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Globalized Climate Precarity: Environmental Degradation, Disasters, and the International Brick Trade

Laurie Parsons,[a] Ricardo Safra de Campos,[b] Alice Moncaster,[c] Ian Cook,[b] Tasneem Siddiqui,[d] Chethika Abenayake,[e] Amila Buddhika Jayasinghe,[e] Pratik Mishra,[f] Long Ly Vouch,[g] and Tamim Billah[h]

[a]*Department of Human Geography, Royal Holloway, University of London, UK;* [b]*Department of Human Geography, University of Exeter, UK;* [c]*General Engineering, The Open University, Milton Keynes, UK;* [d]*Department of Political Science, University of Dhaka, Bangladesh;* [e]*Department of Town & Country Planning, University of Moratuwa, Sri Lanka;* [f]*Department of Geography, King's College London, UK;* [g]*Research Field Team Leader, Cambodia;* [h]*Refugee and Migratory Movements Research Unit, University of Dhaka, Bangladesh*

Climate-linked disasters result when natural hazards meet socioeconomic precarity. Recognizing this, scholarship in recent years has emphasized how the precarity that turns climate-linked hazards into disasters is produced within the same global political economy that enables climate change. Nevertheless, despite growing interest in the ways in which the dynamics of global economic history shapes contemporary hazard vulnerability, less attention has been directed toward the dynamism of the contemporary global economy and particularly the ways in which global material flows shape environmental risk. From this standpoint, this article argues, first, the need to account for the economic dynamics of global trade in shaping the factors that intensify disaster risk, and second, the role of multiscalar agency. Exemplifying this issue through a case study of international brick imports from South Asia to the United Kingdom, the article provides a heuristic example of how contemporary globalized flows of goods link local vulnerabilities to economic processes originating thousands of miles away. In an increasingly globalized world, it thus foregrounds a dynamic, global perspective on the genus of climate precarity. *Key Words: brick industry, climate change, climate precarity, environmental degradation, globalization, material flows.*

From the Pakistan floods that displaced 30 million people, to the deadly droughts and famines affecting millions of people in Ethiopia, Somalia, Rwanda, Uganda, and Kenya, the 2020s have brought ever clearer evidence of the destructive power of climate-linked hazards. When disasters like this occur, they tend to be held up as evidence of the forces unleashed by global climate change. "Vulnerable areas" must be protected from this new, untrammeled power, making the identification of impediments to climate resilience a key policy priority (Adger et al. 2020). Yet it is not necessary to look far to find these impediments. Wherever the lens of climate vulnerability is trained, precarity and inequality emerge as "pervasive non-resilient outcomes" (Adger et al. 2020, 1588). Disasters do not, in other words, "fall from the sky" (Ribot 2014, 667), but are created by social injustice (Kelman 2020; Mora 2023).

This recognition has prompted significant recent interest in how the historical determinants of global inequality shape the contemporary landscape of climate vulnerability. It is now well documented that, although they might be triggered by climate stress, the environmental crises we see emerging with growing frequency are "historical, social and political-economic products" (Ribot 2014, 671). Moreover, this is a recognition that jumps analytical scales, highlighting, on the one hand, how whole regions have been rendered vulnerable by historical economic processes (Hickel et al. 2022), and on the other, how social inequalities structure climatic vulnerability at the local scale. In other words, "the

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CORRESPONDING AUTHOR Laurie Parsons Laurie.parsons@rhul.ac.uk

slow unfolding of radical environmental change reveals the intensity of a constellation of socio-political structures and quasi-events that, for generations, have produced an individual and collective precarity" (Bezgrebelna 2021, 343).

More recently, this constellation of vulnerabilities has been developed into a "climate precarity" framing (Natarajan, Brickell, and Parsons 2019; Griffin 2020; Newman and Humphrys 2020; Bezgrebelna 2021; Natarajan and Parsons 2021; Parsons et al. 2022), which interrogates the socio-economic structures underpinning small-scale climate vulnerabilities. Studies like these have made the vital case that precarity not only intensifies climate change impacts, but that climate change also exacerbates precariousness, "disrupting all work and intensifying and extending individual risk in various ways" (Newman and Humphrys 2020, 557). Nevertheless, the structural precarities explored in this work have tended to be presented as both *ex ante* and local, dislocated from the ongoing dynamism of the global economy. Simply put, climate precarity is recognized as historically produced, but not as situated within the current globalized flows of the world economy.

This constitutes a growing gap in understanding. The international mobility of goods and materials is now fundamental to the global economy. Since the 1980s, global material use has tripled, with a third of this material volume now traded across international borders (United Nations Environment Program 2020). As outlined not least in the political ecology literature (e.g., Ajibade and McBean 2014; Blaikie et al. 2014; Peet 2014; Ajibade 2022), this ever-shifting dynamism of the international commodity trade is now a powerful force shaping the world's environments. Nevertheless, reflecting a widespread underestimation of the mutually constitutive "dynamism of modern economies" (Kocornik-Mina and Fankhauser 2015, 22), relatively little attention in recent years has been directed toward understanding how the contemporary global economy shapes climate precarity. Indeed, although various studies have sought in recent years to connect climatic and economic processes (Tol 2018; Botzen, Deschenes, and Sanders 2019), these have largely presented climatic processes as interacting in a unidirectional manner with economic processes. On the one hand, disasters have been shown to promulgate economic decline. On the other, economic inequalities have been shown to shape the landscape of disasters. Yet in an increasingly mobile and interconnected world, the dynamic, globalized interplay of these two trajectories under climate change has been far less explored.

Aiming to bridge this gap, this article draws on an empirical case study of climate precarity linked to international brick supply chains between South Asia and the United Kingdom. Highlighting how global economic and climatic processes interact to intensify disaster risk, we explore how the decline of brick production capacity in the United Kingdom following the 2008 financial crash has led to steeply rising brick imports from outside the European Union (EU). The result, we demonstrate, has been an intensification of the local effects of climate change through the combination of soil heat generated by brick kilns, agriculturally destructive smoke production, and the large-scale clay topsoil harvesting linked to floods and droughts in South Asia. Ultimately, this example serves to demonstrate the role of the global material trade as a dynamic shaper of climate precarity, a situation that presents both responsibility and obligation: the necessity to act, but also a new set of economic levers to do so.

Climatic Precarity in the Global Economy

It is now widely acknowledged that climate change is increasing the prevalence and severity of climatic hazards (Intergovernmental Panel on Climate Change 2018; Moran, Hasanbeigi, and Springer 2018; Lee et al. 2020). In recent decades, climatic changes have increased the intensity and frequency of abnormal weather, as well as its subsequent damages (Lee et al. 2020, 1). These impacts are "diverse and difficult to predict" (Lee et al. 2020, 1), worsening economic (Tol 2018) and social (Hallegatte et al. 2020) vulnerability, as well as the intersection of the two, which presents problems in terms of analysis and forecasting. Climate change could result in damages to physical properties, the human population, and ecosystems (Lee et al. 2020), but how and where this happens is not merely a question of physical changes to climatic and weather patterns. On the contrary, there is often "little concordance in the spatial patterns of change" due to the effects of topography, land use, and human activities (Moran, Hasanbeigi, and Springer 2018), all of which shape how climatic effects such as heat

(Lee et al. 2020; International Labour Organisation [ILO] 2019), droughts (Schlaepfer et al. 2017; Ahmadalipour et al. 2019), and floods (Barichivich et al. 2018; Vousdoukas et al. 2018) manifest.

Reflecting growing awareness of the socioeconomic determinants of environmental risk, climate scholarship has drawn increasingly on social scientific concepts of precarity and inequality in recent years. This "climatic precarity" framing (Natarajan, Brickell, and Parsons 2019; Griffin 2020; Natarajan and Parsons 2021) is linked also to a growing body of literature exploring how disasters are shaped by socioeconomic conditions and choices (D. S. Thomas et al. 2013; Oliver-Smith et al. 2017; Hallegatte et al. 2020; Kelman 2020), especially as they manifest in slow onset or complex ways. The concept of climate precarity, however, seeks to situate these relationships within a wider conceptual context, connecting the socioeconomic roots of disasters to recent debates around Standing's (2011) conception of precarity as "class-in-the-making" (7). In common with recent critical literature on the (anti-) politics of adaptation (e.g., Scoville-Simonds, Jamali, and Hufty 2020; K. A. Thomas 2020; Paprocki 2021), climate precarity therefore aims to deatomize the vulnerable individual, locating them within the household, community, market, nation, and more broadly within the unequal global political economy (Ribot 2014).

This recent body of literature owes a significant debt to political ecology, a field that has explored the nexus of economy and nature for several decades. In particular, it builds on the long-standing recognition of the inseparability of risk from the wider social, economic, historical, and political context in which it occurs. By extending focus beyond natural hazards themselves, toward the surrounding social environment (Blaikie et al. 2014, 4), political ecologists have effected "profound changes" in the meaning of resilience, away from "naturalistic, functionalist, and apolitical interpretations" toward accounts highlighting the structural inequalities that shape the landscape of environmental risk (Ajibade 2022, 2030). Moreover, in highlighting the relatively scarce attention in climate policy and scholarship paid to the factors that underpin risk (Ajibade and McBean 2014), political ecologists have above all drawn the politics of knowledge into the analysis of disasters. As Peet (2014) put it, "the rough and tumble of actual struggles and the relations between households, communities and power state and corporate agents is missing" (10).

Building on—and responding to—these insights, recent work on the politics of adaptation has helped to plug a long-standing lacuna at the nexus of climate and economy. Nevertheless, "a key gap in our understanding of the causality of disasters remains" (Fraser et al. 2020, 1), namely that most lenses on climate vulnerability "underestimate the dynamism of modern economies" (Kocornik-Mina and Fankhauser 2015, 22). Thus, although the structural economic precarities through which climate change impacts are articulated are increasingly recognized as important, these structures tend—in contrast to the inherent dynamism of the changing climate—to be viewed as ex-ante characteristics of a given site.

This raises both practical and conceptual issues. In the first instance, if economic conditions are assumed to be static and climatic conditions are assumed to be dynamic, then the latter will be overemphasized as determinants of disasters (Fraser et al. 2020; Cruz and Rossi-Hansberg 2021; Duvat et al. 2021). On a deeper level, though, it raises questions around the political epistemology of disaster causation (Fraser et al. 2020). Analytic frames that attribute disaster to climate alone might not only lack accuracy, but also divert attention from the place-based vulnerabilities and sociopolitical causes whose dynamism is not only an important factor, but the primary cause of disaster. Consequently, "while politicians may want to blame crises on climate change, members of the public may prefer to hold government accountable for inadequate investments in flood or drought prevention and precarious living conditions" (Lahsen and Ribot 2022, 1).

Integrating the dynamism of the global economy into adaptation planning is therefore essential. Yet it is a complex endeavor. Although a certain number of studies have explored the intersection of climate change with economic globalization, this has been a largely one-way process. Chang and Reuveny (2010), for example, posited that the growing incidence of disasters might slow globalization trends. Cruz and Rossi-Hanberg (2021) explored how geographically heterogeneous climate change impacts could shape areas of the global economy. Klomp (2016) examined the impact of natural disasters on economic development, and Klomp and Valkckx's (2014) meta-analysis examines their impact on economic growth. In each case, the event of the disaster is located at the start of a forward-looking analysis of economic trends, but no analysis has recently applied the same analytical dynamism to the economic conditions leading up to disaster.

Seeking to bridge this gap, this article looks back to less recent geographic literature to forward understanding at the nexus of economic and climatic change. In particular, it builds on and draws forward political ecological work around O'Brien and Leichenko's (2000) concept of "double exposure," which "refers to the fact that certain regions, sectors, ecosystems and social groups will be confronted both by the impacts of climate change, and by the consequences of globalization" (221). By placing globalized trade and resource flows on an equal analytical footing to environmental risk, this article aims to highlight the dynamic processes underlying local structural precarities.

Weak or degraded built infrastructure or flood defenses could act as intensifiers of disaster vulnerability, for example (Freeman 2000; Oliver-Smith et al. 2017), yet the presence of these weaknesses is shaped by ongoing, dynamic systems of globalization. Similarly, in compromising adaptive capacity and resilience, so, too, can poverty (Hallegatte et al. 2020) and social marginality (Parsons and Lawreniuk 2018), both of which result from current as well as historical global processes. From the standpoint that such processes of intensified disaster risk are actively structured by industrial processes, rather than passive *ex ante* characteristics, this article frames these vulnerabilities as globalized climate precarities, a term that calls for a detailed, contextually specified account of both root causes and current structural determinants of environmental risk.

Crucially, this approach aims to place in frame a far wider set of ways in which globalized industry shapes local vulnerability to climate-linked hazards, rooted in both historical and present processes of colonialism, neoliberal policies, capitalist urbanization, and uneven development (Abijade 2022, 2243). Methodologically and conceptually, this means moving beyond an examination of the carbon footprint of industrial processes, to attend to the diverse ways—from low wages to unsafe infrastructures, to local environmental pollutants—that shape and intensify the impact of the changing climate. As shown through the lens of the international brick trade to the United Kingdom in this article, those most vulnerable to globalized climate precarity are those triply exposed to hazard intensification, economic precarity, and local environmental degradation, a position calling ultimately for greater scrutiny and wider accountability of the ways in which global economic processes shape, direct, and intensify these risks. To understand climate precarity at the most granular scale, we must therefore situate it within the largest: our dynamic and globalized economy of material, human, and financial flows.

Context and Methods

The empirical data presented in this article combine secondary data on brick importation from Her Majesty's Revenue and Customs (HMRC) with primary qualitative data collected from brick production sites in India and Bangladesh. Both South Asian nations form part of the South Asian "brick belt," a region with 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 (Boyd et al. 2018). The carbon-intensive processes used by this vast collection of kilns, alongside high levels of "black carbon" emissions (Climate and Clean Air Coalition 2020), make them a key contributor to climate change, responsible for an estimated 131 tons of CO_2 per kiln annually (Tahir and Rafique 2009) and a total of 7,255,697 tons of CO_2 each year across the brick belt as a whole (Boyd et al. 2018), slightly under the total 7.8 million tons emitted by Nepal as a whole.

Brick production in the South Asian brick belt has been widely noted for the dirty, dangerous, and environmentally degrading conditions in which work takes place. As highlighted in a range of reports on the issue (Bangladesh Department of Environment 2017; Climate and Clean Air Coalition 2020; Eil et al. 2020), many of the industry's laborers 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 (Anti-Slavery International 2017; Boyd et al. 2018; Brown et al. 2021), or merely highly exploitative labor (Ercelawn and Nauman 2004; Morgan and Olsen 2015; D. K. Mishra 2020), 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 United Nations's Sustainable Development Goal 8, Economic Growth and Decent Work.

Data collection proceeded in two parts. 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 United Kingdom, data from Environmental Product Declarations and published primary research on the carbon emissions from brick manufacture, as well as data on greenhouse gas conversion factors for company reporting. Using these data, carbon emissions embodied in brick importation to the United Kingdom were calculated which included frequency statistics on brick imports between the years 2015 and 2019, disaggregated by county of origin.

The second element of the brick-focused research component comprised field work undertaken by research teams based in Bangladesh and India, to reflect the wider trend of brick importation from the South Asian brick belt to the United Kingdom. A total of twenty-four interviews were undertaken with local people, brick kiln workers, and kiln owners in two exporting kilns in India, located in Punjab and Gujarat. A total of forty-five interviews were undertaken with local people, brick kiln workers, and kiln owners across five brick kilns in Dhaka and Narsinghi in Bangladesh, one of which was an exporting kiln and four of which were nonexporting kilns. Interviews were undertaken by researchers from the local area. Interviews in Bangladesh were undertaken in Bengali, interviews in Punjab were undertaken in Hindi and Punjabi, and interviews in Gujarat were undertaken in Gujarati. Interview schedules delivered by the research team covered topics related to the participants' occupational experience of climatic change and environmental degradation by industry. Participants were asked about changes to the weather and the problems they generate for livelihoods, the experience of working in brick production, and the local environmental impacts of the brick industry on agriculture.

All interviews were recorded and fully transcribed in the original languages, either Gujurati, Punjabi, or Bangladeshi, before being translated into English. Data analysis subsequently followed an interpretive methodology (Yanow 2007), with more than 100 pages of text being coded. During the coding process, relevant text passages were identified and categorized to inductively inform the analysis. An initial set of ten environmental codes including floods, droughts, debt, rainfall, and landslides were developed through repeated readings (Creswell 2003). The quotations presented in this article are those selected for illustrative purposes.

Climatic Vulnerability, the Brick Trade, and the Brick Belt

Once self-sufficient in terms of brick production, the United Kingdom has since the great recession of 2008 seen production fall increasingly behind demand, leaving the country facing an annual "brick deficit" of more than half a billion bricks (Brick Development Association [BDA] 2017). The result has been a rise in brick imports to more than 400 million per year, predominantly from the European Union but increasingly from Global South countries such as China, India, Pakistan, and Bangladesh (HMRC 2020). The United Kingdom now imports 14 percent of its total brick stock, the highest proportion in the world (Observatory of Economic Complexity 2019). Furthermore, not only is the amount of bricks imported increasing, but the distance across which they are imported is increasing as well. Bricks imported to the United Kingdom from outside the EU increased more than tenfold between 2015 and 2019, from 3,088,902 to 32,942,280: a low-value, high-weight trade that emits carbon on an enormous scale.

Price is a key driver of this trend. Bricks sourced in Bangladesh, for example, cost £50 to £120 per 1,000 bricks depending on production type and cost (Eil et al. 2020), whereas in India 1,000 bricks costs on average £54.75 (Turner and Townsend 2019), a fraction of the £686 charged on average for the same number of bricks in the United Kingdom (Turner and Townsend 2019). Even when factoring in the cost of transporting those bricks, estimated at £39.51 based on a full forty-foot container of bricks (World Freight Rates 2021), the financial incentive to import bricks remains substantial. Nevertheless, in the United Kingdom, as with most other countries, there is currently no requirement for building projects to calculate the embodied carbon of their materials.

In highlighting the issue of hidden embodied emissions passing through the "loophole" of international trade (Moran, Hasanbeigi, and Springer

2018), these statistics point to an issue of growing global relevance. In addition to the carbon cost of transportation, the carbon-intensive processes associated with brick production itself present a major barrier to global decarbonization. The South Asian brick belt of intensive brick production spanning Pakistan, India, Bangladesh, and Nepal incorporates an estimated 55,387 kilns (Boyd et al. 2018), a growing number of which now export to the United Kingdom.

The carbon footprint of these imported bricks is presented in Table 1. Local data from Bangladesh and India place the carbon cost of brick production at 0.55 kg per brick for a traditional bull-trench kiln (Imran et al. 2015), compared with 0.45 kg per brick for UK-produced bricks (BDA 2020), a difference of 22 percent. In addition, the weighted average transport emissions from non-EU sources is 0.6 kg CO_2 per brick, ten times higher than bricks imported from the EU. The combination of these two factors means that each of the 24 million bricks imported from South Asia "costs" on average 2.44 times more in carbon terms than a brick produced in the United Kingdom. A standard house built with 8,000 of these bricks would therefore "cost" 9.2 tons of CO_2 emissions. The excess carbon cost compared to the equivalent house built with domestically produced bricks would be 6.4 tons of CO_2, the equivalent of 13,000 vehicle miles or burning twelve barrels of oil (Parsons et al. 2021).

The carbon emissions ultimately contribute to a process of global heating that is placing farmers in the South Asian brick belt under intense pressure. 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, 3 August 2021). Similarly, as a second Bangladeshi brick export brick producer noted, the pressing issue of soil salinity engendered by the country'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."

Moreover, there is a further hidden cost to construction in the form of black carbon, or soot. Brick kilns produce high levels of both carbon and black carbon emissions (Climate and Clean Air Coalition 2020), making them a key contributor to climate change, responsible for 131 tons of CO_2 per kiln annually (Tahir and Rafique 2009) and 7,255,697 tons of CO_2 each year across the brick belt as a whole (Boyd et al. 2018). Some 20 percent of global black carbon is attributable specifically to brick kilns, 90 percent of which are in central Asia (World Green Building Council 2021). Not only is it a dangerous local pollutant, highly damaging to human and environmental health, but—despite its absence from most greenhouse gas reporting—it is also considered to have a significant effect on global warming (Bond et al. 2013; Climate and Clean Air Coalition 2020).

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

Table 1. Emissions embodied in bricks imported from outside the European Union

Production	
CO_2 per brick produced in South Asia (kg CO_2e)	0.55
CO_2 per brick produced in the UK (kg CO_2e)	0.45
Shipping	
Bricks imported per 12 months	24,480,043
Weight of bricks, at UK average 2.13 kg (tons)	52,142
Average distance (estimate, km)	16,353
Ton kilometers (tkm)	852,686,165
Shipping (average) kg CO_2/tkm	0.016
Total CO_2 imported bricks (tons)	13,642
Total CO_2 per brick from shipping (kg)	0.56
Total	
Total CO_2 per non–European Union imported brick	1.1

result of their impact on farming, they serve indirectly to drive urbanization by incentivizing migration away from rural areas and contributing to the very processes of urbanization that are fueling demand for bricks (Brickell et al. 2018; P. Mishra 2020; Natarajan et al. 2019). By degrading agricultural livelihoods in the periphery of cities, brick kilns intensify the impacts of climate change, hastening the pace at which agricultural livelihoods are abandoned and increasing the risk of maladaptation (P. Mishra 2020).

Indeed, for those living in the vicinity of brick kilns, the impact of industrial processes such as these are so significant that for those involved they predominate over the long-term impacts of climate change, even if those wider changes intensify the problems they face (K. A. Thomas 2020; Paprocki 2021). By focusing exclusively on climate change as an atmospheric process, and on industrial impacts purely in terms of their emissions, the extent to which vulnerability is shaped by ongoing economic processes is elided to the detriment of adaptation scholarship and the communities involved. Globalized material flows not only contribute to global atmospheric warming, but also exacerbate the local impacts of those changes and undermine the economic capacity of communities to respond to them. The following sections outline the processes through which this precarity is created and sustained.

Economic Precarity and the Brick Trade

The conditions in which the 24 million bricks imported from South Asia to the United Kingdom each year are made are notoriously poor for workers. Across India, brick kilns have a long-standing reputation as spaces of labor exploitation with low, mostly piece-rate wages for long hours of work and wage arrangements centered around debt bondage to keep workers attached to the kiln for months or years on end. The laboring population working in brick kilns often consists of some of the poorest and most marginalized sections of India's informal workforce (Government of India National Sample Survey Office, Ministry of Statistics & Programme 2008). Child labor is widely prevalent, workplace hazards are common, and living conditions are generally poor (D. K. Mishra 2020; P. Mishra 2020). Moreover, this is a widely known issue. Brick kilns are frequently featured in domestic and international news coverage. Indian brick workers have been reported in the international media as "living like slaves" (Hawksley 2014), their workplaces considered sites of abuse, physical violence, and sexual violence inflicted by owners and managers on workers.

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 (Climate and Clean Air Coalition 2020), and the sector now accounts for approximately 1 percent of the country's gross domestic product, employing more than 1 million people (Bangladesh Department of Environment 2017). Yet work in brick kilns continues to be associated with a range of serious health hazards, including harmful chemicals in dust, ash, and smoke (ILO 2014). 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 (Cullen 2020). Child labor, as in much of the brick belt, is illegal but endemic (ILO 2014), and national and international news outlets continue to report on the "inhuman torture" facing workers (Hussain 2019).

Although considerable media and policy attention has been directed toward labor 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 United Kingdom changes this. Kilns in Gujarat and Punjab, for example, make up a large part of the 10 million bricks that arrvied from India in 2019. As the owner of one such kiln in Gujarat explained:

> Our bricks only go to the UK. Those bricks are unlabeled, 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 the United Kingdom, but the same piece rate]. We work according to orders. We take an advance of up to 30 percent on the orders from abroad. (Kiln Owner 2, Gujarat, 2 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 labor 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 [whereas] 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, 2 April 21)

Nevertheless, although the quality and price of the export-oriented products might be higher, the conditions in which they are made are largely indistinct from those that prevail throughout the brick belt. 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, 31 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, 16 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, 2 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, 31 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, 31 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 a.m. in the morning during summer and work till 8 p.m.. The most difficult working period is during July. (Migrant 3, 31 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, 8 March 2021). Moreover, as a worker in a second kiln in Narsinghi attested, the long-term impacts of brick work can extend beyond external discomfort:

> 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, 16 February 2021)

Even in these export-oriented brick kilns, debt continues to play a role in keeping workers in place. Kiln owners offer workers advances on their salaries, stating, "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, 2 April 2021). Workers take on these debts as a result of household expenses and also to cover life cycle 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, 1 April 2021). A further worker explained:

> 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 [1,925 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, 31 March 2021)

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

> I receive BDT 60,000 for six 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 any more money once I am done with my work here. (Md. Monir Mia, 16 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, evidencing a new set of linkages between the international materials trade and the dangerous nexus of environmental degradation and human exploitation found in the South Asian brick sector.

The Local Environmental Footprint of the International Brick Trade

As highlighted in the preceding data, both prospective and current brick workers are triply exposed to the impacts of dynamic, globally mediated climatic and economic precarity. First, rural livelihoods are subject to climate-linked pressures such as drought, flood, and salination, a global process exacerbated by carbon-intensive trade processes such as brick exports. Second, local vulnerability to the impacts of these hazards is intensified by industrial livelihoods in the brick sector subject to intense economic pressures on livelihoods, driven by debt, ill health, and low pay. Third, linking these two vulnerabilities is a third form of hazard intensification: the impact of industrial environmental degradation on local agriculture.

Qualitative data collected in the vicinity of brick kilns suggest that living nearby active brick production substantially reduces the resilience of smallholder agriculture to climate change, reducing yields already squeezed by climatic pressures, and increasing the likelihood that certain areas will be hit hard by climate change impacts such as drought and flooding. Residents in the vicinity of brick kilns in Bangladesh, for example, stated 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" (Md Guljar Hossain, small businessman, 20 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, 18 February 2021). Moreover, as the owner of a local small fertilizer 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 thirty-two 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, fertilizer business, 13 February 2021)

As the brick industry rapidly expands across the brick belt, driven in small but rapidly growing part by demand for exported bricks from countries such as the United Kingdom, significant swaths of countries such as Bangladesh and India are therefore 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 overabundance and scarcity, the airborne impacts of brick production play a substantial role in undermining the fertility of local farmers' crops (Hossain et al. 2019).

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 a local in Gujarat complained, "the smoke from the kiln cover the trees and they don't fruit or flower" (Vishnupad, Farmer, April 2021). Moreover, "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." As a farmer complained:

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 neighboring farmers sell off their soil to the kiln as well, to make it level. (Varinder, Farmer, 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. Industrial pollutants such as smoke, excess heat, and topographical changes linked to soil harvesting play a substantial role in intensifying the impact of droughts in the local area and thus worsening the impacts of climate change. The combination of these factors, the disaster footprint of the international brick trade, is set out in Table 2.

Taken as a whole, the combined 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 outmigration 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, 3 April 2021)

This exodus of workers from rural villages, linked in a broader sense to the impacts of climate change, is exacerbated, articulated, and rendered acute by the impacts of a brick industry serving the needs of consumers thousands of miles away in the United

Table 2. The triple precarity of brick exports from South Asia to the United Kingdom

Context	Economic precarity	Climate-linked precarity	Local environmental precarity	Feedbacks and mutual interactions
Brick production in South Asia	Low wages Short- and long-term debt bondage Lack of capital for health and other incidental expenses	Decreasing reliability of rainfall Increasing propensity to droughts and floods	Brick kiln smoke and heat impacting agricultural productivity Floods and droughts intensified by soil harvesting	Land sale and abandonment of agriculture Migration away from the area/immobility Entry to the brick industry

Kingdom. Just as the impacts of the brick kilns on local communities engender a cycle of environmental degradation, therefore, this process itself feeds into a wider cycle of unregulated urbanization that is fueling domestic demand for bricks. Mass migration to urban centers in the brick belt, where newcomers cluster in informal settlements usually established on marginal land and characterized by insecure tenure, poor or next to no provision of basic services, and exposure to environmental hazards (Adger et al. 2021), is thus exacerbated by demand for construction materials in the United Kingdom. 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.

Conversely, a key feature of the environmental footprint of the brick kiln industry is a more broadly defined form of immobility. In particular, gender roles often limit women's mobility and require them to adopt in situ adaptations rather than migrating away from areas of high environmental degradation, which has been observed in relation to disasters as well as gradual change (Call et al. 2017; Ayeb-Karlsson 2020; Khalil and Jacobs 2021). This phenomenon of being immobile, or trapped, is not limited to nonmigrants, but could also become a characteristic of people who have relocated to urban and periurban areas from their original locations. Some migrants became trapped in urban informal settlement in Dhaka, when they are unable to move home or away from precarity (Ayeb-Karlsson 2020; Siddiqui et al. 2021).

Climate precarity in major brick-exporting regions of South Asia is therefore shaped in three linked ways by carbon emission, labor precarity, and the intensification of climate-linked hazards by local industrial processes. All three of these processes can be linked, directly or indirectly, to brick exports: first through emissions generated through the transportation of heavy, low-value material across thousands of miles, second through precarity and low wages, and third by local impacts that intensify the impacts of climate change in the vicinity of production. All three of these industrial characteristics intensify the impacts of climate breakdown for affected populations, on the one hand by making climate-linked hazards more frequent or intense, and on the other by compromising the ability of local residents to respond to these events where they occur. Thus, in major brick-exporting regions, this three-pronged intensification of global precarity plays a substantial role in intensifying the impacts of climate-linked hazards at the local scale. Accounting for all three dimensions of climate precarity is therefore vital in calculating the full environmental impact of the international brick trade, as well as the United Kingdom's responsibility for it.

Globalizing Climate Precarity: Three Industrial Intensifications in a Dynamic Economy

As the case of the international brick trade highlights, economic processes linked to global supply chains intensify the impact of climate change and specific disasters such as floods and droughts in numerous, complex ways. Above all, they emphasize economic influence over environmental risk, the manner in which climate change impacts are articulated through global economic processes that are inherently dynamic and connected to global processes of trade. Thus, "the causal factors that drive risks" (Fraser et al. 2020, 1) are shown here to be linked in each case to processes originating in spatially distant economies, an underappreciated dimension of adaptation planning (Kocornik-Mina and Fankhauser 2015, 22).

In this article, we have highlighted how these linkages to global supply chains manifest through multiple forms of precarity. On the one hand, global supply chains shape economic conditions, contributing to economic precarity that impedes efforts to adapt. On the other, many producer countries within global supply chains face a growing risk of natural hazards linked to climate change. Moreover, the evidence here suggests that industrial production in the Global South brings a third form of precarity, affecting local environments in such a way as to intensify the impacts of climate change through its impact on local livelihoods. Those subject to these three dimensions of globalized precarity face high 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.

Indeed, key to this perspective outlined here, however, is that the geography of climate precarity is dynamic in response both to climatic factors and wider—often global—economic processes. Indeed, as shown here, the influence of global supply chains connects the processes of local environmental degradation that intensify climatic hazards to economic processes acting at multiple scales and often originating in spatially distant regions. Viewed thus, the arrival or expansion of one supply chain, or the withdrawal or contraction of another, could play an important role in intensifying the impacts of climate-linked hazards, adding a further level of dynamism to disaster vulnerability in practice.

To highlight the diverse ways in which climatic and economic processes dynamically interact to produce climate precarity, this article focused on three dimensions of the nexus of climate change vulnerability and global production, as they manifest among India and Bangladesh's international brick exporters. The first dimension is the influence of large-scale economic processes, as exemplified by the global economic downturn of 2008, which led to a reduction in domestic brick production capacity in the United Kingdom. Once demand began once again to outstrip the newly constrained domestic brick supply in the United Kingdom, the result was rapidly increasing brick imports from overseas and in particular from South Asia. Linked to this, the contemporary impact of the industry is intensified by a second pressure: the influence of climate change acting to reduce the viability of South Asian smallholder agriculture, creating an incentive to move out of agriculture and potentially to sell agricultural land to the brick industry. The result is intensified landslide risk due to large-scale digging and a consequent reduction in the agricultural viability of the surrounding areas. Finally, the economic precarity faced both by brick workers and those living in the vicinity of brick kilns further constrains the ability of those in the local area to adapt to these conditions, a factor exacerbated by the inability of brick workers to contribute economically to their sender households. In essence, the low pay and poor conditions of the South Asian brick industry constitute a drain on adaptive capacity in the areas it effects.

Each of these dimensions exemplifies a distinct aspect of the relationship between global economic processes, climate change, and local environmental degradation. Nevertheless, in combination they speak on a deeper level to questions concerning the epistemology of disaster causation (Fraser et al. 2020). Namely, if economic conditions are assumed to be static and climatic conditions are assumed to be dynamic, then the former could be underemphasized as intensifiers of local hazards. This is both an analytical and a political problem. On the one hand, it compromises scientific understanding of the geography of climate change vulnerability. On the other, it diverts attention from "deeper social and political–economic causes of suffering, including the problematic conditions of violence and exploitation that fundamentally strain and diminish the very human lives that most analysts hope to protect" (Lahsen and Ribot 2022, 4). A dynamic global lens on climate precarity, viewed thus, is not only an analytical necessity, helping to redress the monolateral stasis of climate–economy scholarship, but more broadly is a call to foreground the processes and choices within the global economy that shape and intensify the landscape of climate change vulnerability. Indeed, to paraphrase the late anthropologist Graeber (2015), the economic conditions that the climate meets are "something that we make, and could just as easily make differently" (89). Adaptation policy can and must reflect this.

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References

Adger, W. N., R. S. de Campos, S. N. A. Codjoe, T. Siddiqui, S. Hazra, S. Das, H. Adams, M. F. Gavonel, C. Mortreux, and M. Abu. 2021. Perceived environmental risks and insecurity reduce future migration intentions in hazardous migration source areas. *One Earth* 4 (1):146–57. doi: 10.1016/j.oneear.2020.12.009.

Adger, W. N., R. Safra de Campos, T. Siddiqui, and L. Szaboova. 2020. Commentary: Inequality, precarity and sustainable ecosystems as elements of urban resilience. *Urban Studies* 57 (7):1588–95. doi: 10.1177/0042098020904594.

Ahmadalipour, A., H. Moradkhani, A. Castelletti, and N. Magliocca. 2019. Future drought risk in Africa: Integrating vulnerability, climate change, and population growth. *The Science of the Total Environment* 662:672–86. doi: 10.1016/j.scitotenv.2019.01.278.

Ajibade, I. 2022. The resilience fix to climate disasters: Recursive and contested relations with equity and justice-based transformations in the Global South. *Annals of the American Association of Geographers* 112 (8):2230–47. doi: 10.1080/24694452.2022.2062290.

Ajibade, I., and G. McBean. 2014. Climate extremes and housing rights: A political ecology of impacts, early warning and adaptation constraints in Lagos slum communities. *Geoforum* 55:76–86. doi: 10.1016/j.geoforum.2014.05.005.

Anti-Slavery International. 2017. *Slavery in India's brick kilns and the payment system: Way forward in the fight for fair wages, decent work and the eradication of slavery*. London: Anti-Slavery International.

Ayeb-Karlsson, S. 2020. When the disaster strikes: Gendered (im) mobility in Bangladesh. *Climate Risk Management* 29:100237. doi: 10.1016/j.crm.2020.100237.

Bangladesh Department of Environment. 2017. *National strategy for sustainable brick production in Bangladesh*. Dhaka: Bangladesh Department of Environment.

Barichivich, J., E. Gloor, P. Peylin, R. J. Brienen, J. Schöngart, J. C. Espinoza, and K. C. Pattnayak. 2018. Recent intensification of Amazon flooding extremes driven by strengthened Walker circulation. *Science Advances* 4 (9):eaat8785. doi: 10.1126/sciadv.aat8785.

Bezgrebelna, M., K. McKenzie, S. Wells, A. Ravindran, M. Kral, J. Christensen, V. Stergiopoulos, S. Gaetz, and S. A. Kidd. 2021. Climate change, weather, housing precarity, and homelessness: A systematic review of reviews. *International Journal of Environmental Research and Public Health* 18 (11):5812. doi: 10.3390/ijerph18115812.

Blaikie, P., T. Cannon, I. Davis, and B. Wisner. 2014. *At risk: Natural hazards, people's vulnerability and disasters*. London: Routledge.

Bond, T. C., S. J. Doherty, D. W. Fahey, P. M. Forster, T. Berntsen, B. J. DeAngelo, M. G. Flanner, S. Ghan, B. Kärcher, D. Koch, et al. 2013. Bounding the role of black carbon in the climate system: A scientific assessment. *Journal of Geophysical Research: Atmospheres* 118 (11):5380–5552. doi: 10.1002/jgrd.50171.

Botzen, W. W., O. Deschenes, and M. Sanders. 2019. The economic impacts of natural disasters: A review of models and empirical studies. *Review of Environmental Economics and Policy* 13 (2):167–88. doi: 10.1093/reep/rez004.

Boyd, D. S., B. Jackson, J. Wardlaw, G. M. Foody, S. Marsh, and K. Bales. 2018. Slavery from space: Demonstrating the role for satellite remote sensing to inform evidence-based action related to UN SDG number 8. *ISPRS Journal of Photogrammetry and Remote Sensing* 142:380–88. doi: 10.1016/j.isprsjprs.2018.02.012.

Brick Development Association (BDA). 2017. UK brick makers are failing to make demand. *The Construction Index*. Accessed November 4, 2019. http:/theconstructionindex.co.uk.

Brick Development Association (BDA). 2020. Brick sustainability report 2020. Accessed November 23, 2021. www.brick.org.uk.

Brickell, K., L. Parsons, N. Natarajan, and S. Chann. 2018. *Blood bricks: Untold stories of modern slavery and climate change from Cambodia*. Egham: Royal Holloway.

Brown, D., D. S. Boyd, K. Brickell, C. D. Ives, N. Natarajan, and L. Parsons. 2021. Modern slavery, environmental degradation and climate change: Fisheries, field, forests and factories. *Environment and Planning E: Nature and Space* 4 (2):191–207. doi: 10.1177/2514848619887156.

Call, M. A., C. Gray, M. Yunus, and M. Emch. 2017. Disruption, not displacement: Environmental variability and temporary migration in Bangladesh. *Global Environmental Change* 46:157–65. doi: 10.1016/j.gloenvcha.2017.08.008.

Chang, O. H., and R. Reuveny. 2010. Climatic natural disasters, political risk, and international trade. *Global Environmental Change* 20 (2):243–54. doi: 10.1016/j.gloenvcha.2009.11.005.

Climate and Clean Air Coalition. 2020. *Bricks: Mitigating black carbon and other pollutants from brick production*. Accessed July 5, 2021. https://www.ccacoalition.org/.

Creswell, J. W. 2003. *Research design: Qualitative, quantitative and mixed methods approaches*. London: Sage.

Cruz, J. L., and E. Rossi-Hansberg. 2021. The economic geography of global warming. CEPR Discussion Paper No. 15803. Accessed November 17, 2021. https://economie.esg.uqam.ca/.

Cullen, B. 2020. Constellations of weathering: Following the meteorological mobilities of Bangla bricks. *Mobilities* 15 (6):862–79. doi: 10.1080/17450101.2020.1759929.

Diffenbaugh, N. S., J. S. Pal, F. Giorgi, and X. Gao. 2007. Heat stress intensification in the Mediterranean climate change hotspot. *Geophysical Research Letters* 34 (11):330. doi: 10.1029/2007GL030000.

Duvat, V. K., N. Volto, L. Stahl, A. Moatty, S. Defossez, J. Desarthe, D. Grancher, and V. Pillet. 2021. Understanding interlinkages between long-term trajectory of exposure and vulnerability, path dependency and cascading impacts of disasters in Saint-Martin (Caribbean). *Global Environmental Change* 67:102236. doi: 10.1016/j.gloenvcha.2021.102236.

Eil, A., J. Li, P. Baral, and E. Saikawa. 2020. *Dirty stacks, high stakes: An overview of brick sector in South Asia*. Washington, DC: World Bank.

Ercelawn, A., and M. Nauman. 2004. Unfree labour in South Asia: Debt bondage at brick kilns in Pakistan. *Economic and Political Weekly*, 2235–42. Working Paper 24.

Floriani, L. M., and E. N. D. Moura. 2021. The social construction of natural disasters: A systematic review of the literature. *Integrating Social Responsibility and Sustainable Development* 2021:309–20.

Fraser, A., M. Pelling, A. Scolobig, and S. Mavrogenis. 2020. Relating root causes to local risk conditions: A comparative study of the institutional pathways to small-scale disasters in three urban flood contexts. *Global Environmental Change* 63:102102. doi: 10.1016/j.gloenvcha.2020.102102.

Freeman, P. K. 2000. Infrastructure, natural disasters, and poverty. In *Managing disaster risk in emerging economies*, ed. A. Kreimer, and M. Arnold, 55–61. Washington, DC: World Bank.

Government of India National Sample Survey Office, Ministry of Statistics & Programme. 2008. *Employment and unemployment situation in India 2007–08*. New Delhi: Government of India.

Graeber, D. 2015. *The utopia of rules: On technology, stupidity, and the secret joys of bureaucracy*. London: Melville House.

Griffin, P. J. 2020. Pacing climate precarity: Food, care and sovereignty in Iñupiaq Alaska. *Medical Anthropology* 39 (4):333–47. doi: 10.1080/01459740.2019.1643854.

Hallegatte, S., A. Vogt-Schilb, J. Rozenberg, M. Bangalore, and C. Beaudet. 2020. From poverty to disaster and back: A review of the literature. *Economics of Disasters and Climate Change* 4 (1):223–47. doi: 10.1007/s41885-020-00060-5.

Hawksley, H. 2014. *Why India's brick kiln workers "live like slaves*." BBC News, September 2.

Her Majesty's Revenue and Customs (HMRC). 2020. *UK brick import data*. Private communication via the Brick Development Association. London: The National Archives.

Hickel, J., C. Dorninger, H. Wieland, and I. Suwandi. 2022. Imperialist appropriation in the world economy: Drain from the Global South through unequal exchange, 1990–2015. *Global Environmental Change* 73:102467. doi: 10.1016/j.gloenvcha.2022.102467.

Hossain, M. A., A. M. Zahid, M. Arifunnahar, and M. N. A. Siddique. 2019. Effect of brick kiln on arable land degradation, environmental pollution and consequences on livelihood of Bangladesh. *Journal of Science Technology and Environment Informatics* 6 (2):474–88. doi: 10.18801/jstei.060219.50.

Hussain, A. 2019. Brick kilns destroy fertile topsoil in Chittagong. *Dhaka Tribune*, March 27.

Imran, M. A., M. A. Baten, B. S. Nahar, and N. Morshed. 2015. Carbon dioxide emission from brickfields around Bangladesh. *International Journal of Agricultural Research, Innovation and Technology* 4 (2):70–75. doi: 10.3329/ijarit.v4i2.22653.

Intergovernmental Panel on Climate Change. 2018. *Global warming of 1.5° C: An IPCC special report on the impacts of global warming of 1.5° C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Geneva, Switzerland: IPCC.

International Labour Organisation (ILO). 2014. *Health hazards of child labour in brick kilns of Bangladesh*. Geneva, Switzerland: ILO.

International Labour Organisation (ILO). 2019. *Working on a warmer planet: The impact of heat stress on labour productivity and decent work*. Geneva, Switzerland: ILO.

Kelman, I. 2020. *Disaster by choice: How our actions turn natural hazards into catastrophes*. Oxford, UK: Oxford University Press.

Khalil, M. B., and B. C. Jacobs. 2021. Understanding place-based adaptation of women in a post-cyclone context through place attachment. *Environmental Development* 39:100644. doi: 10.1016/j.envdev.2021.100644.

Klomp, J. 2016. Economic development and natural disasters: A satellite data analysis. *Global Environmental Change* 36:67–88. doi: 10.1016/j.gloenvcha.2015.11.001.

Klomp, J., and K. Valckx. 2014. Natural disasters and economic growth: A meta-analysis. *Global Environmental Change* 26:183–95. doi: 10.1016/j.gloenvcha.2014.02.006.

Kocornik-Mina, A., and S. Fankhauser. 2015. *Climate change adaptation in dynamic economies: The cases of Colombia and West Bengal*. Accessed November 17, 2021. https://www.lse.ac.uk/.

Kolbert, E. 2021. Why call recent disasters "natural" when they really aren't? *National Geographic*, February 2.

Lahsen, M., and J. Ribot. 2022. Politics of attributing extreme events and disasters to climate change. *Wiley Interdisciplinary Reviews: Climate Change* 13 (1):e750.

Lee, S. H., J. E. Kang, C. S. Park, D. K. Yoon, and S. Yoon. 2020. Multi-risk assessment of heat waves under intensifying climate change using Bayesian networks. *International Journal of Disaster Risk Reduction* 50:101704. doi: 10.1016/j.ijdrr.2020.101704.

Mishra, D. K. 2020. Seasonal migration and unfree labour in globalising India: Insights from field surveys in Odisha. *The Indian Journal of Labour Economics* 63 (4):1087–1106. doi: 10.1007/s41027-020-00277-8.

Mishra, P. 2020. Urbanisation through brick kilns: The interrelationship between appropriation of nature and labour regimes. *Urbanisation* 5 (1):17–36. doi: 10.1177/2455747120965199.

Moran, D., A. Hasanbeigi, and C. Springer. 2018. *The carbon loophole in climate policy: Quantifying the embodied carbon in traded products*. San Francisco, CA: KGM & Associates, Global Efficiency Intelligence, Climate Work Foundations.

Morgan, J. A., and W. Olsen. 2015. The absence of decent work: The continued development of forced and unfree labour in India. *Global Labour Journal* 6 (2):173–88. doi: 10.15173/glj.v6i2.2344.

Natarajan, N., K. Brickell, and L. Parsons. 2019. Climate change adaptation and precarity across the rural–urban divide in Cambodia: Towards a "climate precarity" approach. *Environment and Planning E: Nature and Space* 2 (4):899–921. doi: 10.1177/2514848619858155.

Natarajan, N., and L. Parsons. 2021. *Climate change in the global workplace: Labour, adaptation, resistance*. London and New York: Routledge.

Newman, F., and E. Humphrys. 2020. Construction workers in a climate precarious world. *Critical Sociology* 46 (4–5):557–72. doi: 10.1177/0896920519880951.

O'Brien, K. L., and R. M. Leichenko. 2000. Double exposure: Assessing the impacts of climate change within the context of economic globalization. *Global Environmental Change* 10 (3):221–32. doi: 10.1016/S0959-3780(00)00021-2.
Observatory of Economic Complexity. 2019. Bricks/brick trade. Accessed November 29, 2019. https://oec.world.
Oliver-Smith, A., I. Alcántara-Ayala, I. Burton, and A. Lavell. 2017. The social construction of disaster risk: Seeking root causes. *International Journal of Disaster Risk Reduction* 22:469–74. doi: 10.1016/j.ijdrr.2016.10.006.
Paprocki, K. 2021. *Threatening dystopias*. Ithaca, NY: Cornell University Press.
Parsons, L., and S. Lawreniuk. 2018. Seeing like the stateless: Documentation and the mobilities of liminal citizenship in Cambodia. *Political Geography* 62:1–11. doi: 10.1016/j.polgeo.2017.09.016.
Parsons, L., R. Safra de Campos, A. Moncaster, I. Cook, T. Siddiqui, C. Abenayake, A. B. Jayasinghe, P. Mishra, and T. Billah. 2022. Trading disaster: Containers and container thinking in the production of climate precarity. *Transactions of the Institute of British Geographers* 47 (4):990–1008. doi: 10.1111/tran.12545.
Parsons, L., R. Safra de Campos, A. Moncaster, I. Cook, T. Siddiqui, C. Abenayake, A. Jayasinghe, P. Mishra, L. Scungio, and T. Billah. 2021. *Disaster trade: The hidden footprint of UK production overseas*. Egham, UK: Royal Holloway.
Peet, R. 2014. The cultural production of economic forms. In *Geographies of economies*, 37–46. London: Routledge.
Ribot, J. 2014. Cause and response: Vulnerability and climate in the Anthropocene. *The Journal of Peasant Studies* 41 (5):667–705. doi: 10.1080/03066150.2014.894911.
Schlaepfer, D. R., J. B. Bradford, W. K. Lauenroth, S. M. Munson, B. Tietjen, S. A. Hall, S. D. Wilson, M. C. Duniway, G. Jia, D. A. Pyke, et al. 2017. Climate change reduces extent of temperate drylands and intensifies drought in deep soils. *Nature Communications* 8 (1):14196. doi: 10.1038/ncomms14196.
Scoville-Simonds, M., H. Jamali, and M. Hufty. 2020. The hazards of mainstreaming: Climate change adaptation politics in three dimensions. *World Development* 125:104683. doi: 10.1016/j.worlddev.2019.104683.
Siddiqui, T., L. Szaboova, W. N. Adger, R. Safra de Campos, M. R. A. Bhuiyan, and T. Billah. 2021. Policy opportunities and constraints for addressing urban precarity of migrant populations. *Global Policy* 12 (Suppl. 2):91–105. doi: 10.1111/1758-5899.12855.
Standing, G. 2011. *The precariat: The new dangerous class*. London: Bloomsbury Academic.
Tahir, S. N. A., and M. Rafique. 2009. Emission of greenhouse gases (GHGs) from burning of biomass in brick kilns. *Environmental Forensics* 10 (4):265–67. doi: 10.1080/15275920903347487.
Thomas, D. S., B. D. Phillips, W. E. Lovekamp, and A. Fothergill. 2013. *Social vulnerability to disasters*. London: CRC Press.
Thomas, K. A. 2020. The problem with solutions: Development failures in Bangladesh and the interests they obscure. *Annals of the American Association of Geographers* 110 (5):1631–51. doi: 10.1080/24694452.2019.1707641.
Tol, R. S. 2018. The economic impacts of climate change. *Review of Environmental Economics and Policy* 12 (1):4–25. doi: 10.1093/reep/rex027.
Turner and Townsend. 2019. *International construction market survey 2019*. London: Turner and Townsend.
United Nations Environment Programme [UNEP]. 2020. *Sustainable trade in resources: Global material flows, circularity and trade*. Nairobi: UNEP.
United Nations Office for Disaster Risk Reduction. 2015. *Poverty and death: Disaster mortality 1996–2015*. Geneva, Switzerland: United Nations Office for Disaster Risk Reduction.
Vousdoukas, M. I., L. Mentaschi, E. Voukouvalas, M. Verlaan, S. Jevrejeva, L. P. Jackson, and L. Feyen. 2018. Global probabilistic projections of extreme sea levels show intensification of coastal flood hazard. *Nature Communications* 9 (1):2360. doi: 10.1038/s41467-018-04692-w.
World Freight Rates. 2021. Freight calculator. Accessed July 6, 2021. https://worldfreightrates.com/.
World Green Building Council. 2021. Principle one: Protect health and wellbeing. Accessed July 5, 2021. https://worldgbc.org/.
Yanow, D. 2007. Interpretation in policy analysis: On methods and practice. *Critical Policy Studies* 1 (1):110–22. doi: 10.1080/19460171.2007.9518511.

LAURIE PARSONS is a Senior Lecturer in Human Geography at Royal Holloway, University of London, London TW20 0EX, UK. E-mail: laurie.parsons@rhul.ac.uk. His work explores the politics of labor, environment, and climate change, highlighting the complexities and contradictions of environmental governance, sensing, and policy.

RICARDO SAFRA DE CAMPOS is Senior Lecturer in the Department of Geography at University of Exeter, Exeter EX4 4RJ, UK. E-mail: r.safra-de-campos@exeter.ac.uk. His research interests include spatial mobility dimensions of human interaction with environmental change, with a focus on migration, sustainability, and well-being.

ALICE MONCASTER is a Professor of Sustainable Construction in the School of Architecture and Environment at the University of the West of England, Bristol BS16 QQY, UK. E-mail: alice.moncaster@uwe.ac.uk. Her research interests focus on the environmental impacts of construction and on making the built environment more sustainable and resilient for all.

IAN COOK is a Professor of Cultural Geography at the University of Exeter, Exeter EX4 4RJ, UK. E-mail: i.j.cook@exeter.ac.uk. He researches how academics, filmmakers, artists, activists, musicians, and others try to make tangible to their audiences the lives of those who grow and make everyday commodities. He also runs the spoof shopping Web site followthethings.com.

TASNEEM SIDDIQUI is a Professor of Political Science at the University of Dhaka, Shahbag, Dhaka 1000, Bangladesh, and the founding chair of the Refugee and Migratory Movements Research Unit. E-mail: tsiddiqui59@gmail.com. Her works focus on climate change adaptation and migration, drivers and impact of internal and international male and female labor migration, migration governance, diaspora, remittances, and safe and sustainable cities inclusive to migrants.

CHETHIKA ABENAYAKE is a Senior Lecturer in the Department of Town & Country Planning at University of Moratuwa, Moratuwa, Katubedda 10400, Sri Lanka. E-mail: chethika@uom.lk. Her research interests include planning for disaster-resilient cities and communities and emulating nature-inspired solutions for urban planning.

AMILA BUDDHIKA JAYASINGHE is a Senior Lecturer in the Department of Town & Country Planning at University of Moratuwa, Moratuwa, Katubedda 10400, Sri Lanka. E-mail: amilabj@uom.lk. His research interests include urban informatics, spatial analysis, and infrastructure planning.

PRATIK MISHRA is a Postdoctoral Research Associate in the Lancaster Environment Center at Lancaster University, Lancaster LA1 4YQ, UK. E-mail: p.mishra3@lancaster.ac.uk. His research surrounding informal labor in brick kilns and sanitation work in South Asia draws strong connections between studies of labor regimes, urbanization, migration, caste, and political ecology.

LONG LY VOUCH is an independent researcher working at the nexus of environment and development in Phnom Penh, Cambodia. E-mail: longlyvouch@yahoo.com. He brings fifteen years of experience managing research teams in the Global South, report writing, and contextual expertise in the brick industry.

TAMIM BILLAH is a Research Associate at the Refugee and Migratory Movements Research Unit, University of Dhaka, Shahbag, Dhaka 1000, Bangladesh. E-mail: tbillah92@gmail.com. His work explores migration and development in Bangladesh.