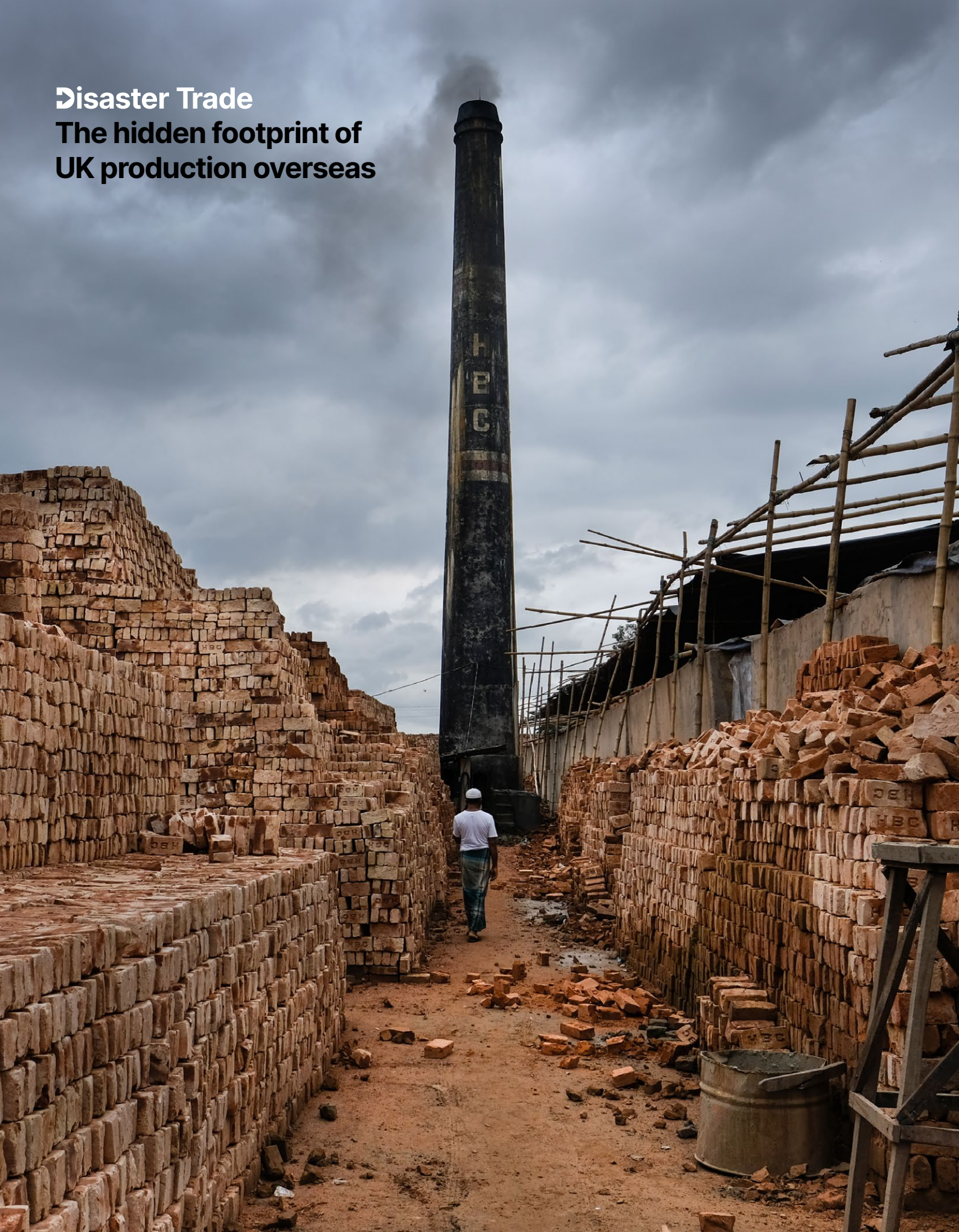
Disaster Trade
The hidden footprint of UK production overseas



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Part 1

Introduction

Disasters like floods, droughts and landslides are a growing risk for millions of people in the global South. Yet in our globalising world, they are increasingly connected to processes originating in the global North. Focusing on imports from Cambodia, Sri Lanka and the South Asian ‘brick belt’, this project examines how British trade shapes the disasters that afflict the UK’s trading partners. As it exemplifies, the UK’s trade in garments, bricks and tea serves to displace emissions and environmental degradation, whilst intensifying the impacts of natural hazards linked to climate change. These complex impacts constitute the UK’s hidden disaster footprint.

1.1

Trading disasters in a globalised environment

The clothes we wear and building materials we live in still need to be made, but their production overseas allows the emissions associated with their manufacture to be regulated less stringently and accounted for less carefully.

Disasters are increasingly a fact of life around the world. Each year, floods, droughts and landslides affect tens of millions of people, leaving vast human and economic destruction in their wake wherever they occur. The cost in human lives and livelihoods each year is enormous. Yet their labelling as 'natural' disasters or 'acts of God' has seen has cast them as difficult to predict and thus prevent. As the impacts of climate change are felt more and more clearly, their severity is expected to worsen and their predictability diminish. As global temperatures continue to rise, we are facing a future world increasingly defined by disaster.

Faced with this reality, the UK and other countries like it have committed to ambitious targets on carbon emissions reduction, with apparent success. Yet despite the rhetoric, the achievements of such policies are grossly overstated. Many of the environmental gains achieved by major polluters derive from moving carbon intensive processes to manufacturing bases in the global South, rather than sustainable emissions reductions. The clothes we wear and building materials we live in still need to be made, but their production overseas allows the emissions associated with their manufacture to be regulated less stringently and accounted for less carefully. Consequently, whilst emissions produced within the UK's borders have declined by over 44% since 1990, the emissions British people consume has declined only 10%[1]. As of 2016, almost half of UK emissions were produced overseas, compared with 14% in 1990 (Figure 1). Worse still, the process of moving these emissions creates emissions of its own. With freight expected to account for 28% of global emissions by 2050[2], the UK's carbon footprint is increasingly global, mobile, and harder to define as a result.

Moreover, the carbon footprint alone doesn't tell the whole story. As carbon emissions continue to rise globally, increasing the risk of natural hazards such as droughts, floods and landslides, the local effect of British trade and investment are worsening their impacts. In Cambodia, from where the UK imports 4% of its garments, factories providing clothes for the British market are linked to carbon intensive energy generation, large-scale deforestation, and mismanagement of water resources, intensifying the impacts of drought.

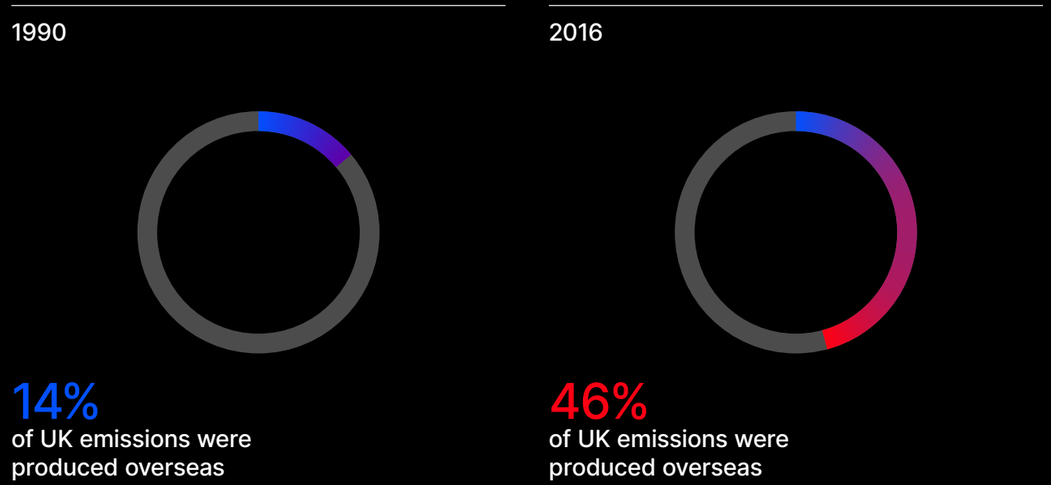


Figure 1. Change in the provenance of UK CO_2 emissions between 1990 and 2016.

In South Asia, from where the UK imports a growing proportion of its bricks, brick production plays a major role in degrading the environment, engendering droughts and floods, whilst undermining agricultural livelihoods. In Sri Lanka, a major exporter of tea for the British market, land use change related to tea cultivation and the privatisation of the industry has seen the growing frequency of environmental hazards in the Sri Lankan uplands translated into a tragic propensity to landslides.

By degrading local environments in this way, British trading practices channel and intensify the impacts of climate change, reducing overseas populations' resilience to the impacts of the changing climate and making natural disasters more likely. The result is that when we import goods, we are effectively exporting disasters: not only contributing to climate change globally, but also exacerbating its impacts locally. Yet despite their global reach and severity, this 'disaster footprint': the environmental impacts of British trade, which turn global hazards into local disasters, are not recorded in the UK's statistics or strategies on climate change.

This project will elucidate this hidden disaster footprint of British trade, highlighting both the shortcomings of overseas emissions accounting and the manner in which supply chain complexity conceals the intensification of climate impacts in the global South. Disasters, as it shows, may unpredictable, but they are anything but random. As the climate continues to change, the global systems and structures we depend upon in our everyday lives will play an ever role in channelling the manifestation of hazards in the global South, shaping the incidence and intensity of the disasters they create.

Smoke rises over a brick kiln outside Dhaka.

When we import goods, we are effectively exporting disasters: not only contributing to climate change globally, but also exacerbating its impacts locally. Yet despite its global reach and severity, this 'disaster footprint' is not recorded in the UK's statistics or strategies on climate change.

1.2

Emissions, growth and disasters in a climate emergency

In November 2019, 11,000 scientists from around the world united to declare a climate emergency,[3] insisting, as have media and political forces from the Guardian newspaper to the UK parliament, on an end to business as usual. As they declared at the time, the world's people face 'untold suffering due to the climate crisis' unless global society accepts major transformations. Simply put:

> 'To secure a sustainable future, we must change how we live. [This] entails major transformations in the ways our global society functions and interacts with natural ecosystems'. —*The Guardian*, 2019

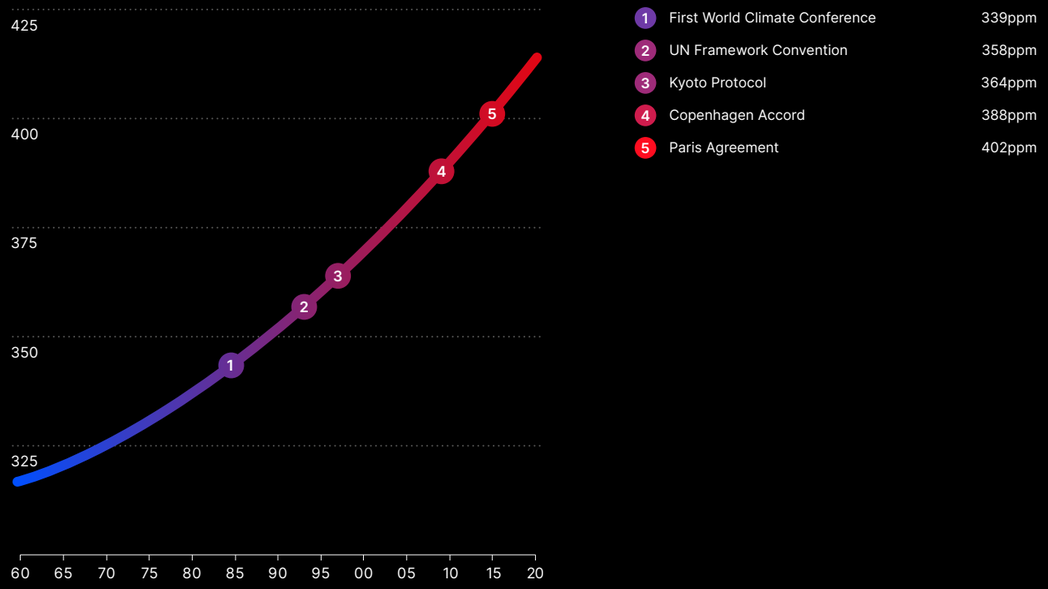
In the latest in a series of stark messages on climate, the underlying urgency of the situation has been laid bare. It is a harrowing message, but more disturbing than the message itself is its familiarity. Similar proclamations were made in advance of the Paris Agreement of 2016, which succeeded in setting out a framework to limit warming to 1.5˚C. It was an agreement that drew much acclaim and celebration for its clarity of vision and commitment. Yet only three years later, annual emissions reached an all-time high.[4] Something, it is increasingly clear, is not working.

This is not, moreover, a novel problem. The Paris agreement is only the latest in a long running series of international agreements to make limited tangible impact on emissions. From the first World Climate Conference in 1979, via the UN Framework Convention on Climate in 1992, Kyoto in 1999, Copenhagen in 2009 and finally Paris in 2016, agreements have become more specific and binding over time. Yet all the while the atmospheric CO_2 concentrations have continued to increase. As shown in Figure 2, at the time of the first World Climate Conference, atmospheric CO_2 stood at 339 parts per million; at the foundation of the UNFCCC 13 years later, it was 358. As the fireworks boomed in Paris it was 402 parts per million; and today, it stands at 417.[5]

The apparent lack of impact of these agreements presents something of a conundrum to environmentalists. Each of these agreements has, to a greater or lesser extent, agreed frameworks and policies with the world's heaviest emitting nations that would be expected to reduce carbon emissions. Moreover, the data show that in many cases, they have resulted in reduced emissions.

The EU's net emissions fell from 5.6 billion tons of CO_2 in 1990 to 4.2 billion in 2018,[6] whilst the UK – historically one of the EU's largest emitters – claims a 44% reduction in emissions since 1990.[7] Even the United States, a country whose efforts have been deemed 'critically insufficient' by monitors, has achieved a modest decline, from 7.1 billion tons in 1998 to 6.7 billion today.[8]

Emissions from major economies are either falling or stabilising, yet the relentless uptick of global carbon emissions continues undiminished.



1 First World Climate Conference 339ppm
2 UN Framework Convention 358ppm
3 Kyoto Protocol 364ppm
4 Copenhagen Accord 388ppm
5 Paris Agreement 402ppm

Figure 2. Atmospheric CO_2 concentration (ppm) from 1960 to 2020, with international climate agreements.

China, one of the world's largest and most rapidly increasing carbon emitters of recent decades, has begun to slow the rate of increase, with emissions projected to plateau over the next five years[9] as part of a national plan to achieve carbon neutrality by 2060.

So what, then, lies behind this discrepancy? Emissions from major economies are either falling or stabilising, yet the relentless uptick of global carbon emissions continues undiminished. Are major emitters being untruthful about their emissions figures? Not in a direct sense. Rather, it is the reductions themselves that are illusory, the product of a system of carbon accounting which remains firmly national and bordered within an increasingly global and interconnected world. As richer nations increasingly diminish their share of global industry, 'outsourcing' lower margin and more environmentally damaging processes to the global South,[10] the emissions associated with those processes – at least in headline figures – go with them.

Indeed, there is a growing recognition that national accounting of carbon usage may lie at the root of the more generalised failure to make concerted inroads into carbon emissions.[11] The ability of wealthier countries to effectively outsource emissions to less wealthy ones has been described as 'carbon colonialism'[12] and there is increasing unease over the effectiveness of production-based UK emissions targets,[13] which allow ever more greenhouse gas emissions to 'flow through the carbon loophole of international trade'.[14] In total, imported emissions now account for a quarter of global CO_2 emissions,[15] making this the 'next frontier of climate policy'.[16]

Crucially, this is a perspective that casts service-oriented economies like the UK – many of which have achieved substantial reductions in domestic emissions in recent years – in an especially poor light.

The UK is now the G7's largest proportional importer of emissions, with carbon consumption from imports now 28% higher than 1997 in absolute terms.[17] The value of UK imports has more than doubled in the last two decades,[18] with environmentally regulated EU exporters accounting for a falling proportion of the total.[19] This rise in imported – or embodied – emissions chips away substantially at the UK's much trumpeted domestic emissions reductions, reducing it from the government's gross 44% figure to a net 10% reduction in emissions consumed.[20] Rather than the substantial reductions claimed by the UK government, therefore, the last two decades have seen a concerted shifting of emissions away from the domestic to the imported, as the UK effectively outsources its carbon intensive industry to the global South.

On a planetary level, this is pressing concern, masking as it does an ongoing reliance by major economies on high emission technologies and processes. Yet beyond the global climate emergency, there is also a smaller scale human and environmental cost. Not only will a temperature rise of more than 1.5°C likely result in 'several hundred million' more people in poverty by 2050[21] at a global scale, but the local effect of trade and investment in terms of worsening the impact of climate change on poverty and livelihoods are equally concerning. Removed from the regulations and standards governing domestic production, the industrial processes that manufacture the goods consumed by British people remain dangerous and environmentally destructive. Global systems ostensibly protect against this but, as with the broader issue of emissions, they do so on a 'methodologically nationalist' basis, framed around the nation state.[22] This gives countries the opportunity to hide the damage their productive processes engender, not by resolving it, but by moving it across a national border and thus largely out of sight of regulation and accounting.

Climate change impacts, including the slow-burn disasters of droughts and floods, are effectively traded out by wealthier countries and imported by less wealthy ones as the price of economic growth.

Bringing together empirical and secondary data generated across four national settings, The Disaster Trade project aims to exemplify this process using three complementary investigations of how trade, emissions and local environmental destruction intersect in the production of everyday goods used in the UK. Outlined here are inquiries into the export of bricks from the 'brick belt' of Bangladesh and India, garments from Cambodia, and tea from Sri Lanka. Yet whilst each investigation begins in a key exporting site, it extends its reach beyond each point of origin to highlight the global and mobile nature of trade processes and their impacts on the environment.

In the brick belt, this is a relatively direct trade. Environmentally degrading processes are outsourced to lower cost and lower regulation exporters where the vast carbon and human costs associated with this production and transportation are rendered invisible by complex supply chains and limited corporate obligation to report on it. Yet whilst the complexity of supply chains is one issue, their mobility is another. As highlighted in the case of Cambodia, the environmental degradation association with the industry is in constant flux, as impacts are mobilised and relocated to sites where the need for economic growth is greatest and present levels of environmental destruction lowest. Moreover, this is not just a question of slow burning environmental degradation. Rather, as shown in Sri Lanka, environmental degradation of this sort makes areas thus afflicted a lightning rod for the impacts of climate change, increasing the likelihood and intensity of disasters.

Climate change impacts, including the slow-burn disasters of droughts and floods, are therefore effectively traded out by wealthier countries and imported by less wealthy ones as the price of economic growth. All the while, this environmental degradation remains hidden by the analytical legacy of nationalism, an emphasis on the structures and strictures of the nation state no longer appropriate for a globalised and interconnected world. In view of this, what is necessary is a new conception: one that recognises disasters not as autonomously emergent or globally induced, but as rooted in specific process of industry, trade and consumption.

Bringing together experts in supply chain analysis, embodied emissions, and construction to work with government and industry on the environmental and human impacts of international trade, this report aims to reframe both the global and local impacts of climate change as articulated through the economic structures that sustain our globalised economy. Emphasising the 'close links between climate change and social inequality',[23] it will highlight the role of global trade both in shaping, mobilising and concealing the impacts of the changing climate, creating the space, in doing so, for a system of regulation better suited to a mobile and globalised world. Ultimately, it will make a case to account for a national and corporate 'disaster footprint' in order to better account for the intensification of climate change impacts and disaster risk as a result of international trade.

A garment sector dump on the outskirts of the Cambodian capital, Phnom Penh.

Part 2

Concepts and methods

Emphasising the complexity and mobility of environmental processes as they relate to global trade, this project aims towards a novel perspective capable of communicating the inherent porosity of supply chains to both unrecorded resource flows and environmental harms.

A woman prepares food in a Sri Lankan tea plantation.
As rainfall becomes more intense and less predictable,
workers like this are increasingly vulnerable to landslides.

2.1

Framing disaster in the global economy

The term ‘natural disaster’ is still widely used to refer to events such as droughts, floods and landslides. Yet as is increasingly recognised,[24] this is a misleading term, attributing as it does such events to a ‘natural’ world distinct from the global economy. In reality, this is far from the truth. Not only are global processes of carbon emission driving such events with increasing regularity,[25] but local economic processes articulate their manifestation in practice. When floods destroy houses and droughts destroy crops, where, when and to what extent they impact depends on the flows of goods, people and money that structure the local environment.

For every good that we use and every object we import, therefore, there is a triple cost. First, there is the carbon cost which contributes to climate change and makes extreme weather more likely. Second, there is a local environmental cost, which exacerbates the effects of extreme weather. And finally there is a human cost, as people and communities absorb the impacts of climate change, driven and intensified by global trade.

Local studies reveal ample evidence of such processes in action. Supply chains involve a whole range of actors beyond the key companies involved and the impacts of trade extend far more widely than is often appreciated. These secondary impacts of trade often aren’t fully understood in supply chain analysis, but they can be extremely substantial, playing a major role in shaping local environments and the resilience of local communities to climate change.

In highlighting the intersection of climate change, environmental degradation and global trade, this project aims both to contribute to overcoming some of the difficulties of understanding environment-trade linkages and to highlight the pressing necessity of doing so. In particular, it aims to challenge scalar conventions which place the nation-state, often implicitly, as both a producer of environmental bads and container of environmental damage. Indeed, a key goal here is to challenge the persistent emphasis on climate change as it impacts on space, rather than flows of goods, people and money: a static interpretation that fails to account for the dynamic economic processes through which climate change is articulated. Simply put, the predominance of conventional scalar geographies in the analysis of climate change impacts leads to an under-representation of the systems and processes that connect these scales.

This is an issue of growing relevance on a number of fronts. First, as critical scholars of climate change accounting have argued in recent years, national accounting models effectively render international trade a ‘loophole’ through which emissions regulations may be flouted. Consumption based carbon accounting therefore represents not only the ‘next frontier’ of climate policy,[26] but also a topic of considerable interdisciplinary academic interest.

Reflecting this, recent years have seen calls for a shift in how carbon emissions are accounted for, from a production-based metric in which only emissions produced within a country’s borders are counted, to a consumption-based metric in which emissions associated with imported goods also figure in the total. This, argue its advocates, is necessary to ‘close the carbon loophole in carbon policy’,[27] wherein wealthy countries claim successes in cutting emissions, despite increasing the total emissions with which they are associated.[28]

When floods destroy houses and droughts destroy crops, where, when and to what extent they impact depends on the flows of goods, people and money that structure the local environment.

This project provides a new body of evidence to support this view, yet in doing so, it also highlights understudied aspects of consumption-based carbon accounting, demonstrating, in particular, the need to explore supply chains – and their environmental impacts – as complex rather than merely linear entities. By exploring how UK pressures on urban development have led to increased Bangladeshi brick exports and consequent acute rural and urban land pressures due to the industry’s use of topsoil,[29] this project provides a key exemplification of how economic processes structure environmental degradation overseas. As shown here, changes to production and land use in the global North have specific and measurable environmental impacts on the global South, promulgated in many cases by regulatory and economic transitions, effectively transmitting, or ‘telecoupling’,[30] environmental degradation from one national setting to another.

From this perspective, spatially distant environments are viewed as always interconnected by trade. Yet they are also linked in the more direct sense by the burgeoning global trade in materials. Indeed, as the UNEP[31] outline, ‘global material use has tripled over the past four decades, with total global consumption of raw materials predicted to double again by 2050. From sand to clay to wood, a third of the total volume of materials extracted in the world economy are now linked to the production of an internationally traded good.[32] As more and more of the natural environmental is packaged in this way, the logic and logistics of trade are playing an ever more central role in environmental processes, demanding a fresh interrogation of the conceptual containers that govern the division, mobility and redistribution of the environment.

Emphasising the complexity, interconnectedness and mobility of environmental processes as they relate to global trade, this project therefore aims towards a novel perspective capable of communicating the inherent porosity of supply chains to both unrecorded resource flows and environmental harms. Analytically, this means interrogating the conceptual containers that structure thinking on environmental change: metaphors of commodity spatiality like carbon footprints and commodity chains that implicitly denote spatial characteristics to environmental degradation as a starting point from which departure has often proved challenging.

Three containers, in particular, are identified for confrontation. First, the spatial container itself, emphasising the porosity and flows that shape environmental impacts, over the scalar conventions of national and local accounting practices. The second container to be challenged here is the sectoral container, whereby industrial thinking tends to structure the assessment of environmental impacts both within particular industries, and within the boundary of industry itself. As shown here, environmental degradations transect such boundaries, as social, cultural and economic structures link otherwise disconnected spheres. The third and final container is temporal, seeking

to challenge in particular the development teleologies – most famously exemplified in the environmental Kuznets curve[33] – which indicate a reduction in environmental impacts associated with late-stage economic growth. As this project aims above all to demonstrate, societies such as the UK and its global Northern peers, are not innovating cleaner methods of production, but simply moving, or trading out environmental impacts beyond the purview of the accounting mechanisms they employ.

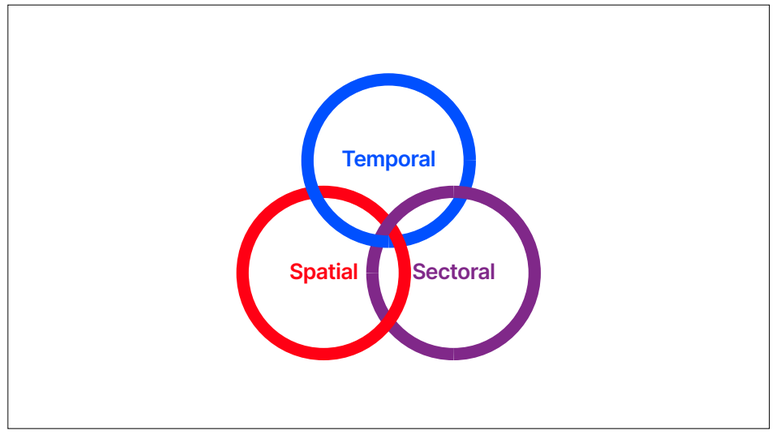
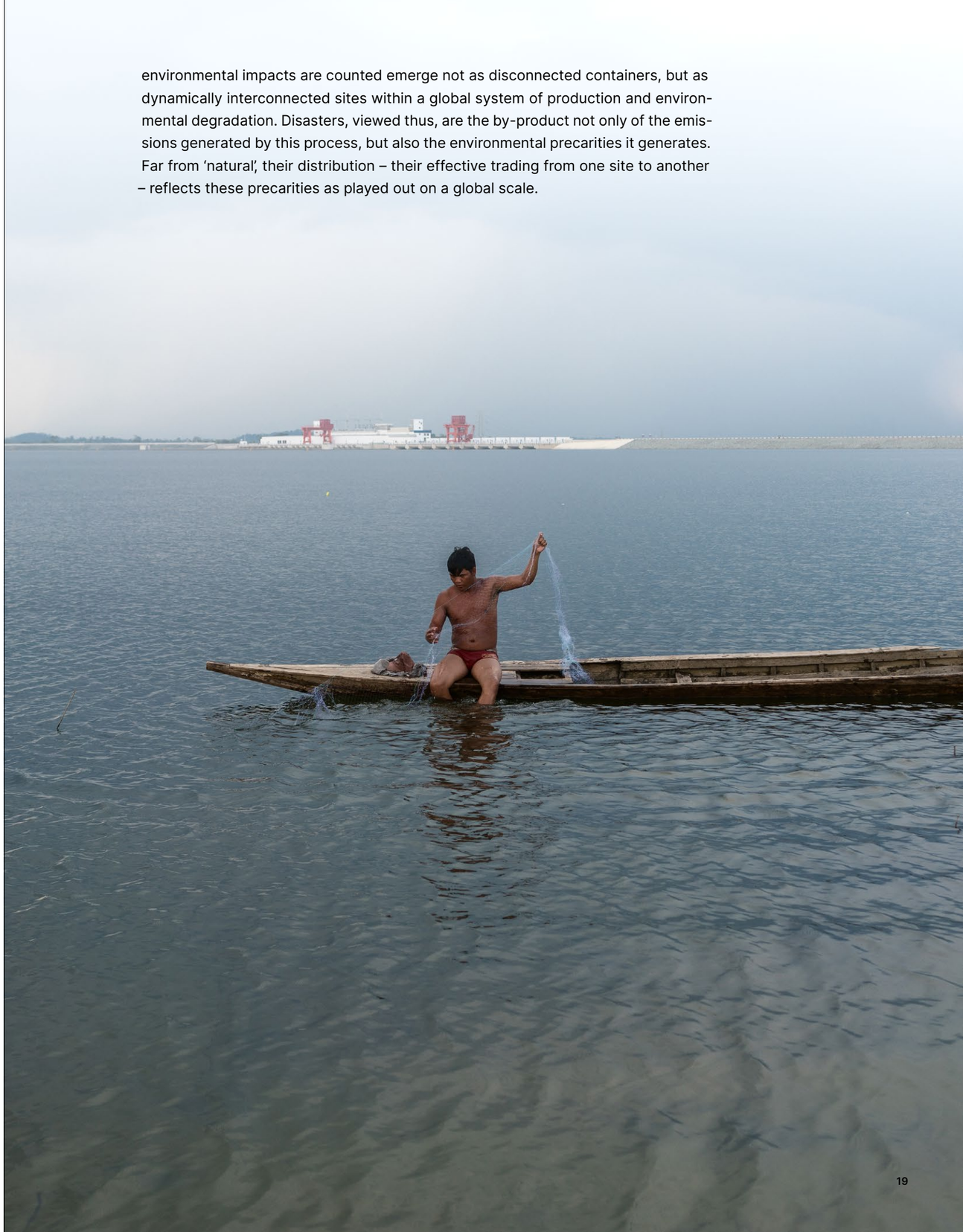


Figure 3. The analytical containers that shape climate policy.

In departing from these containers, the goal is freeing conceptions of climate change impacts and environmental degradation from some of the underlying assumptions that go unchallenged in climate change analysis, as a result of their ubiquity. By emphasising the intersection of human, economic and environmental processes, these processes are not only linked together but recast 'the accelerated circulation of ships, goods, capital, and labor across the world'[34] that characterise 'the emerging container economies'[35] of global trade. With materials circulating at the current high and accelerating rate, it no longer suffices to view environmental impacts associated with their extraction, use and consumption as static within space(s). Instead, they must be viewed as flowing, connected and traded according to the demands of the global economy.

Though focused on supply chains, however, this reformulation is directed not towards a linear ontology of environmental degradation, but a porous one capable of recognising the complex 'patch geographies'[36] and 'material biographies'[37] that characterise contemporary global commodity trading and production. This perspective both underscores the primacy of supply chains as environmental arbiters and opposes their abstraction within simplified linear logics. Instead, it emphasises the porous, gaseous and 'hazy' nature of emissions and their impacts,[38] drawing in both spatially adjacent and telecoupled sites of connection beyond those originally envisioned.

By accounting, in this way, for the complex flows that territories within which territories are entangled,[39] this project aims not only to draw attention to 'the wider relational roles territories play in emissions beyond their borders',[40] but also the histories and temporalities of these processes. Viewed from this historically and geographically embedded perspective, the territories within which emissions and environmental impacts are counted emerge not as disconnected containers, but as dynamically interconnected sites within a global system of production and environmental degradation. Disasters, viewed thus, are the by-product not only of the emissions generated by this process, but also the environmental precarities it generates. Far from 'natural', their distribution – their effective trading from one site to another – reflects these precarities as played out on a global scale.



A man fishes near a hydropower dam in Cambodia. Cambodia has recently begun a transition away from renewables and towards a predominantly coal powered grid.

2.2

Methods employed in the study

This study draws on data collected by an interdisciplinary team of more than twenty people, working across multiple field sites across five countries: Bangladesh, India, Cambodia, Sri Lanka and the UK. In seeking to construct a novel perspective on how climate change emissions and impacts are linked though international trade processes, it combines primary and secondary data collection and analysis across the three material focal points of garment production in Cambodia, brick production in the South Asian brick belt, and tea production in Sri Lanka. Where primary fieldwork was undertaken, all interviews were undertaken outside, with face coverings mandated, at a minimum distance of three meters.

2.2.1 Garment manufacture in Cambodia

This garment-focused component of the project comprised three dimensions. First, an analysis of international trade was undertaken using the UN's Comtrade database (2015 – 2018 for Cambodia imports and 2015 – 2019 for UK imports), in order to generate data on the volumes of garments and other textiles traded between Cambodia and the UK, as well as the raw materials involved in their manufacture. Combined with a review of literature and existing published data, this secondary analysis produced data on a) the volume of trade flows between Cambodia and the United Kingdom (UK) with regards to the garment industry; b) the countries of origins and sub-national locations from which Cambodia imports materials used for manufacturing textiles; c) UK companies connected with and/or exposed to the Cambodian textile industry; d) a review of existing data on environmental problems associated with the production of textiles in Cambodia and its supply chain.

This study draws on data collected by an interdisciplinary team of more than twenty people, working across multiple field sites across five countries: Bangladesh, India, Cambodia, Sri Lanka and the UK.

These data, which included statistics on ports of origin and destination, as well as the mode of transportation employed for transportation, were then used to calculate figures on embodied emissions associated with Cambodia's garment exports to the UK. In addition, they were used to set up the second component of research in the Cambodia site: primary data collection on the environmental impacts of garment production for UK brands.

This second component, lasting six weeks from February to March 2021, involved visiting factory sites in order to observe the environmental issues with which they were associated. In total, twenty factories linked to British brands were observed in person. In addition, 30 qualitative interviews lasting between 10 and 40 minutes were undertaken with local people living and working in the vicinity of these target factories.

The final component, lasting four weeks from June to July 2021, comprised a

Figure 4. Field sites:
1. Loolkadura
2. Meeriyabedda
3. Dickwella
4. Narsingdi
5. Gujurat
6. Punjab
7. Kampong Speu
8. Set Bo

nationally representative sample of fuel use in the Cambodian garment industry. Data were obtained via a randomly selected sample of 255 GMAC registered factories (of which 158 yielded responses). Surveys were undertaken anonymously with workers involved in the process of wood delivery. Their names, roles and the factories from which data were obtained are withheld here, in order to protect this anonymity.

2.2.2 Brick exports from the South Asian brick belt

As with the garment focused research component, the component on brick production in the South Asian brick belt comprised two dimensions. First, a secondary analysis of carbon emissions associated with the South Asian brick trade was undertaken, based on data from HMRC on brick importation trends to the UK over time. Using these data, which included frequency statistics on brick imports between the years 2015 and 2019, disaggregated by county of origin, it was possible to calculate the carbon emissions embodied in brick importation to the UK.

The second element of the brick-focused research component comprised fieldwork undertaken by research teams based in Bangladesh and India, in order to reflect the wider trend of brick importation from the South Asian brick belt to the UK. A total of 24 interviews were undertaken with local people, brick kiln works and kiln owners in two exporting kilns in India, located in Punjab and Gujarat. A total of 45 interviews were undertaken with local people, brick kiln works and kiln owners across five brick kilns in Bangladesh, of which one was an exporting kiln and four were non-exporting kilns. Interviews were undertaken in local languages by researchers from the local area. Interviews in Bangladesh were undertaken in Bengali, interviews in Punjab were undertaken in Punjabi, and interviews in Gujarat were undertaken in Gujarati and Hindi.

These two contexts were selected to represent different facets of the brick belt. In Bangladesh, one of the most vulnerable countries to climate change due to a combination of floods, droughts and sea level rise, the brick industry is widely acknowledged as one of the most environmentally destructive sectors. As a result, brick exports are technically illegal in Bangladesh, yet as evidenced here they continue to take place, especially for non-standard brick types. In India, by contrast, brick exports are relatively prevalent, accounting for around 1% of all brick production and millions of those imported by the UK. Thus, by highlighting issues linked to brick exports across different systems of environmental governance, these linked studies are intended to represent an issue which extends across multiple South Asian countries and distinct systems of governance.

2.2.3 Tea exports from Sri Lanka

The third research component, focused on tea production in Sri Lanka, comprised three dimensions, each of which are intended to elucidate the role of land use change related to tea plantations in shaping the prevalence and intensity of landslides in Sri Lanka.

The first element of the Sri Lanka component used secondary datasets made available by the Central Bank of Sri Lanka and the World Bank to establish long term trends in the economics of the Sri Lankan tea industry, as well as changes in the relative share of British exports in the Sri Lankan tea market. This component also provided background data and maps on the locations of tea plantations in plantations in Sri Lanka and the geographical changes to the sector over time.

The second element of the Sri Lanka component involved cross-referencing the previously established database on tea holdings with geospatial data on landslide vulnerability and land use change. This element provided data on the statistical relationship between transitions into and out of tea cultivation, as well as the relative landslide risk associated with tea landholdings, compared with other forms of land use. In addition, this element specifically focused on the landholdings of British-owned tea plantations, in order to highlight the particular impact of UK investment on the risk of landslides in the Sri Lankan highlands.

The final element of the Sri Lankan work package comprised the collection of qualitative data in three highland locations in Sri Lanka: Two active British tea plantations located in areas of high landslide risk and one resettlement site for the survivors of a previous landslide on a British tea plantation. In total, 15 semi structured interviews were carried out with tea plantation workers and supervisors, lasting between 30 – 60 minutes. All interviews were undertaken in Sinhala or Tamil by a local team of researchers.

Part 3

Garments

Garment supply chains are long, complex and obscure, hiding environmental impacts and making them challenging to fully assess. Garment supply chains are often much longer than reported, concealing high levels of emissions from transport. Compounding this, limited supply chain regulation means that serious environmental abuses occur in the UK overseas production, whilst changes to overseas energy production generate massive increases in the UK's consumed carbon footprint.

A garment sector dump on the outskirts of the Cambodian capital, Phnom Penh.

The global garment industry is enormous, accounting for more than 75 million workers worldwide. The industry as a whole is estimated to be worth $2.4 trillion, with textile and apparel exports totalling more than $750 billion in 2017.[41] A growth industry, worth 3 trillion USD, or 2% of global GDP,[42] it is nevertheless a sector characterised by significant concerns over its environmental impact. Described as 'the world's second most polluting industry' after oil,[43] it is an industry to which a significant share of both carbon emissions and local environmental degradation – related in particular to the overuse of water and release of industrial pollutants – is attributed.[44] In 2015, it is estimated that the apparel industry alone was responsible for 1.3 gigatons of carbon emissions, 2.4% of the global total.[45]

Various attempts have been made to establish the environmental impact of the garment industry.[46] Yet a key constraint in this respect is its sheer size and complexity. The industry in recent years has undergone a substantive separation of 'consumer and producer countries and in practice concealed actors in the workforce via nested subcontractor relationships, so the geographic locations where a garment causes environmental and social impacts may not be obvious even to the retailer'.[47] As per data provided to the Open Apparel registry, the top six British retailing brands as of 2020, for example (including the now defunct Arcadia group), sourced goods from an average of 560 factories in 25 countries each. Between all six of them, a total of 6194 factories in 57 different countries are involved in the supply of British garments: a number that makes establishing environmental impact extremely challenging. Moreover, the supply chain logistics of the industry – increasingly, but still only partially transparent[48] – make establishing responsibility for environmental degradation more problematic still.

Described as 'the world's second most polluting industry' after oil, it is an industry to which a significant share of both carbon emissions and local environmental degradation – related in particular to the overuse of water and release of industrial pollutants – is attributed.

Across four parts, this section focuses on the case of Cambodia, as an example of an end stage 'cut-make-trim' garment industry in which raw materials are predominantly imported and processed before being re-exported to buyers such as the UK. One of many such intermediary producers worldwide, Cambodia here exemplifies several of the key mechanisms through which carbon emissions are hidden or under-reported in supply chains.

The section begins with an example of how supply chain complexity serves to obfuscate the geographical extent of production processes, concealing both the extent of transport emissions and the conditions in which primary materials are produced. Linked to this, the case of Cambodia's pivot to coal power will be explored, in order to exemplify how global Southern energy transitions impact the extent of consumed emissions in the UK. Beyond this global scale analysis, however, the remainder of the section will highlight how the same processes that serve to conceal emissions ultimately incentivise supply chain growth in areas covered by limited or ineffectual regulation, setting in motion local processes that intensify the impacts of climate change along supply chains providing garments to British consumers.

3.1

Clothing the garment industry's environmental footprint

The garment industry is acknowledged to be a major contributor to climate change, contributing between 5%[49] and 10% of global carbon emissions.[50] Yet despite a growing awareness of 'the price of fast fashion',[51] the scale and complexity of the industry, as well as the opacity of supply chains defined and delimited predominantly by large scale end-stage buyers,[52] means that much of its impact continues to be underestimated.

By analysing import and export data from the UN's Com-Trade database, rather than relying on data provided by corporate supply chains, this section aims to elucidate some of the pathways through which emissions are 'lost' in calculation. Although this does not facilitate the attribution of specific corporate responsibility for resource flows and environmental impacts, it does establish the size and direction of both direct and indirect flows, rendering visible the UK's share of international resources and responsibility.

A central example of how complex garment supply chains serve to obscure garment provenance and environmental impacts relates to the place of China within international garment supply chains. According to World Bank trade data, China is directly responsible for only around 20% of apparel imports to the UK, as of 2018.[53] Yet as the figures below show, the proportion of UK apparel imports with an indirect Chinese provenance is likely to be far higher.

This has both ethical and environmental implications. British retailers – and indeed the UK government itself – has come under increasing pressure in recent years to eliminate cotton originating from the Xinjiang region of China from their supply chains.[54] The region is controversial for its association with the forced labour of hundreds of thousands of ethnic minority labourers, in which 'grave concerns about systemic, state-sponsored coercion' in the annual cotton harvest have been raised.[55] Following the Better Cotton Initiative's removal of its seal of approval from Xinjiang,[56] several brands, including Uniqlo, Calvin Klein and C&A, have consequently issued statements claiming not to source any materials from Xinjiang. Nevertheless, the predominance of Xinjiang in global supply chains make this a more difficult claim on an industry scale. China is the world's largest producer of cotton, accounting for some 20% of world output, within which the Xinjiang region produces the lion's share of national output, at 84%.[57]

This substantial share means it is difficult to avoid, especially in Southeast Asian intermediary manufacturers, which are heavily dependent on cotton imports particularly from China. For example, in Cambodia, as in neighbouring Vietnam, there is no domestic cotton industry at all (bar a small-scale artisan revival in recent years), meaning that the raw materials for cotton-based garment production must be imported from overseas. Of the cotton imported to Cambodia, 81.6% arrives directly from China and a further 4.8% via Hong Kong; meaning that a total of 86.4% of the cotton

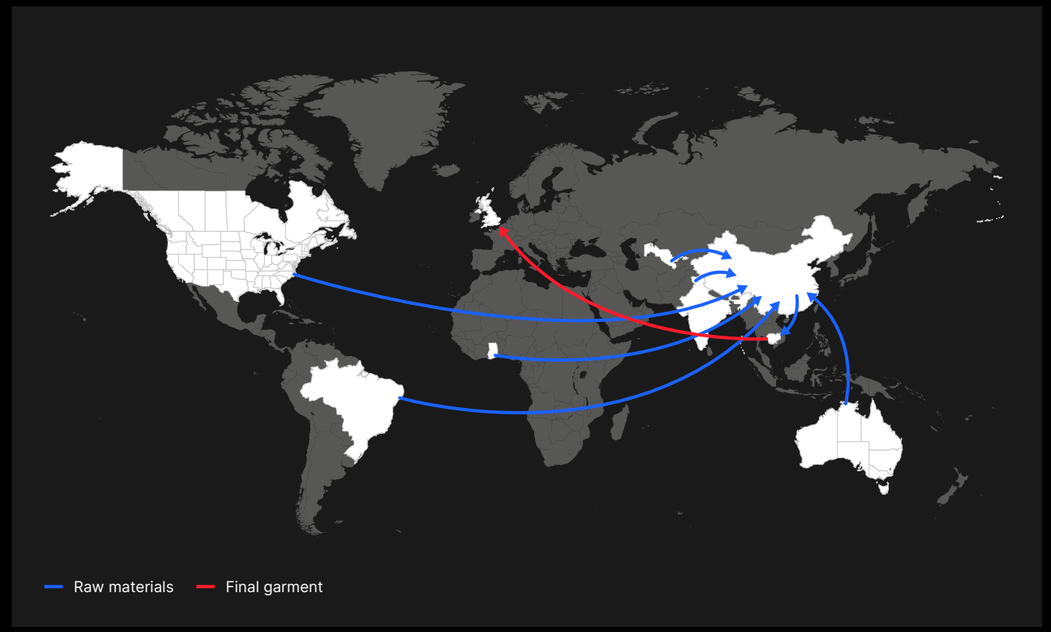
used in Cambodia originates directly or indirectly from China. Assuming that Chinese cotton exports are produced and imported in the same proportions as the national average, this suggests that some 71.5% (84% of 85.1%) of cotton garments made in Cambodia, including those exported to the UK, are made with cotton grown in the controversial province of Xinjiang.

These raw figures suggest that it would be difficult, if not impossible, for all of the UK's major apparel companies to be honouring their ethical commitments. Yet, as brands themselves concede, the obscurity of extended supply chains makes it 'extremely difficult'[58] to prove or disprove linkages between end retailers in countries such as the UK and regions such as Xinjiang.

Moreover, in addition to the ethical implications, supply chain obscurity of this sort presents substantial challenges to environmental accounting. In disguising the provenance of the raw materials used in garment manufacture, the complexity and opacity of garment supply chains serves also to conceal their length. Between 2014 and 2018 almost a third of China's total cotton supply was imported, making it the largest importer of cotton in the world, as well as the largest producer.[59] Of this third, the vast majority of imports came from five countries: Australia (25.9%), the USA (28.9%), Uzbekistan (7.75%), India (12.9%) and Brazil (12.7%). Besides a small contribution from Mexico, the remaining 7.5% of imports were produced predominantly in Africa, most notably Burkina Faso, Cameroon, Mali, Cote d'Ivoire, Benin and Zimbabwe.

The weighted average distance between China's primary cotton producing regions – Xinjiang, Hebei, Shandong and Hubei – and the primary export port of Shanghai is 4100 km. In contrast the mean distance travelled by China's imported cotton to reach China is 19,000 km, around five times the distance travelled by domestic cotton. Assuming equal usage of imported raw materials across export and domestic sectors and weighting distances according to relative proportions of China's total cotton usage, this increases the total mean distance travelled by raw materials in China to 9,000 km, more than double the domestic figures used by studies such as Wang (2015).

Figure 5. The Chinese cotton supply chain underpinning Cambodia-UK exports.



Finding alternatives to this complex supply chain is difficult. Besides the 81.6% of Cambodia's cotton originating in China, the next biggest exporters are Hong Kong's 4.8% and a further 6.4% from Vietnam. Both Hong Kong and Vietnam, Cambodia's second and third largest cotton exporters, are geographically far closer than China's north-eastern textile export hub. Yet unlike China, neither produces cotton domestically on an appreciable scale, importing over 99% of what they use or sell. Both countries therefore offer processed re-exports from other countries, thereby extending, rather than shortening the length of the raw material supply chain. Almost three quarters (72.53%) of Hong Kong's cotton exports come directly from China, for example. Vietnam, which imports cotton predominantly from USA, Brazil, Australia, India and Cote d'Ivoir, has an even longer supply chain.

Even before it departs Cambodia for the UK, the materials in a cotton shirt have already travelled 14,000km and emitted some 63g of carbon from transportation alone.

Taking all this together, this means that the cotton processed into clothing in Cambodia's factories has travelled a weighted average of 14,000km to get there. Even before it departs Cambodia on the 18,000 km sea journey to UK shops, this circuitous journey means that the materials which comprise a typical 280g cotton shirt have already emitted some 63g of carbon from transport alone, almost exactly doubling the additional 64g direct carbon cost of transportation from Cambodia to the UK. Once they arrive in British shops, they have travelled on average over 32,000km, three quarters of the way around the world and accompanied by total emissions from transport of 127g CO_2e per shirt.

If this is now extrapolated to the 22,783 tonnes of cotton-based exports from Cambodia to the UK that originated in China (56% of a total annual 40,684 tonnes), this equates to emissions from transport of 6,173 tonnes CO_2e annually, of which 2,522 tonnes CO_2e is derived from the transport of raw materials. Yet despite their huge scale, these emissions are effectively invisible under accounting measures which fail to account for the complexity and obscurity of the international textile supply chain. That's the equivalent of 33 tanker trucks full of gasoline being burnt, or the average total annual emissions of almost 1000 Europeans, concealed by the logistics of global production.

The key implication here is not that Cambodia is a uniquely significant offender in the complexity and carbon inefficiency of its supply chain. Indeed, Cambodia is a rather typical 'cut-make-trim' processing intermediary within a highly globalised industry. Rather, what this case demonstrates is the ill fit of current emissions calculations such as WRAP (2017) and the Environmental Audit Committee (2019), which do not account for transport emissions, to the highly mobile context of a contemporary global industry in which complexity serves to conceal length. In order to account for the true carbon cost of the goods and services we use, it is therefore necessary to look beyond the two-country input-output analysis that tends to characterise the field[60] towards a dynamic global perspective, which recognises and accounts for the extensive and complex chains through which global emissions are generated.

3.2

Climate change and Cambodia's pivot to coal

Cambodia's new energy plan will increase the UK's embodied carbon footprint by 126,200 tons of CO_2 annually, equivalent to almost 70,000 tons of coal being burned each year in the UK. All from 4% of the UK's garments.

The hidden mileage travelled by UK clothes and their component materials constitutes, in itself, one dimension of the garment industry's hidden environmental footprint. Yet there is also a wider story at play, rooted not in the movement of goods, but energy. Industrial processes, such as those employed in the manufacture of clothing, are energy intensive, relying heavily on the national grid of wherever they are based. As a result, the energy embodied in garments depends to a significant extent upon energy decisions made in the global South, many of which are linked themselves to climate change.

In exemplifying the role played by energy transitions in the global South on UK emissions figures, Cambodia again provides an instructive example. Endowed with relatively little infrastructure for electricity generation, the Kingdom has historically relied on imported electricity for its power needs, leaving it heavily dependent on its neighbours, Vietnam and Thailand. Seeking to address this dependency, recent years have seen substantial investment in electricity generation, according to a strategy centred predominately on hydropower. Since 2000, some 29 hydropower dams have been brought online in Cambodia, alongside a further 44 planned, with devastating ecological consequences in some cases. Environmental campaigners have fought for years to halt or mitigate the ecological impact of unchecked dam building in Cambodia; a struggle which recently took an unexpected twist.

In the grip of a prolonged drought – and the now almost annual period of low rainfall linked to 5 El Niño events in the last 6 years[61] – Cambodia's decade long pivot to hydropower hit a brick wall in early 2019. Without the stored water needed to power Cambodia's new dams, the country plunged into a deep power shortage, resulting in rolling blackouts for almost six months. This was not only an inconvenience to residents of Cambodia, forced to endure the hottest part of the year without power for six hours or more a day, but a major blow to industry. The country's dominant garment industry was forced to reduce working hours and turn to highly polluting and expensive diesel generators, creating delays in supply chains and badly affecting the environmental rating presented by factories to brands.

Viewed by the government as a national embarrassment, Cambodia's season of power shortages instigated an abrupt change in strategy. Since 2020, four coal burning power plants have been proposed by the Cambodian government: three planned within Cambodia's borders and a further plant, intended to be based in Laos for Cambodian supply. This latter station is expected to generate a staggering 3.4

GW of electricity for Cambodia each year, in the process consuming so much coal that it will require its own coal mine to be dug to fuel it. It is expected to produce an additional 3.6 megatons of CO_2e annually, more than the total carbon footprint of DR Congo and a huge increase for a country with a relatively small carbon footprint in global terms.

The story of Cambodia's poorly planned and now apparently abortive drive towards hydropower illustrates the cruel irony of climate change in the global South. Scuppered in a path towards renewable energy by the severity of climate-linked drought, the government has decided on a course of action which will ultimately deepen the ecological crisis which sees Cambodia consistently ranked as one of the most climate vulnerable countries in the world. Unable to overcome the impacts of climate change, the decision has been made, it appears, to join in contributing to them. Nevertheless, this fundamental transformation of Cambodia's energy landscape has implications far beyond the borders of the Kingdom.

From a profile of 49% renewable, 34% non-renewable, and 16% imported energy today, Cambodia's four new plants will see 80% of the Kingdom's energy generated from non-renewable sources by 2030. Yet this change of direction is thrown into sharper relief still in the context of previous plans. From a sustainable energy strategy to halve the carbon intensity of the national grid, from 806 tCO_2/GWh to 413 tCO_2/GWh, Cambodia's new plan would see the grid's carbon intensity – already the highest in ASEAN – increase by a further 10% to 888 tCO_2/GWh.

Assuming non-grid energy usage remains constant, Cambodia's pivot to coal will see the total carbon footprint of a ton of garments increase by over half a ton to 8.3t/CO_2e by 2030. To put this into perspective, the previous energy plan was expected to decrease the carbon intensity of Cambodia's grid substantially, to only 413 t/GWh. Were this plan to have gone ahead, the total carbon footprint of a ton of Cambodian garments would have decreased to 5.2 tons/CO_2e.

The new energy plan underway in Cambodia therefore represents a relative increase in the carbon cost of garment of 37% over the previous energy plan, a change of direction that means each 220g garment supplied to the UK will be associated with an additional 680g of CO_2 emissions: slightly over the volume of a standard bathtub. Extrapolated to the UK's 40,684 tons of annual garment imports, this policy, shift which has gone almost entirely unnoticed in the UK, has therefore increased the UK's consumption-based carbon footprint by some 126,200 tons of CO_2 annually, equivalent to 70,000 tons of coal being burned in the UK each year. All of this from the change in the energy underlying garment production in a country that supplies under 4% of the UK's garments.[62]

As of 2021, Cambodia's energy sector comprised 29% imported energy (of which 28% from Thailand, 34% from Laos and 38% from Vietnam). The remaining 71% is split between non-renewables (39%) including coal and fuel oil and renewables (32%), of which more than 90% is hydropower. Given projected future power demands, Cambodia had previously announced plans to expand the capacity of the grid by focusing on the development of natural gas capacity and hydropower. By 2030, this plan aimed to eliminate power imports whilst delivering an energy composition of 17% coal, 33% hydropower and 50% natural gas. The new plan will see Cambodia transition towards 80% non-renewable power, predominantly coal.

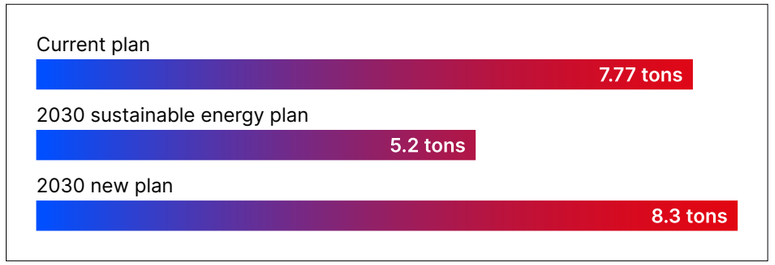


Figure 6. Embodied emissions – mean CO_2 emitted per ton of garments produced – generated under Cambodia's current, previously planned and currently planned energy profile.

On the level of governance, this shift in strategy runs counter to both national and international environmental statutes. The National Strategic Development Plan [NSDP] 2019–2023,[63] for example, includes actions to implement the government's priorities related to energy, including both 'promoting sustainability in development that ensures economic prosperity while preserving the quality of the environment, sustainable livelihoods and the availability of natural resources' and 'improving policies and regulations to increase the contribution of renewable energy in Cambodia's diverse energy sector'.[64] On an international level, moreover, Cambodia's obligations are clearer still. As laid out by the ADB,[65] 'Cambodia's Nationally Determined Contribution, enshrined in the 2015 Paris Agreement, commits to a 16% reduction in greenhouse gas emissions from the energy sector from a business-as-usual scenario by 2030'.

This reversal in energy policy therefore appears to constitute, in terms of its contribution to the national grid, a breach of the terms of the Paris Agreement. Yet in reality, the domestic nature of carbon accounting means that this need not be the case. Rather, by 'outsourcing' a large segment of coal power generation to Laos, Cambodia itself is spared the burden of the emissions it generates, potentially freeing up the 'national' energy quote for the higher proportion of renewables required under its Paris agreement national target of a 27% reduction in forecasted emissions.[66] This case therefore exemplifies the counter-intuitive role played by domestic emissions governance in mobilising carbon intensive energy production beyond national borders. Yet, more complex still, the globalised nature of production means that the impact of Cambodia's energy policy extends far beyond the Kingdom itself, shaping the emissions embodied in every garment produced in a Cambodian factory.

Indeed, given the substantial implications for the emissions embodied in the supply chain of exporting companies, this news has been met with some dissatisfaction amongst major buyers. In late 2020, a letter signed by 8 major brands, including H&M, Adidas and Puma, was addressed to Cambodia's deputy prime minister stating that 'shifting from hydroelectric to coal is not the solution needed by industry today, and we must stress that price alone is not enough to overcome regional industrial competitiveness that is increasingly prioritising environmental sustainability as central to business decision making and planning'. As it concluded, 'Cambodia is at an important crossroads. Electricity decisions made today will lock Cambodia into a future that appears to be the opposite of global and regional trends and less attractive to industry'.[67]

Figures on the energy costs of a given garment vary considerably, but an oft quoted figure for the production of a ton of garments in Cambodia is 42 Giga joules (GJ) per ton of garments produced in the Kingdom.[216] Based on this figure, the production of a ton of garments today – with the grid producing 806g of CO_2/ GWh – would produce emissions of 9.4 tons of CO_2, were the process entirely powered by grid. However, factoring in 10% of energy produced using biomass and a further 36% through small scale diesel generators[217] provides a lower figure of 7.77t CO_2.

Nevertheless, although it demonstrates corporate concern over the issue of global South energy transitions, what this letter highlights above all is the extent to which decisions over emissions – especially those which are embodied and traded across borders – are left to the purview of economic, rather than political actors. UK based firms are subject to government guidance[68] which states the following:

> "Since 1 October 2013 the Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013 has required all UK quoted companies to report on their greenhouse gas emissions as part of their annual Directors' Report. From 1 April 2019, quoted companies must report on their global energy use and large businesses must disclose their UK annual energy use and greenhouse gas emissions. This is required by the Companies (Directors' Report) and Limited Liability Partnerships (Energy and Carbon Report) Regulations 2018."

Although these regulations cover Tier 1 (directly produced) and Tier 2 (produced via energy use) emissions, Tier 3 (supply chain) emissions are subject only to voluntary submission.[69] Consequently, despite the concern expressed by major brands over Cambodia's energy transition, supply chain emissions and environmental impacts remain beyond the purview of external scrutiny in many cases. Were brands minded to require the full extent of the emissions produced by their supply chains, then the possibility exists simply to sub-contract dirtier and more carbon intensive processes. Indeed, this practice is already commonplace both globally, where it is estimated to be employed in some 36% of factories and in Cambodia specifically, where 52% of factories subcontract orders without authorisation.[70] In order to account more fully for the implications of energy policy in the global South, therefore, a more rigorous approach to carbon accounting and environmental impacts on a national and international scale is necessary.

3.3

Water pollution, environmental destruction and the Cambodian garment industry

Before climate change began to take centre stage in global environmental policy, the management of local pollutants formed the mainstay of environmental governance in the industrial economies of the global North. Following decades of worsening environmental conditions, culminating in London's famous 'pea souper' smogs of the 19th and early 20th century, the UK's domestic environmental policy was tightened to place stringent regulations on manufacturing. Local pollution, both water and airborne, is governed by the Environmental Protection Act (1990), which requires companies to report and document all impacts on the local environment, whilst providing frameworks also for complaints, enforcement and the imposition of penalties. In the UK, this combination of environmental legislation and enforcement has been, in historical terms, a resounding success, generating major tangible gains in the quality of domestic water resources. Indeed, as the Environment Agency[71] summarises:

> "Since 1995 some of the worst pollutants in our rivers have been cut dramatically: ammonia levels are down 70% and phosphates down 60%. Toxic metals like copper, lead, cadmium and mercury have also been reduced, the last two by 50% since 2008. Serious water pollution incidents have been cut by nearly two thirds, from 765 in 2002 to 266 in 2019.
>
> Since the 1990s there has been a big increase in the numbers of small animals that live in rivers like snails, worms and insects – a key indicator of the overall improving health of our waters. Many of the artificial barriers to fish and other wildlife have been removed: in the last ten years the Environment Agency and its partners have removed over 130 weirs and improved fish passage at more than 420 other sites, allowing salmon, other fish and eels to migrate and breed. Meanwhile the bathing waters around our coasts are in a much better state than they were twenty years ago. In 2019 98.3% met or exceeded the minimum standard and for the first time more than 70% achieved the Excellent standard."

Nevertheless, as manufacturing continues to decline as a proportion of the UK economy, with more and more goods being imported each year,[72] the proportion of goods consumed by UK residents that are governed by these strictures is declining also. Companies importing goods are subject to only voluntary agreements in relation to their environmental impacts overseas, with responsibility for transparency over environmental impacts largely being left to companies themselves and subject to environmental regulations that are far less stringent than those governing the UK

“In the past, we could use water from the lake for cooking and household consumption. Since the factory came here, we cannot use the water from the lake anymore, especially the last 2 or 3 years … We cannot drink it because it is oily. The oil is everywhere.”

itself. As a result, much of the environmental impact associated with imported goods goes either unreported, or under-reported, concealing the true environmental impact of the UK population’s consumption.[73]

The World Health Organization estimates that more than 12 million people die annually from environmental health risks largely caused by air, land, and water pollution,[74] much of it linked to export focused industrial production.[75] Nevertheless, despite, or perhaps due to its disproportionate impact on developing countries, ‘industrial pollution in the global South it remains one of the most under-recognized global problems’.[76] Far from being managed on a global scale, therefore, water land and airborne pollutions are increasing rapidly in many parts of the global South, including the Greater Mekong Subregion.

In the Cambodian garment industry, where just under 4% of the UK’s clothes are produced, three key facets of environmental degradation predominate: pollution, resource depletion, and carbon emissions, all of which have already left a serious and lasting impact on the environments within which UK garments are produced. Although industrial pollution is governed in principle by the Law on Environmental Protection and Natural Resource Management (1996), the reality of enforcement remains far removed from the legal principles in place. As outlined in the global Environmental Performance Index,[77] Cambodia ranks 139th out of 180 indexed countries, with wastewater treatment specifically ranked 134th. Reflecting this position, rural water quality in Cambodia has been described as a ‘crisis’, posing ‘significant challenges for the government’ in terms of sanitation, health and environmental sustainability.[78]

Moreover, these are issues that can be traced directly to the activities of UK industry. UK owned and linked factories continue to emit harmful chemicals into public water systems, many of which are ultimately released into the natural environment without further treatment.

Smoke rises from a garment factory in Cambodia. Expensive mains electricity means that many garment factories produce power by burning garments or wood.

A woman living in the vicinity of a garment factory in Kandal province. Liquid and airborne pollution are a major problem for many of those living in the vicinity of the industry.

In an industrial agglomeration to the South of the Cambodian capital Phnom Penh, for example, one of the largest factories in the area and a major supplier to UK brands is responsible for liquid emissions with a history of damaging local farmers crops and significantly affecting local ecology. Despite liquid emissions from this factory being treated on site, residents of the local area have for some years complained of the impact of wastewater on their crops when the large reservoirs locate behind the factory overflow in the rainy season.

> “As we know, the laundry water always has chemicals in it. It is not cleaned 100%. If there is a lot of rain, then it rises up and spills out and floods the nearby land. It is sour. That is the problem. If we complain to the commune chief, or village chief, nothing is solved. As a citizen, we cannot do anything … They give [them] some money. Then, they are just silent.” — Fishers, Set Bo, March 2021

Despite the obvious damage underway, a key issue in local people’s ability to resist the environmental impacts generated by nearby factories is that many of the worst

impacts are associated with ‘natural’ environmental processes viewed as beyond the control of industry. Local people experience periods of high water and flooding on a regular basis, often resulting in overspill of treated or untreated wastewater into farmlands and fisheries. Yet the idea that such impacts are the result of ungovernable environmental processes is used as a key argument against industrial culpability. With little incentive to provide robust protections against wastewater overspill during periods of heavy rain, industrially induced crop destruction of this sort are consequently both frequent and unanswerable:

> “There was a big flood last year. It was natural disaster. So, how can we complain to the factory? We have no right to complain to them because we don’t have a system to release [flood water] to the river. Consequently, [they argue], we deserve only what we have left [after the chemical damage]. We did not know whether there would be a flood or not, or even that the factory stores pollute water. But [still] we cannot beat them.” — Fishers, Set Bo, March 2021

Worse still, the impacts of irregular or ‘unexpectedly’ heavy rainfall are increasingly common in the area. As farmers complain, this is a daily occurrence when factory orders are regular:

> “If the factory is operating, it creates polluted water and if there is a rain as well, the polluted water [rises] high and flows into here [the lake and surrounding area].” — Fishers, Set Bo, March 2021

Moreover, as local residents elaborated, this discharge has a profound effect, not only on local agriculture, but also the water supply more generally:

> “Last year, it destroyed the crop of the villagers and then villagers complained to the factory about that. They complained that water leaked out and damaged their mint crop because it contained oil and other substances. After that, they made a blockage to prevent water leaking out of the factory. However, when there was a flood, [the factory managers] were afraid that water would come inside the factory [itself], so they released the blockage and the water flowed out of the factory … In the past, we could use water from the lake for cooking and household consumption. Since the factory came here, we cannot use the water from lake anymore, especially the last 2 or 3 years … We cannot drink it because it is oily. The oil is everywhere.” — Female Wage Labourer, Set Bo, March 2021

Even during the course of normal operations, the expulsion of factory wastewater into the nearby lake appears to have had a profound impact on local ecology in this area. As fishers working in the local area explained, when the ‘cleaned’ industrial liquid was initially pumped into the lake, it resulted in degradation of the local ecosystem, instigating substantial changes in the local fish population. As local people explained:

Rice farmers near a factory complex in Kampong Speu providing garments to the UK market. Water and air pollution, as well as overuse of water resources, are common problems in the industry.

“They have an underground pipe system from the factory to here [the lake]. The water flows through it to the canal and then to the lake. They made the underground pipe system about two years ago. So, if the factory works constantly, then water goes up and flows down here. If the [water storage] reservoirs of the factory are full, they will release the water out. At times of full production, if they work every day, they release water out [like this] every day.” — Wife of Fisher, Set Bo, March 2021

Inevitably, this regular industrial discharge has negatively impacted local livelihoods. Casting doubt on assertions from authorities that ‘there is no bacteria in the polluted water” — Fishers, Set Bo 08-03-2021), locals consistently report deleterious environmental impacts resulting from the water-borne pollution from the factory. Local fishers explained that despite the Ministry’s assurances, “even the weeds inside the lake also died. Before it had a lot of weeds. The polluted water killed everything.” — Fishers, Set Bo, March 2021. As a local woman continued:

“In the past, when there was no water from outside coming to the lake, we could find a lot of snails and fish. But since that water come into the lake, it kills the fish and snails, and it makes our life harder and harder to [earn] rice to eat … It occurred after the establishment of [the factory] Goldfame [Star]. Before the factory was located here, we could [even] use the water for household consumption and other purpose” — Wife of Fisher, Set Bo, March 2021

For people already struggling to adapt to the impacts of climate change-linked floods, therefore, industrial pollution of this type effectively catalyses the destruction of livelihoods, intensifying and extending the impacts of Cambodia’s increasingly irregular rainfall through chemical pollution. This is, moreover, a nationally attributable impact, with each of these cases linked to people living, farming and fishing in the vicinity of a factory which manufactures and processes clothing for a number of major British brands. In contrast to the strictly enforced legal frameworks governing domestic production, therefore, these accounts highlight how UK manufacturing continues to play a key role in driving environmental degradation in the global South. Overarchingly, however, it evidences the key flaw in a system whereby companies themselves are handed responsibility for oversight of their supply chains.

In this industry, as in others, the ‘extremely poor state of Cambodia’s water resources monitoring and assessment systems’,[79] combined with consistently ‘ambiguous regulatory enforcement’ by environmental institutions[80] has seen water pollution, even from exporting factories, subject to limited scrutiny, creating very little incentive to meaningfully manage the environmental impacts of their operations. Without the checks and balances provided by enforceable legislative oversight in the vicinity of production sites, local people in the vicinity of UK industry have little meaningful capacity to raise complaints to authorities and no capacity to raise these issues to the brands charged, in theory, with their oversight.

3.4

Carbon emissions, deforestation and drought in the production of UK clothing

In certain communities around Cambodia, industrial liquid discharge from garment factories plays a significant role on local livelihoods, yet it is by no means the only, or even necessarily the worst, example of the Cambodian garment industry's environmental impact. Indeed, as evidenced by the billowing black smoke emerging daily from many of the factories supplying British shops, ground-based pollutants of this sort are only one dimension of a far wider footprint of British overseas production.

Compounding these regulatory failings, economic factors have further incentivised deleterious environmental regulation. Faced with high grid energy tariffs compared with other countries in the region,[81] garment factories have long sought to mitigate energy expenditure through the use of boilers and burners which generate power through the combustion of both forest wood and – increasingly commonly – garment offcuts.[82] In the case of garment burning, the impact of this form of industrial combustion on the local population is immediate. Those living in the vicinity of the factories that burn garments for fuel complain of persistent health problems and the need to cover their possessions when prevailing winds draw the fumes to their homes. As residents of one factory exporting to the UK explained:

> "Since the factory was built, it has been difficult to live here. Now they've just bought land close to the village and they bring garment waste for burning. It is smoky and [makes the air] full of smoke. They make the smoke pile very low. When the wind comes [in this direction] it brings [the smoke] to our village. At that time, we called the [factory] but they didn't come to check on what we told them … We called the boss and the staff there. Garment waste is carried by two-wheel tractor and burnt behind our village. Burning the garment waste is very smoky …
>
> Here, we experience the impact from the factory [of a local tycoon]. He burns the garment waste. He has made something [to mitigate it] but there is still an impact. The smoke does not go up in the air but even if it does it impacts the environment as well … All of his factories are like that. He makes [a closed system] but it is still producing smoke. The smoke is black and makes it difficult for the villagers to live here. We have requested him [to do something] many times. We don't want to stop him. We just want him the chimney higher. They don't burn only for one or two hours but they burn it for the whole morning." — Kampong Speu Village Chief, March 2021

A waste burner attached to an exporting garment factory. Waste burning is common practice in the Cambodian garment industry, often being used to generate power for the factory.

"Since the factory was built, it has been difficult to live here. Now they've just bought land close to the village and they bring garment waste for burning."

The impacts of garment burning are, therefore both visible and immediately tangible. As outlined in a UK parliament report on the fashion industry,[83] the practice of incinerating garment waste 'multiplies the climate impact of the product by generating further emissions and air pollutants that can harm human health'. Indeed, this is precisely the result witnessed currently in Cambodia, where widespread garment burning not only plays a substantial hidden role in the industry's carbon footprint, but also intensifies the impacts of climate change by undermining health and wider livelihoods.

Nevertheless, problematic though it is, garment burning is ultimately of secondary importance to the equally prevalent – but similarly unremarked upon – practice of burning forest wood in the Cambodian garment industry. Cambodia has experienced the highest rate of deforestation in the region[84] and one of the highest in the world[85] since the 1990s, yet the loss of Cambodia's forest cover has been predominantly ascribed to land concessions linked to high value wood.[86] The loss of low value trees for firewood, by contrast, has received far less attention, tending to be perceived by scholars,[87] international advocacy groups[88] and even local people in some cases[89] as predominantly associated with small scale household consumption, rather than larger scale industrial processes. Nevertheless, far from being limited to isolated infractions of environmental legislation, the practice of burning forest wood is a widespread phenomenon in the garment industry.[90]

Truck drivers unload wood at night in Kandal province. Forest wood harvesting is illegal in Cambodia and has been cracked down on heavily since 2018, yet remains a common source of fuel in the garment and other industries.

Attracted by the high caloric value of forest wood, compared to farmed wood alternatives such as acacia, eucalyptus or rubber trees, the garment industry has historically been a significant driver of this secondary form of deforestation in Cambodia.[91] Although harvesting firewood from forests is illegal in Cambodia – indeed, in announcing a recent crackdown, Prime Minister Hun Sen stated he had commanded those tasked with enforcing the restrictions "to be shot from helicopters in the sky"[92] – a substantial proportion even of registered exporting factories to UK brands continue to burn forest wood due to its efficiency and low cost as a fuel. Even following the national crackdown on forest wood usage since 2018, the practice has continued largely unabated, with wood now delivered at night rather than during the day, as previously. According to local informants, some larger factories use hundreds of tons of forest wood each day in order to meet their energy needs. For economic reasons, the wood sourced for this purpose tends to be from Cambodia's Central and Southern areas, with wood tracked from one factory specifically to Baseth district, in Kampong Speu. Yet this is by no means an isolated practice. Despite enhanced enforcement, firewood continues to be collected surreptitiously from Cambodia's remaining areas of forest cover, such as Kampong Thom province, where the sale of wood by the roadside remains common. As one such roadside wood seller explained:

> "The firewood for factory [use], Korean trucks [large industrial trucks] come and deliver it out every day … They collect firewood from the local mountain nearby … We have to pay [the police] money at every checkpoint. Otherwise, they catch us." — Aural Roadside Seller, March 2021

Far from being an isolated or small-scale infraction, the substantial continuing appetite for forest wood by factories in the vicinity of Phnom Penh – predominantly linked to the garment and brick industries – continues to play a major role in deforestation. Even in the vicinity of major national parks, such as Prey Long, one of Cambodia's last remaining areas of old growth rainforest, logging for firewood to feed domestic industry remains common, as a second local wood seller outlined:

> "For firewood, I think most of them [are taking it] from Kampong Thom to Phnom Penh. For this firewood, they just collect from very small forests nearby … As far as I know, the firewood from every place goes to Phnom Penh. I think once one place is finished, then they will go to another place for firewood. They cut down the forest for] firewood a lot in land concessions.
>
> Firstly, they cut the inside of the forest and just leave the forest next to the road standing, to prevent [themselves] being watched by other people … Based on my perception, I think Prey Lang will soon be cleared. Now the big forest has been cleared in Prey Lang. I can say now 95 or 99% of the forest has gone." — Wood Seller, Kampong Thom, March 2021

Similarly, in Preah Vihear province, one local woman explained how increasing regulation had served predominantly to push control of deforestation further into the hands of the biggest local actors:

> "Yes, they do [cut it secretly, but] only the big people. I mean the big people use the small people to cut the wood for them. If the small people cut the wood for themselves, they will be caught, but if the small people cut the wood for the big people, it is OK. It is corruption …
>
> As far as I know, now it is strict, so before they go to the forest, they need to pay money first to the authorities. In the end, after that [the people who cut it] have nothing left. The profit from the wood is shared to everybody [else]." — Preah Vihear Roadside Seller, March 2021

Indeed, despite the recent crackdown on forest wood usage, evidence from the garment industry suggests that the trade in forest firewood has moved underground, rather than halted. As shown in Figure 7, statistics obtained via a national representative sample of workers associated with 255 GMAC registered factories (of which 158 yielded responses) indicated that 32% of factories used forest wood either exclusively or in combination with other fuels, whilst 13.9% burned garment wast produced in the factory itself, either exclusively or in combination. For comparison, only 36.1% depended exclusively on mains power or generator usage, highlighting the widespread prevalence of carbon intensive small-scale combustion within the industry as a whole.

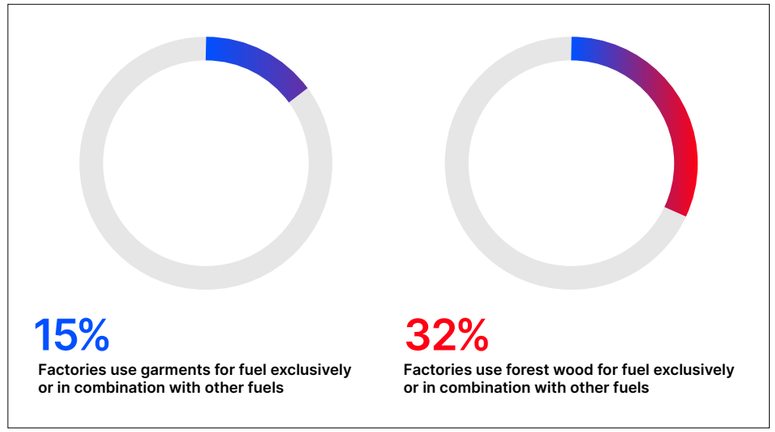


Figure 7. Fuel use by garment factories in Cambodia.[93]

Garment burning, a practice known both for its carbon intensity and its release of multiple toxic substances in the local environment,[94] is an issue rather more widespread than noted in previous reporting on the issue.[95] Yet it is firewood burning that presents arguably the larger issue, in view of the dual problem engendered by its usage. The survey results suggest that each factory burning firewood utilises a daily average of 3.25 tons. Extrapolated to the 31% of 558 GMAC member factories nationwide burning firewood, this indicates an average of 562 tons of forest wood being burned by the Cambodian garment industry every day, or 205,130 tons, equivalent to 810 to 1,418 hectares of forest being burned each year. It should be noted also that, due to the large number of non-responses, including from factories known to burn very high volumes of forest wood, this figure is likely to be a substantial underestimate.

In addition to the carbon emissions associated with production, therefore, the contribution of the industry to Cambodia's 'alarming rate of deforestation'[96] represents a substantial concern in its own right. The ongoing loss of forest cover, still occurring at one of the fastest rates in the world,[97] is contributing to widespread local environmental degradation, the loss of habits and ecological diversity. Linked to this, moreover, the experience of countries suffering similar rates of deforestation suggests that it may also have a role to play in intensifying Cambodia's struggles with drought. Elsewhere, rates of deforestation have been statistically linked to dry season intensity in the Amazon,[98] whilst the 'experiences of African countries demonstrate that the removal of forest cover increases incidents of flash floods and worsens the effects of droughts'.[99] Although similar trends have been difficult to extricate in Cambodia due to the range of confounding contributory factors, not least the frequency of El Niño events, which have worsened droughts in recent years,[100] local climate narratives unequivocally support this relationship. As villagers in Kampong Speu province, one of Cambodia's most drought-hit explained:

> "[Drought] has happened every year since 2003. In 2003, there was drought for the whole year. After that, the rain was not regular. Old people always said that since the forest has gone, the rain has never been regular anymore … For rich people, they can buy a water pipe for 200 or 300 meters to pump water to their farm, [but] for the poor, they cannot do anything. They just watch the rice dying …
>
> From this area till Koh Kong province, the forest was cut down or cleared [and] the rain is not regular as it was in the past. In [former King] Sihanouk's time [broadly 1941-2004], there was so much forest. Now the forest is very thin, the rain is irregular, the forest is gone and even the firewood has almost gone." — Kampong Speu Farmer, March 2021

Compounding the wider issue of Cambodia's changing rainfall patterns is the local problem of water usage by garment factories, most of which is unmeasured and unregulated despite the substantial volume utilised by the industry. Garment factories located in Kampong Speu province, for example, have been criticised by nearby residents for their abuse of local water resources in recent years, placing further pressure of scare water resources, even as the country as a whole – and Kampong Speu in particular – has been gripped by water scarcity and drought. Local residents complained that:

> "In the past, there were five wells in my village that the Prasac and World Bank organizations had made for us. Later on, they did not have water anymore. Before the garment factories were established here, we could get water at a depth of 22 meters from the wells. After the garment factory made their wells too, then our wells did not have any more water. In the last two years, the factory wells ran out of water as well and then they used the water from the canal." — Kampong Speu Petty Trader, March 2021

As a local official tasked with the measurement of water resources acknowledged, this has been a known issue in the district, only recently alleviated by the construction of a water delivery system for some of the factories in the province. As he explained:

> "Regarding the wells, they have broken down. Like at the North side [of the district], factories made a lot of wells at the time there was not a [separate] water system yet. But our wells, we made before them and they were shallower than the wells the factory made later on, so now they don't have any water." — Kampong Speu Provincial Department of Water Resources and Meteorology Official, March 2021

The disaster footprint of UK garment production in Cambodia is therefore a complex one, incorporating an array of environmental issues linked to production for UK consumers. Beyond the purview of UK environmental regulations as they are, Cambodian garment factories produce pollutants in such a way as to intensify the impact of climate-linked disasters at both the local and the national scale. Not only does large scale deforestation engender a higher likelihood of droughts – a phenomenon regularly bemoaned by the 80% of Cambodians who live in rural areas and the 42% who depend on primary agriculture for their livelihoods (UNDP, 2019) – but local impacts, similarly, may be seen to exacerbate the impacts of climate change. From toxic smoke to liquid waste, small-scale, but widely replicated hazards such as these ultimately serve to compound pressures on livelihoods and health, even as they contribute more broadly to the atmospheric emissions under-girding global environmental change.

A wood depot outside a major exporting garment factory in Cambodia. At full capacity, large factories like this one burn thousands of tons of forest wood every week to generate power for production processes.

Part 4

Bricks

The UK is the world's largest importer of bricks, importing over 400 million each year. A growing proportion of these bricks are produced in the South Asian 'brick belt' where they produced in dangerous and exploitative conditions. Long distance transport and carbon intensive production processes, mean that a brick imported from South Asia 'costs' almost triple the carbon emissions of a domestic brick. And there is also a local cost. Brick production in South Asia enhances disaster risk, intensifying the impacts of climate change for communities in the vicinity of production.

Workers collect fired bricks in a brick factory in Narsingdi, near Dhaka.

Urban areas and their construction are increasingly recognised as major contributors to climate change, with the built environment currently responsible for 39% of energy-related carbon dioxide emissions worldwide.

We are living, for the first time in history, in an urban world. By 2008, more than half of the world's population was living in towns and cities:[101] a development with profound implications for sustainability. Urban areas and their construction are increasingly recognised as major contributors to climate change, with the built environment currently responsible for 39% of energy-related carbon dioxide emissions worldwide.[102] Yet what makes this is a somewhat intractable issue is the diversity of impacts. 28% of these emissions are due to the energy used within existing buildings (17% residential and 11% non-residential), while the remaining 11% are due to the construction processes for new buildings and infrastructure.[103]

Moreover, there is a further hidden cost to construction in the form of black carbon, or soot. Some 20% of global black carbon is attributable specifically to brick kilns, 90% of which are in central Asia.[104] Not only is it a dangerous local pollutant, highly damaging to human and environmental health, but – despite its absence from most greenhouse gas reporting – is also considered to have a significant effect on global warming.[105]

These two dimensions of environmental impact compound one another, undermining the viability of rural livelihoods through a combination of climatic precarity and local environmental degradation. As a result of their impact on farming, they serve indirectly to drive urbanisation by incentivising migration away from rural areas and contributing to the very processes of urbanisation that are fuelling demand for bricks.[106] By degrading agricultural livelihoods in the periphery of cities, brick kilns exacerbate the impacts of climate change, encouraging urbanisation through migration away from the vicinity of kiln sites[107] and contributing to rapid land use change in countries like Bangladesh, where 1% of land area transitions away from agriculture each year.[108]

Viewed in this context, both the impact of the built environment and responsibility for it are becoming increasingly geographically complex. Upfront carbon – carbon emissions released in material sourcing and transport before a building or infrastructure begins to be used – will be responsible for half of the entire carbon footprint of new construction between now and 2050.[109] This has been a rapidly growing phenomenon as construction has rapidly increased in developing countries. Over the last 40 years, global material use has tripled.[110]

However, the number of countries who are net importers of raw materials – including materials such as sand, gravel and metal ores which play a crucial role in construction – is rising rapidly, both in the West and emerging economies of the Asia and Pacific region.[111] This reflects a shift in the global economy with 'numerous countries shifting to becoming net importers of resources, but very few switching to becoming net exporters'.[112] In this context, national accounting of the built environment's environmental impact is increasingly unfit for purpose.

A brick factory on the outskirts of Dhaka. Brick factories like this generate air pollution and excess heat that are damaging to local people and agriculture.

4.1

The hidden carbon footprint of imported bricks

The excess carbon 'cost' of a house built with imported over domestic bricks would be 5280kg: over 13,000 vehicle miles, or burning 12 barrels of oil.

As the UK economy transitions ever further from manufacturing – with the sector declining from 16.7% of GDP in 1990 to 8.6% in 2019[113] – the nation's own urban infrastructure is becoming ever more prone to carbon embodied in the burgeoning global trade in materials. That the UK is now the world's sixth biggest importer of raw materials[114] highlights the pressing relevance of the issue, yet specific examples from the construction industry highlight the shortcomings of domestic environmental policy more starkly. The anticipated shift in trade towards non-European partners following Brexit is expected to exacerbate this discrepancy, ultimately engendering a rise in imported emissions of between 5 and 11%, depending on the scale of the shift towards non-EU trading partners.[115]

Within this darker picture of UK emissions, a worrying trend is emerging. Domestic brick production is insufficient to meet demand, leaving the UK facing a 'brick deficit' of more than half a billion bricks per year.[116] The result has been a rise in brick imports to more than 400 million per year, predominantly from the EU but increasingly from global Southern countries such as China, India, Pakistan and Bangladesh.[117]

The UK now imports over 16% of its total brick stock, the highest proportion in the world,[118] yet the embodied carbon associated with these imports has yet to be fully accounted for in policy responses. The wider environmental and social footprint of these additional bricks being produced in nations recognised as a source of key humanitarian and socioeconomic issues, including modern slavery,[119] has similarly been ignored in UK policy.

When it comes to brick imports, distance is key. Within the EU as a whole, the weighted average carbon emissions per brick amounts to 0.42 kg CO_2e per brick, an addition of carbon through transport of only 0.02kg CO_2e per brick, around 6% of the manufacturing emissions and thus within the traditionally estimated range[120] that transport emissions account for around 9% of the total emissions involved in the lifecycle of a brick. Nevertheless, this is a by no means universal picture. The large scale of the EU means that there is substantial variation in transport emissions within the block itself, depending on the country exporting to the UK. Bricks from Portugal, for example, 'cost' an additional 0.14kg of CO_2 emissions per brick, an extra 35% over manufacturing emissions. Bricks from Italy, similarly, 'cost' an additional 0.31kg of CO_2 to transport to the UK, an excess of 70% over the emissions generated in production.

Non-EU bricks imported to the UK carry average embodied emissions of 1.11kg per brick on arrival: 2.5 times more than UK bricks.

With regard to the emissions embodied in UK construction, this is cause for significant concern. On average, the transportation costs associated with brick imports ensure that they are associated with a considerably higher volume of CO_2 emissions than domestically produced bricks. Moreover, the situation is worsening. As brick imports increase, the trajectory is towards longer distance imports and thus higher level of emissions embodied in transportation. Within the varied landscape of UK brick imports, the historical dominance of the geographically closest importing countries – specifically Belgium and the Netherlands, which supplied 58% and 32% of EU brick imports to the UK respectively in the last 5 years – is fading. Geographically further removed countries such as Italy and Portugal are increasing as a share of the total, even as the total volume of imports itself increases. And the trend of greatest relevance lies further afield still. A growing proportion of bricks are now arriving in the UK from sources in the global South producers such as India, China, Pakistan and Turkey. Given the far greater distances involved in transporting bricks from major non-EU exporting countries, the carbon emissions embodied in brick imports from these non-EU sources are far higher.

Taken as a whole, the transportation emissions associated with non-EU brick imports is 0.56kg CO_2e per brick: far higher than bricks imported from the EU. Combined with higher levels of emissions released in production compared with UK brick production processes 0.55kg / brick compared with 0.45 kg / brick, this means that non-EU bricks imported to the UK carry average embodied emissions of 1.11kg per brick on arrival: 2.5 times more than UK bricks, or an excess carbon cost of 0.66kg per brick. A standard house built with 8000 of these bricks would therefore 'cost' 9000kg of CO_2 emissions, equivalent to a car driving 23,000 miles. The excess carbon cost alone (i.e. compared to the equivalent house built with domestically produced bricks) would be 5280kg: over 13,000 vehicle miles, or burning 12 barrels of oil.

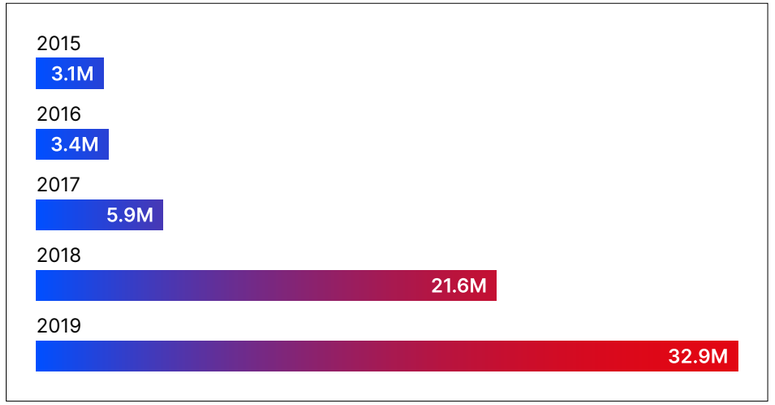


Figure 8. Growth in non-EU brick imports to the UK over time.

In the context of the pressing need to reduce the UK's carbon footprint, these figures are clearly cause for concern. Whilst brick importation from the global South in this way is a relatively new phenomenon, it is one that is growing rapidly. In 2015, the proportion of imported bricks arriving to the UK from outside the EU amounted to just 1.1%, but within five years this had increased to 8.8%.[121] This proportional rise, moreover, is in the context of an overall increase in brick imports, meaning that the number of bricks imported from outside the EU increased more than tenfold between 2015 and 2019, from 3,088,902 to 32,942,280.[122] Yet from a carbon accounting perspective, the scale of the increase is starker still. The exceptionally high transportation emissions associated with brick imports from the global South mean that they carry an outsize influence, accounting for 25.5% of all emissions from brick imports in 2019.

Given the rate of increase, the key issue to consider is what is driving these trends. This is a question with multiple answers, the first and most obvious of which is price. Bricks sourced in Bangladesh, for example cost £50 to £120 per 1000 bricks depending on production type and cost,[123] whilst in India 1000 bricks costs on average £54.75,[124] a tiny fraction of the £686 charged on average for the same number of bricks in the UK.[125] Even when factoring in the cost of transporting those bricks, estimated at £39.51 based on a full 40-foot container of bricks,[126] the financial incentive to import bricks remains substantial.

Coupled to these financial incentives is the lack of regulation with which the importation of construction materials of this sort is associated. Indeed, far from successfully regulating the estimated 620 tons of CO_2e emitted in the journey of a 40-foot container full of bricks from South Asia, UK environmental legislation does not currently require even a disclosure of the emissions and environmental impacts associated with corporate supply chains. Rather, as noted above in relation to garment imports, the two key pieces of current legislation covering environmental reporting remain the Directors' Report for companies and the Energy and Carbon Report for Limited Liability Partnerships, both of which require the disclosure of greenhouse gas emissions. Linked to this, DEFRA provides specific guidelines for Scope 1 (direct emissions) and Scope 2 (purchased energy) emissions. Yet reporting on Scope 3 (supply chain emissions) is discretionary even within the voluntary guidance as a whole.

Beyond this, UK environmental policy on material imports – as well as more broadly – is governed predominantly by three statutes. First, the Climate Change Act (2008), which aims to reduce UK carbon emissions by at least 80% by 2050, but whose targets, though ambitious, refer to domestic emissions only. Second, the Planning and Energy Act (2008), allows planning authorities in England and Wales to impose energy use and efficiency requirements on local planning applications. Yet whilst this statute covers construction efficiencies, imported and embodied material emissions are not assessed. Finally, the Energy Act 2011 requires energy providers to meet certain energy efficiency requirements relating to carbon emissions and home energy wastage. Again, however, energy efficiency relating to overseas energy production and its implications for manufacturing imports are beyond the remit of the act. Thus, although each of these legal frameworks speaks to one dimension of brick importation, none extends to the meaningful regulation of this, or other similar, practices.

This lack of legal coverage for imported materials exemplifies how bulk imports of this sort fall through the cracks of environmental governance. It is an issue of cross-cutting relevance to multiple government and non-government agencies, yet the international, displaced nature of the environmental impact dislocates it beyond the reach of regulation. Brick kilns are recognized as one of the largest stationary sources of black carbon[127] and are 'stringently' regulated by Defra within the UK's borders,[128] but remain the top air polluter in Bangladesh[129] and a key environmental challenge in numerous other South Asian brick exporters to the UK.[130]

Moreover, the UK is far from alone in this problem. In the EU, the Energy Performance of Buildings Directive (2002) has driven building regulations in all member states to require increasing operational energy efficiency performance from 'regulated' energy, including fixed lighting, and space and water heating and cooling. Yet embodied energy, from construction materials, was and continues to be excluded from the Directive. Indeed, as Becque et al., point out of the EU as a whole:

> 'The European Union is broadly credited with reducing its emissions of greenhouse gases (GHGs) and is on track to meet its goal of a 20% reduction in GHGs in 2020 compared to 1990 levels. But a full lifecycle accounting of European member state carbon emissions, including those emissions caused through consumption of imported goods, tells a different story: Under this accounting method, EU emissions have actually grown by 11% – with some nations seeing substantially higher emissions growth than others.'[131]

As these examples highlight, rather than ensuring a meaningful reduction in real terms emissions, the domestic accounting of emissions targets ultimately serves to undermine their efficacy by incentivising the exporting of emissions overseas. Referred to as 'displacement',[132] or 'carbon leakage',[133] this is a widespread phenomenon that represents a major obstacle to the efficacy of environmental regulation. Moreover, as highlighted in the contextual data outlined below, the carbon dimension of brick importation is only one element within a wider process of articulated environmental damage. In the South Asian brick belt, from where the majority of the UK's non-EU bricks originate, climate change is not only hastened by unregulated and unaccounted emissions, but directed and intensified in its impacts by the mechanics of international trade.

4.2

Labour rights and the brick trade

Figure 9. Distribution of brick kilns in the South Asian 'Brick Belt'.[218]

The South Asian 'brick belt' covers a total area of 1,551,997 km^2, extending from Pakistan in the West, via Northern India and Nepal, to Bangladesh in the East and encompassing an estimated 55,387 kilns.[134] The carbon intensive processes utilised by this vast collection of kilns, alongside high levels of 'black carbon' emissions,[135] makes them a key contributor to climate change, responsible for an estimated 131 tons of CO_2 per kiln annually[136] and a total of 7,255,697 tonnes of CO_2 each year across the brick belt as a whole.[137] Brick production in the South Asian brick belt has been widely noted for the dirty, dangerous and often degrading conditions in which work takes place.

“I feel weak due to the heat from the fire. My head gets hot. My skin has deteriorated as well. I feel terrible breathing in the fumes from the burning coal gas.”

As highlighted in a range of reports on the issue[138] many of the industry’s labourers are debt bonded, made to work – alongside their families in many cases – in unhealthy and sometimes lethal conditions to pay off interest on long term debts accrued outside of the kiln. Viewed on its own terms, this is an issue of considerable significance. Whether classified as modern slavery, as has been the case in some quarters,[139] or merely highly exploitative labour,[140] it has been flagged by monitoring bodies as contravening human rights related to employment, including Universal Declaration of Human Rights Article 4 ‘Freedom from Slavery’ and the UN’s Sustainable Development Goal 8 on Economic Growth and Decent Work.

Across India, for example, brick kilns are notorious spaces of labour exploitation with low, mostly piece-rate, wages for long hours of work and wage arrangements centred around debt bondage to keep workers attached to the kiln for months or years on end. The labouring population working in brick kilns often consists of some of the poorest and marginalized sections of India’s informal workforce.[141] Child labour is widely prevalent, workplace hazards are common and living conditions are generally poor.[142] Moreover, this is a widely known issue. Reflecting these conditions, brick kilns also frequently featured in domestic and international news coverage. Indian brick workers have been reported in the international media as ‘living like slaves’[143] as sites of abuse, physical and sexual violence inflicted by owners and managers upon workers.

Workers collect fired bricks in a brick factory in Narsingdi, near Dhaka.

In Bangladesh, conditions are similarly harsh. As in India, the brick industry has boomed in recent years. An estimated 7,759 brick kilns produce 34 billion bricks each year in Bangladesh,[144] whilst the sector now accounts for approximately 1 percent of the country's GDP, employing more than a million people.[145] Yet work in brick kilns continues to be associated with a range of serious health hazards, including harmful chemicals in dust, ash and smoke.[146] Bricks, as in India, are made throughout the hottest part of the year, during which time workers are compelled to work in the intensity of direct sunlight with little access to shade.[147] Child labour, as in much of the brick belt, is illegal but endemic,[148] whilst national and international news outlets continue to report on the 'inhuman torture' facing workers.[149]

Although considerable media and policy attention has been directed towards labour conditions in the South Asian brick belt in recent years, the issues faced by the industry have generally been seen as domestic, a matter for the territories in which such abuses occur. Nevertheless, the growing practice of brick export to countries such as the UK changes this. Kilns in Gujarat and Punjab, for example, make up a large part of the 10 million bricks arriving from India in 2019. As the owner of one such kiln in Gujarat explained:

"Our bricks only go to the UK. Those bricks are unlabelled, without our kiln's name. The bricks are of a different size to the standard and have a good polish. We measure it up to the millimetre and reject any bricks that are substandard [workers aren't paid anything extra for the bricks made for UK, but the same piece rate]. We work according to orders. We take an advance of up to 30% on the orders from abroad." — Kiln Owner 2, Gujarat, April 2021

In the words of a second kiln owner:

"Even with COVID, the demand for our bricks is still high. All our work is done through labour contractors. Workers are paid on a piece rate basis. The price of the bricks we make range from Rs.7 to Rs. 80 (0.067 to 0.77 GBP) per brick [whilst] the export quality bricks begin from Rs.40 per brick. Our suppliers are based in Delhi, and that is from where we get our orders. And then we export it through Mundhra port. Our work is to transport it to Mundhra, and the rest of the exporting is done by the supplier firms." — Kiln Owner 1, Gujarat, April 2021

Nevertheless, although the quality and price of the export-oriented products may be higher, the conditions in which they are made are largely indistinct from those which prevail throughout the brick belt. Many brick workers are driven to the industry due to worsening environmental conditions, many of which are linked to the region's high vulnerability to climate change. As one worker in an exporting kiln in Bangladesh explained, for example:

"In my village drought is very common environmental hazards during the dry season. Due to extreme drought we could not produce our crops." — Alim Mia, March 2021

Similarly, as a second Bangladeshi brick export brick producer noted, the pressing issue of soil salinity engendered by the county's growing vulnerability to rising sea levels was a key factor in this departure of the industry. In his words, "in my village salinity is a very common environmental hazard. Due to extreme salinity in soil and water farmers could not cultivate their lands."

Child labour, as in much of the brick belt, is illegal but endemic.

A young brick worker transports bricks near Dhaka. Child labour is commonplace throughout the global brick industry.

Linked to and often emerging from these environmental factors, familial issues also played a key role in driving entry to the kilns. As one worker in Gujarat noted: "currently, there is no other work for me to do. So, [since] this work is going on, we came to the kiln because our financial condition was really bad." — Migrant 2, March 2021. A second worker, working near Dhaka, explained:

> "I don't have my own house in my village, we live in government housing. I wanted to buy my own land and build a house there, but I can't afford to. All my costs keep increasing. I have to spend more than I am earning. I'm paying for my elder sister's wedding with the money I'm earning here". — Johirul Islam, February 2021

Another worker in Gujarat explained how, in the absence of alternatives, bereavement had led her and her son to enter brick work:

> "Our village's land is stony. The only work is mining stone and sand, which I worked in both. But both are stopped now because owners have switched to a contract-based system. We used to make just about enough there for running the household. There was no other work elsewhere, so we managed this. After the death of my husband, I had to come here. I also had to get one of my sons out of school because of the economic hardship". — Migrant 6, April 2021

Workers at the kilns complain of the hardship of work in the kilns, which leaves them in frequent pain. In the words of one Gujarati worker, "the work is quite laborious, my whole body is in pain, my hands are hurting" — Wife of Migrant 2, March 2021. Workers complain of degrading conditions and a lack of basic facilities in the workplace. As a second worker stated: "we have to go [to the toilet] in the fields. Sometimes farm owners see us going in their fields and come with sticks to beat us" — Migrant 3, March 2021. As a third worker from the same region elaborated, work in the kilns is far harder than they are used to, both in terms of the work itself and the living conditions that surround it:

> "At our village home, we have a fan, a TV, a fridge. Here we don't have any of those comforts, but we have to come here for work. It gets really hot and we have to manage with it. There is no work in the village. The work in the kiln is painful, I have constant pain in my hands. I have to wake up at 4 AM in the morning during summer and work till 8 AM. The most difficult working period is during July." — Migrant 3, March 2021

Similar stories prevail across the brick belt, as exemplified by testimonies from the Bangladeshi brick industry, where workers complain of acute pain and physical degradation. As one Bangladeshi brick worker producing bricks for the export market explained, "our factory produces bricks with automated machines. In this case, we have to prepare soil by mixing it. Sometimes I feel a burning sensation on my skin, after I have been working constantly for long hours." — Alim Mia, March 2021. Morever, as a worker in a second kiln, in Narsinghi, attested, the long term impacts of brick work can extend beyond external discomfort:

"After the death of my husband, I had to come here. I also had to get one of my sons out of school because of the economic hardship."

> "I feel weak due to the heat from the fire. My head gets hot. My skin has deteriorated as well. I feel terrible breathing in the fumes from the burning coal gas. They can find coal debris in my body when I get checkups done, so I get coughing and colds as well." — Johirol Islam, February 2021

Even in these export-oriented brick kilns, debt continues to play a role in keeping workers in place. Kiln owners offer advances on their salaries, stating that "we give advances to the workers. We give debts when they have no work or need money, and then deduct it from their pay" — Kiln Owner 2, March 2021. Workers take on these debts as a result of household expenses and also to cover lifecycle costs, such as weddings. As one worker put it, "If we have any trouble at home, we borrow from the kiln owner, with no or minimal interest." — Migrant 6, March 2021. A further worker explained that:

> "I have taken money from owner (advance) because my son has to marry. In our community, the son's side has to pay bride price, and around Rs.200,000 (1925 GBP) to the girl's parent. The owner doesn't take any interest on the loan, and gradually deducts it from our wages." — Migrant 6

Nevertheless, although these debts are often framed as ad hoc transactions, the use of 'advances' of this sort is often used as a means by which to ensure that workers remain with the kiln throughout the dry season, even when wet days interrupt production. As one worker explained:

> "We don't take debt from the owner. But the owner gives us an advance in the beginning to make us come to the kiln, and deducts it from our wages in the end. Whenever we want to have money though, we take money from the owner, and don't have to return, and owner deducts it from the wages. When it rains, the owner gives us Rs.100 [0.96 GBP] per day as compensation for not being able to do any work, this is because we are locals and could leave the site to find work elsewhere. We, Banjaras, have a reputation for being hardworking and the owner doesn't want to lose us." — Migrant 2, March 2021

As a second worker explained, this advance from the brick kiln owner in some cases take the form of providing an entire seasonal salary upfront, leaving workers effectively bonded to the kiln for six months, unable to leave or find work elsewhere:

> "I receive BDT 60,000 for 6 months work. I was paid the whole amount in advance before coming here to work. My living costs here are covered entirely by my employer and I am also given a BDT 300 weekly allowance. I will not be getting anymore money once I am done with my work here." — Md. Monir Mia, February 2021

These arrangements are by no means unusual. Reflective as they are of dirty, dangerous and poorly paid working environments, stories such as these are typical of a notorious industry encompassing tens of thousands of kilns. Nevertheless, that they can be found with equal ease in an export oriented industry in which bricks sell for up to Rs.40 (0.39 GBP) each – almost ten times the price of a brick for domestic consumption at Rs. 4.5 (0.044 GBP) – is notable, reflecting as it does how little of the additional cost of exported bricks is passed on to workers themselves. Even in highly mechanised, export oriented kilns, where imported machinery facilitates the production of UK-oriented bricks with nostalgically British product names such as Imperial Red, Rustica London Stock and Suffolk Multi, there remains very little difference in wages or labour standards, compared with kilns focused purely on domestic production. Nor, similarly, is there an observable reduction in the incidence of child labor.

Furthermore, beyond these highly mechanised firms, there is a further layer of sub-contracted brick manufacturing, where firms predominantly providing domestic materials undertake orders for middlemen who subsequently sell and ship their wares abroad to international buyers such as the UK. An example of this type of operations is the kiln explored here in Godhra in Gujarat, where the nearby port of Mundra, one of the largest in India, provides ample opportunities for export. Bricks produced in kilns such as these are similar to the ones made for the local market, only with further quality checking for imperfections. Besides this additional quality control, they are indistinguishable from the billions of bricks produced annually throughout the brick belt.

Bricks exported to the UK from India and Bangladesh are therefore associated with conditions notorious throughout the brick belt more broadly. Work is undertaken in hard and hazardous conditions, in an environment so filled with brick dust and sand that it is difficult for those unused to it even to open their eyes. During the hottest part of the year, temperatures above the kiln, where firemen spend their days stoking the flames to ensure even burning, can rise above 60 or even 65 degrees Celsius. These workers, recognisable by the coating of black coal dust on their skin, wear wooden slippers while working, because rubber soles melt in a few minutes where they stand.

Working conditions such as these, in which almost 24 million bricks are produced for the UK each year in brick belt countries, are clearly a cause for concern in themselves. Yet even beyond the labourers who produce these bricks, there is a wider environmental implication. In addition to the substantial carbon footprint of exported bricks, production for export is associated with local environmental effects that direct and intensify the impacts of climate change, worsening its impacts in South Asia in the service of the UK's housing stock.

A Bangladeshi brick worker rests after a hard day's work. The brick industry both in South Asia is notoriously unhealthy and physically draining.

4.3

Environmental destruction and the brick trade in Bangladesh and India

The impact of unregulated brick production overseas – combined with the additional carbon embodied in transporting them – has substantial implications for the UK's consumed carbon footprint. Yet alongside their contribution to global emissions, production practices such as those undertaken in the brick belt serve also to exacerbate the impacts of climate change, enhancing current and future vulnerabilities, and structural inequalities through investment practices. In countries such as Bangladesh and India, brick production is associated with 'toxic fumes and atrocious working conditions',[150] alongside growing concerns over the impact of air pollution and massive topsoil harvesting for the brick industry on local people's ability to sustain traditional livelihoods.[151]

The impact of brick production in South Asia is felt in both human and environmental health. In the first instance, brick kilns are notorious for their impacts on the health not only of workers, but the surrounding populations also. In Bangladesh, one local man living in the vicinity of brick kilns complained that "our skin becomes black while the raw bricks are burnt in the kiln. I learnt that this smoke can cause cancer." — Rayhan Alam, Petty Trader and Agricultural Worker, February 2021. A second, living beside a second kiln, confirmed "those who are living near the brick kilns, they are suffering a lot. Those who are living within 5 kilometres of the kiln, they are acutely suffering." — Jakaria Ahamed, Livestock Farmer and Petty Trader, February 2021. Similar stories were repeated by locals living near multiple kilns near Dhaka. One farmer and petty trader explained that:

Farmers incur immense losses due to the smoke, as major portions of the crops are damaged by the poisonous gas and heat of brick production.

> "Smoke from brick production is affecting the health of local people. Local people's shortness of breath is increasing, especially when they leave the house in the morning. Then I see everything [looks] dark because of the smoke. There is a strong stench. Our body is always covered with the dust and sand particles. The skin of the people here becomes completely black. Children, the old and people of all classes in the area are being affected by this trend. Not only people but also animals, birds and cattle are being affected by this." — Alamgir Bhuiyan, Farmer and Petty Trader, February 2021

Similarly, the owner of a fertiliser business near Dhaka related:

> "In the morning, it seems as if a gas has formed. You can't look ahead, your eyes burn a lot. The atmosphere is getting heated due to the smoke from the brick kiln, as a result of which people are getting infected with various diseases. Consequently, the average life expectancy is declining day by day. People are getting weak at a young age. Children are being affected the most. Again, those who are a little physically weak are also being attacked." — Ataur Rahman Bhuiyan, Fertiliser Business, February 2021

As evidenced by the testimonies of local residents, airborne and heat pollution linked to the brick kilns are critical everyday issues for local people, who face their own health degrading in parallel to that of their local environment. Nevertheless, whilst these acute hazards decline outside of the months of production, the wider impacts of the industry in terms of shaping the impacts of climate change are both enduring and cumulative, engendering both heightened vulnerability and intensified impacts to floods and droughts in the vicinity. In circular fashion, this is an issue both driven by and contributing to the impacts of drought. Threatened by increasingly unreliable rainfall in areas traditionally reliant on rain-fed rice paddy,[152] many farmers are willing to sell parts of their topsoil to the brick industry to be processed into clay. As one local farmer from Gujarat, who had not yet sold any land explained:

"Brick kiln owners extract soil deeply from the land, which brings a high risk of collapse. We have seen a lot of land collapse due to the extraction soil in the nearby areas."

Bangladeshi brick workers collect soil to mould bricks.

Brick workers arrange bricks for firing. This traditional system of brick production is largely unchanged for centuries.

"Some people sell their soil because they don't have access to borewell water. Many people here don't have access to groundwater through borewells. In summer there is no water in the canal or the river. This is a drought prone area." — Local 4, April 2021

As a second Gujarati farmer, who had already sold his soil for these reasons, confirmed, the lack of water available to him for farming was a key factor in his selling part of his land to the kiln. Indeed, this soil sale formed part of a wider scheme to continue farming by digging a bore well to irrigate the remainder of his rice field:

"Because we did not have groundwater access, we took the kiln's offer to level our field, to dig a borewell on our land and give a motor pump in exchange for the soil, instead of paying money. There is a river nearby, but it is mostly dry or shallow. There are not any canals or reliable surface modes of irrigation in the village." — Local 2, April 2021

Nevertheless, although farmers selling land to the brick industry tended to calculate the costs and benefits of doing so on a household basis, their doing so has wider implications for the local farming community. As a farmer and local businessman in Narshingdi, on the outskirts of Dhaka, explained:

"The local land is in extreme danger due to the collection of topsoil. The land around the area they are cutting out has collapsed and the hole gets filled by [dirt] again. Soil is being carried away by the trucks, which run over the land surrounding the part where the soil was extracted, leaving it in a dangerous condition. Afterwards, due to the accumulation of water in the hole, the surrounding lands are also unstable, which leads to their collapse." — Alamgir Bhuiyan, February 2021

"The local land is in extreme danger due to the collection of topsoil. The land around the area they are cutting out has collapsed and the hole gets filled by dirt again."

Not only is this an issue for farmers in the immediate term, rendering it "not possible to cultivate the adjacent land due to the cutting of soil" — Asharf Uddin Fakir, Farmer and Fisher, February 2021, but locals fear longer term implications for the integrity of their surrounding lands. As a teacher in the local school argued:

"Brick kiln owners extract soil deeply from the land, which brings a high risk of collapse. We have seen a lot of land collapse due to the extraction soil in the nearby areas. We will see the worst impact after 20 – 30 years, but I think the potential for landslides [in this area] depends on the depth of soil extraction from the land." — Md. Monurujjaman Bhuiyan, February 2021

Land collapse due to the overexploitation by the brick industry therefore presents a key risk to affected farmers in Bangladesh, as it does elsewhere in the brick belt. Nevertheless, as farmers in the local area elaborated, it is only one dimension of the wider environmental challenges brough about by large scale topsoil removal. In Bangladesh, a country badly affected by droughts and floods made more frequent and damaging through climate change,[153] soil harvesting by brick kilns is intensifying the impacts of climatic pressures by disrupting flows of water in the vicinity of brick kilns and impacting the livelihood of subsistence and smallholder farmers.[154]

"The water flow changes due to soil extraction. Due to the brick kiln, the water of the area cannot pass on rainy days, causing water logging. As a result, the agricultural lands of the area become stagnated, so farmers cannot cultivate their lands."

By lowering one section of land within an agricultural landscape dependent on capturing a high volume of rainwater, this reshaped topography of the landscape alters hydrological flows in the area, creating a draining effect that accentuates water shortage in surrounding fields. Consequently, the widespread topographical changes arising from the brick industry's hunger for topsoil are well understood throughout the brick belt, as too are its impacts on agricultural livelihoods. As a local factory worker living near one of these kilns explained:

> "The water flow changes due to soil extraction. Due to the brick kiln, the water of the area cannot pass on rainy days, causing water logging. As a result, the agricultural lands of the area become stagnated, [so] farmers cannot cultivate their lands." — Hafizullah, Factory Worker, February 2021

As a result of these changes, "the environment is being extensively damaged" due to persistent water logging leading to the rotting of crops and soil — Ataur Rahman Bhuiyan, Fertiliser Business, February 2021. Moreover, as an agricultural and construction worker nearby outlined, the loss of tracts of topsoil increases vulnerability to both flood and drought, even within the same area and in the same year:

> "There are changes to water flow due to the cutting out of topsoil from the croplands. Water cannot pass properly through the channels, which results in water logging in the lands. As most of the kilns are situated in a somewhat higher place [than the surrounding lands], our area goes under water during the monsoon period, which damages the fertility of the land. Consequently, during dry season the earth is dried up like a drought. Earlier, we could produce crops in two seasons. Now we are to produce [only] one season of crops. Stagnant water is [also] dangerous for many kinds of bacteria and leads to infection from water-borne diseases among the people." — Ismail Hossain, Agricultural Worker and Construction Worker, Dhaka Tribune, 2019

Faced with these issues, local people have in many cases sought unsuccessfully to protest against the presence of brick kilns in their area. As locals in Narshingdi, near Dhaka, related: "we demanded to remove the brick kilns from our area [so] we could at least save our lands. But we were not able to continue our protest against the brick kilns as the brick kiln owners have political power. They can influence the local administration." — Rabiul Hasan, February 2021.

Indeed, the political connections possessed by brick kiln owners was a recurring theme across all of the sites explored here. Locals in Gujarat, for example, stated similarly that "the ones who set up kilns are politically powerful. They don't fear any authority, and bribe regularly to get their way. The kilns pay the Pollution Control Officers so that the kilns are not shut down due to pollution." — Surtan Singh, Gujarat, April 2021. Unable to push back against the operations of the brick industry, the intensified climate impacts engendered by soil removal – which render floods and droughts in the local area more common, extensive and damaging – set in motion a vicious cycle of environmental degradation, crop failure and land sale in the local area. As a Gujarati farmer explained:

"If one farmer sells soil to the kiln, then nearby farmers have to sell. Because if his farm is at a low level, then the rain runoff from the other lands gets to his land, and the other lands remain dry and lose their fertility. Out of frustration, the neighbouring farmers sell off their soil to the kiln as well, to make it level."

> "If one farmer sells soil to the kiln, then nearby farmers have to sell. Because if his farm is at a low level, then the rain runoff from the other lands gets to his land, and the other lands remain dry and lose their fertility. Out of frustration, the neighbouring farmers sell off their soil to the kiln as well, to make it level." — Vyanshak, Farmer, April 2021

Similarly, in Narsingdi, locals explained how the environmental impacts engendered by topsoil collection served to reduce the value of nearby lands, thereby further incentivising the practice and accelerating the spread of land sale through the local area:

> "[Our] local land is in a dangerous way due to the collection of topsoil. Nearby lands have collapsed from the extraction of soil [because], due to stagnation of water in the land, the soil…becomes soft and breaks down. As a result, farmers have nothing to do but sell soil from their lands [leaving] the land of the whole area in a dangerous condition. They first cut the soil from the land by offering more money, and then they cut off the soil from the adjacent land with a little money." — Aminul Fakir, Farmer and Tractor Driver, February 2021

As the brick industry rapidly expands across the brick belt, therefore, driven in small but growing part by demand for exported bricks from countries such as the UK, significant swaths of countries such as Bangladesh and India are experiencing a heightened vulnerability to the impacts of the changing climate. Even as the frequency and intensity of droughts and floods increases elsewhere in the area, this increase is greater and more acute where the influence of the brick industry is felt.

Yet these direct articulations of climatic variation are only one dimension of the brick industry's impact on the environment and the livelihoods it supports. Further compounding this cycle of water over-abundance and scarcity, the airborne impacts of brick production play a substantial role in undermining the fertility of local farmers' crops.[155] For many farmers, who have already shifted away from rice production after selling their topsoil to the brick kilns, this means that their efforts at adaptation are once again blocked by industrial impacts on the environment. As locals in Gujarat complain, "the smoke from the kiln cover the trees and they don't fruit or flower." — Vishnupad, Farmer, April 2021. Moreover:

"Yes [the smoke] does affect productivity. I have a mango orchard, and before the kilns there used to be much more production. Now because of the pollution and the dust from the kilns, the trees don't bear fruit anymore. Because of dust, the nearby fields' production is impacted as well." — Varinder, Farmer, April 2021

With the climate-linked impacts of sporadic rainfall accentuated from above and below by the impacts of the brick industry, adapting to the impacts of climate change is increasingly challenging for those dependent on agriculture. Yet compounding both of these issues is less visible issue of environmental heating linked to the continual firing of bricks.

As farmers reported, "because of the heat of the kiln, the plants in the surrounding area don't grow, and trees don't fruit or flower." — Vishnupad, Farmer, April 2021. Moreover, as a second farmer elaborated, "the brick season is for seven months, where [the kiln] is continuously burning. The kiln's heat seeps into the soil, and the groundwater up to fifty meters around the kiln comes up warm." — Varinder, Farmer, April 2021

In Bangladesh, similarly, "farmers incur immense losses due to the smoke, as major portions of the crops are damaged by the poisonous gas and heat of brick production." — Md Guljar Hossain, small businessman, February 2021. As locals describe it, "the paddies are badly burnt due to the emission of toxic gas from the adjacent brickfield. The plants look like they have been scorched, and the leaves and fruits began falling off the trees." — Md Gazi Mokarram, Small Businessman, February 2021. Moreover, as the owner of a local small fertiliser business set out:

"Brickfields are having the biggest impact on agricultural production. Due to the brick kiln the crops become black, vegetation and plants are turning black due to the smoke of the brick kiln. It creates a kind of covering on the leaves which causes the trees to gradually weaken and die. [All of this] results in declining production. From my 32 years of experience, I am saying that before the brick kilns [arrived], the crops that used to be grown here are now less than one tenth [of their former yield]. Due to the brick kiln, the fertility of the soil is declining, as a result of which the land is not yielding as much as before, even after using additional fertilizers and pesticides. [Consequently], although the cost of production for farmers has increased manifold, production is not increasing at that rate." — Ataur Rahman Bhuiyan, Fertiliser Business, February 2021

Given the substantial impact of the brick industry on agriculture, the knock-on effect on the wider village economy is inevitably substantial. Local villagers told stories of growing social problems linked to the kilns, whose owners are protected by their status in the local community. The result, as they outlined, has been large scale out migration from local villages, as more and more farmers find themselves unable to meet the needs of their livelihoods through livelihoods alone:

"The kilns make no positive contribution to the economy of the village, otherwise why would so many villagers migrate out for jobs? There is a lot of alcohol being sold in the village for the workers, who cannot do this laborious task without drinking. Because of [this] rampant alcoholism, many women in the village are widowed." — Local 7, April 2021

This exodus of workers from rural villages, linked in a broader sense to the impacts of climate change, but exacerbated, articulated and rendered acute by the impacts of a brick industry serving the needs of consumers thousands of miles away in the UK. Just as the impacts of the brick kilns on local communities engenders a cycle of environmental degradation, therefore, this process itself feeds into a wider cycle of unregulated urbanisation which is fuelling domestic demand for bricks. Mass migration to urban centres in the brick belt, where newcomers cluster in informal settlements usually established on marginal land and characterised by insecure tenure, poor or next to no provision of basic services, and exposure to environmental hazards,[156] is thus exacerbated by demand for construction materials in the UK. In effect, this constitutes the transmission, via the mechanism of trade, of an industrial shortfall and its environmental impacts across national borders and from one global region to another.

The disaster footprint of brick imports to the UK is therefore a multi-faceted one, incorporating both high levels of emissions generated through the transportation of heavy, low value material across thousands of miles, and local impacts that intensify the impacts of climate change in the vicinity of production. Excess heat, air pollution and soil harvesting are all key dimensions of the footprint of the brick trade, increasing the risk of floods and droughts, whilst decreasing the ability of local residents to respond to these events where they occur. Accounting for both these contributions to climate change is therefore vital in calculating the full environmental impact of the international brick trade, as well as the UK's responsibility for it.

"Now because of the pollution and the dust from the kilns, the trees don't bear fruit anymore."

A worker covered in brick dust. Brick dust is a key source of environmental degradation, reducing agricultural productivity in the vicinity of the kiln.

Part 5

Tea

Climate change is linked to changing rainfall and growing risk of landslides in Sri Lanka. Yet their growing deadliness is rooted not only in changes to the weather, but also degrading local conditions linked to tea production. Tea plantations are intensifiers of landslide risk, raising the population of landslide-prone upland areas, whilst also undermining the integrity of the soil where tea is grown. Many of these plantations are British owned, whilst others produce goods for the British market.

A tea plantation worker stands in front of his house. The cracks behind him are the result of previous landslides nearby.

The need to situate tea plantations on slopes, to avoid waterlogging, in areas associated with monsoon rainfall patterns, places the large number of workers involved in the cultivation of tea crops at heightened risk of landslides.

Tea is the world's most popular drink. Consumed by an estimated 3 billion people each day,[157] the global tea trade amounted to 5.98 million tons in 2017 and is worth an estimated 8 billion USD.[158] It employs 13 million people, 9 million of whom are smallholder farmers, while the remaining 4 million work in tea estates.[159] Yet it is also an industry associated with persistent dangers. The need to situate tea plantations on slopes, to avoid waterlogging, in areas associated with monsoon rainfall patterns,[160] places the large number of workers involved in the cultivation of tea crops at heightened risk of landslides. These local dangers associated with tea production contrast with a relatively innocuous carbon footprint, compared with other everyday commodities such as garments and bricks. In total, it takes approximately 32 kg CO_2e to make one kg of tea, including all processes related to packaging and transportation.[161] Yet its lightness and relatively sparing scale of use (on a per cup basis) places it amongst the less carbon intensive commodities consumed in the UK each year. Thus, although the more than 36 billion cups of tea drunk each year in the UK contribute a total 2 million tons of CO_2 to global emissions, the vast majority of this figure is expended in heating the drink and the milk that is added to it. As Mike Berners-Lee[162] summarises, drinking even large quantities of carbon intensive milky tea has a very small impact compared to other common behaviours. For example, even "if you drink four mugs of tea with milk per day … [for a year] … that's the same as a 60-mile drive per year in an average car."

Given that the UK imports around 16% of its tea from Sri Lanka, amounting to 1.3 million tons each year, with a carbon footprint of 300,000 tons of CO_2e, the impact of this relatively diminutive trade on global and local disasters might at first glance appear limited. Nevertheless, as a closer look reveals, the impact of trade on climate change impacts is not limited to the most carbon intensive goods. Rather, the case of tea exemplifies how the hazards associated with primary agricultural production are shaped by the twin forces of economy and climate, resulting in heightened dangers and intensified environmental impacts in the global South.

A worker repairs a wall damaged by a landslide in the Sri Lankan highlands. Landslides are a growing threat to workers in the area.

5.1

Climate change, declining trade and land use change

First cultivated by the British in 1839, in response to a catastrophic coffee blight which scuppered a prior effort at crop importation, tea has been one of Sri Lanka's major exports for over 150 years.[163] At the height of its global dominance, in the 1970s, the Sri Lankan tea industry supplied some 40% of the world's tea,[164] yet the industry has since faded substantially from this apogee. A new crop of tea-growing countries—Argentina, Brazil, Cuba, Malawi, Malaysia, Peru, and Vietnam—have begun to produce for tea for export in globally significant quantities,[165] joining the traditional competitors of China, India and Kenya. Though still one of the world's major tea exporters, Sri Lanka's proportion of the global market had shrunk to 15% by 2019,[166] with total exports stagnating over the last two decades at around 300 million kilos.[167]

There are various reasons behind Sri Lanka's regression in the global tea market, including the collapse of the Soviet Union which previously provided a substantial market for Ceylon tea and the rise of cheaper black tea alternatives in India, China and Kenya. Yet chief amongst the challenges posed to Sri Lankan tea in recent years has been the changing environment in which it is cultivated. Sri Lanka is currently undergoing a number of changes to its climate, with extreme heat in particular becoming more common. Under high emission or 'business as usual' scenario, the number of days surpassing 35°C is predicted to rise from a baseline of 20 days to more than 100 days by the 2090s. This not only 'threatens human health and living standards, particularly for outdoor laborers in urban areas', but also places downward pressure on agricultural yields, including tea.[168]

Indeed, the effects of these changes are already being felt in the industry. In recent years, 'changes in temperature, rainfall, and the occurrence of extreme weather events have adversely affected the sector' leading to significant dips in tea production.[169] Both the yield and production of tea are influenced by weather patterns,[170] with drought in particular affecting both the quantity and value of tea harvests, leading to considerable loss of export earnings. Compounding this, production costs often increase during periods of drought due to the need for additional inputs such as irrigation,[171] rendering them a triple blow to the economy of the industry. Even setting aside the economic dimensions, therefore, 'under a high emissions scenario, by mid-century, a decline of 12% in annual tea production is predicted.'[172] Combined with confounding economic issues, the reality may be a far steeper decline. In economic terms, this is clearly problematic for an industry that employs some 600,000 people, roughly 7% of the country's labour force.[173]

Yet there are also implications for acute human impacts of climate change in Sri Lanka. Landslides linked to rainfall changes are one of the major current and projected impacts of climate change and have increased substantially in frequency in the last 30 years.

From 1990 to 2001, an average of 587 Sri Lankans were affected by landslides each year. From 2002 to 2019, this annual figure rose to 15,400: a 26-fold increase.[174] Since then, the frequency of landslides has rapidly increased,[175] moving them from the status of 'minor disaster' to one of the country's most pressing and persistent threats.[176]

What Sri Lankan are currently witnessing is increasing intensity of climate change impacts, articulated through the lens of international trade.

This increasing frequency and deadliness is strongly associated with land use. 'Human-induced' landslides, linked to land use change, are estimated at 80% of total landslide incidents,[177] in large part due to the changes in soil consistency and associated erosion. Indeed, estimates of human-mediated activities in Sri Lankan upland suggest that land use changes 'have increased rates of ongoing erosion by [more than] 100 times over the background rates of natural erosion'.[178] Nevertheless, although most land use changes contribute to this process, tea plantations stand out as especially problematic. As studies consistently highlight[179] tea plantations are the form of land use most closely associated with landslides, with statistical analysis suggesting that tea plantations account for 35% of landslides, the greatest share of any form of land use.[180] Nevertheless, a crucial detail in this respect is that the establishment of tea plantations is in fact less of a risk factor than their conversion to other uses.

As outlined by Gunarathna et al. (2018), for example, the conversion of tea plantations to any other land use presents one of only three 'high risk' land use transitions, alongside two forms of conversion away from rubber plantations. This is not a phenomenon unique to tea transitions, yet the reduction in soil volume associated with tea cultivation makes it an especially deleterious to soil stability over time and thus particularly prone to landslides if abandoned.[181]

The hazards associated with primary agricultural production are shaped by the twin forces of economy and climate, resulting in heightened dangers and intensified environmental impacts in the global South.

As such, what Sri Lankan are currently witnessing is increasing intensity of climate change impacts, articulated through the lens of international trade. As the changing climate makes tea cultivation more difficult and less profitable, the market for Sri Lankan tea exports is shrinking, leading to a slow transition away towards smallholder plots and alternative land uses. With soil stability already compromised by the transition into tea production, the transition away from tea production heightens the risk of landslides still further. At the same time, the widespread privatisation of the Sri Lankan tea industry in the 1990s, intended to increase efficiency and regain something of the ground lost in the global market, has seen a significant reduction in expenditure on maintenance of tea estates' physical infrastructure. In the absence of state support, much of the residential and industrial building stock – originally built during the British colonial period in many cases – has been allowed to fall into dangerous levels of disrepair, accentuating the risks faced by workers in increasingly landslide prone areas.

This combination of increasing natural hazards due to climate change, with the local impacts of land use change and built infrastructural decline constitutes a triple threat to the inhabitants of tea plantations. As rainfall becomes heavier, less predictable and more intense, the frequency of landslides is increasing, yet crucially their threat is not evenly distributed. Rather, the threat of landslides is articulated by the specific environmental characteristics of the tea sector, effectively channelling the impacts of climate change through the lens of economic structures and international trade. Lethal climate change-linked landslides in the Sri Lankan uplands are therefore socio-economically articulated disasters, which the tea trade plays a key role in shaping.

A worker points out the large cracks in his house. Tea plantation residents fear that their residences have been severely weakened by previous landslides nearby, leaving them vulnerable to collapse.

5.2

Land-use change and landslide risk in the international tea trade

The landslide risk associated with tea has been noted in a global literature encompassing cases studies from Shizuoka, Japan,[182] to Riza[183] and Anatolia[184] in Turkey, to the Central Kenyan Highlands.[185] As these studies demonstrate, various attributes of tea plantations enhance vulnerability to landslides. In the first instance, the 'topographic setting, as well as other natural characteristics including geotechnical conditions'[186] underpin an underlying predisposition to landslides. Yet this is inherent vulnerability is compounded both by the nature of the tea crop itself and the manner in which it is harvested. In the first instance, the 'deeper root system of the trees [are] replaced by [the] shallow root system of the tea plant'.[187] As a result, 'many slopes with tea plantations are subject to soil subsidence'[188]: an issue compounded by the manner in which the crop is cultivated. As Uyeturk[189] outlines, '61% of the areas where landslides occur in Rize have tea plantations'[190] in part because:

'Plantation on slopes requires creating small horizontal benches (sets) on the slopes for growing tea; therefore the natural drainage conditions of the slope are also changed by creating these flat surfaces, which reduces the surface runoff, thus increasing infiltration of rainfall into the ground.'

Although the relationship between landslides and tea plantations is widely noted, however, it is nowhere more in evidence than Sri Lanka. Indeed, for Sri Lankans, this nexus is a national issue of growing importance. According to historical data, the 'first eight decades of 19th century recorded only six major landslide events in Sri Lanka, but the two decades since 1981 have registered five major occurrence of landslides'[191]: a trend which has accelerated in recent years. Whilst Sri Lanka experienced an average of less than 50 annual landslides up to 2002, this number has since rapidly increased as part of a rising trend in both incidence and fatality in recent decades.[192] They are now a clear and ever-present danger to communities living in the affected areas, punctuated by intermittent major disasters. In 2017, for example, floods and landslides were responsible for the deaths of over 150 people,[193] whilst December 2019 saw flooding and landslides prompt the evacuation of over 20,000 people.[194]

Yet remote as they may seem to UK residents, this regular procession of disasters is neither natural, nor as far removed from their everyday lives as they might appear. Rather, ever since British colonisers first introduced tea to the Sri Lankan highlands in 1839, the region's endemic hazards have been structured increasingly by the products that are grown and traded there. In 2014, for example, 37 people were killed on the British-owned Meeriyabadda tea plantation, when part of a cultivated hillside collapsed, burying dozens.[195] Some 180 years after the British first began commercially cultivating Sri Lanka's uplands, the UK and other importing countries are continuing to enjoy the fruits of this increasingly hazardous landscape, whilst remaining far removed from the risks of their production.

British tea plantations play a key role in enhancing the likelihood and risks associated with landslides in Sri Lanka.

And the situation is worsening. As the impacts of climate change shift rainfall patterns around the region, landslides are becoming more common and more deadly. Recent precipitation variation studies in Sri Lanka have revealed a significant increase of rainfall in terms of intensity and frequency: factors strongly linked to the risk of landslides.[196] As shown in Figure 10, the cost of damage associated with floods and landslides in Sri Lanka has increased more than tenfold from around 35 million USD in 1989 to nearly half a billion USD in 2017.

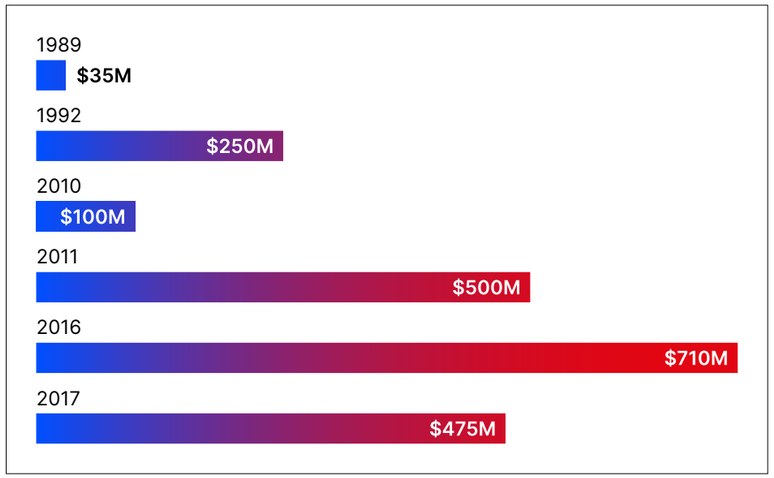


Figure 10. Damages due to landslides in Sri Lanka over time.[197]

Moreover, British tea plantations play a key role in enhancing the likelihood and risks associated with landslides in Sri Lanka. As shown in Table 1, British tea plantations are distributed across a range of categories of landslide risk. Of these, two plantations, representing 3.7% of the total British-owned tea plantation land area are located in areas where landslides are most likely to occur. However, a further 29 plantations, accounting for some 43.71% of British tea plantations are found in areas in which landslides are 'to be expected'. A further 33, slightly smaller plantations, accounting for 42.44% of total land area are found in areas with a modest risk of landslides, whilst only 10 plantations, accounting for 10.14% of total British tea cultivation, are found in areas where landslides are unlikely to occur.

Hazard zone	Land area (Ha)	%
Landslides not likely to occur	385.17	10.14
A modest level of landslide hazard exists	1612.20	42.44
Landslides are to be expected	1660.32	43.71
Landslides most likely to occur	140.79	3.71
Total	3798.48	100

Table 1. Summary of British own tea lands and its hazard category.

If the same plantations are sorted by their geographical distance from existing landslide locations, as shown in Table 2, two plantations, accounting for 2.7% of the British total, may be observed as located within 500m of previous landslides, whilst a further 5.3% are located within 1km. In total, 18.7% are located within 2km of a previous landslide, whilst all 75 are located within 5km.

The clustering of British tea plantations predominantly within Sri Lanka's central highlands means that, as the risk of landslides has grown in Sri Lanka, the vast majority are in areas which have already experienced landslides or are likely to do so in future. Further compounding the issues in the area, a number of British plantations in high-risk areas have reduced the size of their plantation holdings, thereby heightening the risk faced by those living and working in the remaining cultivated areas, due to the processes of land use changed described in section 5.2.

Range	500m	1km	2km	3km	4km	5km
No. of lands located within different buffer zones	2	4	8	15	20	25
% of lands located out of identified lands	2.7%	5.3%	10.7%	20.0%	26.7%	33.3%

Table 2. British owned tea estates which are located in landslide locations (N=75).

As these data highlight, therefore, the location of tea plantations in the Sri Lankan uplands has in recent years become a source of substantial risk to those working them. Whilst landslides have traditionally been a rare occurrence despite the precipitous nature of tea growing topography, recent years have seen a marked upturn in their regularity. As heavier and more intense rainfall becomes a feature of the Sri Lankan climate, these risks are growing ever greater. Yet they are far from inevitable. Land use associated with tea growing plays a key role in enhancing the likelihood of landslides relative to other uses, but the management of existing tea plantations plays a greater role still. As changing rainfall patterns and the risks with which it is associated begin to hit the Sri Lankan tea industry economically, the transition away from tea is raising risks further for those that remain.

A tea plantation worker in the Sri Lankan highlands. Older workers report substantial changes to the climate of the area since their youth.

5.3

Living landslide risk as a British tea producer

The Sri Lankan tea trade employs hundreds of thousands of workers, divided between the private and state sectors which comprise 60% and 40% respectively.[198] Within this, tea plantations are further divided into smallholder tea growers and larger scale estates, of which the smallholding sector accounts for 302,575 acres of tea extent (i.e., 61%) compared with 191,637 acres of tea extent (i.e., 39%) belonging to the estate sector.[199]

Having been nationalised in the 1970s and subsequently partially privatised, the estate sector is one in which workers have seen considerable change in recent decades. State facilities such as medical centres and dispensaries have been discontinued in some cases, whilst estate housing and infrastructure such as roads and water delivery have been allowed to decline in some cases. In addition, support for workers experiencing environmental hazards has diminished, negatively impacting preparedness for extreme weather events and accentuating the risks associated with these hazards, including landslides.

Indeed, with more than half of the industry's plantations located in areas of high or moderate landslide risk, a proportion reflected in British owned estates, working in the industry means living against a backdrop of environmental threats to life and property. For workers in the more than 10% of British tea plantations located in areas categorised as the highest level of landslide risk, this danger often manifests in physical signals, integrating an awareness of the dangers of landslides into everyday life and labour, as outlined across the following three case studies of British owned plantations.

5.3.1 The Dickwella Estate

"The company focus is profit. Therefore, the company does not take necessary action immediately."

Located in the Hali-ela district of upland Sri Lanka, the Dickwella Estate has been categorised by the Sri Lankan National Building Research Organization [NBRO] as an area of high landslide risk for a variety of reasons. Families working on the estate rely extensively on lands in landslide-prone areas, whilst houses have been designed without professional support and constructed without approval from relevant authorities. In addition, houses are constructed on steep slopes (up to 31° in some cases), with no drainage system to discharge rainwater. Despite the presence of tell-tale landslide signs in the vicinity of houses, there is a lack of access routes to settlements, inadequate instructions to inhabitants on disaster preparedness, and a lack of work undertaken to strengthen housing and infrastructure to protect against landslide hazards.

Two landslide incidents have been previously reported in Hali-ela district, in 1986 and 1990, yet none in the vicinity of the Dickwella estate and none in the area in recent

A woman preparing to pick tea for export to the UK and other markets.

years. Consequently, residents perceive the risk of these events to be low compared with the surrounding areas. Instead, workers are concerned primarily with the threats posed by wildlife whilst working in the fields. As one tea plucker explained, 'we are not afraid of the environmental conditions of this estate. We are afraid of some animals such as snakes, wasps, etc. Wasp attacks are very common in the plantation fields" — Tharushi, fieldworker, 08/04/2021). Beyond this, as outlined by a worker who has spent 17 years on the estate, the main environmental hazards perceived by workers relate to storms and water scarcity during the dry season:

> "Drought and thunderstorms are the main hazards in this area. Especially during drought periods, we suffer from scarcity of water. During the rainy season, water is not an issue for us. But natural water springs dry out due to drought. On those days we have to go to the river to get water which is far away (3.5 km) from the place where we live. Absence of a permanent water line or water source is a major issue that affects us due to drought." — Lahiru, Watchman, April 2021

Although workers are well aware of the potential for landslides in the surrounding highland areas, they express a confidence borne of insulating local factors and perceived risks elsewhere. As the deputy manager of the estate outlined:

> "I think landslide risks are somewhat low in this tea plantation when comparing the other hilly areas of Sri Lanka. Because old tea plantations can combine the soil stability with their roots." — Chathura, Deputy Manager, April 2021

Similarly, as a watchman on the estate argued:

"The [nearby] Nuwara Eliya area has steep mountains and people are cultivating in those hills. That may be a reason for the landslides. In past times, those areas were mountain forests, but now people cut down the forest and do plantations. As a result, the Nuwara Eliya area has frequent landslide events." — Lahiru, Watchman, April 2021

Despite this confidence, though, locals are aware of soil slips and slope failures – potential warning signs of landslides – occurring in the local area. As one fieldworker stated, "I have never experienced a landslide while working at the Dickwella Estate. Here, I have seen [only] a few small-scale soil slips in rainy seasons." — Tharushi, Fieldworker, April 2021. As the deputy estate manager continued:

"Within my working period of 13 years, I have not heard about a landslide in a nearby location. However, some slope failures were reported in the Hali-ela town area [2km away from the estate]." — Chathura, Deputy Manager, April 2021

Amidst this sense of security, however, the primary caveat expressed by workers was the lack of commitment to safety, hazard mitigation and compensation for environmental risk. In particular, the transition from public ownership to private since 1992 has resulted in substantial changes to operating practices.[200] Services previously offered to workers have been scaled back in terms of both size and efficiency, a phenomenon widely observed by workers themselves, especially in relation to environmental management:

"The company focus is profit. Therefore, the company does not take necessary action immediately. But they are providing some mitigation actions to preserve the environment such as soil conservation strategies, drainage maintenance, etc … Currently, [though,] these estates are managing by private companies. They are giving priority to maximising profit. As a result of that, some sort of delays may happen from the estate side during compensation and mitigation works." — Lahiru, Watchman, April 2021

As testimonies from the Dickwella estate demonstrate, therefore, living within a high-risk landslide area is not an issue of pressing concern for tea plantation workers. Residents recognise the importance of local factors in shaping the likelihood of landslides and believe the context of their work to be sufficiently safe to avoid a major disaster. Whilst this is by means a guarantee of safety – indeed, the residents of the Meeriyabadda estate where 37 people were killed in 2014 recall that they were themselves confident due to the lack of recent landslides in the area – it does nevertheless point to the importance of infrastructure in the local perception of risk.

"Now we are living without any future hopes. Because we are expecting future landslides which will destroy everything if we do not move away."

With the Dickwella estate having transitioned to private ownership only relatively recently, investment in maintenance of the estate has only recently begun to decline, leaving the majority of the estate's facilities and residential infrastructure in good condition and endowing residents with a certain degree of confidence in their ability to withstand the effects of an increasingly capricious climate. As outlined in the next case, that of Loolkandura Estate, however, a longer decline in maintenance produces a very different outlook.

5.3.2 The Loolkandura Estate

The Loolkandura Estate was the first tea plantation estate in Sri Lanka, having been founded in 1867 by Scotsman James Taylor. Yet despite operating continuously for more than a century and a half, recent years have seen the area categorised as increasingly susceptible to landslide risk. In 2006, a landslide occurred in the Upper Gonawa area, roughly 700 – 800m away from the workers' residential settlement. Following a number of soil slips in recent times, the government has declared the area highly susceptible to landslides due to its steep slopes and increasingly high intensity rainfall and declared that residents should move away.

Nevertheless, with houses yet to be constructed on the resettlement sites, the majority of the residents remain in place, despite a widespread awareness of the dangers they face. Residents explained that "the government has warned us that in the near future, our houses will be affected by landslides" — Shehan, Retired Permanent Labourer, April 2021. As a supervisor at the estate admitted, "yes, our laborers are at higher risk of landslide. In particular, Upper Gonawa division people are at high risk. They are experiencing landslide signals" — Ishara, supervisor, April 2021. Indeed, some on the estate already have direct experience of these events:

"Yes, I have experienced it. There was a landslide event in 2006. That did not happen within our settlement, but it happened 800m away…That was a heavy rainy day. Our settlements were located at the top of the mountain. Suddenly small soil portions dropped from the lower part of the mountain. Then a huge soil portion moved downwards. Nobody was injured from the landslide, but our houses were damaged… I saw the landslide while working on the other slope of the mountain." — Buddhika, Farmer and Former Permanent Worker, April 2021

Although workers now are keen to move away from the dangers of the estate, Loolkandura is a well-established community whose residents often go back several generations. As those longstanding residents explain, this is an area that has undergone substantial environmental change in recent decades, in order to give rise to the current high level of landslide risk. One worker explained that 'I was born here. However, now the exposure to the environmental hazards has increased in this area" — Shehan, Retired Permanent Labourer, April 2021. Another, similarly, commented that:

"I was born in the Loolkandura tea estate. Now our settlement's risk is higher because of the possibility of landslides. There was no environmental risk when I was young. But now it has changed totally. We have many signs of an upcoming landslide, so we know it will happen soon. Our settlement is located in a very risky area when compared with the other areas of the country" — Buddhika, Farmer and Former Permanent Worker, April 2021

Nevertheless, although residents of the estate widely noted the changing environmental profile of the area, they were keen also to note the role of degrading residential infrastructure in intensifying this risk. As heavy rain and strong winds have become more frequent, they have progressively degraded the structural stability of

“The landslide happened away from this settlement, but it has caused severe damage to the houses. Now the walls have been cracked and those cracks have decreased the strength of the house walls. We cannot repair our roofs even, because nobody can work on the roof with confidence as the walls are weak.”

tea workers’ housing. Large cracks have appeared in the walls of many houses and roofs are increasingly vulnerable to the effects of storms. One retired worker explained that:

“Loolkandura tea estate is my original and current home. Environmental risk on the estate has increased compared with my younger days. We did not experience this much risk of windstorms when we were young, because the walls of the house were not cracked at that time … Our houses’ roofs are not in good condition now. Furthermore, we have a huge landslide risk now. The size of the wall cracks increases on every day of heavy rain. Further, we notice cracks in our lands when heavy rains occur. So now we are at high risk.” — Chathura, Retired Permanent Worker, April 2021

As such, there is a strong sense in Loolkandura that the effects of their changing environment are accumulating in the infrastructure they depend on to protect them, heightening the risk of disaster with every new hazard they face. One worker explained, for example, that “I have not lost any property due to landslides, but our houses have been cracked. Those cracks occurred during the previous landslide event [and] the size of the cracks increases when heavy rains occur.” — Shehan, Retired Permanent Labourer, April 2021. In a similar vein, a second local resident bemoand that ‘all of our houses were partially damaged by the landslide. Now, all of the walls of the house have been cracked because of [it and] the size of the cracks is increasing day by day with the rains” — Buddhika, Farmer and Former Permanent Worker, April 2021. A third worker articulated the implications of this cumulative damage for the environmental risks they face:

“There were no injuries because of the [previous] landslide, but we are anticipating huge damage if a landslide occurs again. We desperately need [the company’s] support, as we are not able to build new houses on our own. If a landslide happens, it will cause huge damage. Then we will lose our lives and properties.” — Chathura, Retired Permanent Worker, April 2021

Despite the clear danger presented by unsafe housing, however, a key issue facing Loolkandura residents is the difficult in repairing heavily damaged houses. Roofs, frequently needing repair following increasingly intense storms in the area, sit atop walls too cracked to climb in order to access them. One worker outlined how this

The cracked wall of a tea plantation worker’s house. Many houses are now so weakened by landslides that they are impossible to repair.

instigated a viscous cycle of degrading infrastructure, wherein “damages and the risk of windstorms have been exacerbated by the nearby landslide incident that had occurred in 2006 … [so that] … we cannot repair our houses because of the cracks in the walls” — Nethmi, Day Labourer, April 2021. Indeed, this was a story repeated again and again by Loolkandura residents, who bemoaned that:

“We need to repair our houses in the rainy season, but now our houses are not in a good state due to the previous landslide. All of the houses are attached in a row, [so] if one gets damaged, then it affects the other houses also. Nobody is willing to climb the roof to repair [it] because the walls are weak, but we somehow replace the metal roof sheets when they get damaged by windstorms.” — Buddhika, Farmer and Former Permanent Worker, April 2021

Many workers had a bleak outlook on their future prospects:

“The landslide happened away from this settlement, but it has caused severe damage to the houses. So, now the walls have been cracked and those cracks have decreased the strength of the house walls. We cannot repair our roofs even, because nobody can work on the roof with confidence as the walls are weak. Now we are living without any future hopes. Because we are expecting future landslides which will destroy everything if we do not move away from this area.” — Nethmi, Day Labourer, April 2021

Faced with what they view as the inevitability of a catastrophic landslide event in their immediate vicinity, residents of Loolkandura above all expressed disappointment and frustration at the lack of support they are receiving from the management of the estate. Key to their grievance is the fact that, despite doing everything they can to mitigate their exposure to forthcoming disasters, their capacity to meaningfully reduce their own risk is limited. The structural factors they recognise as crucial to mitigating disaster risk – such as adequately maintaining existing housing, or providing alternative living sites – are beyond their own control. As workers outlined: “we have requested to get new lands and houses, but nobody supports us. We are not able to build our own houses by obtaining new lands, so we are living with risk” — Shehan, Retired Permanent Labourer, April 2021. As a second worker continued:

“They should support us as workers of the estate. We work for them. If we get their support, we can get rid of the higher risk of the windstorm and landslide. If we move to a safe location and construct houses with walls [that can] resist strong winds our risk level will be low. But now our exposure level is very high. I do not have any hope for our lives because of the environmental risk” — Buddhika, Farmer and Former Permanent Worker, April 2021

Frustratingly for workers, the ability to reduce this risk remains strictly in the purview of corporate actors whose apparent disinterest in doing so appears both illogical and callous to the residents themselves. Indeed, as residents complained, if and when a disaster does occur, “then they need to spend more money [than preventing it]. If we get impacted, they will have to wait until recovering our damages to restart estate operations…

A tea plantation worker holds a scale for weighing tea. The tea industry is already being hit hard by Sri Lanka's changing climate.

We are at high risk, so they need to take necessary actions on mitigation before severe disaster losses" — Chathura, Retired Permanent Worker, April 2021. As the same, retired worker continued:

> "We look for their support, because now we are living in the estate. If we experience any damage, then it will affect the tea estate. We are facing severe environmental risks. If they did not take any action to mitigate our risk, it will cause severe damage. So, the company should support mitigating the risk before a huge disaster [occurs]." — Chathura, Retired Permanent Worker, April 2021

At the same time, these practical arguments were underpinned by a moral logic. As workers argued, "we are providing our services for them. The estate continues functioning because of our people, so they should not abandon us in a difficult time" — Buddhika, Farmer and Former Permanent Worke, April 2021. Similarly, as a day labourer concluded: "I think they should support us. We cannot buy land and build a house [on our own and] we are their only workers. They will not have people to work in the estate if we are dead" — Nethmi, Day Labourer, April 2021.

In highlighting the importance of corporate governance in shaping tea workers' exposure to disaster risk, Loolkandura estate workers articulate a clear understanding of the intersection of environmental and economic factors in shaping the terms of landslide risk in their area. Whilst disaster has yet to strike in earnest in Loolkandura, the case of the Meeriyabadda estate landslide in 2014 highlights how high the cost of such corporate inaction may ultimately come to be.

"I saw soil and rocks were coming down, then the entire mountain came down with huge soil portions. It was like a sea wave. Everything had gone within 3 minutes."

5.3.3 Meeriyabadda Tea Estate

On the 29th of October 2014, a massive landslide occurred in the Haldummulla Divisional Secretariat in the Sri Lankan highlands' Badulla district. The affected site was an identified landslide-prone area, located in a tea estate known as Meeriyabedda Watta in Koslanda. The landslide was triggered by monsoon rains and extended to around 3 kilometers in length. As a direct result, 37 people were found dead or missing, 70 houses were destroyed completely, whilst over 275 individuals were left homeless. The Government of Sri Lanka initiated a relocation program for the victims and constructed 75 housing units at Makaldeniya estate. However, vulnerable communities still remain in the Meeriyabadda division, with no action having been taken to move those communities to a safer area. Meeriyabadda's remaining community therefore remains highly exposed to the future landslides.

Workers who survived the incident recall the event as a sudden, catastrophic collapse in the early morning, which left large parts of the area buried under mud and rubble within minutes. Even those who did not lose family members are able to recall near misses, with workers' aid being a crucial factor in the number of lives that were saved. Many, however, were not so lucky. As one survivor of the landslide recalled:

> "That was the darkest day for me. The landslide happened early in the morning. The time was around 6.30 AM. I was cooking. I have two children. One child was working in Colombo. She was not in the home. My younger son was sleeping. My husband was working on our farm. Those were heavy, rainy days. So, we noticed severe cracks on the road. We noticed those cracks the evening before the day of the landslide. Then we heard a huge sound in the early morning of the landslide day. My husband told us to pay attention to the top of the mountain. Afterwards, he went to the neighbours' houses to inform them about the incident. After 5 minutes, the whole mountain collapsed. We were shouting to my husband and other neighbours. Then we ran to the other side of the mountain. My husband was affected by the landslide, but he was not injured. He was covered with soil up to his hip, but neighbours helped to get him out." — Sanduni, Former Seasonal Worker, April 2021

Despite the unexpected nature of the landslide itself though, which occurred in the early morning whilst most workers were still at home, witnesses to the event recall warning signs in the run-up to the disaster. One worker explained that "we received early warnings before the landslide disaster [itself]. Those were heavy rainy days. We had a channel near to our houses and we noticed very darkly coloured water was flowing along the channel" — Roshan, Driver, April 2021. As a plantation supervisor at the time of the disaster elaborated:

“They had been aware of this issue in advance. They could have attempted to provide new lands to settle the people who were living in the landslide risk area, but they did not take any responsibility.”

“The previous three days were rainy. We noticed cracks in the road but those were small cracks … The day before the landslide, the waterways had changed to a very thick, dark coloured water. We did not care because it was a rainy day. We never noticed that much dark coloured water in the waterway.” — Hashan, Supervisor, April 2021

Although workers did not connect these warning signs to the possibility of a major landslide, the recent government warning over landslide risk was enough to ensure that a number of them did report these signs to the company. Workers explained that they “communicated our observations to the plantation administration, but they did not take it seriously” — Hashan, Supervisor, April 2021. Moreover, as a second worker explained:

“In the early morning of the landslide day, we noticed the road had cracks [in it]. So, we informed the plantation administration about the issue. Then they responded to us that it was not a big issue and to report to work. We were getting ready to work when I heard a huge sound. Then I came out of the house and looked up. I noticed something was happening on top of the mountain. So, I called to my neighbours. Then I saw soil and rocks were coming down, then the entire mountain came down with huge soil portions. It was like a sea wave. Everything had gone within 3 minutes. Fortunately, a small soil portion came down our side, which stopped near to our house. My cattle farm and [crop] farm were destroyed, but neither my wife nor I got into any trouble as a result of that.” — Roshan, Driver, April 2021

As these testimonies demonstrate, workers recall making multiple reports to the plantation management in the immediate leadup to the landslide, with no action being taken in response. Nevertheless, whilst the early morning timing of the landslide left limited response time – as one worker put it, “they didn’t have much time to act because, after 20 minutes of reporting cracks the incident occurred” — Hashan, Supervisor, April 2021 – the disaster was shaped by a longer-term failure to act. The area in which the landslide occurred had already been identified by the government as unsafe for habitation, with workers advised to move away from the area. Yet, as in Loolkandura today, a lack of alternative housing provision meant that workers remained in place despite the risk. In the words of one worker:

“I had not experienced any disaster before, but the government had informed us to move away from this place. They had identified this area as a landslide risk-prone area. But we did not take the warning seriously, so we did not make any attempt to move away from there. I had never heard about these kinds of incidents even in nearby locations. We had no experience related to landslides.

The government had issued a warning before the landslide incident, [but] we did not have an idea about the extent of the expected landslide. In addition to that, we did not have any option to move from Meeriyabadda, as we were living in the estate owned houses. We did not have alternative lands to settle on, or any income to afford to rent a home or pay for transport if we settled away from the estate. So, we lived there with the risk.” — Hashan, Supervisor, April 2021

Beyond the limited response to the concerns raised by workers in the immediate lead-up to the landslide, this longer-term inaction in response to government warnings is viewed by workers as a placing significant proportion of responsibility for the disaster on the plantation administration. Workers argue that the company ignored multiple warnings and had a number of opportunities to respond appropriately to the impending hazard, yet failed to do so, with catastrophic consequences:

“We got an early warning of the landslide incident three days beforehand. The plantation administration has been aware of the pre-incidents, but they did not take any action over it. Approximately 37 people lost their lives. All of them were labourers. Their houses and their farms were destroyed. In my neighbour’s house, only a child survived. His father, mother, grandfather, and sister all died due to the landslide.” — Hashan, Supervisor, April 2021

Similarly, as a second worker explained:

“The company had not done anything to mitigate the landslide in advance. We had informed them about the early warning signs of landslides, but they did not take any action over it. The government had informed [them] about this possibility a few months before, but the plantation administration did not take any action over that. We were informed to leave the area by the government, but the estate did not provide any land or settlements for us. The company needs to be partially responsible for the damage. They had been aware of this issue [in advance]. They could have attempted to provide new lands to settle the people who were living in the landslide risk area, but they did not take any responsibility for that. If they had taken responsibility for that, we could have moved away from that area before the landslide.” — Roshan, Former Driver, April 2021

As these stories make clear, the lack of provision for relocation by the company administration for dominate recriminations over the incident. Yet there is also an associated sense that the risks faced by the local population was underplayed by the company administration, that “people had not no idea about the extent of the risk” — Dinesh, Former Permanent Worker, April 2021.

By increasing the population of high-risk areas whilst failing to renovate degrading housing and protective infrastructure, tea plantations producing for the UK market play a major role in raising disaster risk in Sri Lanka, placing workers in the supply chain at substantial and increasing risk.

Workers on the plantation were lulled into a false sense of security, rather than being helped to move, as recommended by the government. As those affected explain, this led directly to the huge loss of life faced by those working on the plantation:

> "They did not explain about the risk of the landslide. I think even they did not know the real risk of the landslide. If they provided a good place to [move to], my son would still be alive, with us. They needed to take responsibility for that. They had a lot of free lands, but they did not make that lands available for us." — Ranga, Former Permanent Worker, April 2021

Above all, the testimonies of those who survived the Meeriyabadda landslide evidence a key message over safety in the tea industry: the disaster was by no means inevitable. Both government and company officials were aware of the issue in the leadup to the landslide, but chose not to action, leading to the deaths of 37 people, as well as a huge loss of property and livelihoods for others. Yet this sentiment, repeatedly espoused by Meeriyabadda's former residents, points to a wider truth about the nature of disaster. As climate change continues to increase exposure to natural hazards such as the strong winds and heavy rains that ultimately triggered this and other landslides, the circumstances within which work takes place play a major role in structuring their manifestation. Whether or not a hazard becomes a disaster therefore depends to a great extent on the terms of work in which it manifests.

As a tea plantation producing crops for the British market, the disaster at Meeriyabadda was one connected to British consumers by the mechanism of trade. Dickwella and Loolkandura, similarly, are British companies, wherein the conditions of work shape the climatic risks faced by workers. As accounts from Loolkandura in particular make clear, these conditions are playing a major role in intensifying the impacts of the changing climate, rendering the likelihood that everyday hazards manifest in a future disaster substantially more likely.

The disaster footprint of British trade, in Sri Lanka as elsewhere, plays an observable role in intensifying these climatic hazards, shaping and directing the impacts of the changing climate on multiple fronts. Indeed, despite its relatively low contribution to carbon emissions, as a result of the low carbon intensity of tea production, the significant contribution to climate change impacts necessitates tea's recognition as product whose overall environmental footprint is substantial. By increasing the population of high-risk areas whilst failing to renovate degrading housing and protective infrastructure, tea plantations producing for the UK market play a major role in raising disaster risk in Sri Lanka, placing workers in the supply chain at substantial and increasing risk.

A tea plantation worker rests after a day of work. Behind her, red mud is revealed after a recent landslip.

Part 6

The UK’s disaster footprint

Almost half of the UK’s emissions are now imported. Yet measurement and regulation of overseas emissions and environmental impacts is less stringent than it is domestically. At the same time, UK trade is intensifying the impact of natural hazards linked to climate change: a dual impact that demands closer attention to the UK’s full disaster footprint.

6.1

A disaster footprint for UK trade: prospects, pitfalls and proposals

Neither climate change, nor its impacts are domestic issues, yet we continue to view both through a national lens. Our economy is both global and hugely influential over the natural world. The vast network of processes and interconnections that make up the global economy not only underpin and distribute the production of carbon, but shape its impacts also, distributing processes of production – and the environmental impacts that go with them – to places far from where those goods are ultimately used. The goal of this project has been both to exemplify the complexity of the processes that shape environmental change – and in doing so, to highlight the ill fit of the national accounting mechanisms used to measure it – but also to raise the question of responsibility. How environmental degradation is measured and how its costs are attributed and managed are two elements within the same equation. By drawing on three distinct cases of the trade-environment nexus, Disaster Trade has aimed to highlight the shortcomings of systems of governance which implement domestic environmental standards, whilst neglecting to regulate global systems of trade. In pursuit of a new approach, each of the investigations here explored distinct dimensions of this issue.

The first case examined here concerns the rapidly growing phenomenon of brick importation from outside the UK. Once self-sufficient in terms of brick production, the UK has since the great recession of 2008 seen production fall behind demand. As a result, the UK has now risen to become the world's largest importer of bricks, importing more than 400,000 in 2019.[201] Moreover, these bricks are coming from further and further afield. Bricks imported from outside the EU increased more than tenfold in the five years between 2015 and 2019, from 3,088,902 to 32,942,280: a low value, high weight trade that generates carbon on an enormous scale. Produced in largely unregulated kilns and shipped thousands of miles by boat, a three-kilogram house brick imported from outside the EU has a carbon cost three times higher than one produced domestically. Worse still, they carry with them a legacy of local environmental destruction and human exploitation on a scale that the UK has long since eliminated domestically, yet on which the goods we consume continue to depend.

In the second case, that of Cambodia, the aim is to highlight the role of the country within a wider process of trade and environmental destruction. A garment labelled 'Made in Cambodia' tells only a small part of a far larger, global story. Cambodia has no cotton fields, it neither produces, nor processes the raw materials which comprise its clothes. Rather, these materials have come in many cases from as far away as the United States, Ivory Coast or Brazil. In large part, those materials come from China: a country whose status as 'the world's factory'[202] has come at a heavy environmental

cost.[203] With China now committed to net zero in the next four decades, many of these high emission and environmentally damaging processes are being moved to countries with a net carbon budget remaining. Just as the UK did before it, China is therefore beginning to outsource emissions and environmental degradation, moving a problem in such a way that – through a national accounting lens – it appears to be solving.

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The third and final investigation of this study explores the production of Ceylon tea in Sri Lanka's central highlands. Long a central pillar of the Sri Lankan economy, the tea trade has suffered in recent years, as the impacts of climate change increase costs and reduce yields. Tea plantations have begun to decline in response, yet as land use in the highlands changes, the impacts of climate change are further intensified. Former tea plantations are now a major risk factor for the growing problem of landslides: an economically destructive and lethal phenomenon, closely associated with a declining trade introduced by British colonisers and still enjoyed daily in British homes.

Although each of these cases focuses upon a distinct commodity and geographical area, they serve in combination to demonstrate a wider quality of the global intersection of trade and environmental degradation. Simply put, the environmental regulations that appear in a domestic sense to resolve issues of environmental degradation frequently do not in fact result in their amelioration or cessation, but rather induce the mobility of environmental bads across borders and beyond the reach of predominantly nationally focused regulations. The result of this 'outsourcing' of environmental impacts along supply chains is that environmental impacts reflect the channels of economic and physical goods through which they influenced and directed, rather than the sites in which they are consumed. Economic and environmental processes therefore become spatially intertwined, mutually shaping the geography of each other's impacts.

This mobilisation of environmental processes takes multiple forms. At its most basic level, this might refer simply to the transportation of waste material across international borders, a phenomenon increasingly noted in recent years as international waste shipments have increased substantially, almost doubling in the EU since 2001.[204] Yet the aim here has been to highlight a more complex and environmentally destructive reality. First, that it is not only waste that is traded across borders, but environmental degradation itself, as polluting industrial processes are 'outsourced'[205] from heavily regulated nations to ones where environmental strictures are less stringent. Crucially, this applies not only to local pollutants, but also to carbon emissions, which are hidden by the complexity of the supply chains within which they are emitted. With international transport emissions, in particular, tending to fall outside of the purview of regulation, the result is a vast source of carbon emissions hidden amidst the movement of international trade.

The complex mobility of our globalised world therefore serves to obscure key processes driving global climate change. Yet there is a further element at play also. As rising atmospheric carbon concentrations increase the risk of extreme weather and natural hazards, processes of international trade shape, direct and intensify its impacts. Indeed, as is increasingly recognised, the impacts of disasters are neither random, nor natural, but articulated by the socioeconomic circumstances within which they manifest.[206] Carbon emissions may therefore increase the likelihood of a

given hazard – floods, or heavy rain, for example – but whether that hazard becomes a *disaster* in which lives are lost or displaced, and homes and livelihoods destroyed, depends upon the conditions it finds. Thus, it is these elements *in combination* that constitutes the full disaster footprint of international trade.

The deforested landscapes of Cambodia thus become, in statistical terms, magnets for droughts instigated in a wider sense by climate-linked ENSO abnormalities. In the 'brick belt' of Bangladesh and India, excavated paddy fields in the vicinity of sand dredged rivers, shaped by bricks produced for UK consumers, become focal points of vulnerability to flooding, whilst pollution and environmental degradation render adaptation more challenging for those affected. In the Sri Lankan highlands, similarly, heavy rains linked to climate change present a far greater risk to those lands reformed for tea production than others around them, thereby directing and channelling the risk of landslides towards those tasked with producing the beverage for British breakfast tables. Disaster risk, viewed thus, is therefore the price paid by the UK's trading partners in return for the economic benefits of export. As the emission concealed by trade continue to render extreme weather more likely, local economic processes direct the impacts of climate change through trade networks, towards the producers of products consumed in the UK.

The incentive created by domestic carbon regulations may mean that they are not only ineffectual, but actively antithetical to the goals of the laws in which they feature.

This is not, moreover, a case of one-off displacement, but a mobile process within which environmental degradation may be moved through trade from one site to another. As regulation in Bangladesh has limited the extent of brick exports, for example, brick production for the UK market has expanded elsewhere to compensate, carrying its environmental impacts with it. India, in in response, has been a key recipient of the brick trade diminished in Bangladesh, intensifying the impacts of climate change in the vicinity of the industry and expanding the Indian labour force involved in the wider process of UK construction. Cambodia, similarly, presents a clear example of the dynamic global trade in environmental destruction and disaster risk. With Chinese manufacturing having instigated both rapid economic growth and widespread environmental destruction, Chinese economic development is increasingly taking the form of displacing low value economic processes beyond national borders into emerging global Southern economies like Cambodia.

Having experienced rapid growth in a garment sector focused on intermediary processing, Cambodia has been both economic beneficiary and environmental loser of this transition, as dirty and destructive processes accompany the arrival of a burgeoning industry whose profitability and international appeal is underpinned by laxity and loopholes in environmental management. Yet economic benefit is by no means the inevitable accompaniment to trade-linked environmental damage, as highlighted in the Sri Lankan case, where an opposite process is underway. As climate change increasingly undermines the economics of the tea industry, competition from producers in India, China and Kenya has seen a transitioning away from tea cropping, further undermining soil stability already weakened by the tea industry and heightening the risk of landslides still further. The Sri Lankan economy is losing, rather than gaining from this transition, yet the relationship between international trade and the articulation of climate change impacts are equally clear.

As these examples show, the true footprint of global trade must account both for its role in promulgating changes to the climate via the production – and concealment – of emissions, but also in directing and mobilising the impacts of these changes. Climate change impacts are, viewed thus, economically articulated, mobile transboundary flows, dynamically linked to the shifts in the global economy. Yet despite growing evidence of this economic-environmental intersection, climate change and its impacts continue to be treated overwhelmingly in both static and domestic terms, hampering efforts to assess, mitigate and adapt to the impacts of the changing climate.

This project has aimed not only to highlight what is missed through our prevailingly domestic conception of emissions and environmental impacts, but also the potential for a new formulation, capable of recognising how environmental processes are channelled through and influenced by economic ones. Achieving this is complex. It requires, overarchingly, a shift in emphasis across multiple sectors of governance and corporate practice, yet before this may be achieved it requires a renovation of the manner in which environmental impacts and policies are conceptualised. Rather than the nationally focused container thinking that has tended to characterise environmental policy, we therefore advocate for the formulation of a disaster footprint that is freed from these conceptual constraints in order to connect the dislocated policy spheres of adaptation, mitigation and corporate governance. In constructing this footprint, it is necessary to connect policy and scholarship in four dislocated spheres, joining the dots of mitigation, adaptation and accounting in order to reshape climate change policy for an increasingly globalised and interconnected world.

Recommendation 1: Accounting for emissions

The ongoing dominance of domestic carbon emissions accounting presents a key issue for climate governance. Nevertheless, although advocated against on a number of fronts in recent years,[207] it remains a difficult point to address both because national responsibility for environmental impacts is enshrined in all major environmental treaties, from Paris to Kyoto,[208] but also because it tends to portray major global economies in a positive light, lending it support amongst influential political actors. The UK's success in reducing domestic carbon emissions by 44% since 1990 is a key case in point. Viewed in terms of what is consumed – rather than produced – within UK borders, carbon emissions have declined by at most 15%.[209] Yet without a clear motivation to transition to a footprint approach,[210] the uptake of consumption-based and embodied emissions accounting remains limited.

Despite this problem of incentive, it is a key priority that carbon accounting transitions to supply chain-led model of emissions regulation. This is because as things stand, legal environmental standards effectively apply only to domestically produced products, whilst imported and supply chain emissions are subject to voluntary corporate standards.[211] In practice, this has the effect of pushing environmental issues away, rather than resolving them, resulting is a global circulation of environmental issues and carbon emissions that extends and deepens environmental destruction rather than resolving it. In order to halt this process of burden-shifting, 'major economies must recognize that even strong regulation on domestic emissions in major economies may not be effective in reducing total global emissions due to their imported carbon footprint'.[212] Indeed, as shown in the cases explored here, the incentive created by domestic carbon regulations may mean that they are not only ineffectual, but actively antithetical to the goals of the laws in which they feature. Rather than encouraging a reduction in emissions, the domestic framing instead encourages 'out-

sourcing'[213] emissions overseas. Scholars and practitioners are increasingly aware of this issue, raising – as also evidenced here – the capacity of this framing to conceal domestic emissions.

Recommendation 2: Coordination of policy

The recent announcement of the UK's sixth carbon budget in April 2021, saw the UK commit to reducing net carbon emissions by 78% compared to 1990 levels. This document includes targets which have been lauded in many quarters as ambitious, most notably in relation to the incorporation of international aviation and shipping emissions. As the UK government itself claims, this commitment 'sets in law the world's most ambitious climate change target'.[214]

Nevertheless, if these emissions are to be meaningfully eliminated, rather than simply moved, coordination of government policy is key. Central to ameliorating this broader issue is understanding how responsibility for complex, international supply chains and their impacts is disaggregated between government departments. As exemplified in the UK government Environmental Reporting guidelines,[215] domestic environmental management, waste and sustainability are managed by The Department for Environment, Food and Rural Affairs [DEFRA], whilst carbon accounting and supply chain emissions fall under the remit of the Department for Business, Energy and Industrial Strategy [BEIS]. Adaptation to climate change impacts domestically is overseen by DEFRA in partnership with the Environment Agency, amongst others, whilst adaptation overseas is the remit of the Foreign, Commonwealth and Development Office [FCDO].

This range of actors involved in the management of UK climate change reflects the breadth and scale of the issue. Yet the distinct approaches to governance practiced by each agency introduces issues of competing and sometimes counterproductive incentives. Whereas domestic environmental regulations are stringently monitored, and domestic carbon accounting mandated, supply chain environmental impacts and emissions are subject only to voluntary reporting. In some respects, this reflects the contrasting remits of DEFRA – responsible squarely for domestic environmental management – and BEIS – whose dual responsibility for both 'business' and 'industrial strategy' that incentivises a lighter tough on regulation. Nevertheless, the ultimate result is to incentivise offshoring of emissions and industrial environmental impacts, a process demonstrated throughout this report.

UK government agencies related to industry, development and climate finance must be encouraged to work collaboratively, rather than discretely, in order that their goals complement each other rather than working against one another.

In contributing to the intensity of climate change impacts overseas, therefore, strict domestic industrial regulations set out by DEFRA, combined with somewhat looser international guidelines set out by BEIS, effectively undermine the sustainable development and adaptation goals overseen by the FCDO. This is not only environmentally damaging, but fiscally inefficient. Yet in a positive sense, the coordination of government objectives and budgets has the potential not only to deliver meaningful improvements in the sustainability of UK business, but to do so without additional investment of government funding.

UK government agencies related to industry, development and climate finance must be encouraged to work collaboratively, rather than discretely, in order that their goals complement each other rather than working against one another. First, further co-ordination of regulation between DEFRA and BEIS – including more stringent supply chain monitoring intended to match the regulation set out by DEFRA – will attend to reducing the incentive to offshore emissions. Second, co-ordination of BEIS supply chain regulation with FCDO development and adaptation goals is needed, in order to ensure that British business overseas does not contribute to undermining FCDO funded adaptation and sustainable development programs in the global South.

Recommendation 3: Definition of supply chains

Corporate self-definition of supply chains presents significant problems in terms of emissions reporting.

In the context of our increasingly interconnected global economy, a key issue facing both carbon emission mitigation and climate change adaptation efforts is the difficulty of delineating the true extent of the supply chains contributing to the production of UK goods. As things stand, companies are given the freedom to define their own supply chain, both for their (voluntary) emission reporting obligations and for the purposes of any commercial claims made concerning waste, recycling and environmental impacts.

As outlined in this report, however, particularly in relation to the case of Cambodian garment exports to the UK, this self-definition of supply chains presents significant problems in terms of emissions reporting. Neither buyers themselves, nor intermediary firms along the supply chain, are incentivised by this system to discern the complex processes that supply them, resulting in oversimplified supply chains in which only primary actors are represented. The suppliers of primary materials – as well as subsidiary companies undertaking elements of production processes – are thereby rendered opaque, allowing companies to make claims of 'zero-waste' or 'carbon-neutral supply chains' without meaningful oversight over their accuracy.

This system presents three problems. First, it incentives the subcontracting of more environmentally destructive processes to subsidiary operations, beyond the regulation of buyers oversight: a process that renders supply chains artificially simple to regulate. Second, it allows supply chains to be conceptually shortened, often hiding the true distances travelled by raw materials in the course of producing UK goods. Third, it elides the complexity of production processes, presenting supply chains as fundamentally linear, where in reality they depend on networks of industrial producers working in collaboration, each element of which carries its own environmental impact.

Given the announcement, in the recent sixth carbon budget, that emissions from shipping will form part of the UK's net zero commitments, this failure to account for the true extent of supply chains and the systems of shipping that support them, presents a significant issue. In the case of the garment industry, current assessments of the length of shipping supply chains – and thus the carbon emissions with which they are associated – are significant underestimates and it is likely that similar issues prevail elsewhere. Greater regulation and oversight of the provenance of raw materials within complex supply chains is therefore an essential precondition not only for meaningful compliance with the UK's upcoming carbon commitments, but also the ability to monitor the environmental impacts of UK trade as a whole. To be genuinely meaningful, moreover, such monitoring must extend beyond a reliance on voluntary self-reporting of corporate supply chains.

Recommendation 4: The UK's disaster footprint and the global economy

Alongside rising global temperatures, climatic unpredictability is one of the most widely observed characteristics of climate change. Environmental risk is growing in many global regions, increasing the frequency and intensity of natural hazards leading to disasters such as floods, droughts and landslides. Evidence of these global processes appears most obviously in the incidence of sudden, catastrophic disasters, destructive to life and property, but it also manifests as slower onset impacts. The growing unpredictability of seasonal rainfall in the global South, for example, is making subsistence agriculture increasingly non-viable for many farmers, leading to loss of livelihoods, accrual of debts and worsening health and welfare.

Local environmental impacts worsen the impacts of climate change in the vicinity of production processes, shaping a geography of climatic precarity in which large scale climatic and local economic factors combine to generate an intensified geography of climate change impacts.

Yet as this report has aimed to demonstrate, the impacts of this unpredictability are far from random. As highlighted in the case of Cambodia, Sri Lanka and the South Asian brick belt, the contexts within which climate impacts emerge are structured in predictable ways by economic processes, shaping the manifestation of climate change in certain areas, so as to direct and intensify its impacts. Understanding climate impacts in this context therefore requires a monitoring framework capable of extending beyond geographical boundaries, in order to better reflect the mobile processes of trade shaping environmental change in the global South.

Whether this takes the form of local resource depletion, such as water or forest wood; or local environmental degradation in the form of water or airborne pollutants, the impact on health and livelihoods compromises the adaptive capacity of those affected, intensifying the impacts of the changing climate where they are felt. These local environmental impacts worsen the impacts of climate change in the vicinity of production processes, shaping a geography of climatic precarity in which large scale climatic and local economic factors combine to generate an intensified geography of climate change impacts.

On the one hand, global supply chains shape economic conditions, contributing to economic precarity that impedes efforts to adapt. On the other, they impact also on local environmental conditions in longer – and shorter-term ways, shaping the conditions through which climate change is 'articulated' by local circumstances. Those subject to this kind of complex climate risk face high levels of exposure to climatic hazards, low levels of capital to adapt and high levels of risk intensification engendered by local environmental degradation linked to supply chains extending beyond the local area. That these supply chains are often linked to global Northern consumers presents both responsibility and opportunity: the necessity to act, but also the ability to do so.

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