The disaster trap: cyclones, tourism, colonial legacies, and the systemic feedbacks exacerbating disaster risk

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Abstract

The long, open-ended period of recovery from a disaster event is the phase of a disaster that the interdisciplinary field of disaster studies struggles to understand. In the process of rebuilding, places do not simply reset – they transform, often in ways that confound any reduction of disaster risk, instead making people and settings more vulnerable to future hazard events. Reducing disaster risk is regarded as a global priority, but policies intended to reduce disaster risk have been largely ineffective. This obduracy represents a grand challenge in disaster studies. Here, I propose that the correlated trends of runaway economic costs of disaster events, growing social inequity, environmental degradation, and resistance to policy intervention in disaster settings are hallmark indicators of a system trap – a dynamic in which self-reinforcing feedbacks drive a system toward an undesirable and seemingly inescapable state, with negative consequences that tend to amplify each other over time. I offer that these trends in disaster settings are the collective expression of an especially powerful and distinct kind of system trap, which here I term the "disaster trap" – a new theoretical concept to help explain and address runaway disaster risk. I suggest that disaster traps are likely strongest in tourism-dominated coastal settings with high exposure to tropical cyclones and colonial histories of racial capitalism, which I explore with an empirical illustration from Antigua & Barbuda. Formalising a linkage between gilded and safe-development traps matters because their effects likely compound each other nonlinearly, such that disaster risk only increases and disaster risk reduction becomes increasingly difficult to achieve. Addressing traps requires understanding them as dynamic systems, described as fundamentally and completely as possible – their components, mechanisms, drivers, and structure – in order to reveal when and where interventions might be most effective at reducing disaster risk.

Keywords

disasters; risk reduction; coupled systems; social traps; tourism; longitudinal analysis

1 Introduction

The long, open-ended period of recovery from a disaster event is the phase of a disaster that the vast field of disaster studies struggles to understand (Olshansky et al., 2012). In the process of rebuilding, places do not simply reset – they transform, often in ways that confound any reduction of disaster risk, instead making people and settings more vulnerable to future hazard events (Mileti, 1999; Burby, 2006; Cutter and Emrich, 2006; Kates et al., 2006; Sovacool, 2017; Tselios and Tompkins, 2019; Finucane et al., 2020). Follow the trajectory of a coastal tourist destination after a tropical cyclone: despite formal guidance to the contrary, buildings get rebuilt not better (UNDRR, 2015) but bigger (Lazarus et al., 2018), protected by bulkier coastal defences (Sovacool, 2011; Gittman et al., 2015; Logan et al., 2018; Nunn et al., 2021); people who cannot afford to rebuild get displaced by others who can (Cutter and Emrich, 2006; Gladstone and Préau, 2008; Gould and Lewis, 2018); public assets and services are sold and contracted to for-profit multinational corporations (Klein, 2007; Gunewardena and Schuller, 2008; Gotham, 2012; Loewenstein, 2015); to attract visitors and investments, tourism consumes the local economy (Mair et al., 2016; Wright et al., 2020); the built environment expands at direct expense of the natural environment (Mileti, 1999; Lewsey et al., 2004; Nordstrom, 2004; Carr and Heyman, 2009). This increased exposure makes the next disaster more severe, and more costly: economic costs (adjusted for inflation) of disaster damages worldwide in the last decade exceeded $USD 1.8 trillion – four times higher than in the 1980s (CRED, 2021).

Although reducing disaster risk is considered a global priority (UNDRR, 2015) policies intended to reduce disaster risk have been largely ineffective (Nohrstedt et al., 2021). This obduracy is a grand challenge in disaster studies (UNDRR, 2019). For decades, thematic reviews of disaster risk have called for holistic perspectives and approaches that address disaster settings as dynamic systems of interconnected social and environmental elements related by feedbacks (Mileti, 1999; UNDRR, 2019). But even as critical research perspectives gain insight into social, economic, and

environmental aspects of disasters, reducing disaster risk has been hindered in part by fragmentation of discipline-specific, case-based, research snapshots that never capture the full structure of a global pattern that evolves over time – and so also by an incomplete understanding of disaster settings as dynamic systems (Mileti, 1999; Cutter et al., 2015; UNDRR, 2019; Finucane et al., 2020).

Here, I suggest that the correlated trends of runaway economic costs of disaster events, growing social inequity, environmental degradation, and resistance to policy intervention in disaster settings are hallmark indicators of a system trap – a dynamic in which self-reinforcing feedbacks drive a system toward an undesirable and seemingly inescapable state, with negative consequences that tend to amplify each other over time (Meadows, 2008; Boonstra and de Boer, 2014; Haider et al., 2018; Dornelles et al., 2020). Further, I offer that these trends in disaster settings are the collective expression of an especially powerful and distinct kind of system trap, which here I term the "disaster trap", as a new theoretical concept to explain and address runaway disaster risk.

I propose that a disaster trap is a powerful and distinct dynamic that emerges when two known types of system traps become coupled: a gilded trap, in which a local economy becomes dependent upon a single, lucrative sector at the expense of a more diverse economic ecology (Steneck et al., 2011; Lazarus, 2017); and the safe-development trap, in which the proliferation of economically valuable infrastructure in hazard zones is encouraged by hazard defences (Burby, 2006; Stevens et al., 2010; Di Baldassarre et al., 2015; Armstrong et al., 2016; Lazarus et al., 2016; Pérez-Morales et al., 2018; Armstrong and Lazarus, 2019). The gilded trap locks in a kind of economy that grows too profitable to abandon; the safe-development trap locks in a kind of built environment too valuable to abandon. The crux of the disaster trap is likely in the attenuated process of rebuilding and recovery, when both the gilded and safe-development components can be intensified – and future risk exacerbated – by regressive planning decisions

and speculative economic revival (Lewsey et al., 2004; Burby, 2006; Berke and Campenella, 2006; Lazarus et al., 2018; Pérez-Morales et al., 2018; Smith et al., 2018).

2 Settings and geographies

Disaster traps are likely strongest in tourism-dominated coastal settings with high exposure to tropical cyclones and colonial histories of racial capitalism (Scott et al., 2012; Cruz-Martínez et al., 2018; Gould and Lewis, 2018; Schmude et al., 2018; Bledsoe and Wright, 2019; Davis et al., 2019; Look et al., 2019; Moulton and Machado, 2019; Popke and Rhiney, 2019; Lightfoot, 2020; Bonilla, 2020; Rivera, 2020; Rhiney, 2020; Wright et al., 2020). Along the tropical cyclone corridor (20–30ºN) of the Northern Tropic, for example, cyclone intensities tend to be highest (Bloemendaal et al., 2020) and can compound multiple hazards at the coast (e.g., flooding, landslides) (AghaKouchak et al., 2020). The cyclone corridor of the Northern Tropic also crosses tectonically active zones, introducing the possibility of earthquakes, tsunamis, and volcanic activity that could exacerbate the impacts of a cyclone event, or vice versa (Matthews et al., 2002). These same regions are tourist destinations. In 2019, the top three regions in which tourism contributed the greatest proportion of whole-economy GDP were the Caribbean (14%), Southeast Asia (12%), and Oceania (12%) (WTTC, 2020). Of the top ten locales where economic impacts of recent disasters (calculated as %GDP) have been highest, nine are in the Caribbean (CRED and UNDRR, 2020). Moreover, European colonial occupation and systematised racial capitalism were pervasive across the Caribbean, Southeast Asia, and Oceania, with cultural, societal, and administrative legacies that persist in the present (Cohen, 2011; Bledsoe and Wright, 2019; Davis et al., 2019; Gahman and Thongs, 2020; Look et al., 2019; Lightfoot, 2020; Rivera, 2020). While these settings are not necessarily the only places where disaster traps might manifest, they are where disaster severity (in economic terms) tends to be

greatest (CRED and UNDRR, 2020), and therefore where signatures of disaster traps will be most discernible in empirical data.

Despite the overlapping geographies of disaster settings and tourist destinations, some tourism scholars have noted a dearth of work on "the interface of tourism and disaster" (Cohen, 2011). Research has tended to examine the effects of disasters on the tourism industry (Scott et al., 2012; Becken et al., 2014; Mair et al., 2016; Schmude et al., 2018), while little attention has gone to a more critical perspective of what tourism entails – socially, culturally, environmentally – for the places it affects (Bianchi, 2009). In many settings, the tourism industry functions as a power broker in post-disaster recovery (Klein, 2007; Cohen, 2011; Wright et al., 2020). Tourism-driven interests have been linked to "disaster capitalism": the deliberate and opportunistic profiteering from societal disruption (Klein, 2007; Loewenstein, 2015), including in the wake of disaster events, such as government-sanctioned "land grabbing" of public lands and/or smallholdings by private, for-profit entities (Cohen, 2011). Beyond a handful of case studies, new analyses of the relationship between tourism and disaster capitalism have been slow to emerge – and beyond its conceptual premise (Wright et al., 2020), there has been no systematic examination of the tourism industry as a facet of disaster capitalism.

Research suggests that disasters themselves now represent a new market for corporate investment, termed the "disaster-capitalism complex" (Klein, 2007). A predicate of the disaster-capitalism complex is privatisation, or the replacement of formerly state or public-sector roles and provisions by for-profit contractors, particularly multinational corporations (Klein, 2007; Gunewardena and Schuller, 2008; Gotham, 2012; Loewenstein, 2015). Although processes of recovery and reconstruction are fundamental to disaster-risk reduction, privatisation of those processes typically lacks transparency (Klein, 2007; Gotham, 2012; Loewenstein, 2015; Gould and Lewis, 2018; Lightfoot, 2020). Privatisation appears to be a key process intrinsic to both the gilded and safe-development components of disaster traps, and while private-sector involvement

in post-disaster response is not new, the scale of its involvement is (Gotham, 2012; Gotham and Greenberg, 2014). Cost inflation by for-profit entities remains a largely unexplored driver behind the rising economic costs of disasters (Klein, 2007; Gotham, 2012), and the extent and magnitude of the disaster-capitalism complex following hazard-triggered disasters has not been systematically surveyed.

A growing body of critical scholarship that joins disasters studies with tourism examines the omnipresence of colonial legacies in a sprawling geography of post-disaster settings (Cruz-Martínez et al., 2018; Davis et al., 2019; Moulton and Machado, 2019; Popke and Rhiney, 2019; Bonilla, 2020; Gahman and Thongs, 2020; Rivera, 2020; Popke, 2020; Faria et al., 2021). Although critiques differ, scholarship agrees that many disaster settings are shaped by legacies of colonial occupation and systematised racial capitalism. Channels of aid and intergovernmental discourse regarding disaster response, responsibility, and recovery are freighted by, and inextricable from, historical colonial relationships (Moulton and Machado, 2019). Rivera (2020) coined the term "disaster colonialism" to explicitly tie cyclical disaster events to the perpetuation of colonisation through the contrivance of structural, systemic dependencies and the ingrained effects of coloniality. In cyclone corridors, disaster colonialism overlaps with cultural, social, political, and economic legacies of systematised racial capitalism (Bledsoe and Wright, 2019; Davis et al., 2019). The manifestation and intensification of present-day disaster traps cannot be explained without accounting for coloniality (Bonilla, 2020; Gahman and Thongs, 2020; Rivera, 2020) – and resistance to racial capitalism may hold clues for how to break disaster traps (Davis et al., 2019).

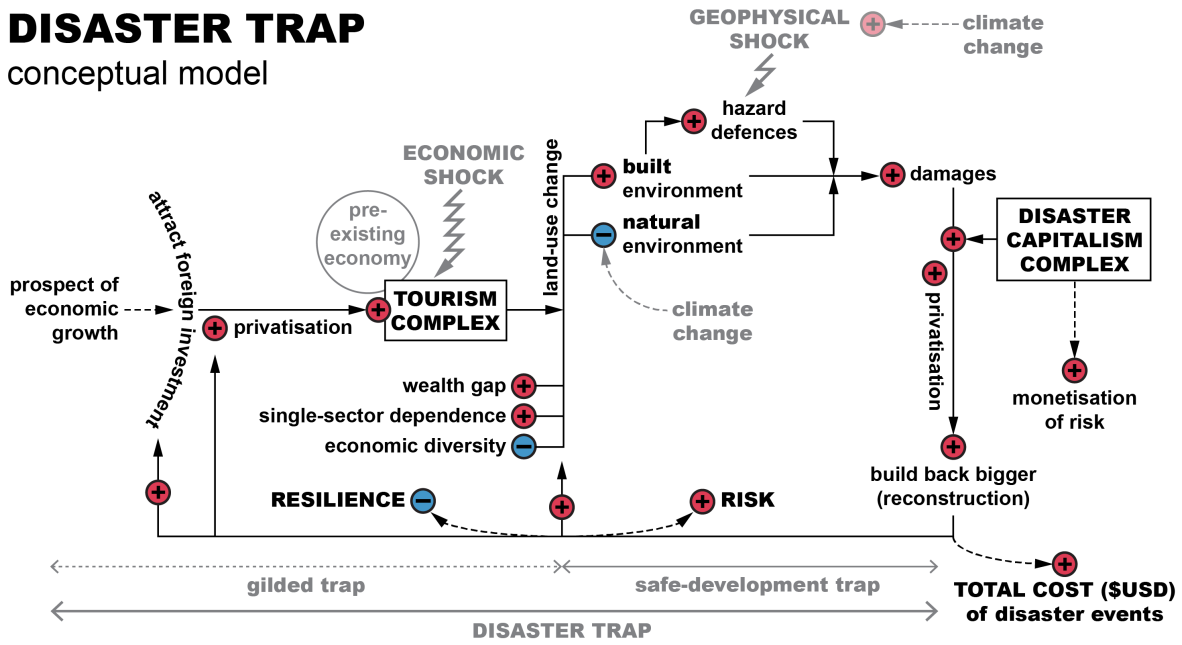


Figure 1. *Conceptual model of the disaster trap. In a gilded trap (left), a local economy becomes precariously dependent on a single, lucrative economic sector. In a safe-development trap (right), protection against hazard impacts enables the development of high-value physical infrastructure in a hazard-prone setting. A disaster trap emerges where the infrastructure protected and enabled by the safe-development trap takes its high value from the economic engine of the gilded trap. Plus signs (red +) denote a positive feedback; minus signs (blue -) denote a negative feedback. Dashed lines indicate an indirect and/or emergent relationship. External forcings (e.g., shocks, climate change) and/or contextual conditions (e.g., "pre-existing economy") are shown in grey.*

4 A conceptual illustration of the disaster trap

A conceptual model of the disaster trap **(Fig. 1)** illustrates how the components of this system – from tourism and privatisation to geophysical shocks and disaster capitalism – are related by feedbacks among social structures and environmental change. The example below steps through a generic coastal locale to explicate the theoretical premise.

Here, I start with the gilded trap. A common strategy for economic growth is to attract foreign investment in local assets that promote tourism (Endo, 2006; Barrowclough, 2007; Fauzel et al.,

2017). Transforming space into tourist amenities (e.g., hotels, resorts, holiday homes) can displace existing, if less lucrative, local economic sectors, and likewise displace people from existing, if less lucrative, forms of land tenure (e.g., common ownership, subsistence agriculture) (Gould and Lewis, 2018; Look et al., 2019; Lightfoot, 2020). Consequently, local employment shifts into service roles for the burgeoning "tourism complex" (Cutter and Emrich, 2006). Many coastal resorts are controlled by multinational corporations (Scott et al. 2012), meaning tourist money spent locally does not stay local, and wages and benefits may be depressed for lack of competitive alternatives (Cutter and Emrich, 2006; Lightfoot, 2020). This can open a wealth gap (Cutter and Emrich, 2006; Tselios and Tompkins, 2019), or exacerbate inequities from a colonial legacy (Cruz-Martínez et al., 2018; Bledsoe and Wright, 2019; Davis et al., 2019; Look et al., 2019; Moulton and Machado, 2019; Popke and Rhiney, 2019; Bonilla, 2020; Gahman and Thongs, 2020; Lightfoot, 2020; Popke, 2020; Rivera, 2020; Faria et al., 2021). As the local economy depends increasingly on tourism, the gilded trap gains strength. The stronger the gilded trap, the more vulnerable it is to economic shocks like the global collapse of tourism during the COVID-19 pandemic (ILO, 2020; Mohammed and Rei, 2020).

This gilded trap of tourism can in turn drive a safe-development trap of hazard protection. Coastal resort infrastructure tends to degrade the physical environment on which it depends for natural capital (wide beaches draw more people) and natural hazard protection (dune fields buffer waves; tidal wetlands absorb storm surge) (Lewsey et al., 2004; Nordstrom, 2004; Carr et al., 2009; Masselink and Lazarus, 2019). Because coastal resorts are such economically valuable assets, they can demand engineered protection (seawalls, beach nourishment) from natural hazard impacts (cyclones) – despite being deliberately situated in zones of high exposure (Lewsey et al., 2004; Nordstrom, 2004; Scott et al., 2012; Lazarus et al., 2016). The presence of hazard protection can have the unintended result of stimulating additional development behind that protection (Burby, 2006; Di Baldassarre et al., 2015): a defended coastline is perceived as a "safe"

coastline, where investment in seawalls and beach nourishment is construed as an investment in the real estate behind those defences, irrespective of hazard exposure. While hazard protections tend to prevent minor damage from extreme weather events, the development intensification spurred by the safe-development trap means that when the defences do fail the economic repercussions are then disastrous (Mileti, 1999, Werner and McNamara, 2007; Lazarus, 2014; Lazarus et al., 2016).

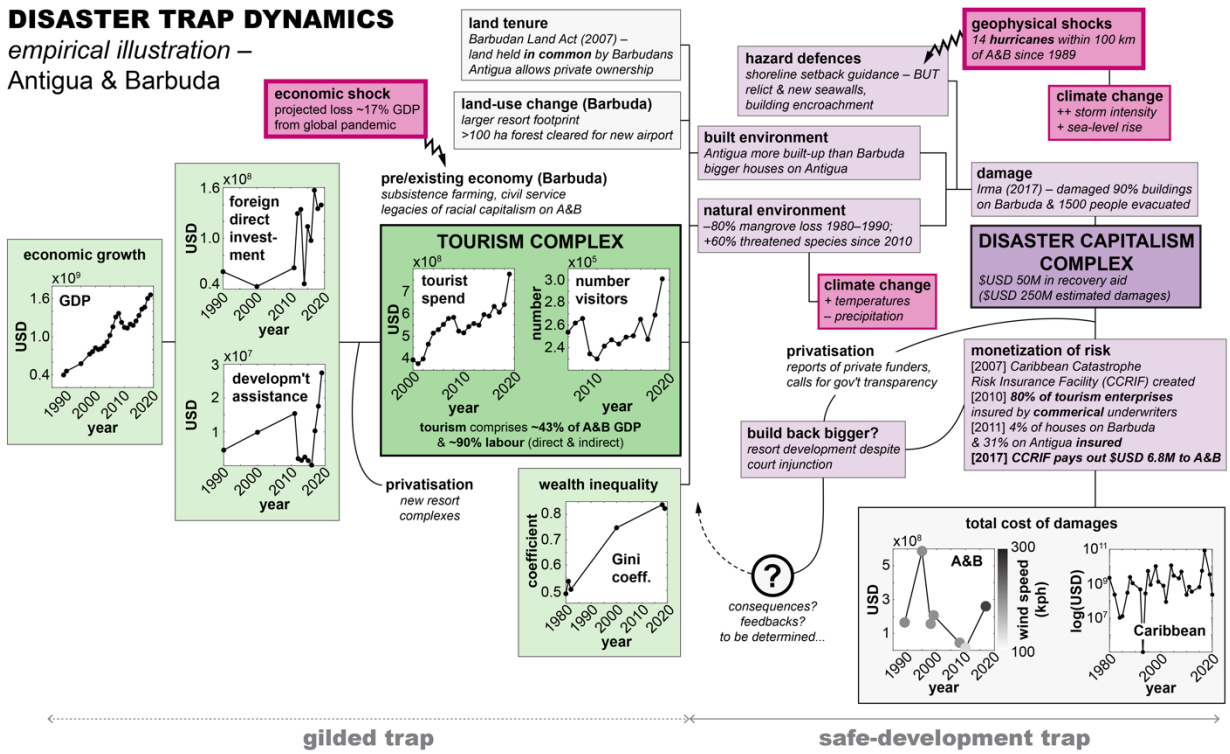
Damage by a hazard event necessitates post-disaster reconstruction, a phase in which for-profit multinational corporations may exert powerful influence, and formerly public services and/or resources get outsourced to private contractors (Klein, 2007; Gunewardena and Schuller, 2008; Gotham, 2012; Loewenstein, 2015). The safe-development trap twists the rhetoric of "building back better" (UNDRR, 2015) into "building back bigger" (Lazarus et al., 2018) – increasing the exposure of at-risk assets, reinforcing the predicates of the gilded trap, decreasing collective resilience, and ensuring that the total economic cost of the next disaster events will be even greater. Building back bigger refers to a net increase in the physical footprint of the built environment in a hazard zone, occurring in the quiescent years between successive hazard events. At the scale of individual residential properties, houses damaged by a cyclone, for example, might be rebuilt to larger dimensions. This collective bulking out (and/or up) can be an emergent consequence of disaster-recovery processes and economic incentives, rather than an intentional or mandated response by planners and authorities (Lazarus et al., 2018) – or it can indeed be intentional, as a way of literally cementing a forced or otherwise opportunistic change in land tenure (Cohen, 2011; Gould and Lewis, 2018; Look et al., 2019; Lightfoot, 2020). Monetisation of risk into re/insurance markets can enable further infrastructure and investment in hazard zones, pooling risk for major investors (and thus making investments more palatable) but also inscribing physical landscapes with spatial patterns of insured versus uninsured real estate (Auffret, 2003; Joyette et al., 2015; Taylor and Weinkle, 2020), which in turn affects how

recovery plays out following subsequent disasters. Privatisation in the gilded trap, via foreign direct investment in tourism assets, and in the safe-development trap, via the disaster-capitalism complex of post-disaster reconstruction, functions as a kind of dynamical accelerant, fuelling both components of the disaster trap.

5 An empirical illustration of the disaster trap: Antigua & Barbuda

To demonstrate how the generalised disaster trap **(Fig. 1)** can be constructed for a given setting from a portfolio of social and physical evidence, here I provide a preliminary sketch of disaster-trap dynamics in Antigua & Barbuda **(Fig. 2)**. But to be clear: a trap describes a dynamic, not a place nor its peoples.

Antigua & Barbuda, an independent Commonwealth nation of islands in the eastern Caribbean, presents one example of disaster-trap dynamics. In pursuit of economic growth, the parliamentary government of Antigua & Barbuda works to attract foreign direct-investment and development aid (World Bank Group 2013, 2017; World Bank DataBank, 2021) – typically in forms that serve the interests of international tourism (Gould and Lewis, 2018; Look et al., 2019; Lightfoot, 2020). Dependence on tourism is nearly total: tourism accounts for >40% of Antigua & Barbuda's GDP, and engages >90% of its labour (direct and indirect) (ILO, 2020; Mohammed and Rei, 2020; Antigua & Barbuda Statistics Division, 2021). Wealth inequality is significantly higher than the global average (Thomas, 1994; Davies et al., 2007; Credit Suisse, 2018, 2019). Those numbers reflect one of the strongest gilded traps in the Caribbean.



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234 ***Figure 2.*** *Empirical illustration of disaster trap relationships and dynamics from Antigua & Barbuda,*

235 *constructed from various sources (see footnote).*[1] *Layout follows conceptual model shown in Figure 1. Green*

236 *indicates primary components of the gilded trap (left); purple indicates primary components of the safe-development*

237 *trap (right). Magenta boxes denote external shocks and forcings. Grey boxes denote aspects of the system in which*

238 *the two component traps are especially intertwined.*

239

240 However, what makes this example illuminating for this project is that while a gilded trap has

241 long gripped Antigua, Barbuda has resisted – due in part to their starkly contrasting land-use

[1] Sources for system components shown in **Figure 2**: *economic growth, foreign direct investment, and development assistance* (World Bank DataBank, 2021); *tourism complex* (ILO, 2020; Mohammed and Rei, 2020; Antigua & Barbuda Statistics Division, 2021); *economic shock* (ILO, 2020); *pre-existing economy* (Lightfoot, 2020); *land tenure* (Look et al., 2019; Lightfoot, 2020); *land-use change* (EJA, 2021; GLAN, 2021; own data – Google Earth Pro); *wealth inequality* (Thomas, 1994; Davies et al., 2007; Credit Suisse, 2018, 2019); *climate change* (Simpson et al., 2009; Wong et al., 2014; Birchenough, 2017; WHO and UNFCCC, 2020); *geophysical shocks* (CRED, 2021; NOAA, 2021); hazard defences; *built environment* (own data – OpenStreetMap, 2021); *natural environment* (Lewsey et al., 2004; Carr et al., 2009; Johnson et al., 2020; Hubbart et al., 2020; UN, 2021); *damage* (Look et al., 2019; Lightfoot, 2020); *disaster capitalism complex and privatisation* (Ferrando, 2018; Gould and Lewis, 2018; Gruenbaum, 2018, 2021; Look et al., 2019; Sou, 2019; Brown, 2020; Lightfoot, 2020; Wright et al., 2020); *monetisation of risk* (World Bank and GFDRR, 2010; Antigua & Barbuda Census, 2011; CCRIF, 2021); *build-back recovery* (Lightfoot, 2020); *total cost of damages* (CRED, 2021).

histories and post-colonial governance (Look et al., 2019; Lightfoot, 2020). Where the land of Antigua is carved up into private and foreign ownership and the economy is dominated by the tourist industry, the land of Barbuda is held in common among Barbudans and the economy is largely one of civil service and subsistence (Lightfoot, 2020) – plus a subsidy from Antigua (Gould and Lewis, 2018). Under British colonial rule, Antigua was converted to sugarcane plantations farmed by enslaved people; Barbuda could not sustain plantation agriculture, and so was used as a provisioning island controlled by a single colonial family (Look et al., 2019; Lightfoot, 2020). With emancipation, Antigua became entangled in the continuance of private holdings by foreign owners, while Barbuda essentially defaulted to the formerly enslaved people living there. Although not codified until the Barbuda Land Act of 2007, Barbudan land is held in common by Barbudans; land can be leased but not owned, thus discouraging the kinds of major hotel and resort developments now characteristic of Antigua (Look et al., 2019; Lightfoot, 2020).

Relative to Antigua, buildings on Barbuda tend to be smaller, and there are far fewer of them (OpenStreetMap, 2021). With its sparse built environment, Barbuda has kept its beach systems more intact than other islands with intensive resort development (Gould and Lewis, 2018). The spatial extent of mangrove systems around both islands has declined steeply, and the ecological health of their reef and fish ecosystems remain vulnerable (Lewsey et al., 2004; Carr et al., 2009; Johnson et al., 2020; Hubbart et al., 2020; UN, 2021) – especially given climate change projections that suggest the future may bring less precipitation, hotter temperatures, and sea-level rise (Simpson et al., 2009; Wong et al., 2014; Birchenough, 2017; WHO and UNFCCC, 2020). National guidance advises shoreline set-backs, dune and vegetation conservation, and coastal stewardship, but seawalls are prevalent on Antigua (James, 2003; Simpson et al., 2012); the more rural Barbuda still appears largely free from seawalls. However, for both islands, even if cyclone frequency and intensity remains unchanged, sea-level rise guarantees that the severity of cyclone impacts can only increase (Wong et al., 2014).

Antigua & Barbuda have been struck by dozens of hurricanes during the past century (CRED, 2021; NOAA, 2021), but Hurricane Irma, in 2017, triggered unprecedented changes in the socio-political relationship between the two islands that struck many observers as a case of disaster capitalism (Ferrando, 2018; Gould and Lewis, 2018; Look et al., 2019; Sou, 2019; Lightfoot, 2020; Wright et al., 2020). Hurricane Irma destroyed ~90% of buildings on Barbuda and precipitated the evacuation of its population to Antigua (Lightfoot, 2020). Over Barbudan opposition, the national government used the disruption of the hurricane to override Barbudan land law and force open opportunities for private investment and ownership – specifically for two resort complexes and a new international airport to service them (Gould and Lewis, 2018; Gruenbaum, 2018, 2021; Look et al., 2019; Brown, 2020; Lightfoot, 2020). These new developments directly impact a Ramsar-designated dune and wetland system (GLAN, 2021), and >100 ha of forest and ecologically sensitive habitat have already been cleared (EJA, 2021). At one of the new resort sites, a new 250 m seawall is visible from space – and behind it, the spatial footprint of a resort already five times larger than its predecessor.

The prime minister, Gaston Browne, promised that Barbuda would be rebuilt "bigger and better" (Beauchamp, 2018) – but his plans prompted accusations of disaster capitalism (Gould and Lewis, 2018; Lightfoot, 2020). Browne invited extensive journalistic coverage of Barbuda's post-hurricane condition, in part to attract investment in a reconstruction agenda that included, in addition to the new airport, works on two schools, and $USD 20 million for new homes (along with land for purchase as freehold property, contravening Barbudan law) (Lightfoot, 2020).

Privatisation of Barbudan assets would also expand the reach of insurance and reinsurance instruments into Antigua & Barbuda. With land on Barbuda held in common, homes on the island are not underwritten by private insurance (Lightfoot, 2020). In 2011, only 4% of households on Barbuda and 31% on Antigua carried "dwellings" insurance (Antigua & Barbuda

Census, 2011); meanwhile, in 2010, 80% of tourism enterprises were insured by commercial underwriters (World Bank and GFDRR, 2010). After Irma, in 2017, Antigua & Barbuda received $USD 6.8 million from the Caribbean Catastrophe Risk Insurance Facility – a private company that provides insurance coverage granting national governments short-term liquidity in the event of a disaster (CCRIF, 2021). Insured properties get reported in damage assessments, and fast-tracked for compensation; uninsured properties do not, and their ownership may be contested (Esnard and Sapat, 2018; Sou and Webber, 2019). Scholarship from other disaster settings suggests that the growing presence of reinsurance will begin – or has already begun – to transform the characteristics of the country's built environment (Taylor and Weinkle, 2020).

If these programmes of land privatisation and resort development on Barbuda advance (as some have, despite court injunctions) (Lightfoot, 2020; GLAN, 2021), then so will the ratchet of the disaster trap – making the country as a whole more dependent on a single economic sector, with greater infrastructural and socio-economic exposure to future natural hazard impacts. A higher risk profile will drive greater uptake of insurance and reinsurance, in part to attract and retain additional private investments that want some guarantee of protection in the event of a disaster. Making even more of the national labour force reliant on tourism will reduce the country's resilience: in this case, the relative severity of a disturbance, and how quickly the country can recover from it. Interviews with journalists and researchers suggest that Barbudans are not opposed to economic opportunity, but to the inevitabilities of the services corps of the tourism industry, specifically (Gould and Lewis, 2018; Lightfoot, 2020). With the shutdown of international tourism under the coronavirus pandemic, Antigua & Barbuda face an estimated loss of ~17% GDP (ILO, 2020). Responses to this shock have focused on rearrangements within the tourism sector, but not potential alternatives to tourism – noting, for example, the quick rebound of "yacht tourism" in Antigua & Barbuda and neighbouring countries (Mohammed and Rei, 2020). Through court injunctions on the development projects and other political actions,

Barbudans are resisting the imposition of post-hurricane changes that would dramatically alter the character of their island (Gould and Lewis, 2018; Long et al., 2019; Lightfoot, 2020).

6 Future directions

Disaster traps, as a theoretical framework, could help guide interdisciplinary, comprehensive, longitudinal, critical empirical investigation of disaster settings around the world. Such study would deliver formalised descriptions of disaster-trap system states and behaviours that reveal when and where policy interventions into disaster systems might be most effective at reducing disaster risk. Demonstrating quantitative, empirical evidence of systemic feedbacks is the crux challenge of current disaster research (UNDRR, 2019), and the nature of disaster traps as coupled human–environmental systems, with tangled social and cultural histories, necessitates an interdisciplinary approach (Mileti, 1999; Cutter et al., 2015; Haider et al., 2018; UNDRR, 2019; Dornelles et al., 2020). A growing body of disaster scholarship is emphasising the importance of contextual data in assessments of disaster impacts (Dwyer and Horney, 2014; Philogene Heron, 2018; Sou and Webber, 2019; UNDRR, 2019). Moreover, testing theory with empiricism requires synthesis: expansion beyond isolated case studies (Mileti, 1999; Cutter et al., 2015; UNDRR, 2019) to systematic, comparative assessments that capture commonalities and key differences across disaster settings.

Formalising a linkage between gilded and safe-development traps matters because their effects likely compound each other nonlinearly, such that disaster risk only increases and disaster-risk reduction becomes increasingly difficult to achieve. "Safe development" maladaptation in hazard-prone coastal zones is especially topical because of the kinds of projects typically supported by climate-finance programmes for climate-change adaptation, per the UN Sustainable Development Goals (Sovacool, 2011; Donner et al., 2011; Seddon et al., 2020). Even

programmes under the banner of sustainable development can drive up disaster risk: as long as climate finance, via major development banks, underwrites hard-infrastructure projects like seawalls (Sovacool, 2011), then a proliferation of the built environment behind those coastal defences appears inevitable, reinforcing the trap.

Finally, although longitudinal analyses in disaster studies remain comparatively rare (Mileti, 1999; Zhang and Peacock, 2009; Olshansky et al., 2012; Peacock et al., 2014; Elliot and Howell, 2017; Lazarus et al., 2018; Howell and Elliott, 2019; Sou and Webber, 2019; Tselios and Tompkins, 2019; UNDRR, 2019; Fanchiotti et al., 2020; Finucane et al., 2020; Houston et al., 2021; Rivera, 2020), longitudinal dynamics are intrinsic to systems perspectives (Werner and McNamara, 2007), and future studies of disaster traps should make them central. Post-disaster recovery is diffuse and attenuated, as different aspects of local recovery play out at different rates (Olshansky et al., 2012; Finucane et al., 2020). Some patterns of post-disaster change may take years to decades to become apparent (Zhang and Peacock, 2009; Elliot and Howell, 2017; Lazarus et al., 2018; Howell and Elliott, 2019; Houston et al. 2021). Consideration of time scales longer than those typically addressed by disaster-impact studies is essential to reframing scientific understanding of post-disaster recovery (Olshansky et al., 2012).

There is no consensus regarding how to break and escape social traps (Meadows, 2008; Dornelles et al., 2020). However, if addressing traps requires understanding them as dynamic systems (Meadows, 2008; Boonstra and de Boer, 2014; Haider et al., 2018; Dornelles et al., 2020), then any solution starts with interrupting the reinforcing feedbacks that lend the trap its strength (Meadows, 2008). Breaking and escaping a disaster trap will likely require multiple, coordinated interventions to counter the rapid mechanisms of opportunistic, technocratic responses to disasters. The intergrowth and persistence of colonial legacies, racial capitalism, and structural inequities in settings prone to extreme natural hazards and vulnerable to rapid environmental degradation suggests that any counteraction to disaster traps will be found outside of

conventional economic and policy interventions. A holistic empirical effort to research and understand disaster traps will help reveal their full complexity.

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