Chapter 16
Does the Social Metabolism Drive Environmental Conflicts?

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16.1 Introduction

The proposition that changes in social metabolism drive environmental conflicts is frequently found in studies of ecological distribution conflicts. Martinez-Alier (2009) identified a *"three-tier relation between the increasing social metabolism of human economies pushed by population and economic growth, the resulting ecological distribution conflicts among human groups, and the different languages of valuation deployed historically and currently by such groups when they reaffirm their rights to use the environmental services and products in dispute."* Diverse studies and attempts to shed light on these relations have stimulated much interdisciplinary research at the interface of political ecology and ecological economics (see special issues by Martinez-Alier et al., 2010; Muradian et al., 2012; Temper et al., 2018a). Yet, questions remain regarding why, how, and when the proposition *'more metabolism, more conflicts'* is useful and valid to understand the emergence of environmental conflicts. At first sight, the countries with higher consumption of energy and materials per capita and year seem not to be the countries with more environmental conflicts.

This chapter provides a brief overview of some of the theoretical foundations underlying this proposition and the main pathways through which increases in socio-metabolic processes may trigger environmental conflicts, often at distant locations where energy and materials are consumed. Environmental conflicts can emerge over socio-environmental impacts and injustices that arise at the input, throughout, and output stages of the global social metabolism, hence, at the stages of resource extraction, transport and processing, and waste disposal. The chapter points also to several other properties of socio-metabolic processes beyond the

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increase in resource flows in the economy, which are expected to co-shape conflict dynamics together with other social and biophysical dynamics. Three additional propositions are outlined: the potential of socio-metabolic processes to trigger conflicts increases with (i) the degree of toxicity and ecological harmfulness of the materials extracted, processed, and consumed; (ii) the temporal immediacy of the perceived risks of adverse impacts from societal resource uses; and (iii) the spatial proximity of social groups to adverse impacts resulting from resource uses. Finally, the chapter places the socio-metabolic perspective into context with other 'grand explanations' of environmental conflicts (i.e. the expansion of capitalism under a neo-Marxist perspective), and points to the important role of other social, political and cultural variables in shaping conflict dynamics.

Overall, the chapter argues that a socio-metabolic perspective has much to offer to explain some of the drivers of environmental conflicts because it allows linking local conflicts to the resource use profiles of economies as well as to global production and consumption systems and their 'commodity extraction frontiers' (Moore, 2000). However, these processes must be placed into context with the political economy governing them, as well the specific social, economic, historic, and cultural contexts in which conflicts unfold and which shape how contestations manifest and develop. Thus, the nuanced study of environmental conflicts requires the consideration of the interaction of both biophysical and social aspects in a dynamic manner to understand how human, non-human, and more-than-human natures dynamically co-produce and co-constitute the socio-material worlds in which we live (Kolinjivadi, 2019).

16.2 More Metabolism, More Conflicts? Theoretical Foundations

The proposition that changes, specifically increases, in social metabolism drive environmental conflicts has originated with the parallel development of ecological economics and political ecology. The social metabolism, a central field of study in ecological economics (Gerber & Scheidel, 2018), refers to the processes of appropriation, transformation, and disposal of energy and materials by an economy or social system, in short, the material exchange relations between society and nature (Haberl et al., 2019). Environmental conflicts, which are at the core of political ecology research, refer to social conflicts over the use of the environment and natural resources (Robbins, 2012). They manifest through mobilizations by individuals or groups in response to perceived environmental injustices and detrimental socio-environmental impacts of resource use (Scheidel et al., 2020). Environmental injustices can include issues of unjust distributions of environmental benefits and burdens, procedural injustices in how decisions affecting the environment were made, or a lack of recognition of the worldviews and values of different social groups, including their material and cultural relations with the environment

(Schlosberg, 2004). Joan Martinez-Alier was the first one who put forward the proposition that higher rates of social metabolism would lead to more environmental conflicts (Martinez-Alier, 2007, 2009).

This proposition rests on theoretical insights from ecological economics, particularly from the observation that the economy is entropic, and not circular (Georgescu-Roegen, 1971). Materials are recycled only to a small extent (Haas et al., 2015). This implies that even a non-growing economy would constantly need new resources on the input side, while creating unrecycled waste, pollution, and emissions on the output side. The resulting pressures on material sources and sinks arguably amplify with an increase in the social metabolism, globally, as well as at the country level. Because of (pre-existing) power relations and inequalities, this leads frequently to unequal distributions of environmental benefits (such as access to resources) and burdens (such as exposure to pollution) across different social groups, triggering social conflicts (Martinez-Alier, 2007). The resulting 'ecological distribution conflicts' (Martínez-Alier & O'Connor, 1996) can be observed, and analysed at the input, throughput, and output side of the economy (i.e. at the stages of resource extraction, transport and processing, and waste disposal).

At the input side of the economy, the expansion and deepening of resource extraction frontiers to satisfy the global resource demand (Banoub et al., 2020) frequently triggers environmental conflicts over dispossession and displacement of local social groups from their territories and resources. While, it could be argued that growing resource demand could potentially produce higher revenues for local resource producers, in practice, the increasing competition over access to resources driven by relative resource scarcity has commonly provoked the dispossession of customary users to make way for extractivist projects because of unequal power relations (Muradian et al., 2012). Global and national resource demand may also exceed the capacity of local customary resource use systems to provide surplus flows at the speed demanded by a growing economy (Scheidel et al., 2013). To obtain larger surplus flows per area of land use, and to appropriate the economic and material benefits resulting from these flows, states and corporations have pursued through the process of 'development' and industrialization a fundamental restructuring of what Nicholas Georgescu-Roegen (1969) termed the 'funds' of the economic production process (i.e. a reorganization of labour, land, and technology). Karl Marx referred to these processes as a 'metabolic rift', pointing to the rupture between humanity and nature caused by industrial production methods.

This restructuring of funds caused by the metabolic rift – for example, from customary farming to intensive agrobusiness (Dell'Angelo et al., 2021), from artisanal miners to large-scale excavations (Geenen, 2014), and from decentral energy uses based on local biomass to large centralized energy provision infrastructures such as dams (Del Bene et al., 2018) or fossil fuel explorations (Orta-Martínez & Finer, 2010) – has created vast distributional conflicts over who is able to benefit from the environmental benefits and burdens resulting from these transformations. The specific sectors in which these ecological distribution conflicts emerge tend to coincide with the changes in the metabolic profile of the economies undergoing industrialization (Pérez-Rincón et al., 2019; Spiric, 2018). Such processes of so-called

development have also provoked many conflicts over the violent transformations of worldviews, values, and livelihood systems towards industrial modes of societies that have left many people with hunger and in poverty (Escobar, 2012).

Conflicts at the extraction sites can also arise from contamination and environmental degradation of adjunct ecosystems, even if there is no direct dispossession or displacement of local groups. The extraction at high rates of minerals, fossil fuels, and biomass through industrial agriculture and other resources produces significant levels of pollution that are often not contained within the formal concession boundaries of an extractivist project, but expand through ecological processes such as water and air flows into adjunct ecosystems. For example, the massive mining spill at the *Padcal mine* in the Philippines, causing the release of 20.6 million tons of toxic tailings into water bodies, created a vast environmental disaster in the surrounding areas (EJAtlas, 2015). This caused conflicts over the severe impacts on customary groups whose lives and livelihoods depended on the larger ecosystems, such as through health impacts from exposure to environmental pollution, livelihood impacts through loss of key resources (fish, wildlife, etc.), as well as cultural impacts through the degradation of sacred landscapes, decline in traditional knowledge or loss of sense of place. Such environmental burdens tend to be unequally distributed across different groups because of inequalities in power, locally, as well as internationally (Martinez-Alier, 2007)

Neo-classical economists call these adverse impacts 'externalities' that arise from 'market failures' (Martinez-Alier, 1995). William Kapp (1950), one of the intellectual fathers of ecological economics, described them more appropriately as cost-shifting processes through which powerful groups are able to make large benefits, because they shift some of the social and environmental costs and impacts resulting from resource uses to more vulnerable groups (e.g. Demaria, 2010). Local communities and social movements contest the resulting distributional injustices locally, nationally, and globally through protests and mobilizations that shed light on the causes of unsustainable and unjust resource uses (Martinez-Alier et al., 2016; Walter & Urkidi, 2017). This 'environmentalism of the poor' (Martinez-Alier, 2002) has become a powerful social force for more sustainable and just resource uses (Scheidel et al., 2018; Temper et al., 2018b)

Environmental conflicts are not limited to the extraction sites, but occur along the entire resource use chain, from the cradle to grave of commodities (Martinez-Alier et al., 2010). Conflicts over pollution, environmental destruction, dispossession of livelihood resources, or disrespect of local customary uses occur also along transport routes and infrastructures. A well-known example is the conflict around the Dakota Access Pipeline (DAPL) that created the #NoDAPL movement. Thousands of protesters led by members of the Standing Rock Sioux Tribe have mobilized against the pipeline construction since 2016. The concerns voiced by different groups and people include not only issues of lacking consultation, or safety concerns, but also fundamental issues of recognition of different values and worldviews, and repeated injustices committed against the Tribe within the history of US colonialism (Whyte, 2017).

At the output side of the economy, increases in social metabolism translate into growing amounts of solid, liquid, and gaseous wastes. Only a few actors are able to take advantage of the growing waste production as an emerging commodity frontier (Demaria & Schindler, 2016). For most urban and rural dwellers, garbage and waste pollution represents a threat to the environment and their health. This can cause environmental conflicts over growing and disproportionate exposure to waste across different social groups, whereas vulnerable and marginalized actors along the lines of race and class are frequently most affected (Bullard, 1990; Mohai & Saha, 2015). A well-known historic example of a waste conflict is the rise of the US environmental justice movement in the early 1980s, which contested the burdens of waste and pollution disproportionally imposed on poor black neighbourhoods (Bullard, 1990, 1994). Nowadays, one of the biggest global waste problems is the massive release of CO_2 and other climate gases into the atmosphere, caused by fossil resource consumption. Also, here strong and diverse social movements have emerged that contest these unsustainable resource uses, thus contributing to climate change mitigation (Temper et al., 2020; Thiri et al., 2022; Tramel, 2016).

16.3 Further Propositions on the Links Between Social Metabolism and Environmental Conflicts

As illustrated so far, increases in the *quantity* of social metabolism can act as key drivers of environmental conflicts across all stages of social metabolism. However, also the *qualities* of resources used by societies, as well as the characteristics of how they are extracted, transported, and processed further shape whether environmental conflicts emerge, or not. Consider for example the degree of toxicity of extracted materials, the temporal immediacy (or latency) of adverse health and environmental impacts resulting from waste disposal and pollution, or the spatial proximity (or distance) of social groups exposed to adverse impacts from resource processing plants. These characteristics also have an important role in shaping the dynamics of environmental conflicts. In addition to the general proposition of *more metabolism, more conflicts*, the following three propositions may be further useful to conceptualize and understand the interactions between socio-metabolic processes and environmental conflicts.

The first proposition is that *the more ecologically harmful the extracted, processed, and disposed materials are, the higher their potential to provoke social conflict*. Not only the quantity but also the types and qualities of materials metabolized by an economy shape the social, environmental and health risks posed to different social groups, and thus the potential to produce social conflicts. This proposition applies to the input, throughput, and output stages of the social metabolism. For example, compared to the large amounts of construction materials such as sand and gravel that are constantly processed by economies for infrastructure development, the extraction, transport, and disposal of much smaller amounts of highly

toxic substances such as uranium or nuclear waste may provoke the perception of high risks for social groups exposed to these substances, thus triggering conflicts (e.g. EJAtlas, 2021; Litmanen, 1996). In short, we may expect that the more ecologically harmful the social metabolism, the more socially conflictive. Future research on the links between social metabolism and environmental conflicts may further consider such qualitative aspects.

The second proposition is that *the more immediate the risk perception of adverse impacts resulting from resource uses is, the higher their potential to provoke social conflict*. Not only the quantity and type of materials shape the conflict potentials of socio-metabolic processes, but also the temporal immediacy (or latency) of adverse impacts resulting from them across all stages of the social metabolism. For example, agrochemicals linked to the extraction of biomass may accumulate in ecosystems over time and provoke health impacts only after continuous exposure to them. Related conflicts may thus emerge only after many years, when impacts are being felt (Navas et al., 2018). In addition to the immediacy of impacts, also their risk perception influences whether social conflicts arise or not. For example, the most severe impacts of climate change are not immediate but will happen in the future. However, the perceived risks of these impacts are high, leading already now to conflicts over fossil fuel extraction and climate change concerns (Temper et al., 2020).

The third proposition is that *the greater the proximity of social groups to adverse impacts from resource uses, the higher their potential to provoke social conflict*. The spatial proximity of human settlements to pollution and environmental degradation occurring at the input, throughput, and output sides of the social metabolism may play an important role in shaping conflict dynamics. Questions such as how distance to conflictive events shapes social conflict dynamics, and the capacity of groups to mobilize, are discussed with much detail in social movement studies within the branch of spatial ecology studies (Tilly, 2000; Zhang & Zhao, 2018) Generally, exposure to adverse impacts from resource extraction, processing, and waste disposal can be expected to be higher when these processes are located closer to human settlements, which in turn is related, among other factors, to population densities (Muradian et al., 2012). Greater spatial proximity to the adverse impacts of socio-metabolic processes thus translates into a higher potential for conflict and social mobilizations.

Finally, also the scale of analysis of the social metabolism must be considered, as socio-metabolic changes at the national level translate in distinct ways to the local level where conflict occurs. For example, from a local perspective, conflicts over conservation areas occur not because of an increase in local social metabolism, but a radical decrease (i.e. the prohibition of customary resource uses), leading often to restrictions and evictions (Brockington & Igoe, 2006). Yet from a national perspective, conservation areas are sometimes developed in response to growing resource extraction elsewhere, to spare some land for recovery while intensifying other land uses to increase resource extraction. An example is the conflict about the Tanintharyi Nature Reserve in Myanmar. The establishment of the conservation area is closely linked to the establishment of three gas pipelines running through it and was funded by the gas companies who aimed to secure the pipelines and

compensate for the environmental damages produced elsewhere (EJAtlas, 2018). Hence, countrywide increases in social metabolism can lead to spatial segregation processes with distinct implications for territories and resource uses at the local level, including both local increases and decreases in social metabolism. The hypothesis *more metabolism, more conflicts* thus applies best to the national and global level, while at the local level also decreases can provoke environmental conflicts.

16.4 Other 'Grand Explanations': Social Metabolism and Neo-Marxist Perspectives

The socio-metabolic changes and the transformations in local production systems leading to conflicts resemble many of the processes described by neo-Marxist scholars when explaining the development and expansion of capitalism. Karl Marx used the term *Ursprüngliche Akkumulation* (primitive accumulation) to refer to a *"process which takes away from the labourer the possession of his means of production; a process that transforms, on the one hand, the social means of subsistence and of production into capital, on the other, the immediate producers into wage laborers."* (Marx, 1887, p. 508). Marx suggested that primitive accumulation was a historical and transitory phase of societies moving to capitalist systems, which then would be replaced by accumulation based on expanded reproduction (i.e. growth). Neo-Marxists suggest however that 'primitive' accumulation is a persistent process, central to capitalist accumulation in general and not only in its origin. Harvey (2004) refers to it as *accumulation by dispossession,* a concept commonly used to discuss environmental conflicts at the nodes of material extraction (e.g. Holden et al., 2011; Veuthey & Gerber, 2012). Jason Moore's idea of *commodity frontiers* (Moore, 2000) draws further attention to how the expansion of global capitalism restructures not only the social relations of production but also the transformation of distant environments connected to the cores of hegemonic centres through commodity chains, thus, through flows of materials and energy.

In this context, some may wonder whether a neo-Marxist perspective on the expansion of capitalism may serve as a more profound explanation for the rise of environmental change and conflicts. It is important to recognize that these are two sides of the same coin. Increases in social metabolism come together with capitalist economic growth and represent thus the material connectors of political-economic processes at global and national levels and local environmental conflicts. (cf. Muradian et al., 2012). Resources mediated by the specific socio-metabolic configurations are a means to power and accumulation. However, this applies not only to the expansion of capitalism as the dominant socio-economic system. For instance, an industrialized or resource-intensive planning economy or autocratic monarchy would also require large amounts of materials and energy. For the same reasons described above, they would likely trigger environmental conflicts, although the ways how these conflicts manifest could be quite different and may range, for

example, from open confrontations and mobilizations to repressed and indirect expressions of discontent (Martinez-Alier, personal communication). The same applies for organized illicit forms of resource extraction, territories under control by armed groups and struggles, or whatever other forms of parallel economies and insurgencies that extract resources for their maintenance and expansion.

The social metabolism resembles therefore a material proxy to track the means for the maintenance and expansion of social systems, power, and profit, no matter in which institutional, political, and economic context they operate and are organized. In that sense, a socio-metabolic perspective is powerful in explaining the emergence of environmental conflicts, because it is not limited to a certain type of social organization such as capitalism. At the same time, this is also its weakness for explaining the ultimate drivers of environmental conflicts. Looking only at the social metabolism does not provide insights on the reasons behind the increases in terms of the social, political, cultural, and economic reconfigurations of the systems of production and consumption that drive the social metabolism.

Analyses of the social metabolism as a driver of environmental conflicts could therefore be more strongly combined with Neo-Marxist approaches, and more generally, with analyses of the political economy in which the social metabolism unfolds (Gerber & Scheidel, 2018). Such combinations can be found, for example, in empirical studies on international trade that combine political economy perspectives with quantitative biophysical studies (e.g. Dorninger et al., 2021; Pérez-Rincón, 2006). These studies illustrate how the international division between centre and periphery countries is based on both an unequal economic and unequal ecological change, through which countries of the global North simultaneously generate monetary surplus and appropriate resources from countries in the global South, where environmental degradation and environmental conflicts arise consequently (Dorninger et al., 2021). Further integration of quantitative socio-metabolic studies with political economy perspectives represents a promising and necessary path to unveil the combined socio-metabolic and political-economic processes at play that co-produce environmental inequalities and environmental conflicts.

16.5 Towards a Balanced View in Environmental Conflict Research

This chapter has summarized some of the main arguments for why, how, and when the social metabolism may provoke environmental conflicts. A socio-metabolic perspective on environmental conflicts is useful because it allows to identify structural causes of conflicts, such as the broader changes in the resource use patterns of economies, and their relation to conflicts over the use of the environment. It also enables linking local environmental conflicts to global production and consumption systems and commodity chains through the material flows and commodities that connect them. Given that material flows continue to rise globally (Schaffartzik et al., 2014), it is also a timely perspective that sheds light on the impacts of growing global

resource use on local socio-ecological systems, as well as the role that diverse local communities and social movements play in contesting them at the input, throughput and output side of social metabolism (Scheidel & Schaffartzik, 2019).

Integration of insights from multiple disciplines and theoretical perspectives will further benefit the nuanced understanding of the drivers and dynamics of environmental conflicts. As Martinez-Alier et al. (2010) have argued, "*Ecological economics explain why environmental conflicts arise shedding light on the material origins of conflicts, whereas 'post-structuralist political ecology' (Escobar, 1996) complements this with insights by looking at cultural discourses shaping material outcomes.*" Furthermore, as discussed by Muradian et al. (2012, p. 565) "*between the material and energy flows in the economy and the actual occurrence of socio-environmental conflicts there is a large variety of "mediating" variables involved.*" This chapter has addressed a few of these variables directly related to socio-metabolic processes, yet there are many more. These are, for example, geographical, ecological, technological, and socio-cultural contexts, the exposure and distribution of impacts across and within diverse social groups, vulnerability of local ecosystems to environmental change, people's risk perception, benefits distribution, how corporations behave and operate, whether there is Free Prior Informed Consent (FPIC) or not, histories of land and resource use and related claims from different actors, local perceptions of justice and injustice, and so on. Close attention must be paid to the political economy and the institutions of societies that shape, and are shaped by, socio-metabolic processes, and which govern the modes of appropriation, distribution, and disposal of materials and energy (Gerber & Scheidel, 2018). Furthermore, cultural aspects centrally shape how conflict and protest manifest and express themselves (della Porta et al., 1999; Hanna et al., 2016).

While it has been beyond the scope of this brief chapter to review the many social, cultural, political, and economic variables that shape the intersections of social metabolism and environmental conflicts, the chapter closes by recalling the need to seek a balanced integration of the social and biophysical processes that co-produce environmental conflicts (Scheidel et al., 2022). The combination of perspectives and the integration of knowledge from different fields as diverse as ecological economics, neo-Marxist approaches or post-structuralist political ecology might create epistemological tensions, but also 'fruitful frictions' (Zimmerer, 2015) that provoke deep learning processes and the careful discussion and consideration of the manifold factors involved in the dynamics of environmental conflicts.

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