms of the valorisation of waste. Instead, the efforts for value

enhancement through ecological modernisation and efficiency increases entailed in biogas production as new accumulation strategy clearly reflect dynamics of intensification. A brief fictional counter-example serves to further illustrate the difference between both dynamics: in the hypothetical case that a non-commodified system of barter has arisen from the need to utilize the surplus manure produced in intensive animal husbandry in the Oldenburger Münsterland, the conclusion could be a different one. If the surplus manure from meat production would constitute some form of commons that is govern by local customs (or any form of collective organisation beyond commodified markets or state control, like for example a self-organized online exchange-platform or community organization) and sustains alternative economic spaces (possibly, but not necessarily subsistence economies), then the processes of valorisation would most probably entail different trajectories. And if the introduction of biogas production would subsequently deprive these alternative economies of the commons on which they were built, then this would indeed constitute a case in which the capitalist production of surplus manure constitutes a form of externalisation that enabled the creation of some ‘provisional exteriority’ which reproduced the “interior limit” (Bair/Werner 2011: 990; cf. Harvey 2003) for another expansion of capital accumulation through processes of dispossession. Just like it is the case if informal recycling networks in India are encroached by the modernization of MSWM or the capital- and technology-intensive formalisation of recycling.

However, one interesting aspect (amongst many others) of the case of the Oldenburger Münsterland is that it also illustrates the closely intertwined articulations of dynamics of intensification and expansion implicated in capitalist waste economies. On the one hand, the ‘Energiewende’ has indeed produced a whole landscape of decentralised small-scale energy producers in Germany, including biogas facilities that are owned by local municipalities (cf. Kanning et al. 2009; Bosch et al. 2016), thus challenging the power of large-scale operators and transnational energy corporations. On the other hand, this case study has also showed that the valorisation of manure through biogas production is to a large degree depending on the supply of imported energy crops (like corn) to facilitate the biomethanisation process. These crops are imported from expanding agricultural regions in countries of the Global South that came to be known as hotspots of deforestation and displacements, like Brazil (cf. Walker et al. 2009). Accordingly, the dynamics of

intensification through biogas production from agricultural waste in the Oldenburger Münsterland are closely entangled with and partly dependent on dynamics of expansion elsewhere on the planet – and more specifically, in countries of the Global South.

Finally, this elaboration of dynamics of intensification and expansion for the cases of the Oldenburger Münsterland and Kolkata points towards – and necessitates – an important theoretical reaffirmation regarding the malleability of structural forms of waste economies under post-colonial, neoliberal formations. Foregrounded by the emphasis on the continued relevance of processes of primitive accumulation (De Angelis 2001; Federici 2004) by dispossession (Harvey 2003) for today's capitalist development, as well as by the evolving conceptual scope of uneven development in economic geography approaches from world-system theory to global production networks and their disarticulation (Bair/Werner 2011; McGrath 2018; Werner 2018), this theoretical twist points to the simultaneousness and intersection of structural forms: While it is crucial to retain a general distinct between economic dynamics at the centres and those along the peripheries, it does not make sense to strictly separate them altogether. Globalised economic activities have given rise to much nuanced fragmentations, fault lines and disruptions as well as intense and often unexpected connections across the uneven geographies produced by capitalist modes of production in close entanglement with socionatures, intersectional power relations and social difference. As a consequence, and to a certain degree, dynamics of intensification (even though more predicted on central spaces of capital accumulation) and dynamics of expansion (even though more predicated on the processes of accumulation by dispossession that governs the peripheral borderlands of capital accumulation) will both reverberate in any given articulation of capitalist waste economies. They will both permeate any effort to capitalise on the production and societal handling of waste – at least in terms of economic exchange and the movement of capital, goods, knowledge and people between dispersed places that link both dynamics at any given time. This is what the concept of waste economies also signifies.

Waste economies demarcate the borderlines of different economic spaces, and in a way they regulate the relations between these economic spaces with recourse to normative orders of the particular societies in question. More specifically, waste economies mark out

the boundaries between “what is constituted as within capitalist relations of production and what is positioned as their interior limit” (Bair/Werner 2011: 990). The two distinct case studies of waste economies presented in this cumulative dissertation have illustrated the difference between ‘constitute within’ (dynamics of intensification) and ‘positioned as interior limit’ (dynamics of expansion). This differentiation is crucial to understand the role of waste production and its societal handling in securing the conditions for future growth across distinct economic, social and political contexts - through the valorisation of waste, as specifically capitalist mode of waste handling.

## 8. Conclusion

The preceding chapters of this cumulative dissertation have introduced an environmental economic geography (EEG) approach to the study of waste and recycling. This approach has been conceptualised under the notion of ‘waste economies’, drawing on the case of manure and digestate from intensive animal husbandry and biogas production in Lower Saxony, Germany, and the case of informal plastic recycling in Kolkata, India. These two case studies are comprised of three articles that contribute – each in itself – to a better understanding of economic ‘outputs’, waste and its valorisation in EEG. Their combined secondary analysis through the concept of waste economies has carved out their analytical linkages and their respective contributions to EEG. It gave rise to an appraisal of the production, societal handling and valorisation of waste on a higher level of theoretical abstraction attuned to the uneven geographies of capitalism.

This concluding chapter first revisits the central arguments and analytical insights provided by the combined analysis of waste economies in rural Germany and urban India. It addresses the research questions that guided this dissertation, and carves out how the analysis of waste economies has served to answer them. The following section highlights the specific contributions of this dissertation to the relevant literature: it is positioned at the intersection of EEG and waste studies and draws on social metabolism and Marxist political economy approaches to socio-natures as well as global recycling networks (GRNs) and global destruction networks (GDNs) within economic geography. As a result of the conceptualisation of waste economies and its analytical application to both case studies, several conclusions can be drawn with regard to the scholarly debate in this field of studies. The assessment of theoretical and analytical results with reference to the state of the art gives rise to more general conclusions about the normative implications and political relevance of the notion of waste economies. The chapter closes with a brief discussion of the limitations of this dissertation that gives rise to an outlook on possible future research trajectories.

### 8.1. Waste Economies – Revisiting the Research Object and Questions

All three articles compiled in this cumulative dissertation have emphasised the entanglement of economic activities and material and energy flows – in terms of inputs, but particularly also in terms of interconnections, trade-offs and transformations pertaining

to outputs – either framed as social metabolism or as the nexus between water, energy and food (WEF Nexus). Thereby, the papers have attended to Coe et al.’s (2008: 378; italics in original) call to consider “production chains/networks as a *system of materials flows and balances*”. In this way, it is possible to relate global production networks (GPNs) “with the fundamental environmental interaction that occurs at every point in the network” (Coe et al. 2008: 378) – especially “in terms of *outputs* to the natural environment in the form of pollution/waste” (Coe et al.’s 2008: 379; italics in original). The combined analysis of the three articles through the concept of waste economies has emphasised how the fundamental interaction between ‘outputs’ to the environment and their societal handling as well as economic organisation reflects the co-constitution of economic and environmental change more generally. Thereby, it paved the ground to address and answer the main research question that was guiding this cumulative dissertation: *What is the role of waste in the expanded reproduction of capitalist (social and economic) relations and their spatial articulations?*

This cumulative dissertation on capitalist waste economies has carved out the particular forms and directions that the fundamental entanglement of economic and environmental processes can take in the case of waste and recycling. Drawing on a “wider view of ‘the’ economy” (Braun et al. 2018: 122) and the definition of waste as ‘hybrid’ form of socionature, the presented analysis has pointed to the often peculiar ways in which capitalist patterns of wasting serve to also reproduce the fundamental and future conditions for the expanded reproduction of capitalist accumulation, that is, for the continued growth of capitalist economies. This peculiarity points to the ways in which different strategies of accumulation – as well as societal modes of regulation related to previously externalised wastes – have repeatedly turned the critical limits constituted by the social and environmental destructiveness of capitalism into actual frontiers enabling further rounds of commodity production and capital accumulation. This peculiarity pertains to the systemic causes of waste production as processes of externalisation entailed in capitalist modes of production that will repeatedly and ‘automatically’ re-inscribe itself into the societal forms of waste handling through the pursuit and implementation of valorisation strategies. To gain a nuanced understanding of the role of waste and processes of wasting in the expanded reproduction of capitalist modes of production, the main research question of this dissertation was subdivided into two sub-questions, which aimed at distinct but

interrelated moments and aspects of waste economies.

The first sub-question addressed the *correlations, intersections and contradictions between different patterns and dynamics of waste production and those of the societal handling and valorisation of waste*. The notion of waste economies has been developed as conceptual framework to describe and analyse the correlations, intersections and contradictions between the production of waste and its societal handling. It draws on insights from waste studies regarding the materiality of waste, the spatial articulations of processes of wasting as well as the way in which different forms of waste and processes of wasting constantly transform and translate into each other, in order to point to the manifold ways in which material and environmental processes impinge back upon economic processes. This provides a better understanding of the interrelations between the production of waste – as a form of externalised socionature (Gille 2007), which is at the same time social and material – and its societal handling.

The second sub-question aligns the concept of waste economies to the main research interest of this dissertation – capitalist waste and the way in which it possibly allows capitalist economies to continually grow and expand. It addresses *how waste economies – as the interplay of waste production, handling and valorisation – are related to the expanded reproduction of capitalist social and economic relations and its spatial articulations*. To understand this peculiar relatedness, this dissertation has put a pronounced emphasis on the valorisation of waste as specifically capitalist form of societal waste handling. The valorisation of waste has been differentiated into dynamics of intensification and expansion, to account for the uneven geographies of capitalist development and the distinct economic spaces it gives rise to. The valorisation of waste through dynamics of intensification and expansion is elaborated through their concrete articulations in the case of manure and digestate from intensive livestock farming and biogas production in Lower Saxony, Germany, and the case of informal plastic recycling in Kolkata, India. While the valorisation of manure through bio-gas production in the Oldenburger Münsterland can be described – by and large – as a dynamic of intensification, the case of informal plastic recycling networks in Kolkata, in contrast, is best understood with reference to dynamics of expansion that tend to seize upon materials, spaces, capital and people previously externalised from the realms of the capitalist accumulation economy. Waste economies provide a pertinent analytical framework at the



interstices of environmental economic geography and waste studies to examine how exactly the production of waste and its subsequent societal handling via (intensive as well as expansive) dynamics of valorisation enable capitalist modes of production to turn the ‘limits’ constituted by its inherent social and environmental contradictions into frontiers for future processes of capital accumulation.

## **8.2. Contribution to the Literature**

This dissertation is concerned with one particular type of “outcomes” of the globalized entanglement of economic and environmental processes that is “manifested very unevenly in both time and space” (Dicken 2004: 8; cf. Bridge 2002): waste, which is still under-researched in EEG. It has focused on the uneven manifestations of waste as ‘outcome’ through the combined analysis of two case studies.

On an empirical level, both case studies have addressed the interrelationships of multiple actors that are involved in and affected by the globalised entanglement of economic and environmental change across several scales. The case study of the Oldenburger Münsterland has analysed the different perceptions of environmental ‘outcomes’ through the analytical category of risk, in order to gain “a better understanding of socio-environmental relations within the WEF Nexus” (ESP-article: 72). It has pointed out that “risk concerns all actors involved in production networks in distinct ways” (ESP-article: 90). And it has elaborated how dynamics of economic globalisation create trade-off situations within a WEF Nexus that involves links between distant spaces but at the same time leads to environmental impacts on particular places, like the Oldenburger Münsterland as “external resource transformer” (Smetana et al. 2016: 404).

Existing studies of informal plastic recycling in South Asia usually don’t address the whole scope of actors involved and the different scales traversed by recycling networks (with the exception of Kulke/Staffeld 2009 and Gill 2012). The case study of Kolkata is marked by its multi-scalar analysis of informal recycling that encompasses the whole ‘passage’ of used plastics from different processes of wasting to the reuse and the remanufacturing of plastics in distinct economic spaces. It entails a broad scope of actors – including a range of ‘non-chain’ actors – and is characterised by the nuanced appraisal of the often messy social, environmental and economic empirical realities of recycling networks, particularly in its labour-intensive up-stream and intermediate trade segments. Based on this multi-

scalar approach, the case study of Kolkata has provided a thorough account of the intensive links as well as vast (social and economic) cleavages between informal and formal economic spaces. In this way, it has improved the understanding of the “passage of value“ (Herod et al. 2014: 425) from waste and through informal and formal economic realms, as well as of the environmental change involved in this processes – which points already to the conceptual contributions of the presented case studies.

On a conceptual level, these case studies have opened up two directions for the appraisal of society-environment relations within the GPN approach and provided a number of empirically grounded insights on the links between its analytical categories of value, embeddedness and power. Through a combination of the WEF Nexus perspective with the GPN approach, the Oldenburger Münsterland case study contrives a real integration of natural and social science approaches for the analysis of global socio-environmental change. Moreover, this case study has shown how the economic power of the regional agro-food industry is intertwined with its strong network as well as territorial embeddedness. This leads to a high regional value capture but enables economically powerful actors at the same time to influence and weaken institutional power of local and regional state institutions, and to subsequently subvert environmental regulations. The case study of Kolkata has analysed combined economic and environmental change through the integration of social metabolism into EEG, and particularly the GPN approach. It has contributed to the understanding of the relationship between waste and value, and particularly the recuperation, revaluation and valorisation of wasted plastics between informal and formal economic spaces with the help of the Marxian differentiation between concrete and (abstract) social use-value. Moreover, it has outline how the specific societal embeddedness of recyclers leads – against the background of obstructive institutional power of state actors – to a situation of territorial ‘dis-embeddedness’ that is conducive to the ‘transfer’ of value. Both case studies have improved the understanding of the interrelationships between forms of embeddedness – or ‘dis-embeddedness’ in the case of Kolkata – and the analytical categories of power and value of the GPN approach.

On a theoretical level, this dissertation has analysed the diverging ‘outcomes’ reflected in both cases through the concept of waste economies, which is positioned at the crossroads of EEG and waste studies, inspired by social metabolism and Marxist political economy approaches to socationatures, and firmly located at the interstices between GRNs and GDNs

(see figure 1). Regarding disciplinary and theoretical paradigms, it has identified and addressed a still existing cleavage between waste studies and environmental economic geography as well as the marginal position of Marxist approaches to the environment and the relationship of waste and value within both fields. This dissertation has theoretically deployed socio-metabolic accounts of material and energy flows in society-environment relations (Fischer-Kowalkski/Weisz 1999; Haberl et al. 2011; for its reception in geography see Swyngedouw 1999; Bridge 2008b; Hudson 2008; Newell/Cousins 2015) as well as the notion of socionature (Swyngedouw 1999; Castree/Braun 2001; Gille 2007; Aoyama et al. 2011), which are found in both economic geography and waste studies. Moreover, social metabolism and the notion of socionature both serve to link the scientific paradigms of 'old' and 'new' materialism,<sup>45</sup> particularly in the form of Actor Network Theory (ANT) and Marxism, which are still often depicted as incompatible, but which both strongly reverberate in the GPN approach as well as in waste studies. Social metabolism and socionature, thus, form a two-fold bridge – between EEG and waste studies as well as between new materialism and Marxism – and enabled an advanced and integrated conceptualisation of entangled economic and environmental change for the case of waste and recycling.

The convergence of this multiple theoretical and disciplinary strands in the concept of waste economies serves – beyond its usefulness for the secondary analysis of the two case studies – a threefold theoretical and disciplinary objective. It has, first, strengthened the integration of waste studies into environmental economic geography with a specific emphasis on GRNs, which are situated in both fields, as well as Marxist works on GDNs and waste-value relationships. Thereby, this dissertation aims to contribute to an improved and up-scaled theoretical understanding of entangled economic and environmental change entailed in the production, societal handling and valorisation of waste as hybrid socionature. Second, this dissertation has strived to bring economic geographies' privileged relational perspective on global production and its uneven geographies into conversation with waste studies, in order to facilitate a spatio-temporally nuanced

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<sup>45</sup> Social metabolism constitutes, in the first place, an exceptionally advanced integration of classical natural science (material and energy flow analysis and accounting) and social science (system theory, Marxism and environmental history) approaches that is easily combined with the WEF Nexus. But it has also been aligned with 'new' materialist thinking (particularly in its weak versions of the 'post-human turn' signaled by ANT, see Castree 2001) by scholars of urban political ecology (Swyngedouw 1999; Swyngedouw/Heynen 2003; Swyngedouw 2006). The notion of socionature strongly reflects a theoretical effort to integrate 'new' materialism with 'eco'-Marxism.

understanding of the economic function of waste in globally integrated as well as disarticulated growth-oriented capitalist economies. This was also marked by an effort to leverage the theoretical potential of structuralist as well as labour-centred Marxist approaches towards waste and uneven capitalist development. Third, these efforts gave rise to a twofold critique of existing theoretical approaches and sub-disciplinary orientations. On the one hand, the JEP-article has argued that the disregard for ‘material and discursive transformations’ involved in processes of wasting and revaluation, articulated in the GDN literature by Herod et al. (2013, 2014), is detrimental to understanding the passage of value from waste, particularly in the post-colonial context of needs-based informal economies. In this vein, the notion of socionature unfolds its full theoretical potential for the integration of Marxist and new-materialist approaches. On the other hand, the SJTG-article has called for caution in the adoption of assumptions of the ecological modernisation paradigm, which is still very influential in EEG scholarship. The secondary analysis of both case studies with the concept of waste economies has stressed that eco-efficiency as well as technological and market based solutions of ecological modernisation do either not work out at the informal fringes of the formal economy (as in the case of Kolkata) or they translate into a form of capitalist valorisation of waste that unequivocally leads to further and often aggravated externalisations (as in the case of the Oldenburger Münsterland), thus asserting the Javons Paradox (c.f. Kosoy et al. 2012). The influence of ecological modernisation on EEG derives from the respective sociological and economic sub-disciplines of environmental sociology and environmental economics. This dissertation has championed instead social metabolism, which has been developed at the intersections of industrial ecology and ecological economics, and the notion of socionature, which merges Marxist with new materialist understandings of socio-environmental relations. In this way, this dissertation also firmly rejects the growth optimism enshrined in the ecological modernisation paradigm and contributes at least implicitly to the on-going discussions of degrowth and post-growth futures in EEG (Schulz/Bailey 2014; Schmitt/Schulz 2016). It aligns with Aoyama et al.’s (2011: 117) emphasis “that growth-oriented policies are not purely technical or objective but are inherently normative and political, which then suggests that growth should be decentred as a central goal of economic (and economic-environmental) activity”. And, it does so by way of analysis of one of the most pertinent outcomes of coupled economic and socio-metabolic growth – waste – and its

environmental implications as well as repercussions on economic processes, which gives rise to specific normative implications entailed in the presented research.

### **8.3. Normative Implications of Waste Economies**

The last decade saw a number of calls for an explicitly normative stance in the analysis of combined economic and environmental change (Bridge 2008a; Schmitt/Schulz 2016; Braun et al. 2018), which Aoyama et al. (2011) consider a hallmark of the appraisal of socionatures in a reconfigured EEG – to repeat the quote given in chapter 2:

“What is desperately needed, then, is for economic geographers to use and develop their expertise to answer these analytical-normative questions about unevenness and the production of socionatures and, in so doing, contribute to envisioning what alternative economic-environmental relations may be like.” (Aoyama et al. 2011: 117)

Such calls provoke the question, what the ‘analytical-normative’ purchase of an up-scaled economic-geography analysis of waste and recycling – of waste economies – elaborated in this cumulative dissertation really is. The perspective on waste economies changes once we acknowledge that capitalist modes of production are not only inherently based on the externalisation of social and material environments, but also cope with the resulting social and environmental contradictions in ways that are unequivocally geared towards continued growth, and thus necessarily produce further externalisation: supposed ‘natural limits’ are turned into ‘frontiers’ for further rounds of commodity production and capital accumulation.

Against the backdrop of aggravating environmental crisis tendencies, it becomes obvious that the ways in which our economies are producing waste, effluents and emissions have to change drastically, from local to regional and global scales and across diverse geographies. Economic activities inevitably result in the production of waste, and this is not necessarily where waste becomes a problem, as waste studies scholars have pointed out (e.g. Liboiron 2018a). However, capitalist modes of production are producing wastes in qualities and quantities that seriously threaten multiple eco-systems that sustain human life on earth, which provokes the question “if we want to do waste *differently*” (Liboiron 2018a: n.p., italics original):

“If discard is necessary for systems to hold together, to subsist and to persist, then differently organized systems are needed that fundamentally alter discarding. We are not talking about eradicating discards altogether. Fundamentally changing discarding means posing the question: how to discard well?” (Liboiron 2018a: n.p.)

The analytical-normative purchase of the presented notion of waste economies is that it draws our attention to the basic question of how we want to and how we can organise the economy in ways that involve different forms of wasting as well as other modes of societal waste handling. Waste economies are based on the normative orders, rationalities and techniques that control what enters and what leaves the ‘household’, as the economy. Although processes of wasting pertain more to the output – to devaluation and rationalities and techniques of externalisation and expulsion – they are intrinsically linked to the rationalities that govern the input into, and the allocation and distribution within the ‘household’. The interrelationship between the production of waste and its societal handling in a society points towards the enormous – and largely untapped – transformatory potential inscribed in the latter. The societal handling of waste necessarily impinges back upon the production of waste, and thus on the mode of production of a society more generally, even if this repercussion lies sometimes only in unequivocally exposing the unsustainability of the particular mode of production in question. This is because of the entanglement of processes of wasting with the normative orders structuring a society – with the logics that govern what leaves and by implication also what enters the economy (as household) in the first place – that demarcate the boundaries of some concept of quality, value or order. Accordingly, waste has the potential to destabilise as well as stabilise such normative orders, depending on the way it is handled by society. Ultimately, the production of waste and its societal handling constitute some sort of political-economic regulatory mechanism. A substantial part of this dissertation reflects an effort to carve out how the dominant societal modes of waste handling under capitalist formations, this is, the valorisation of waste along dynamics of intensification and expansion, is serving to obfuscate, thwart or even forestall the transformatory potential inscribed in societal modes of waste handling – which, indeed, could be imagined as a form of socio-metabolic feedback mechanism.

This insight translates into the following normative claim: If we want to waste differently, it makes sense to organise the way we cope with waste differently and in a way not

oriented towards profits and growth but instead towards degrowth. To be precise, this would mean to reconfigure the societal handling of waste in a way that contravenes the need for future material and monetary growth; that undermines accelerated need creation and surplus production. Accordingly, it does make a difference if biogas production is organised by communities in order to utilise their organic wastes in socio-metabolically meaningful ways, or if it is pursued as strategy for value enhancement and capital accumulation. It makes a difference if the societal handling of waste is dominated by an imperative of disposability geared towards capital- and technology intensive ‘end-of-pipe’ infrastructures like incinerators, or if it is organised as a ‘race-to-the-bottom’ (which can also be read positively in terms of socio-metabolic sufficiency) in a labour intensive needs-based “infra-economy” (Gidwani 2015: 575) of recycling. In Kolkata, the desirable side effect of acknowledging the latter as the way “we want to do waste” (Liboiron 2018a: n.p.) would be the recognition of the economic and environmental contribution of socio-economically deprived and marginalised social groups, which could potentially also ameliorate their livelihood insecurities. In the Oldenburger Münsterland, differently organised biogas production, which is geared towards socio-metabolically meaningful ways of handling organic waste, could trigger and disseminate a consciousness for the need to explore new pathways towards a sustainability transition within a “multifunctional countryside” (Tamasy 2013: 385).

#### **8.4. Limitations and Outlook on Future Research**

There are, however, some limitations entailed in the two case studies and their combined analysis with the concept of waste economies, which also point to some possible trajectories for future research. The operationalization of waste economies by way of differentiating between processes of externalisation as well as dynamics of intensification and expansion (including their intersection, translation and contradiction) arguably represents a broad analytical brush. This has been consciously chosen, because its broad scope enables a situated analysis of the economic spaces of waste production, handling and valorisation within (as well as beyond and below) the uneven geographies of capitalism,<sup>46</sup>

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<sup>46</sup> To be sure, the distinction of processes of externalisation as well as dynamics of intensification and expansion is located on a different scale than the distinction of center, periphery and semi-periphery in world system theory. It nevertheless enables the differentiation of distinct and hierarchically structured economic spaces and the fragmented geographies they give rise to in the course of uneven capitalist development,

while still providing fertile ground for the integration of the analytical repertoire of chain and network approaches in economic geography. At any rate, the conceptualisation of waste economies needs to be further scrutinised through case studies that differ with respect to varying historical and geographical contexts as well as other wasted, revalued and valorised materials.

Cases studies of informal waste handling in the Global North, particularly the informal collection that evolved around the deposit collection system in Germany, constitute promising future research trajectories because they could enrich our understanding of the fragmented articulations of uneven capitalist development and the disarticulations of globalized production implied by waste economies. At the same time, more research is needed on the articulations of dynamics of intensification in classical cases of capital- and technology intensive solid waste management and recycling enterprises in the Global North as well as in the Global South, particularly if they are framed under the influential circular economy paradigm. Such case studies could further improve and enrich the analytical distinction of processes of externalisation and dynamics of intensification and expansion, and thereby refine the conceptual accuracy of how the production, societal handling and valorisation of waste correlate, intersect or conflict under specific circumstances.

Finally, and specifically with respect to the normative implications of the concept of waste economies and its directions towards post- and degrowth futures, it is imperative to put a stronger empirical emphasis on case studies that reflect deviations from or alternatives to the capitalist valorisation of waste. In this vein, it is also important to put a stronger focus on the down-scaled and concrete social and economic relations that point towards ‘diverse’ and ‘more-than-capitalist’ (Gibson-Graham 2008, 2014) economies. The strong interdependencies between waste, value, and the demarcation of normative orders justify future efforts to take on a more pronounced cultural geography lens in the appraisal of waste economies, for example by combining cultural political economy with GPN (cf. Hudson 2008) or by turning towards the “ordinary economy” (Lee 2006). Some of these aspects are certainly already visible in needs-based informal recycling networks as well as community-organised schemes of biogas production, which indicates that additional knowledge could be gained also by revisiting existing case studies.

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although spatially much more nuanced than world system theory, which has been criticized by Henderson et al. (2002) for its territorial limitedness.



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## Appendix 1: Empirical Sample<sup>47</sup>

### Ero-Epic Talks<sup>48</sup>

Date	Attrib.	Location	Description	Original Data
02.10.16	EroEpic-1	East Kolkata	Ero-epic talk with a mobile hawker (itinerant waste buyer)	Field notes
28.10.16	EroEpic-2	East Kolkata	Ero-epic talk with NGO representative	Field notes
02.11.16	EroEpic-3	(Central) Old Kolkata	Ero-epic talk with a scrap shop owner	Field notes
02.11.16	EroEpic-4	(Central) Old Kolkata	Ero-epic talk with a scrap shop owner	Field notes, recording
02.11.16	EroEpic-5	(Central) Old Kolkata	Ero-epic talk with a dana trader	Field notes
02.11.16	EroEpic-6	(Central) Old Kolkata	Ero-epic talk with a scrap shop owner (& reclaimers)	Field notes
03.11.16	EroEpic-7	(Central) Old Kolkata	Ero-epic talk with a wholesaler	Field notes
03.11.16	EroEpic-8	(Central-North) Old Kolkata	Ero-epic talk with reclaimers	Field notes
03.11.16	EroEpic-9	(Central-North) Old Kolkata	Ero-epic talk with reclaimers	Field notes
03.11.16	EroEpic-10	(Central-North) Old Kolkata	Ero-epic talk with a scrap shop owner	Field notes
03.11.16	EroEpic-11	(Central-North) Old Kolkata	Ero-epic talk with a scrap shop owner	Field notes
06.11.16	EroEpic-12	Central-East Kolkata	Ero-epic talk with a mobile hawker (itinerant waste buyer)	Field notes
06.11.16	EroEpic-13	Central-East Kolkata	Ero-epic talk with a scrap shop owner	Field notes
06.11.16	EroEpic-14	Central-East Kolkata	Ero-epic talk with a scrap shop owner	Field notes
11.11.16	EroEpic-15	(North-West) Old Kolkata	Ero-epic talk with a scrap shop owner	Field notes
11.11.16	EroEpic-16	(North-West) Old Kolkata	Ero-epic talk with reclaimers	Field notes
11.11.16	EroEpic-17	(North-West) Old Kolkata	Ero-epic talk with reclaimers	Field notes

<sup>47</sup> The names of interviewees and other research participants as well as the exact details of participant observations have been undisclosed in order to guarantee anonymity.

<sup>48</sup> Some ero-epic talks took the form of receptive interviews, but they are also designated as 'EroEpic' for reasons of consistency.

17.11.16	EroEpic-18	(Central) Old Kolkata	Ero-epic talk with a scrap shop owner	Field notes
25.11.16	EroEpic-19	(Central) Old Kolkata	Ero-epic talk with a scrap shop owner	Field notes
29.11.16	EroEpic-20	Central Kolkata	Ero-epic talk with NGO representatives	Field notes
29.11.16	EroEpic-21	East Kolkata	Ero-epic talk with NGO representatives	Field notes
05.12.16	EroEpic-22	Central Kolkata	Ero-epic talk with civil society organization (business assoc.)	Field notes
06.12.16	EroEpic-23	North-East Kolkata	Ero-epic talk with NGO representatives	Field notes
14.12.16	EroEpic-24	(Central) South Kolkata	Ero-epic talk with NGO representatives	Field notes
14.12.16	EroEpic-25	Central Kolkata	Ero-epic talk with a KMC Chief Engineer at SWM Department	Field notes
15.12.16	EroEpic-26	East Kolkata	Ero-epic talk with recycler and PVC-pipes manufacturer	Field notes
22.12.16	EroEpic-27	(Central) South Kolkata	Ero-epic talk with NGO representatives	Field notes
27.01.17	EroEpic-28	Central Kolkata	Ero-epic talk with a KMC Chief Engineer at SWM Department	Field notes

### Guideline-based Interviews

Date	Attrib.	Location	Description	Original Data
17.11.16	Int-1	Central South Kolkata (Indian Institute of Engineers)	Interview with engineer and former civil servant	Recording
19.11.16	Int-2 <sup>49</sup>	(Central) Old Kolkata	Interview with a scrap shop owner	Recording
22.11.16	Int-3 <sup>50</sup>	(Central-North) Old Kolkata	Interview with SWM Assistant Director for Borough IV (KMC)	Recording
22.11.16	Int-4	Central South Kolkata	Interview with engineer linked to private waste management	Recording

<sup>49</sup> This interview has been prepared in the course of two preceding research interactions (EroEpic. 4 and 18).

<sup>50</sup> This interview has been prepared in the course of two preceding research interactions (PartOb. 2a and 2b).

25.11.16	Int-5	(Central) Old Kolkata	Interview with wholesaler	Recording
03.12.16	Int-6	North Kolkata	Interview with wholesaler	Recording
04.12.16	Int-7	(Central) South-East Kolkata	Interview with a scrap shop owner	Recording
04.12.16	Int-8	(Central) South-East Kolkata	Interview with a scrap shop owner	Recording
04.12.16	Int-9	(Central) South-East Kolkata	Interview with a scrap shop owner	Recording
08.12.16	Int-10	(Central) Old Kolkata	Interview with a recycler, dana trader plastics pre-processor	Recording
08.12.16	Int-11	(Central) Old Kolkata	Interview with a dana trader	Field notes
10.12.16	Int-12	(North) Old Kolkata	Interview with reclaimers	Field notes
10.12.16	Int-13	(Central) Old Kolkata	Interview with scrap shop workers	Recording
10.12.16	Int-14	(Central) Old Kolkata	Interview with scrap shop workers and owner	Recording
10.12.16	Int-15	(Central) Old Kolkata	Interview with a dana trader	Field notes
13.12.16	Int-16	(Central) South Kolkata	Interview with engineer linked to private waste management	Recording
15.12.16	Int-17	East Kolkata, Dhapa	Interview with wholesaler	Recording
16.12.16	Int-18	(Central) South Kolkata	Interview with engineer linked to private waste management	Recording
19.12.16	Int-19	East Kolkata, Dhapa	Interview with cleaner & cutter	Recording
19.12.16	Int-20	East Kolkata, Dhapa	Interview with cleaner & cutter	Recording
20.12.16	Int-21	East Kolkata	Interview with cleaner & cutter	Recording
19.01.17	Int-22	South-East Kolkata	Interview with wholesaler	Recording
23.01.17	Int-23	East Kolkata, Dhapa	Interview with reclaimers	Recording
24.01.17	Int-24	East Kolkata	Interview with reclaimers	Recording
24.01.17	Int-25	East Kolkata	Interview with a scrap shop owner	Recording
24.01.17	Int-26	East Kolkata	Interview with wholesaler	Recording
25.01.17	Int-27	North-East Kolkata	Interview with reclaimers	Recording

25.01.17	Int-28	North-East Kolkata	Interview with a scrap shop owner	Recording
25.01.17	Int-29	North-East Kolkata	Interview with a scrap shop owner	Recording
26.01.17	Int-30	South Kolkata	Interview with a scrap shop owner and mobile hawkers	Recording
30.01.17	Int-31	Central Kolkata	Interview with KMC Director General of SWM Department	Field notes
03.02.17	Int-32	(Central) South Kolkata	Interview with NGO representative	Recording
04.02.17	Int-33	East Kolkata	Interview with a recycler	Recording
06.02.17	Int-34	East Kolkata	Interview with NGO representative	Recording
06.02.17	Int-35	North-East Kolkata	Interview with an engineer of the Kolkata Solid Waste Management Improvement Project (KSWMIP) of the KMDA	Recording
07.02.17	Int-36	North-East Kolkata	Interview with an engineer of the Kolkata Solid Waste Management Improvement Project (KSWMIP) of the KMDA	Recording
08.02.17	Int-37	Haldia, West Bengal	Interview with the director of the Central Institute of Plastic Engineering & Technology (CIPET) in Haldia	Recording
09.02.17	Int-38	North Kolkata	Interview with a recycler	Recording
11.02.17	Int-39	(Central) South Kolkata	Interview with SWM Assistant Director for Borough VII (KMC)	Recording
11.02.17	Int-40	East Kolkata	Interview with a recycler	Recording
13.02.17	Int-41	South-West Kolkata	Interview with a recycler	Recording
14.02.17	Int-42	(Central) Old Kolkata	Interview with a recycler and plastic furniture manufacturer	Recording
17.02.17	Int-43	North-East Kolkata	Interview with a Senior Env. Engineer at the SWM-Cell of the West Bengal Pollution Control Board (WBPCB)	Field notes

**Waste Walks**

<b>Date</b>	<b>Attrib.</b>	<b>Location</b>	<b>Description</b>	<b>Original Data</b>
17.10.16	WasteWalk-1	Central-East Kolkata (around Rash Behari Avenue)	Exploration of waste scapes (MSWM, reclaimers, scrap shops)	Field notes
20.10.16	WasteWalk-2	(Central) Old Kolkata (around Zakaria Road)	Exploration of waste and recycling scapes	Field notes
02.11.16	WasteWalk-3	(Central) Old Kolkata (around Central Avenue)	Exploration of waste scapes (scrap shops, dana trade)	Field notes
03.11.16	WasteWalk-4	(Central-North) Old Kolkata	Exploration of waste scapes (reclaimers, scrap shops)	Field notes
06.11.16	WasteWalk-5	(Central) South-East Kolkata (New Ballygunge)	Exploration of waste scapes (mobile hawkers, scrap shops)	Field notes
11.11.16	WasteWalk-6	(North-West) Old Kolkata (Strand Bank Road)	Exploration of waste scapes (reclaimers, scrap shops)	Field notes
17.11.16	WasteWalk-7	(Central-North) Old Kolkata	Exploration of waste scapes (MSWM, scrap shops)	Field notes
22.11.16	WasteWalk-8	(Central-North) Old Kolkata	Exploration of waste scapes (MSWM, scrap shops)	Field notes
29.11.16	WasteWalk-9	Central to East Kolkata	Exploration of waste scapes (MSWM, civil society)	Field notes
03.12.16	WasteWalk-10	North Kolkata	Exploration of recycling scapes (scrap shops, recyclers)	Field notes
04.12.16	WasteWalk-11	(Central) South-East Kolkata (New Ballygunge)	Exploration of waste scapes (reclaimers, scrap shops)	Field notes
06.12.16	WasteWalk-12	(Central) Old Kolkata	Exploration of waste scapes (scrap shops, dana trade)	Field notes
08.12.16	WasteWalk-13	(Central) Old Kolkata	Exploration of recycling scapes (recycling, dana trade)	Field notes
09.12.16	WasteWalk-14	(Central) Old Kolkata	Exploration of waste scapes (reclaimers, scrap shops)	Field notes
10.12.16	WasteWalk-15	(Central-North) Old Kolkata	Exploration of waste scapes (reclaimers, scrap shops)	Field notes
15.12.16	WasteWalk-16	East Kolkata, Dhapa	Exploration of recycling and waste scapes (reclaimers, scrap shops, processing, recycling)	Field notes
19.12.16	WasteWalk-17	East Kolkata, Dhapa	Exploration of recycling and waste scapes (reclaimers,	Field notes

			scrap shops, processing, recycling)	
20.12.16	WasteWalk-18	East Kolkata	Exploration of recycling and waste scapes (reclaimers, scrap shops, processing, recycling)	Field notes
19.01.17	WasteWalk-19	South to East Kolkata	Exploration of waste scapes (reclaimers, scrap shops)	Field notes
24.01.17	WasteWalk-20	East Kolkata	Exploration of waste scapes (reclaimers, scrap shops)	Field notes
25.01.17	WasteWalk-21	North-East Kolkata	Exploration of waste scapes (reclaimers, scrap shops)	Field notes
28.01.17	WasteWalk-22	East Kolkata	Exploration of recycling scapes (waste processing & recycling)	Field notes
31.01.17	WasteWalk-23	East Kolkata	Exploration of recycling scapes (waste processing & recycling)	Field notes
09.02.17	WasteWalk-24	Old to North Kolkata	Exploration of recycling scapes (waste processing & recycling)	Field notes
13.02.17	WasteWalk-25	South-West Kolkata	Exploration of recycling scapes (recycling & remanufacturing)	Field notes
14.02.17	WasteWalk-26	North Kolkata	Exploration of recycling scapes (scrap shops, recyclers)	Field notes

### Regular Participant Observations

Date	Attrib.	Location	Description	Original Data
17.11.16	PartOb-2a	(Central-North) Old Kolkata	Participant observation at KMC MSWM office of Borough IV	Field notes
18.11.16	PartOb-2b	(Central-North) Old Kolkata	Participant observation at KMC MSWM office of Borough IV	Field notes
08.12.16	PartOp-4	(Central) Old Kolkata	Participant observation at pre-processing/recycling workshop	Field notes
16.12.16	PartOp-5	South-West Kolkata	Participant observation at gated housing complex private SMW	Field notes
31.01.17	PartOb-7	East Kolkata, Dhapa	Visit to Kolkata's landfill Dhapa supervised by KMC officials	Field notes
08.02.17	PartOb-9	Haldia, West Bengal	Visit to CIPET in Haldia	Field notes, recording

**Event Observations**

<b>Date</b>	<b>Attrib.</b>	<b>Context</b>	<b>Description</b>	<b>Original Data</b>
21.10.16	PartOb-1	'Citizens meeting' on SWM organized by NGO platform at Moulali Yuva Kendra, Kolkata	Public Event including civil society and local government/ state representatives	Recording
24.11.16	PartOb-3a	6 <sup>th</sup> International Conference on Solid Waste Management (IconSWM) 2016 at Jadavpur University, Kolkata	Scientific conference including (besides scholars) several high-profile bureaucrats and practitioners from regional to national and international level	Field notes
25.11.16	PartOb-3b			Field notes
26.11.16	PartOb-3c			Field notes
21.12.16	PartOb-6	Protest Rally organised by the 'Association of Rag Pickers' from (Central) South Kolkata to Central Kolkata	Protest Rally by reclaimers and civil society supporters to hand over a list of demands to KMC	Field notes, recording
03.02.17	PartOb-8a	Workshop on Plastic Waste Management & Recycling organised by the Central Institute of Plastic Engineering & Technology (CIPET)	The first day of the workshop was aimed capacity building for informal recyclers (reclaimers). The second day was aimed at students, practitioners and government officials.	Field notes, recording
04.02.17	PartOb-8b			Field notes, recording

## Appendix 2: Abstract (Deutsch)

Diese kumulative Dissertation präsentiert auf Basis von zwei unterschiedlichen regionalen Fallstudien eine erweiterte Konzeption von ‚Abfallökonomien‘ innerhalb der umweltorientierten Wirtschaftsgeographie. Das Konzept der Abfallökonomien beschreibt den Zusammenhang zwischen der Produktion sowie gesellschaftlichen Handhabung und ökonomischen Inwertsetzung von Abfällen. Die erste Fallstudie untersucht die Inwertsetzung von überschüssiger Gülle aus der Massentierhaltung durch Biogasproduktion in einer hochindustrialisierten ländlichen Region im Nordwesten Deutschlands – das Beispiel von Gülle und Gärresten im Oldenburger Münsterland. Die zweite Fallstudie ist auf die Rückgewinnung und Verwertung von Abfallmaterialien in der arbeitsintensiven informellen Ökonomie einer Metropolregion im Osten Indiens fokussiert – das Beispiel von informellen Plastikrecyclingnetzwerken in Kalkutta.

Auf theoretischer Ebene ist das Konzept der Abfallökonomien an der Schnittfläche von umweltorientierter Wirtschaftsgeographie und den interdisziplinären *Waste Studies* verortet. Es baut auf dem wirtschaftsgeographischen Ansatz Globaler Produktionsnetzwerke, dem Konzept des sozialen Metabolismus und marxistischen Analysen von Müll als Form ‚hybrider‘ Sozio-Natur auf. Einer qualitativen Methodologie folgend, wird entlang der zwei Fallstudien die enge Verstrickung von ökologischen und ökonomischen Prozessen im Zuge der Produktion sowie gesellschaftlichen Handhabung und ökonomischen Inwertsetzung von Abfällen analysiert und verdeutlicht wie dieser Zusammenfall der Kapitalakkumulation zuträglich ist. Drei unterschiedliche ökonomische Prozesse und Dynamiken dienen als zentrale Analysedimensionen, um relevante Aspekte von Abfallökonomien für die erweiterte Reproduktion kapitalistischer Akkumulation im Sinne kontinuierlichen ökonomischen Wachstums zu skizzieren: Prozesse der Externalisierung sowie Dynamiken der Intensivierung und Expansion. Durch die kombinierte Analyse von zwei Fallstudien auf einer höheren Abstraktionsebene trägt diese Dissertation zum Verständnis der ökonomischen Funktion von Abfall für wachstumsorientierte kapitalistische Ökonomien bei. Die Dissertation leistet dadurch einen Beitrag zu wirtschaftsgeographischen Ansätzen der Globalen Recycling- und Destruktions-Netzwerke und verbindet diese mit dem wissenschaftlichen Interesse an globalen Umweltveränderungen.



### **Appendix 3: Abstract (English)**

This cumulative dissertation presents an environmental economic geography approach to the study of waste and recycling. Thereby, it introduces the notion of ‘waste economies’, which describes the conjunction of the production of waste with the societal handling as well as the valorisation of waste. Two distinct regional case studies serve to illustrate different aspects of waste economies. The first case investigates the valorisation of surplus manure from intensive livestock farming through biogas production in a highly industrialized rural region in north-western Germany – the example of manure and digestate in the Oldenburger Münsterland. The second case focuses on the recovery and revalorisation of wasted materials in the labour-intensive urban informal economy of a metropolitan area in eastern India – the example of informal plastic recycling networks in Kolkata.

On a theoretical level, the conceptualization of waste economies is located at the intersection of environmental economic geography and the interdisciplinary field of waste studies. It draws on the global production networks approach, social metabolism and Marxist political economy to analyse waste as a form of ‘hybrid’ socio-nature. Following a qualitative research methodology, the analysis of the two cases depicts the close entanglement of economic and environmental processes in the production, societal handling and economic valorisation of waste, and reveals how this intersection is conducive for capital accumulation. Three different economic processes and dynamics serve as central analytical dimensions to delineate the characteristics of waste economies with regard to the expanded reproduction of capital accumulation, that is, the continued growth of capitalist economies: processes of externalisation as well as dynamics of expansion and intensification. Through the combined up-scaled analysis of two empirical cases on a higher level of theoretical abstraction, this dissertation offers a better understanding of the economic function of waste in growth-oriented capitalist economies. In this way, it contributes to the global recycling network and global destruction network approaches within economic geography and relates them to scholarly concerns about global environmental change.

### Erklärung an Eides statt über die Eigenständigkeit der erbrachten wissenschaftlichen Leistung<sup>1</sup>

Ich erkläre hiermit an Eides statt, dass ich die vorliegende Arbeit ohne unzulässige Hilfe Dritter und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Die aus anderen Quellen direkt oder indirekt übernommenen Daten und Konzepte sind unter Angabe der Quelle gekennzeichnet.

Bei der Auswahl und Auswertung folgenden Materials haben mir die nachstehend aufgeführten Personen oder Organisationen in der jeweils beschriebenen Weise entgeltlich/unentgeltlich geholfen.

Martin Franz und Kim Philip Schumacher haben mich bei der Auswahl und Auswertung des

1. ....

Materials unterstützt, welches dem Beitrag in Environmental Science & Policy zurgunde liegt.

2. ....

3. ....

Weitere Personen oder Organisationen waren an der inhaltlichen materiellen Erstellung der vorliegenden Arbeit nicht beteiligt. Insbesondere habe ich hierfür nicht die entgeltliche Hilfe von Vermittlungs- bzw. Beratungsdiensten, Promotionsberaterinnen oder Promotionsberatern oder anderen Personen in Anspruch genommen.

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.....  
Osnabrück, 30. Juli 2019  
(Ort, Datum)

.....  
Nicolas Schlitz  
(Unterschrift)

<sup>1</sup> Nach § 9 Absatz 3 Satz 3, § 7 Absatz 4 Satz 2 NHG darf die Universität von den Doktorandinnen und Doktoranden eine Versicherung an Eides statt verlangen und abnehmen, wonach die Promotionsleistung von ihnen selbständig und ohne unzulässige fremde Hilfe erbracht worden ist.

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