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Original article

Economy and Space

EPA: Economy and Space
2022, Vol. 54(5) 867–910
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DOI: 10.1177/0308518X221084313
journals.sagepub.com/home/epn
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Between the colossal and the catastrophic: Planetary urbanization and the political ecologies of emergent infectious disease

Neil Brenner
University of Chicago, USA

Swarnabh Ghosh
Harvard University, USA

Abstract

Against the backdrop of contemporary debates on the transcendence of city-centric epistemologies in urban theory, this article proposes a theoretical framework for exploring the connections between processes of planetary urbanization and the political ecologies of emergent infectious disease. Following a brief overview of research on cities and the coronavirus pandemic, we elaborate a critical interrogation and heterodox synthesis of two distinct lines of investigation—(1) research by Roger Keil and his collaborators on the embeddedness of emergent infectious diseases within processes of extended urbanization and (2) work by radical epidemiologist Rob Wallace and his colleagues, which productively situates emergent infectious diseases in relation to the geographies and political ecologies of agribusiness under neoliberalizing capitalism. We direct attention to the ways in which processes of planetary urbanization are remaking the human and nonhuman geographies of *non-city* spaces, causing infectious pathogens to be unmoored from previously localized ecosystems and catapulted into broader territories of circulation. This line of analysis requires rigorous application of dialectical methods that can illuminate the internal relations through which cities dynamically co-evolve and co-transform with the non-city spaces, more-than-human territories, and multispecies political ecologies that support their metabolic operations, including at the microbiological scale of novel pathogens. The elaboration of such an approach yields an interpretation of the urbanization/emergent infectious disease nexus as a medium and expression of the agro-ecological crisis tendencies of neoliberal capitalism. A concluding section outlines three emergent arenas of agro-industrial transformation in which processes of extended urbanization have created new spatial configurations and infrastructural pathways for the production and proliferation of emergent infectious diseases.

Corresponding author:
Neil Brenner, Urban Theory Lab, Department of Sociology, University of Chicago, 1126 E. 59th Street Chicago, IL 60637, USA.
Email: neilbrenner@uchicago.edu

Keywords
Planetary urbanization, extended urbanization, emergent infectious disease, agro-industrial restructuring, socioecological crisis

"Logic and violence belong together."

--Lefebvre (2009 [1978]: 246)

Introduction

Planetary urbanization involves not only an intensification of city-building processes, but the remaking of territories and political ecologies beyond metropolitan centers, whether in zones of high-intensity agro-industrial and extractive capitalism, or in more remote hinterlands, forests, and oceans that are being more directly subsumed into global circuits of capital (Arboleda, 2015, 2016, 2020; Brenner, 2016, 2019; Brenner and Schmid, 2015; Ghosh, 2017; Ghosh and Meer, 2021; Gordillo, 2019; Katsikis, 2014, 2018a, 2018b; Sevilla-Buitrago, 2014; Wilson and Bayón, 2015). How have such transformations been intermeshed with the proliferation of new forms of infectious disease such as Ebola, avian flu, severe acute respiratory syndrome (SARS), and COVID-19?

Against the background of contemporary debates on the transcendence of city-centric epistemologies of urban theory (Angelo and Goh, 2021; Angelo and Wachsmuth, 2015, 2020; Brenner, 2019; Buckley and Strauss, 2016), this article explores the connections between contemporary processes of planetary urbanization and the political ecologies of emergent infectious disease (EID). This line of analysis underscores the centrality of emergent, unruly political ecologies of nonhuman and more-than-human life to the dynamics, contradictions, and crisis tendencies of planetary urbanization. It also requires rigorous application of dialectical methods that can illuminate the "internal relations" (Ollman, 2015) and processes of "reciprocal codetermination" (Lewontin and Levins, 1997) through which cities dynamically co-evolve and co-transform with the non-city territories and political ecologies that support their metabolic operations, including at the microbiological scale of novel pathogens.

Following a brief overview of recent research on cities and the coronavirus pandemic, we offer a sympathetic critique of the heterodox theoretical framework developed by Roger Keil, Harris Ali, Creighton Connolly, and their collaborators to explore the interplay between urbanization and EIDs. In particular, we scrutinize the Keil group's analysis of EIDs in relation to the dynamics of *extended urbanization*, a concept which they equate largely with transformations in the peri-urban or suburban fringes of major metropolitan regions. While appreciating their insights, we argue that Keil et al.'s writings have been grounded upon a predominantly zonal and morphological conception of extended urbanization that tends to externalize essential dimensions of the transformations under investigation. Drawing upon the approach to urban theory developed by scholars in the Urban Theory Lab (UTL) in collaboration with Christian Schmid and his research group at ETH Zürich, we cast the notion of extended urbanization more broadly, with reference to what we have elsewhere termed the "hinterlands of the Capitalocene"—the full spectrum of non-city geographies and more-than-human political ecologies that contribute to and result from agglomeration processes under capitalism (Brenner and Katsikis, 2020).

From this point of view, processes of extended urbanization include the industrial remaking of non-city hinterland zones (of extraction, agricultural production, and circulation) in direct relation to city-building processes, or concentrated urbanization. Especially essential, in this regard, are the dynamics of agro-industrial restructuring under the global-neoliberal food regime and their wide-ranging consequences for labor and property regimes, land-use configurations, and political-

ecological relations (Ghosh and Meer, 2021). In the context of EIDs, processes of extended urbanization are implicated not only in the human-to-human circuits of disease transmission on which the Keil group focuses their investigations. Just as importantly, *prior to* the fateful moment of zoonotic spillover, the distinctive patterns and pathways of extended urbanization of the neoliberal era have engendered new circuits of multispecies, animal-to-animal disease transmission (both enzootic and epizootic) in which pathogens are dislodged from nonhuman hosts in "wild" or "remote" forest environments and projected into zones of hinterland industrialization and associated circuits of capital (Kaup, 2021). Here, in a global network of industrial farms, feedlots, slaughterhouses, and meat-processing facilities, both landscapes and animals are artificially homogenized into high-volume, rapid-throughput monocultures. Despite the discourses and practices of "biosecurity" that have become ubiquitous within the technoscientific enclaves of the industrial meat regime, such spaces remain fully enmeshed within capital's metabolic relays, and are thus highly vulnerable to pathogen transmission (Hinchliffe et al., 2013; Schneider, 2017; Wallace et al., 2020). Such industrial-agrarian environments may also become breeding grounds for pathogenic mutations that intensify disease virulence, thus generating much more dangerous forms of EID.

These arguments are elaborated further with reference to the work of radical epidemiologist Rob Wallace and his collaborators, which seeks to illuminate the deadly symbiosis of EIDs and neoliberal agro-industrial transformation in the factories, fields, and forests of west and central Africa, Southeast Asia, and China. We find strong epistemological, methodological, and substantive convergences between the Wallace group's account of EIDs under neoliberal capitalism and the approach to planetary urbanization developed by the UTL and ETH research teams. To explore those affinities, we devote particular scrutiny to Wallace's relational-dialectical conceptualization of the etiologies, political ecologies, and geographies of EIDs (including Ebola, avian flu, and COVID-19), which we interpret through the lens of contemporary debates on the agro-ecological crisis tendencies of modern capitalism (Moore, 2010; Schneider and McMichael, 2010). Doing so, we argue, offers a generative basis on which further to explore the crisis-riven interplay between processes of planetary urbanization and the intensified, accelerated circulation of EIDs through circuits of global capital in the neoliberal era.[1]

Taking inspiration from dialectical theorizations of biogeophysical processes (Büscher, 2021; Levins and Lewontin, 1985; Lewontin and Levins, 1997, 2007; Ollman, 2003), this article seeks to illuminate the cascading political-ecological transformations, contradictions, and crisis tendencies that reciprocally co-produce the capitalist urban fabric within and beyond the city, from the microbiological to the planetary scales. Among the major analytical consequences of our critical engagement with the Wallace group's work is an incipient theorization of the multispecies political ecologies that underpin, mediate, and result from the dynamics of planetary urbanization, in close conjunction with the large-scale territorial enclosures, landscape simplifications, and metabolic intensifications associated with neoliberalized agrarian environments. Planetary urbanization and neoliberalized forms of agro-industrial development are, we argue, dialectically intermeshed expressions of the relentless drive to appropriate and capitalize historical natures under capitalism, at once as accumulation strategies and (increasingly futile) mechanisms of crisis displacement (Moore, 2015). Accordingly, our analysis seeks to articulate research on planetary urbanization more systematically to the more-than-human political economies, political ecologies, and socio-ecological crisis tendencies of agro-industrialization under modern capitalism. The geographies of extended urbanization and capitalist agro-ecological restructuring are intertwined in ways that urban researchers and scholars of agrarian change have only just begun to decipher (Ghosh and Meer, 2021; see also Khan and Karak, 2018; Paprocki, 2020). In a concluding section, we consider these connections with reference to three emergent arenas of agro-industrial transformation—mega infrastructures of agro-industrial production and circulation; the global industrial feedlot matrix (GIFM); and

multispecies "virospheres." In each of the latter, we argue, processes of extended urbanization have directly reshaped planetary political ecologies and, consequently, have created new spatial configurations and infrastructural pathways for the production and proliferation of EIDs.

The COVID-19 pandemic has put into stark relief the planetary circuits of capital in which cities, factories, fields, and forests are embedded and mutually shaped, and their uneven, devastatingly destructive consequences for human and nonhuman webs of life. Under these conditions, the exploration of such interconnections has become especially urgent, not only as a basis for deciphering the volatile metabolic relays through which urbanization, agro-industrial restructuring, and EIDs co-evolve, but as an essential reference point for ongoing efforts to repair the brutal socio-environmental destruction that has been wrought during the *longue durée* history of global capitalism. This article contributes epistemological orientations and conceptual tools for these intertwined projects.

Urbanization and emergent infectious disease

Scholars of urbanization have long been aware of the public health dangers associated with the concentration of populations in urban centers, where interhuman disease transmission may be facilitated not only through the dense clustering of settlement units, but also due to inadequate sanitary infrastructures. Indeed, the birth of modern urban planning was animated, in significant measure, by a proliferation of state strategies to manage the public health crises associated with capitalist industrial and colonial urbanization, leading eventually to the consolidation of the "bacteriological city" through a range of modernizing innovations in civil engineering, sanitation, and hydrological infrastructure, housing design, and public works (Gandy, 2006). The widespread privatization of public services and infrastructures of collective consumption during the last four decades of global neoliberal restructuring has fractured the (unevenly implemented) technomodernist ambition of comprehensive urban biopolitical management. This has led to an intensified exposure of marginalized, often racialized segments of metropolitan populations to resurgent public health risks, including malnutrition, inadequate access to medical care and medicines, and a range of asymmetrically distributed environmental dangers associated with deregulated urban development, such as the toxic contamination of air, water, and soil (Gandy, 2006).

The unfolding planetary crises unleashed through the coronavirus pandemic of 2020–2021 have prompted a veritable explosion of social science scholarship on the power geometries and spatial politics of infectious disease (see, e.g. Lussault, 2021; Rose-Redwood et al., 2020; Sparke and Anguelov, 2020; Sparke and Williams, 2022). A significant stream of COVID-19-related research has explored the urban dimensions of the pandemic, often echoing classic themes from the established scholarly literature on cities, infectious disease, and the urban governance of public health (Doucet et al., 2021). Much of this work has been animated by the conviction that, as United Nations Secretary-General António Guterres declared in July 2020, cities are the "ground zero of the COVID-19 pandemic" (Guterres, 2020; see also UN 2020).

One important line of investigation seeks to investigate how intracity geographies of class and ethno-racial division are being rewoven and exacerbated as successive waves of disease collide with inherited sociospatial injustices, infrastructural arrangements, and regulatory configurations (Florida et al., 2021; Pitter, 2020). Another influential research current has explored whether urban spatial arrangements—in particular, those related to population density levels—meaningfully impact morbidity and mortality rates (Angel and Blei, 2020; Hamidi et al., 2020; Nathan, 2021). There are also comparative studies that seek to illuminate the differential impacts of urban governance responses—themselves powerfully shaped through national public health infrastructures—upon the disease's trajectory and the prospects for its containment (Ren, 2020a, 2020b). Critical urban scholars have also analyzed the complex articulations of the COVID-19 emergency with

the vicissitudes of insurrection and revolt in major metropolitan regions, whether in relation to struggles against neoliberal austerity, authoritarian state repression, or racist police violence (Guzmán-Concha, 2020; Mayer, 2020; Yardımcı et al., 2021). This work has drawn attention to the multiplication of mutual aid networks through which community organizations and activist alliances have sought to address the devastating socioeconomic fallout from the pandemic, especially in relation to the intensification of food and housing insecurity, the maldistribution of personal protective equipment (PPE), and the intensified social isolation of vulnerable populations within major metropolitan regions.

Taken together, these research forays offer important perspectives on key aspects of the coronavirus pandemic's evolution from a relatively localized threat within China's Hubei province into a planetary contagion that has ricocheted across the global metropolitan network. These investigations have illuminated not only the strategic role of cities and metropolitan regions as major "hot spots" of disease transmission, but the essential role of municipal, provincial, and regional governance systems, as well as community organizations, in animating public health responses to the pandemic. Among the key insights that have emerged from this outpouring of research, the following are particularly salient:

1. The neoliberalization of local public health infrastructures through decades of privatization and austerity has severely undermined the capacity of many municipal governments to manage the coronavirus pandemic and to confront its disastrous economic and public health consequences, especially for poor, racialized, marginalized, and/or vulnerable populations (Navarro, 2020; see also, more generally, Sparke and Williams, 2022).
2. There has, nonetheless, been a broad range of local responses to the pandemic, leading to a profound variegation of public health conditions—manifested, for instance, in differential rates of transmission, morbidity and mortality, and widely varying degrees of containment and recovery pathways, around the world. The pandemic's circulatory vectors, evolutionary pathways, and public health impacts are thus profoundly differentiated across places and regions. These patterns of uneven spatial development have been powerfully shaped by state institutions and regulatory strategies, including at the subnational scale of municipal, metropolitan, and regional governments.

Given the dire humanitarian emergency that has imposed far-reaching social suffering and mass death upon nearly every region and territory in the world, these and related streams of urban social science offer invaluable contributions to our understanding of the coronavirus pandemic, its uneven geographies, and their political-institutional mediations.

Between naïve objectivism and spatial dialectics

Despite the empirical richness, policy relevance, and moral urgency of the research currents summarized above, much of the urban scholarship on the pandemic has tended to bracket highly consequential questions regarding the nature and scale of its "urban" site of investigation. The previously quoted statement by UN Secretary-General Guterres epitomizes the *episteme* that organizes the majority of urban scholarship on the coronavirus pandemic. The city is conceived as a distinctive yet universally generalized settlement unit in which human populations are concentrated. Due to their large, often dense, populations, these units are considered as the "ground zero" for important macrosocial processes—in this case, for the pandemic's major public health impacts and associated public health responses. This is, at core, a naïve-objectivist epistemology (Sayer, 2000) in which cities are viewed as empirically self-evident, territorially discrete, and universal units of human settlement, generally through an implied or explicit contrast to other generic

settlement types, such as suburbs, towns, and rural areas. Within this framework, urbanization is defined, *tout court,* as the growth of cities—in effect, as *city*ization (Brenner, 2019).

Especially since the interventions of radical urban theorists such as Henri Lefebvre, David Harvey, and others in the 1970s, this naïve-objectivist, city-centric epistemology of the urban has been subjected to sustained critique in dialectical traditions of critical urban studies, which emphasize, by contrast: (a) the ideological mediations of all forms of urban knowledge; (b) the essential role of abstract theoretical concepts through which to decipher the making and remaking of urban spaces; and (c) the continual mutation of urban spaces through the crisis-riven, creatively destructive forward-motion of capitalist development and ongoing popular struggles to (re)appropriate urban life. From this point of view, all forms of urban knowledge are enmeshed within the same sites and processes of urbanization they seek to illuminate. Reflexivity regarding our concepts, methods, and cartographies of analysis is, consequently, an essential dimension of critical urban research (Brenner, 2009). It is on this basis alone that we can decipher the intensely contested power relations in which urban research is embedded, while also recognizing the recurrent need to reinvent our conceptual frameworks in relation to the ongoing mutation of urban life under modern capitalism. The city and the urban, then, are not empirically pregiven sites to be catalogued through concrete research, data collection, and descriptive mapping. Rather, they are variegated matrices of sociospatial relations that are continually made and remade through strategy, struggle, and crisis: they are, in short, arenas and products of urbanization *processes*.

To investigate these processes, dialectical approaches to urban studies seek to develop historically specific conceptual tools, "concrete abstractions" that can illuminate—in Marx's (1973 [1939]: 101) classic formulation from the *Grundrisse*—the "multiple determinations" that underpin the production of concrete, differentiated patterns and pathways of urban sociospatial transformation across places, territories, and scales. In exploring the manifold determinations of urban processes, such approaches reject the "endogeneity trap" (Sassen, 2006) in which naïve-objectivist approaches to urban studies are frequently ensnared. This methodological trap results from the attempt to explain changes within places on the basis of intralocal causal mechanisms, when the key *explanans* may be constitutively linked to a constellation of supralocal or multiscalar forces. The endogeneity trap has been closely intertwined with "methodological cityism" (Angelo and Wachsmuth, 2015), the tendency to enclose urban processes within generic, "city-like" spatial units, to naturalize their existence as universal features of human social formations and to bracket the constitutive role of non-city sociospatial relations as key parameters for the analysis of urbanization and urban restructuring.

During the last several decades, dialectical escape routes from the endogeneity trap and associated city-centric epistemologies have been forged by embedding urban spaces within broader spatial divisions of labor, multiscalar formations of state power, worldwide metabolic circuits, and patterns of uneven spatial development. This has entailed analyses of, among other issues, globalized urbanization and global urban hierarchies (Brenner and Keil, 2006; Sassen, 2018), worldwide intercity networks (Taylor, 2004), the rescaling of urbanization and urban governance (Brenner, 2004), the political ecologies of urban metabolism (Heynen et al., 2006; Swyngedouw, 1996), the operational landscapes of planetary urbanization (Arboleda, 2020; Brenner and Katsikis, 2020), and the interplay between urbanization and agrarian dispossession (Ghosh and Meer, 2021; Zoomers et al., 2017).

How might such dialectical traditions of urban studies animate research on the urban dimensions of the coronavirus pandemic? What are the "multiple determinations" that might be most centrally relevant to such an exploration? In a grimly concise analysis of "the urban process under covid capitalism," Madden (2020: 677) confronts this question by suggesting that the pandemic has at once exacerbated the "brittleness of neoliberal urbanism" while simultaneously inaugurating a "new phase of urban political-economic recomposition, realignment, and restructuring." On the one hand, the coronavirus pandemic has reinforced the role of cities as "sites of increasingly punitive

austerity" where the working classes and racialized populations are subjected to new forms of accumulation by dispossession. This has been occurring through a bitter cocktail of platformization, informalization, and other forms of financialized extraction, bolstered through the fracturing of established (waged and non-waged) relays of social reproduction and the omnipresent threat or reality of police repression. At the same time, Madden suggests, the pandemic appears to offer ideological cover for a host of political strategies to reshape urban life through new assemblages of market-disciplinary, technomanagerial and biopolitical rationality, the contradictions of which appear to be laying the groundwork for a resurgence of urban uprisings and associated strategies to (re)appropriate public space. Consequently, Madden (2020: 679) argues, "urbanization under covid capitalism appears set to become more accelerated, riskier, more authoritarian and yet also a more contested version of the variety of urban neoliberalism that took shape in the last decade."

Madden's intervention effectively illustrates one way in which a dialectical methodology may orient and inspire urban research on the coronavirus pandemic. His core argument is not simply that the pandemic is changing conditions within cities and metropolitan regions, but that new urban spaces are being produced through the contested roll-out of political strategies to manage its variegated impacts. In a similarly dialectical spirit, our goal here is to explore the urbanization of EIDs such as COVID-19 from a vantage point that is, in a causal sense, "upstream" from the issues addressed in Madden's account. Our analysis is likewise oriented toward the exploration of new urban spaces, but they are considered here as structural *animators*, rather than as *consequences*, of EIDs. Our guiding question is: How have contemporary patterns and pathways of planetary urbanization produced distinctive political ecologies in which new infectious diseases may emerge, *prior to* their proliferation through the global metropolitan network? Specifically, we argue in what follows that, especially through their role in reshaping *non-city, more-than-human* political ecologies, processes of planetary urbanization have figured centrally in the very production of EIDs.

Building upon previous work with our collaborators, we conceptualize urbanization under capitalism as a multifaceted dialectic comprised of (a) *concentrated* urbanization—the moment of city-building, or agglomeration; (b) *extended* urbanization—the remaking of non-city spaces in support of, or as a result of, agglomeration processes; and (c) *differential* urbanization—the recurrent creative destruction of inherited sociospatial configurations through the contradictions and crisis tendencies of capitalism (Brenner and Schmid, 2015; see also Brenner, 2014, 2016, 2019; Brenner and Katsikis, 2020; Ghosh, 2017; Ghosh and Meer, 2021; Sevilla-Buitrago, 2014). From this point of view, the dynamics of city-building are one moment within a dialectic of sociospatial and political-ecological transformation that equally includes the variegated, non-city operational landscapes that sustain and result from agglomeration processes. Consequently, the restructuring of non-city geographies—including agrarian environments, zones of extraction, storage landscapes, energy grids, logistics networks, and the manifold "sacrifice zones" of capital (terrestrial, subterranean, oceanic, fluvial, and atmospheric)—is a constitutive moment of capitalist urbanization. Insofar as the sociospatial relations, infrastructures, and political ecologies of these non-city spaces co-evolve in dialectical relation to city-building processes, the "multiple determinations" of that dialectic must be subjected to careful analytical and historical scrutiny in any critically reflexive account of capitalist urbanization.

As we argue below, the dynamics of capitalist urbanization have also entailed major transformations and disruptions in the political ecologies of the nonhuman world that have proven highly consequential for the generation of EIDs, especially within non-city operational landscapes. In this sense, our analysis breaks not only with naïve-objectivist, city-centric epistemologies of the urban, but with equally entrenched forms of social reductionism that obscure the mutually recursive structuration of human and nonhuman worlds to produce more-than-human political ecologies of urbanization. Such an approach is especially urgent in the context of the Capitalocene, the

longue durée "epoch of capital" in which the metabolic circuitry of nonhuman life on a planetary scale has been successively appropriated, capitalized, degraded, and exhausted to sustain the imperatives of capital accumulation (Moore, 2017, 2018).

Global cities, extended urbanization, and emergent infectious disease

Since the mid-2000s, Roger Keil and his collaborators have made major contributions to the study of EIDs from a reflexively urban-theoretical angle. Through his long-standing work with Harris Ali and, more recently, with Creighton Connolly and others, Keil has sought to decipher the urban dimensions of the major EIDs of the 21st century, including SARS and, more recently, COVID-19. The Keil research group has presented a nuanced mapping of how EIDs such as SARS and COVID-19 have circulated within and among globally interconnected metropolitan regions. In so doing, Keil and his co-authors have also engaged productively with some of the core theoretical challenges associated with such investigations, leading to several generative conceptual and methodological innovations for urban studies.

Keil's initial forays into this field, jointly produced with Harris Ali following the SARS outbreak of 2003, built upon and extended earlier contributions to the study of global city formation that had exercised a powerful influence on critical urban social science during the 1980s and 1990s (Ali and Keil, 2006, 2007, 2008; Keil and Ali, 2011; on global city theory, see Brenner and Keil, 2006). Through a series of theoretically driven articles and a major edited volume on disease, globalization, and interurban connectivity, Ali and Keil presented the SARS outbreak as a methodological challenge at once for urban epidemiology and for urban studies more generally. In their detailed case studies of the SARS outbreak, Ali and Keil presented powerful evidence that the nodal connections among "clique" cities such as Hong Kong, Taipei, Beijing, Singapore, and Toronto played a decisive role in engendering a major "alteration of patterns in microbial traffic, *vis-à-vis* the global city network," leading in turn to significant disease outbreaks in each of the clique members (Ali and Keil, 2006: 493). Consequently, they argued, the urban dynamics of EIDs could not be adequately understood at the scale of cities and their intralocal niches of disease diffusion, but had to be explored at the macro scale of the world intercity network. In this sense, globalized urbanization was producing specific, deeply uneven topographies of pathogenic circulation not only within, but among major global cities.

For Ali and Keil, this apparently simple observation engendered a double methodological imperative. First, they called for urban epidemiologists to delocalize their analytic lens by exploring the myriad interlocal, and ultimately worldwide, networks through which pathogens circulate among human populations. The world intercity system would thus need to become a central focal point for any urban analysis of EIDs; the city and the metropolis had to be situated within these broader global networks. Second, Ali and Keil elaborated an equally programmatic challenge to scholars of globalized urbanization—namely, to conceptualize the latter process not only with reference to the enhanced mobility of capital, commodities, and populations across the world economy, but in terms of new vectors of transnational disease transmission. The dynamics of globalized urbanization, they argued, have not only compressed the operational distance between dispersed metropolitan locations, but multiplied the circulatory pathways through which EIDs can traverse long distances. Global circuits of capital are thus thoroughly intermeshed with the microbiological circulation of pathogens, and vice versa. In this way, Ali and Keil articulated their developing research agenda on cities and EIDs to various emergent streams of urban social theory—including Actor Network Theory, assemblage theory and other elaborations of posthumanism—that sought to illuminate the agency of nonhuman, biophysical processes in the production of urban space (see also Ali, 2008; Braun, 2008; Gandy, 2008).

Ali and Keil's early theorization of the urbanization/EID nexus and its geographies was premised upon a topological conception of cities as nodes within global networks. This conceptualization, which represented an important counterpoint to methodologically localist traditions of urban social science, had gained broad currency during the 1990s, in significant measure due to the influential work of scholars such as Castells (1996) and Sassen (1991), as well as through the collaborative endeavors of the Globalization and World Cities (GaWC) group in Loughborough (Taylor, 2004). Ali and Keil's (2006: 491) signal intervention, in this regard, was to demonstrate how the "capillary structures of the globalized [urban] network" were mechanisms not only for the circulation of capital, but of "microbial traffic." Connectivity and vulnerability were, therefore, inextricably entangled dimensions of globalized urbanization. The need to balance the competing priorities of global connectivity and local public health engendered new governance tensions and conflicts over bacteriological containment across multiple institutional scales, from those of the World Health Organization (WHO) and national governments to provincial, regional and municipal authorities (Keil and Ali, 2011).

Despite their productive emphasis on the centrality of nonhuman, microbiological factors in the dynamics of globalized urbanization, Ali and Keil's account of EIDs was focused largely upon the circulation of pathogens within human populations, following zoonotic spillover from animals to humans. Their analyses appropriately referenced various sites in which, according to mainstream epidemiological scholarship, zoonotic spillover was thought to have occurred—in particular, the live-animal or "wet markets" of southern China. Ali and Keil (2006: 497) describe such sites as a "contact point or interface for the urban and rural sub-populations to converge" under conditions in which "an expanding urban population base increasingly extends into the hinterland" (see also Ali, 2008: 243; Ali and Keil, 2007: 1214).

On the one hand, this conceptualization explicitly underscores the fluid, blurring boundaries "between the urban core and the rural periphery," and in so doing, it acknowledges the dynamically mutating territorialities of contemporary global urbanization. At the same time, this framework leaves the inherited urban/rural distinction relatively intact, at once as a basis for typologizing political-ecological conditions and as a cartographic orientation point. While EIDs are claimed to engender massive impacts upon urban populations (and, consequently, upon multiscalar formations of urban governance), their etiologies are understood to be sited beyond city limits, and thus to be extrinsic to urbanization. The "contact point or interface" in question does not actively produce EIDs, but serves as a passage-point through which microbes may circulate from an exterior, rural/nonhuman world of "previously untouched nature" (Ali, 2008: 243) into the interior circuits of urban/human life. To be sure, the authors acknowledge that "changes in the human-environment relationship" (Ibid) are likely a central mechanism underlying the intensification of this microbial traffic. However, the exploration of such changes is understood to lie beyond the remit of an urban analysis of EIDs.[2] That investigation is instead focused primarily upon the dynamic network topologies, governance consequences, and sociopolitical struggles that emerge *after* a pathogen has found its way into the human population from a largely black-boxed, "rural" exterior realm. Consequently, amidst its otherwise agenda-setting contributions, Ali and Keil's early work on EIDs effectively bracketed the question of whether, and how, globalized urbanization might be causally implicated in such "human-environment" changes, prior to their subsequent "interface" with city-based human populations and the resultant intensification of microbial traffic via worldwide city networks.

Keil's recent work with Ali, Connolly, and other collaborators on the EIDs/urbanization nexus extends this line of analysis while opening up important new layers of conceptualization and interpretation in relation to the contemporary COVID-19 pandemic (see, especially Acuto et al., 2020; Biglieri et al., 2020; Connolly et al., 2020, 2021; Keil et al., 2020; Treffers et al., 2021). Much of this work was under development prior to the COVID-19 outbreak of 2020. The timing of several

subsequent publications converged with the early phase of the pandemic, giving this work even greater scholarly and public urgency. Accordingly, Keil and his collaborators have played an influential role in contemporary social science discussions of COVID-19, in relation to which they have produced a wide range of articles, essays, interviews, and podcasts that seek to decipher the pandemic's manifold urban dimensions.

Building upon new developments in the burgeoning field of urban political ecology (UPE), to which Keil has long been a key contributor (for an overview, see Keil, 2020a), as well as Keil's work on global "suburbanization" (Keil, 2017, 2018a, 2020b), this line of investigation has devoted more analytical and empirical attention to peri-urban fringes—including a diversity of sociospatial formations such as "informal settlements, gated communities, tower estates, kampungs, desakota, peri-urban villages, and […] classical subdivisions of ground-related housing" (Tzaninis et al., 2021: 231). This expanded, peri-urban approach to EIDs is advanced through two interlinked claims that at once complement and extend the previous work undertaken by Ali and Keil. First, peri-urban zones—to which the Keil group variously refers as the global urban periphery, suburban or post-suburban zones, or areas of "extended" urbanization—are now viewed as a key political-ecological niche for the spread of EIDs due to a range of demographic, infrastructural, and governance conditions. Due to the same constellation of factors, the impacts of EIDs in such zones may also be more devastating than in central city cores. Second, the worldwide interconnections among peri-urban zones—supported by advanced logistics infrastructure and articulated across global supply chains—are argued to contribute to an acceleration and intensification of long-distance, interhuman microbial traffic. Thus, not only are global city cores interconnected at a worldwide scale, as Ali and Keil previously argued, but so too are their peri-urban extensions, or strategic portions thereof. This makes EID outbreaks considerably more difficult to contain, at once within individual metropolitan regions and at the larger scale of the world intercity network.

This is a productively reterritorialized mapping of the urbanization/EID nexus that, like Ali and Keil's earlier investigative forays, seeks to transcend inherited city-centric epistemologies. This work has important implications not only for urban research on EIDs, but for urgent practical considerations related to governance, planning, and public health in the age of COVID-19. In particular, Connolly, Keil, and Ali's recent explorations represent a salient injunction to researchers and practitioners alike to develop more nuanced understandings of the variegated, rapidly changing intra-metropolitan political ecologies that animate the microbial traffic associated with EIDs, and their mediations through the governance of urban public health.

These are foundational contributions to urban studies and to the social-scientific investigation of EIDs. Nonetheless, we suggest that the Keil group's recent work reproduces the blind spots that were outlined above with reference to Ali and Keil's earlier work. In our reading, the root issue here is not an empirical omission, but the authors' conceptualization of the urban *problematique*—specifically, their understanding of extended urbanization. This concept forms the basis for the Keil group's updated, peri-urban reterritorialization of the urbanization/EIDs nexus. As indicated previously, the concept of extended urbanization figures centrally in our own work on planetary urbanization. Despite the terminological overlap, our conceptualization diverges sharply from that embraced by the Keil group, and as we explain below, this produces a different orientation for research on the articulation of urbanization to EIDs (for general overviews of the genealogy and contemporary application of this concept in critical urban studies, see Brenner, 2022; Castriota and Tonucci, 2018; Monte-Mór and Castriota, 2018).[3]

Keil and his collaborators define extended urbanization in zonal and morphological terms: it corresponds, they argue, to new "patterns of urban expansion and sprawl" that crystallize at the moving edge between metropolitan cores and their surrounding peripheries (Connolly et al., 2021: 3). Keil and his collaborators are concerned, above all, with the "stretching out" of the city into its contiguous hinterland, and with the distinctive demographic, infrastructural, and political-ecological

consequences of that process. Accordingly, they deploy the term "extended" synonymously with that of "expanded"; they proceed similarly with the lexical couplet extension/expansion. The "extended" aspect of urbanization is thus understood as a more regionalized, stretched-out pattern of urban settlement than that associated with inherited metropolitan geographies (as similarly argued by Soja (2014) with reference to "regional extended urbanization"). This is, in effect, a *city-extensionist* conceptualization: extended urbanization occurs because the city extends beyond its inherited territorial boundaries.[4]

While Keil has elsewhere engaged with the Lefebvrian conception of generalized urbanization (see, e.g. Keil, 2018a, 2018b, 2020a), his collaborative work on EIDs applies the latter mainly to the contemporary remaking of peri-urban or suburban zones, while preserving intact a relatively conventional typology among urban (city), suburban (peri-urban), and rural zones. This position is illustrated, for instance, in the authors' references to the "interactions between urban, suburban, and rural landscapes," and in their consistent use of the term "rural" with reference to spaces they wish to contrast to others they classify variously as urban or suburban/peri-urban (see Connolly et al., 2021: 6, 9, passim). Following from this tripartite city-suburban-rural settlement typology, the Keil group deploys the notion of extended urbanization as an umbrella term around which to frame their various hypotheses regarding the growing importance of the city's edge zones or peripheries in the spread of EIDs (as illustrated programmatically in Keil, 2017). Figure 1 summarizes the Keil group's spatialization of extended urbanization.

Two major occlusions flow from this conceptualization. First, because Keil and his collaborators narrow the process of extended urbanization to a particular morphological zone—the peri-urban fringe—their analysis unwittingly reproduces the analytical externalization of non-metropolitan spaces that continues to prevail in more conventional, city-centric epistemologies of the urban. Although the Keil group recognize the role of industrial agriculture, land grabbing, and deforestation in the production of EIDs (see, e.g. Connolly et al., 2021: 7, 14), they narrate such processes primarily as contextual background conditions rooted in a rural exterior rather than, as we advocate below, as essential expressions (in dialectical terms: "internal relations") of this process. The

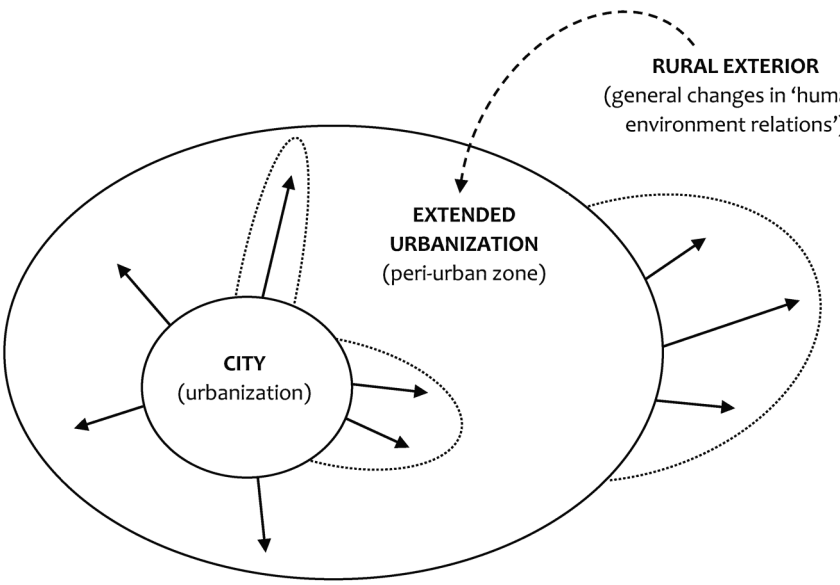

Figure 1. Extended urbanization as peri-urban extension (based on Connolly et al., 2020, 2021).

authors' engagement with the concept of landscape and their efforts to develop what they elsewhere term a "landscape political ecology" underscore the need for "blurring distinctions between the urban and rural," and thus seem to acknowledge the problems with such conceptual externalizations (Ibid., 6; see also Tzaninis et al., 2021). For the most part, however, the concept of landscape operates in the Keil group's writings to bolster their city-extensionist, peri-urban demarcation of extended urbanization. It is not explicitly deployed to theorize or investigate the political ecologies of EIDs beyond the metropolitan edge, or to connect transformations of the latter back to the dynamics of city-building, suburbanization or peri-urbanization. In this sense, the Keil group's work on EIDs largely preserves an agglomeration-centric epistemology of the urban in which the worlds of extended urbanization are definitionally circumscribed with reference to their locational contiguity, zonal articulation, and morphological contrast to inherited city cores (but see also Connolly, 2019).

This implicitly agglomeration-centric epistemology in the Keil group's otherwise heterodox account of peri-urban political ecologies is closely connected to a second occlusion. Keil and his collaborators offer major insights into the inter-*human* circulation of pathogens across the global city network and peri-urban regions—including, in their most recent work, with reference to growing role of the latter zones in contributing to zoonotic transmission (Connolly et al., 2021: 3). In so doing, however, the authors' analytical framework continues to externalize the question of how, why and where novel pathogens emerge, circulate and mutate among nonhuman species, such as industrial livestock and commercially traded animals, as well as among other species (such as domesticated and "wild" animals) whose habitats and ecologies increasingly interface with the latter. The authors occasionally refer to such issues with regard to other scholarly literatures, but on a conceptual level, the role of nonhuman animals in the circulation of pathogens is treated as a general expression of "socio-environmental change" or "human/environment relations" that lies outside the parameters of their theorization of extended urbanization (Connolly et al., 2021: 6, 14).

While metropolitan regions and their peri-urban fringes are evidently an important terrain on which the urbanization/EIDs nexus must be explored, the pre-spillover, multispecies political ecologies of novel pathogens are as vast, variegated, and uneven as the worldwide circuits of capital through which they circulate. As we discuss below with reference to Rob Wallace's work, they are tightly intermeshed with the production of operational landscapes for industrial livestock production, commercial forestry, and intercontinental logistics configurations, often at a considerable remove from metropolitan regions, and they are also forged through the enclosure, infiltration, and degradation of previously remote forests through new forms of ecological plunder and commercial appropriation. For this reason, an agglomeration-centric spatial frame, even the productively decentered, peri-urban one advanced by the Keil group, offers a partial perspective on such transformations, which are reconstituting the political ecologies of nonhuman life around the world in ways that have massive implications for the production and circulation of EIDs.

This line of analysis suggests, then, that the Keil group's conceptual demarcation of extended urbanization circumscribes the urbanization/EIDs nexus too narrowly. In thus proceeding, their approach risks short circuiting the challenge of exploring the aforementioned transformations through a rigorously dialectical lens that articulates city-building processes to the ongoing remaking of non-city, more-than-human political ecologies under global capitalism.[5]

Because our own conceptualization of extended urbanization is defined in relational-dialectical terms rather than zonally or morphologically, it may offer a useful theoretical resource through which to confront this task. In this framework, the capitalist form of urbanization is conceived as a dialectical process of *implosion-explosion* with variegated sociospatial and metabolic expressions. Our approach seeks to illuminate that dialectic through the exploration of mutually constitutive yet contradictory moments of concentrated, extended, and differential urbanization, each of which

contains material (infrastructural), politico-institutional (regulatory), political-ecological (metabolic), and everyday (experiential) dimensions (Brenner, 2019; Brenner and Schmid, 2015). This argument is summarized in Figure 2, which situates the Keil group's work on peri-urban fringes and global city networks (columns 3 and 4) within a broader typology of "hot zones" in which the urbanization/EIDs nexus may be investigated, including several related to the capitalist transformation of wildlands, forests, fields, and factories that will be explored below with reference to Rob Wallace's epidemiological research (columns 1 and 2).

Additionally, Figure 2 contrasts the Keil group's zonal-morphological conceptualization of extended urbanization (row 3), which externalizes these non-city political ecologies of EIDs, to the relational-dialectical approach to planetary urbanization we have previously developed, in which the creative destruction of non-city spaces is conceived as a constitutive moment of the implosion-explosion dialectic (row 4).

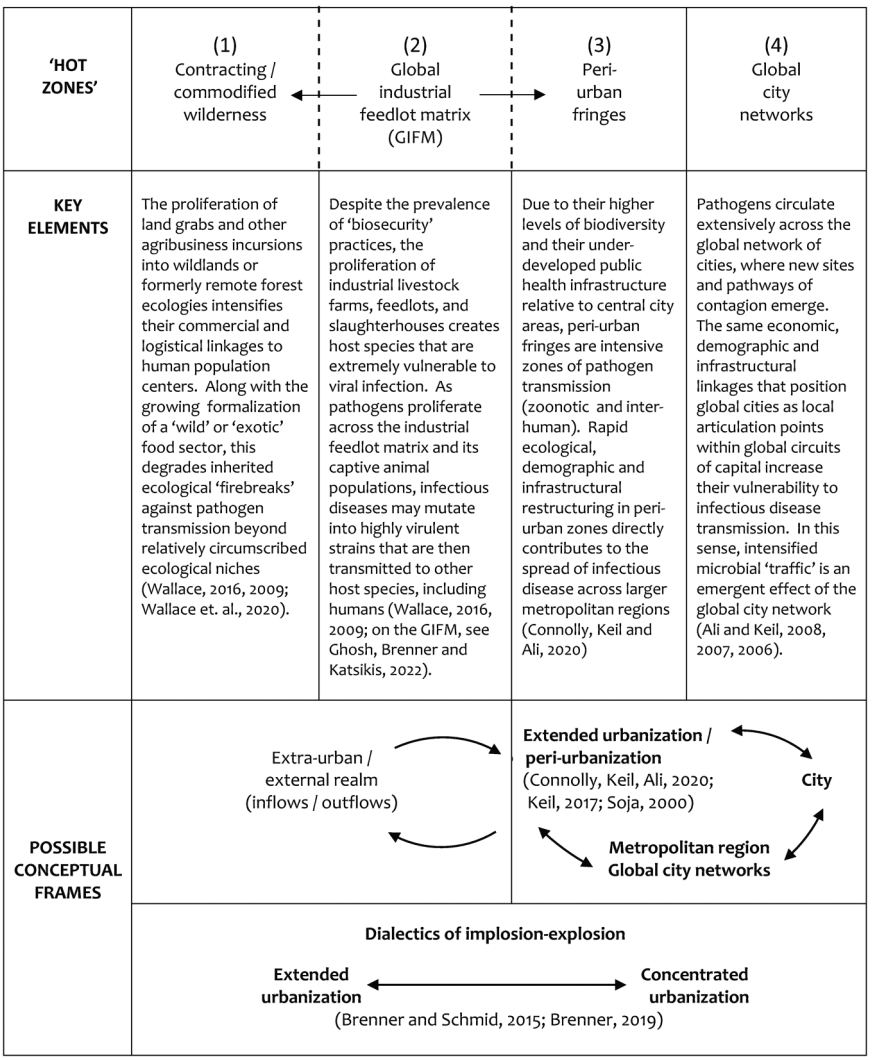

Figure 2. Four "hot zones" of emergent infectious disease (EID) transmission—and their conceptualization.

We thus arrive at the following question: how are EIDs articulated to the implosion-explosion dialectic of capitalist urbanization? While the UTL's previous work has not directly engaged with questions about EIDs and their more-than-human political ecologies, the foregoing discussion opens up the prospect that our approach might productively inform such an investigation. The remainder of this article seeks to lay the groundwork for such an exploration, which may also productively sharpen some of the key concepts and methods associated with our approach to the *problematique* of planetary urbanization, especially in relation to the multispecies dimensions of the Capitalocene.

Methodological interlude: Spatial dialectics of planetary urbanization

One of the core agendas of research on planetary urbanization is to explore the multiscalar interplay between agglomeration processes and the remaking of non-city spaces. In contrast to the pervasive methodological cityism of mainstream urban theory, this dissident, neo-Lefebvrian epistemology of the urban prioritizes the dynamics of implosion-explosion that constantly churn through places, territories, and political ecologies, forming and reconstituting the spaces of agglomeration through articulations to myriad non-city spaces, which are themselves thereby recurrently remade, or creatively destroyed. It is this *churning* process itself, rather than the provisionally stabilized sociospatial configurations it may engender, that forms the central *problematique* of planetary urbanization (Brenner, 2019).

This churning of sociospatial relations and political ecologies is materialized, on one level, in the colossal techno-infrastructures of capital—including the office towers, factories, and utilities configurations of megacities; the intercontinental logistics matrix composed of airports, roads, railways, seaports, canals, and undersea cables; the robotized, bio-engineered fields of industrial mega farms and high-throughput livestock feedlots; the high-technology mines that supply the world with copper, cobalt, and petrochemicals; and the large-scale technical systems associated with fossil capital, from oil wells, offshore drilling platforms, and transcontinental pipelines to energy processing plants and the vast assemblage of technomass associated with the industrial, residential, and transport-related consumption of fossil fuels. Just as importantly, the implosions-explosions of planetary urbanization are also articulated through the shattering violence of neo-imperialist domination, accumulation by dispossession, and ecological plunder upon which such colossal infrastructural configurations are premised. In this relational-dialectical sense, the geographies and political ecologies of planetary urbanization are equally embodied in the brutality of land enclosures and depeasantization, which induce mass population displacement from agrarian and "rural" regions into megacity "slums"; the degradation or decimation of forests, wildlands, rivers, and oceans through the accumulation strategies of agribusiness and extractive capital; the concomitant proliferation of species extinctions and the obliteration of biodiversity; and the treatment of the biosphere itself as a sacrifice zone into which toxic waste, as well as combusted fossil fuels, can be externalized.

As overaccumulation crises proliferate, these circuits of political-economic and political-ecological appropriation are subjected to still greater pressures, as capital seeks to address profitability shortfalls by ratcheting up the pace, intensity, and throughput of extraction, and consequently, drastically accelerates its drive to extract value from previously uncommodified realms of life. Capitalist strategies to amplify metabolic throughput lead not only to systemic crises of underproduction, as inherited relays for the appropriation of "cheap" natures are progressively exhausted, but to a concomitant intensification in the wasting of human and nonhuman bodies and in the expulsion of toxic material and dissipated entropy into the earth's water, soil, and atmosphere (Arboleda, 2017; Labban, 2019; Moore, 2017; Sassen, 2014). As Lefebvre (2009 [1978]) recognized, the resultant "space of catastrophe"—an imminent horizon of worldwide social and ecological disaster—is as central to the *problematique* of planetary urbanization as any large-scale techno-infrastructure of

capital, within or beyond the city. The colossal and the catastrophic are, therefore, intrinsically connected moments of the contemporary urban condition. In early 21st-century terms, this dialectical perspective requires us to situate, for example, the skyscrapers of Mumbai, Shenzhen, or Chicago on the same plane of analysis as, say, the Tar Sands of northern Alberta, mechanized animal feedlot operations in southern China, monocrop soy plantations in Mato Grosso, the massive plastic garbage gyre floating in the Pacific Ocean or, indeed, the many gigatons of carbon dioxide (CO2) that are expunged into the atmosphere each year (Brenner, 2014).

The metaphor of "implosion-explosion" is meant, then, to capture the relational interplay between agglomeration and sociospatial/political-ecological recomposition that underpins this churning process, as well as its wide-ranging, potentially devastating political-ecological impacts across the planet. It does not connote a stable morphology or a mechanistic, two-step sequence ("*first* implosion, *then* explosion"), but describes the relentless *pulsation* of sociospatial and political-ecological relations within and around the circuit of capital. These churning patterns and pathways cannot be reduced to a familiar typology of settlement space or ecological conditions, because the latter are constantly being rewoven and rearticulated through the whirlwind of capitalist urbanization, its crisis tendencies, and its contradictions. Nor are they confined exclusively to the spaces that are directly enclosed, colonized, simplified, and reengineered by capital, such as metropolitan regions, industrial hinterlands, automated mines, large-scale logistics corridors, monocrop plantations, and mega farms. These colossal assemblages of labor, land, infrastructure, and energy draw upon myriad "hidden abodes" of underpaid and unpaid labor and ecological surpluses (Fraser, 2014; Moore, 2015) and produce massively destructive socio-ecological impacts that are likewise internally connected to the implosions-explosions of capitalist urbanization. As such, their variegated geographies and political ecologies must be explored as central dimensions of the urban *problematique* (Abouelhossein et al., 2022; Gordillo, 2019; Mezzadra and Neilson, 2019).

In this framework of analysis, the dynamics of extended urbanization cannot be reduced to the spillover of city-like spaces into peri-urban fringes or contiguous hinterlands, as in the Keil group's conceptualization. Nor does this process result from the putative boundlessness or morphological amorphousness of contemporary urban transformations, as Scott (2021) and Storper and Scott (2016) assert in their critique of earlier work on planetary urbanization by Brenner and Schmid (2015). Rather, concentrated, extended, and differential urbanization are conceived as moments of a dialectical process whose elements are reciprocally co-determined yet internally heterogeneous parts of an emergent whole (see Levins and Lewontin, 1985; Ollman, 2003; Sève, 2008). Research on planetary urbanization is intended to explore the "multiple determinations" through which those parts, and the whole they form, are relationally intermeshed and thus co-evolve (Marx, 1973 [1939]: 101; see also Addie, 2020; Angelo and Goh, 2021). It is not premised on the universalizing claim that the city is now "everywhere," as a kind of a singular, immanent, and indivisible substance encompassing the entire planet (Merrifield, 2014: 169). The goal, rather, is to explore the hypothesis that, since the large-scale industrialization of capital, city-building processes (concentrated urbanization) have been more directly *related* to major transformations of non-city spaces and political ecologies (extended urbanization)—and vice versa.[6]

Our emphasis on the planetary dimensions of capitalist urbanization underscores that the force fields of urban life cannot be arbitrarily differentiated from a putatively rural, pastoral, wild, or nonhuman exterior. From this point of view, as scholars of UPE have argued, urbanization processes are inextricably intermeshed with the metabolism of biogeophysical processes and transformations. This not only creates cyborg cities (Gandy, 2005; Swyngedouw, 2005), metropolitan natures (Gandy, 2002), and more-than-human geographies (Sheppard, 2016), but produces new, profoundly multiscalar formations of the nonhuman world that are appropriated, instrumentalized, and engineered to support historically and geographically specific forms of capitalist urban development (Boyd et al., 2001; Boyd and Prudham, 2017).

The point here is not simply that urban landscapes hinge upon the commodification of nonhuman materials, organisms, and ecosystems, but that urbanization processes have profoundly transformed the very biogeophysical environments upon which the metabolism of city life depends, often in destructive, even catastrophic ways. Insofar as these circuits of relational interdependency engender historically specific matrices of reciprocal co-determination, co-evolution, and socio-ecological crisis formation (see, e.g. Barua, 2021; Clark, 2020; Hetherington, 2020; Kaup, 2021), urbanization may be viewed as a key animator of the Capitalocene itself. In this sense, the "external relations of cities" are not only threaded through a worldwide network of intercity relations (as in Taylor and Derudder's (2016) powerful analysis), but unevenly pulsate and ricochet across the earth's variegated terrain—through the oceans, the atmosphere, and subterranean zones, creating new webs of relational interdependence and co-evolutionary transformation between cities and myriad non-city spaces. As we argue below, this proposition has massive methodological implications for investigations of the urbanization/EIDs nexus.

Here arises a series of pressingly urgent questions for research and practice for an "urban political ecology beyond methodological cityism" (Angelo and Wachsmuth, 2015; Connolly, 2019) in the context of contemporary socio-environmental transformations, crises, and emergencies (Cohen, 2020). How are cities, city-building processes, and worldwide intercity relations implicated in the massive intensification of industrial livestock production, in the drastic simplification of agro-ecological landscapes to support monocrop agribusiness operations, in the growing concentration of CO2 in the earth's atmosphere, or in the accelerating crisis of biodiversity? In what ways are the socio-ecological crises induced through these and related transformations of the nonhuman world destabilizing, or otherwise transforming, patterns and pathways of urbanization? Most crucially here, what forms of reciprocal co-determination connect the explosive growth of major metropolitan regions around the world to the enclosure or commercial degradation of the forests and wildlands where many of the major EIDs of the 21st century have emerged? The resolutely dialectical, radically open-ended framing of such research questions is far removed from the crudely universalizing assertion that all aspects of city-building are produced exogenously, or concomitantly, that city-building should be the primary or exclusive interpretive reference point through which to investigate all non-city environments (see, e.g. Jazeel's (2018) critique; and Addie's (2020) counterpoints).

In a recent programmatic analysis of the "zoonotic city" in world-environmental context, Gandy (2021) poses a series of questions for the field of UPE that broadly parallel those outlined here regarding the possible role of extended forms of urbanization in contributing to EIDs. As Gandy (2021: 11) explains:

> An initial challenge for urban political ecology is the conceptualization of emerging epidemiological dynamics for extended patterns of urbanization, infrastructure provision, and food provision […] An urban political ecology of extended patterns of urbanization must contend with several interrelated developments: the proliferation of 'edge landscapes' or other types of zoonotic spillover zones produced by intensified forms of ecological disturbance and fragmentation; the accelerated evolutionary dynamics occurring within modified environments such as infrastructure systems or other kinds of 'closed ecosystems' devoid of natural predators; the emergence of new socio-ecological relations, including novel socio-ecological assemblages that favor specific pathogens; and the impact of intensified forms of connectivity or zoonotic time-space compression between different components of the global biosphere.

Like the Keil group, Gandy (2021: 8, 12) underscores the central importance of emergent "peri-urban and ex-urban socio-ecological assemblages" as "accelerator landscapes of environmental degradation" and thus as zoonotic "transfer zones." However, Gandy's vision of the "zoonotic dynamics of urbanization" extends beyond the suburban fringe to encompass diverse "extractive

frontiers" and "operational landscapes" embedded within the "global technosphere for food production, travel and consumption," which he views as strategic terrains for the generation of new forms of epidemiological risk (Ibid., 13). Additionally, Gandy's approach to extended urbanization articulates a forceful critique of the inherited spatial typologies that underpin much of mainstream urban ecology and urban epidemiology, with their continued embrace of relatively asocial, organicist understandings of landscape (as being composed of ecological niches and biomes), their tendency to map spatial differentiation based upon putatively "natural" vegetation types or landscape features, and their systems-based understanding of the urban as a bounded settlement unit (Ibid,. 12, 13).[7]

While grounded in a distinct conceptual and methodological framework, the following analysis is broadly aligned with Gandy's "critical reading of urban metabolic processes" and his concomitant call to investigate the "multiple scales and temporalities of socio-ecological entanglement" that are engendered through contemporary urban transformations and their wide-ranging implications for the production of epidemiological risks (2021: 13). Confronting these challenges, we suggest, entails (a) the development of theoretical approaches that can supersede the blind spots of inherited urban and environmental typologies and (b) the deployment of appropriate methodological strategies to illuminate the reciprocal co-determinations connecting emergent forms of urbanization, infrastructure development, land-use transformation, socio-environmental dislocation, and epidemiological risk across territories and scales. These are monstrously complex research agendas. Their elaboration will require nothing less than a re-imagination of the very parameters, boundaries, and articulations among several major fields of scholarly activity, including urban social science, land use science, agrarian studies, environmental studies, animal studies, and urban epidemiology, among others.

In pursuit of intellectual resources to guide and animate this work, we turn now to the spatially attuned critical epidemiology developed by Rob Wallace and his collaborators. This line of research directly confronts the *problematique* outlined above with reference to the variegated, violent, and volatile political ecologies of neoliberalized agro-industrial restructuring. In so doing, Wallace and his collaborators productively situate EIDs within a radically heterodox cartography of capitalism that includes global financial centers, large-scale logistics infrastructures, and *desakota* regions as well as factories, feedlots, slaughterhouses, fields, forests, and wildlands. As such, we suggest, Wallace's work offers a powerfully generative vantage point from which to investigate the nexus of EIDs and emergent patterns of extended urbanization.

"*Vibrio cholerae* and the World Bank"

Rob Wallace's radical approach to epidemiology has recently acquired a high profile among critical academics and Left activists in the context of the ongoing coronavirus pandemic, which he has powerfully interpreted as the combined result of expanding global circuits of predatory financial capital, agribusiness-led deforestation, land grabbing, intensified capitalization along industrial livestock supply chains and the systemic evisceration of public health infrastructure and workplace environmental safety standards through decades of neoliberal austerity. Wallace and his collaborators stress the foundational role of neoliberal restructuring in producing the political-ecological *and* political-economic conditions for the emergence and circulation of novel pathogens. They do so by tracking disease emergence and transmission—including the evolutionary dynamics of viral pathogens and pathways of epizootic spillover—along with global circuits of capital, which are in turn embedded within patterns of combined and uneven geographical development. They emphasize, in particular, the socio-ecological transformations that have enabled and resulted from the consolidation of the neoliberal food regime since the 1980s, including the globalization of animal protein chains, the intensification of agro-industrial land use, and the expansion of agribusiness-led

deforestation across the global South (see also Kaup 2021; McMichael, 2012, 2014; Schneider, 2014; Tilzey, 2018; Weis, 2013).

One of the Wallace group's most provocative arguments is that each of the major EIDs of the neoliberal era—including Ebola, avian flu and, most recently, COVID-19—has been produced through the intermeshing of global circuits of capital and new political-ecological formations (Figure 3).

Specifically, they argue that EIDs result directly from the distinctive land-use configurations, infrastructural assemblages, and environmental disruptions associated with a neoliberalizing global agri-food system in which local agroeconomies are subjected to comprehensive "re-engineering […] for the benefit of multinationals" (Wallace and Wallace, 2016a: 1). Their striking book title, *Neoliberal Ebola*, succinctly captures this line of analysis (Wallace and Wallace, 2016b). "Emergent" infectious diseases are analyzed as an outgrowth of neoliberal accumulation strategies that are remaking both macroeconomic geographies (circuits of capital) and agrarian landscapes (political ecologies) across strategic regions of the global South, from areas of land-intensive, monocrop, export-oriented agriculture to more remote zones of smallholder farming, contracting forests, and fragmented wilderness. This leads to the crystallization of new microbiological, metabolic, and agro-ecological relays that, via expanding logistics networks, more directly interface with and threaten larger populations of nonhuman animals and humans (Wallace and Wallace, 2016a). For Wallace *et. al*., therefore, the notion of "emergence" in the standardized acronym "EID" is not merely a descriptive adjective through which to denote the relatively recent provenance of the aforementioned disease outbreaks. Rather, "emergence" here signals a qualitative mutation in the very geoeconomic and political-ecological conditions under which infectious diseases are produced and proliferate, and through which their societal impacts are being ratcheted up in scale, intensity, and virulence.

The Wallace group has developed this account of EIDs through methodologically and empirically wide-ranging investigations, many of which are oriented toward a specialized readership of epidemiological experts.[8] However, in several key publications—notably, in the widely read volume, *Big Farms Make Big Flu* (2016); in articles and interviews for radical journals such as *New Left Review*, *Antipode*, and *Monthly Review*; and in a collection on COVID-19, *Dead Epidemiologists* (2020)—Rob Wallace has communicated these arguments to a broader readership of critical social scientists and environmental activists, where he is often positioned alongside Mike Davis as one of the foremost Left intellectuals linking EIDs directly to the ecological dangers of capitalist agriculture (see Davis, 2005, 2020).

In giving causal significance to political-economic processes in disease emergence in the late 20th and early 21st centuries, Wallace's work builds upon the dialectical approach to biological systems pioneered by Richard Levins and Richard Lewontin over the course of their decades-long collaboration at Harvard University (1985, 1997, 2007). Prominent members of the radical science movement of the 1970s and 1980s, Levins and Lewontin developed their dialectical approach in relation to their own respective fields of ecology and evolutionary biology, but their work has exercised a broad influence on radical thought, including in several streams of neo-Marxian political ecology and radical environmental studies (on radical science, see Schmalzer et al., 2018). Their approach, derived from Hegelian-Marxist philosophical foundations, offers a robust alternative to modern biology's dominant onto-epistemology, "Cartesian reductionism," and insists on the importance of a dialectical conception of the whole, or totality, in all forms of scientific inquiry. Cartesian reductionism, they argue, treats physical, biological, or social processes as outcomes of relations among pregiven, fundamentally undecomposable units. Its vision of physical, biological, or social systems is, therefore, purely additive: the latter is seen to emerge through regularized interactions among pregiven, homogeneous entities. By contrast, a dialectical approach enjoins consideration of the constitutive, interactive and co-evolutionary relation between part and whole

	Zaire ebolavirus (ZEBOV)	**Reston ebolavirus (REBOV)**	**Avian flu / influenza A (H5N1)**	**COVID-19 (SARS-2)**
Spatial-temporal context of emergence	2013-6, West Africa: regional articulations in forested Guinea, Liberia, Sierra Leone	2008: Bulacan and Pangasinan provinces, Luzon, Philippines	1997,2001-02: Hong Kong, Guangdong province of China, Pearl River Delta	2019-?: Wuhan as hypothesized regional site of emergence prior to global pandemic
Articulation to neoliberal agro-ecological transformation (landscape simplification)	Expansion of palm oil agriculture based on gridded mono-culture plantations; curtailment of small-holder / artisanal cultivation in multi-species groves	Large-scale conversion of irrigated agricultural land in "rice bowl" regions to industrial, commercial, logistics and recreational functions; expansion of industrial hog production and concomitant expropriation of smallholders	Massive expansion of industrial poultry production in Guangdong and southern China under "Livestock Revolution" displaces smallholder and 'backyard' poultry production	Scholarly debates on these issues contain divergent hypotheses and lines of investigation. Wallace and his collaborators have emphasized the contraction of wilderness zones amidst the intensification of industrial livestock production and the concomitant growth and formalization the of "exotic food" sector across China, which shrinks the operational distance from bat cave to field, factory, and city.
Agro-ecological consequences and implications for non-human habitats	Deforestation and forest degradation: displacement of bats from forest habitats and consequent migration to plantation zones in search of food and shelter, leading to new roosting and foraging behaviors	Deforestation and degradation of primary forested zones, in part through incursion of smallholders displaced by expansion of industrial land uses. Loss of habitat by frugivore bats leads them to begin roosting and feeding on plantation farms and on crops grown to support hog production	New influenza ecologies produced as 'wild birds', local waterfowl and migratory birds interface with industrially produced poultry and hogs in a *desakota* zone undergoing rapid land-use intensification	
Interspecies etiology	Bats → humans (west Africa only)	Bats → hogs → (potentially) humans (Luzon) Also articulated into the global value chain of industrial hog production: hogs (Luzon) → hogs (southern China) → ?	Poultry → Local / migratory birds → Poultry → humans The pathogen traversed diverse bird species (ducks, geese, mallards and other 'wild' aquatic birds) as well as impacting humans.	Bats or pangolins (?) → intermediate host animal (?) → humans It is not yet known whether an intermediate host species contributed to zoonosis
Contexts and consequences of zoonosis	New interfaces emerge between displaced bats and human plantation workers—regionally contained epidemics.	This variant has thus far been non-pathogenic for humans, though it has impacted populations of industrial hog across regions.	Various interfaces in Hong Kong and Guangdong, but regionally contained to date.	Wuhan (site of interface is not known) / Hubei Province—global pandemic

Figure 3. Major empirical investigations of emergent infectious diseases (EIDs) by Rob Wallace and collaborators: Overview.

such that "parts and wholes evolve in consequence of their relationship, and the relationship itself evolves;" consequently, "part *makes* whole, and whole *makes* part" (Levins and Lewontin, 1985: 272–3; italics in original).

In a striking essay originally published in 1996, "The Return of Old Diseases and the Appearance of New Ones," Levins and Lewontin brought their dialectical method to bear directly on the study of EIDs. Here, they noted the "surprise" with which mainstream traditions of public health scholarship reacted to the emergence of "new" infectious diseases in the 1960s and 1970s (Lewontin and Levins, 2007). Due to their reduction of complex, multidimensional, multivariate, and intermeshed processes to "a very small set of independent causal pathways or 'factors'," such approaches had arrived at the untenable conclusion that "infectious disease is in decline forever" (2007: 19). According to Levins and Lewontin, this epistemological "narrowness" obscured a number of essential transformations that, taken together, were reconfiguring the political ecologies of infectious disease. These included, among others, the historical contingencies of environmental reorganization; new pathways of disease emergence in nonhuman species; changes in the ecology of interspecies interactions; and the evolutionary consequences of prior antimicrobial interventions (Levins and Lewontin, 1985: 270-1). Such emergent conditions, they argued, were not to be understood as merely background "noise," but had massive impacts as a "chain of intersecting causes" in a broader context of postwar global and postcolonial capitalist development (Lewontin and Levins, 2007: 19–20; see also Jones et al., 2008). For dominant approaches to public health, "social processes of poverty and oppression and the actual conditions of world trade were not the stuff of 'real' science that deals with microbes and molecules" (2007: 20). By contrast, Levins and Lewontin insisted that an adequate explanation of any major contemporary disease outbreak required a holistic mode of analysis that could illuminate the determinate connections between global capitalism and emergent microbiological transformations. In a memorable formulation, they proposed that the analysis of new cholera outbreaks in the Third World required consideration "jointly [of] *Vibrio cholerae* and the World Bank" (Lewontin and Levins, 2007: 21). In this sense, Levins and Lewontin's intervention underscored the continued import of Georg Lukács' (1971[1923]: 27) classic early 20th-century claim that the dialectical method accords primacy to "the category of totality." It was precisely this methodological position that facilitated their rigorously holistic analysis of the mutually constitutive linkages between political-economic, political-ecological, and microbiological processes.

Levins and Lewontin's prescient insights—including their insistence on the co-determination and co-evolution of the social and natural causes of infectious disease—underpin much of the Wallace group's epidemiological and phylogeographical research, which likewise emphasizes the tightly woven interdependencies between the biology of EIDs, the evolution of pathogens, and transformations in the political economy of capitalism.[9] Rather than seeking to unearth the "originary" location of infectious disease outbreaks and associated "hotspots" of interhuman disease transmission (such as so-called "wet markets"), the Wallace group emphasizes a range of systemic, multiscalar transformations—of political economy *and* political ecology—that at once engender new pathogens, intensify their virulence, and increase the probability that they may interface with human populations. To this end, Wallace and his collaborators connect disease emergence to the "evolutionary selection pressures" and "ecological opportunities" for infections that have been triggered within the monocrop, high-throughput agrarian environments of the global neoliberal food regime (Wallace et al., 2015: 73). From this point of view, the causal geography of a particular disease is not confined to the forest, the field, or the "wet market" as such, but encompasses a large-scale force field of intensifying commodification, capitalist operationalization, infrastructural extension, agro-ecological plunder, and socio-environmental crisis formation.[10]

This analysis also attributes essential causal agency to the predatory actors, institutions, and organizations of neoliberal capitalism—from sovereign wealth funds, private equity firms, and

biofuels corporations to agribusiness multinationals and institutional investors—that directly finance, animate, and coordinate the enclosure and export-oriented conversion of farmland across the global South, "at grave costs to smallholders and the environment alike" (Wallace et al., 2015: 70; see also Fairbairn, 2020). In their analysis of Ebolavirus in Forested Guinea, for instance, Wallace and his collaborators draw a direct causal connection between structural adjustment-driven economic liberalization and the agro-ecological transformations that led to the regional Ebolavirus outbreak of 2013–2014. Specifically, the Wallace group argues that the state-mediated expansion of hybrid monoculture plantations in the 2000s—partly in response to the increased availability of cheap imports from Southeast Asia—transformed the epizoology of agro-forests in the region. The large-scale deforestation effectuated by the growth of intensive palm oil production resulted in the degradation and constriction of bat habitats. This transformed the roosting and foraging behavior of bats, which then began to seek food and shelter in horticulture farms, often in close proximity to human settlements, thus expanding the interface between bats, humans, and domesticated livestock (Wallace and Wallace, 2016a, 2016b; Wallace et al., 2014). Within this geoeconomically driven nexus of appropriation, capitalization, and metabolic churn, EIDs are thus increasingly being produced and circulated along rapid-movement infrastructural-ecological pathways that, in relational-dialectical terms, intimately juxtapose the bat cave and the big city, the remote forest and the international airport, or the plantation and the supermarket (Wallace et al., 2020). This approach also opens up the disturbing yet analytically transformative prospect that "many of our emergencies, pathogens among them, arise from the very structural apparatus called upon to respond" (Wallace et al., 2016: 156).[11]

Contrary to the Cartesian-absolutist conceptions of space that are widely presupposed in mainstream epidemiological science, the Wallace group advances a rigorously relational conceptualization of EID geographies. This methodology underpins the authors' initially startling contention that global financial centers such as New York, London, and Hong Kong are not only "hotspots" of inter-human disease transmission, but figure crucially in the very production of EIDs, prior to their interface with human populations. This, they argue, is due to the role of such financial centers as command-and-control nodes for predatory agribusiness investments in previously remote or "wild" regions, where deforestation, land enclosure, large-scale infrastructural investments, land-use intensification, landscape reengineering, and other forms of profit-driven incursion into previously protected ecosystems have unmoored infectious pathogens and catapulted them into broader circulatory orbits. Equally important, in this regard, is the authors' account of how newly established commercial networks, articulated through the extension and upgrading of transnational logistics infrastructures, have helped transform such spaces from relatively localized ecosystems of potential disease emergence and regional spillover into virulent breeding grounds from which epidemics may begin "trawling their way through global webs of travel and trade" (Wallace et al., 2020: 5).

This relational perspective underscores the cascading agro-ecological impacts of the neoliberal food regime even in the absence of direct subsumption by agribusiness multinationals (Wallace et al., 2015, 2016; see also Bergmann and Holmberg, 2016). One of its major methodological consequences is to explode the naturalized cartography of absolute space (with its implicit or explicit differentiations of background/foreground, upstream/downstream, and inside/outside) that dominates the mainstream discourse on EIDs, permitting instead the exploration of "networks of causes highly interlinked and conditional in time, space and direction" (Wallace et al., 2016: 156). What emerges from this approach is a radically relational-dialectical spatialization of EIDs that situates heterogeneous territories and ecologies—including remote forests, industrial agribusiness hinterlands, intra- and intercontinental logistics corridors, regional towns and cities, peri-urban fringes, and global financial centers—on the same plane of analysis. As we discuss below, the Wallace group's spatialization of EIDs can be productively articulated to the investigation of planetary urbanization.

While framing their analyses more broadly with reference to the neoliberalization of agrarian environments, the Wallace group give central analytical importance to the global livestock sector due to its rapid expansion over the past three decades, its massive metabolic requirements (including freshwater and cropland), its impacts on the evolutionary pathways of pathogens, and its wide-ranging socio-ecological externalizations across both proximate and distant regions. According to Wallace and his collaborators, the epidemiological turbulence generated by agro-industrial livestock production ricochets far beyond the gates of the putatively "biosecure" factory farm: its pervasive "diseconomies of scale" and "inadvertent biotic fallout" are manifested not only in the extreme vulnerability to infection of high-throughput, genetic-monoculture industrial animals (poultry, cows, swine), but in the eroding disease resilience of adjacent, interdependent ecosystems as new animal behaviors and interactions are induced in response to the land grabs, landscape simplifications, and metabolic manipulations imposed by global agribusiness (Wallace and Wallace, 2016a: 2; Wallace, 2009: 919). For example, in their analysis of Reston Ebolavirus disease (REBOV) in industrial hog populations in the Philippines, Wallace and Wallace (2016b: 38) not only underscore the problematic evolutionary consequences of industrial production for livestock, but outline a larger-scale reconfiguration of political ecologies that contains potentially catastrophic risks for multiple species, including humans, across multiple regional contexts. The expanding geographies of commodity hog production, they argue, can engender "critical connectivities" for pathogenic transfer across industrial feedlots and slaughterhouses within the region and along the entire commodity chain (Wallace and Wallace, 2016b; see also Schneider, 2014).

Yet, the epizoological impact of the so-called "Livestock Revolution" far exceeds the problem of disease susceptibility among industrially farmed animals within the intensively engineered operational landscapes of globalized agribusiness supply chains. The intensification and acceleration of industrial meat production yields tangled webs of multispecies relationships across extended agro-ecological territories that ultimately permit "novel pathogens [to] infiltrate agriculture's gated communities" (Wallace et al., 2020: 6). On this account, agribusiness strategies to intensify, accelerate and expand industrial meat production have radically recast biotic interdependencies, not only within feedlots and slaughterhouses, but through the construction of new webs of connection between the latter and the ecosystems of other animal species. These developments not only efface agribusiness's "self-absolving invocations of 'biosecurity'" (Wallace, 2020: 123), but blur the divisions among "wild," "commercialized" and "industrial" animals as the circuit of capital subsumes a broader spectrum of nonhuman animals into its profit-driven metabolic churn.

In their work on EIDs, the Wallace group outlines three broadly interrelated developments in the production of animal-based commodities in the past three decades that have had especially consequential political-ecological ramifications.

1. Agro-industrial production is increasingly encroaching into primary landscapes (including forests) and zones of smallholder cultivation where industrial animal populations face a greater likelihood of encountering new pathogens. For instance, since the 2000s, proliferating industrial livestock and poultry operations in Southeast Asia and southern China have encroached into wilderness zones, wetlands, and other animal habitats, drastically expanding the interface between industrially farmed and wild animals, including pathogen reservoirs such as bats and wild birds (Wallace, 2009, 2016).
2. Smallholders and other small-scale, often family-based production units are being incorporated into livestock and poultry supply chains, often as subcontractors that raise animals to be shipped back to factories for processing. Such linkages between industrial livestock operations and small farmers create additional pathways of pathogen transmission, as commodity animals are exposed to wild animals such as bats, migratory birds, or waterfowl—the "epidemiological elements," in Wallace's (2009: 938) formulation.

3. The so-called "wild food" sector has itself undergone significant realignments. On the one hand, the spatial extension of industrial farming has dislocated the habitats of "wild food" species, pushing them deeper into remote forests, where they may encounter previously isolated pathogens. At the same time, the sector as a whole has been more intensively commercialized, formalized, and capitalized, and has thus been articulated more directly to broader circuits of capital. In the case of porcupines and pangolins, among other "wild" animals, production has been scaled-up within agricultural value chains, often involving the breeding and/or raising of large numbers of these animals in dedicated farms (Wallace et al., 2020; see also Brooks et al., 2010).[12] As this subsumption of labor, land, and animal bodies into circuits of capital intensifies, "the most exotic of pathogens" (Wallace et al., 2020: 4) are able to enter interregional and transnational commodity chains with increasing frequency, potentially amplifying, and generalizing their virulence across diverse species.

Taken together, these lines of analysis provide a robust methodological framework through which epidemiological questions regarding the generation and transmission of disease can be systematically articulated to the new political ecologies of land use associated with capitalist agriculture, especially in relation to the industrial production of livestock and poultry under global neoliberalism and its wide-ranging environmental impacts, contradictions, and crisis tendencies. Across diverse contexts of investigation, Wallace's collaborative work has articulated a multispecies account of pathogen circulation to a dialectical investigation of the circuits of capital that are animating wide-ranging landscape transformations, agro-ecological disruptions, and metabolic rifts. In short, as Wallace and his collaborators argue, paraphrasing Moore's (2011) succinct formulation of capitalist world ecology, "capitalist production does not *have* an epidemiology so much as it *is* an epidemiology" (Wallace et al., 2015: 71).

The key elements of the Wallace group's framework are summarized in Figures 4 and 5. Figure 4 surveys the Wallace group's multispecies account of EIDs (top) and their concomitant mapping of the agro-ecological and urbanizing landscapes within which the latter arise (bottom).

The upper portion of the diagram presents the main categories of animals that figure in Wallace's account—wild, domesticated, commercially harvested, industrial, and human. It also presents a relational matrix through which their entanglements may be explored, prior to and after the moment of zoonosis. The single- and double- arrows in the diagram denote various possible vectors of interspecies pathogen transmission. On a concrete level, as we explain below, the Wallace group has connected EIDs to, among other animals, bats, ducks, geese, mallard, pangolins, porcupines, ostriches, crocodiles, palm civets, and short-nosed dogfish, as well as to industrially produced animals such as chickens, hogs, and cows. The bottom portion of the diagram presents a schematic overview of the political-ecological contexts in which, according to the Wallace group's account, pathogens are generated and circulated under neoliberalized agrarian capitalism.

Our cartographic vocabulary here draws upon that used by Terry McGee in his classic (1991: 6) map of *desakota* regions in Southeast Asia, which likewise sought to destabilize what he termed "city-dominant" approaches to urbanization and to supersede binaristic models of urban/rural relations. Our diagram positions the various landscape types presented in the Wallace group's account —from the city and the peri-urban fringe to the agro-industrial hinterland, various kinds of forests, and wildlands—as intermeshed layers of an integrated political ecology that is currently being profoundly reshaped through multinational agribusiness operations. Figure 4 positions these dimensions of Wallace's account in direct relation to one another, such that their dialectical interconnections can be further investigated.

Figure 5 presents a further concretization of this nexus of relationships. The three boxes in the left column form an analytical matrix through which the generation and circulation of pathogens may be analyzed prior to, during, and after the moment of zoonosis. The arrows within each box

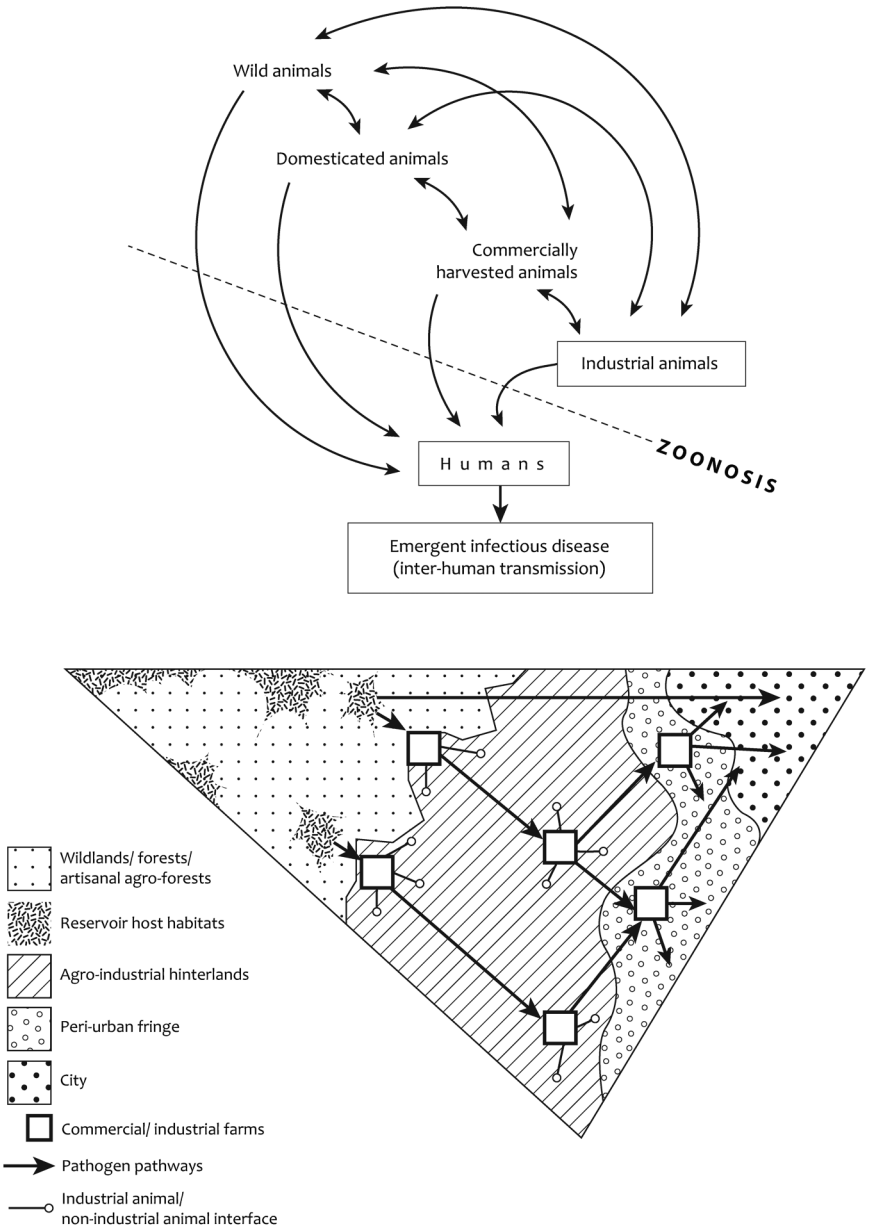

Figure 4. Toward a multispecies political ecology of emergent infectious diseases (EIDs) (1).

denote various possible vectors of pathogen transmission, whether among nonhuman animals, through zoonotic spillover, or among humans.

The upper-right box in Figure 5 summarizes the Wallace group's major contentions regarding the connection between EIDs and the agro-ecological transformations of the neoliberal period. This box presents a narrative overview of the political ecologies of agro-industrial change and crisis that are depicted graphically in the bottom portion of Figure 4. The bottom right box of Figure 5 summarizes the major empirical arguments regarding urbanization and EIDs presented

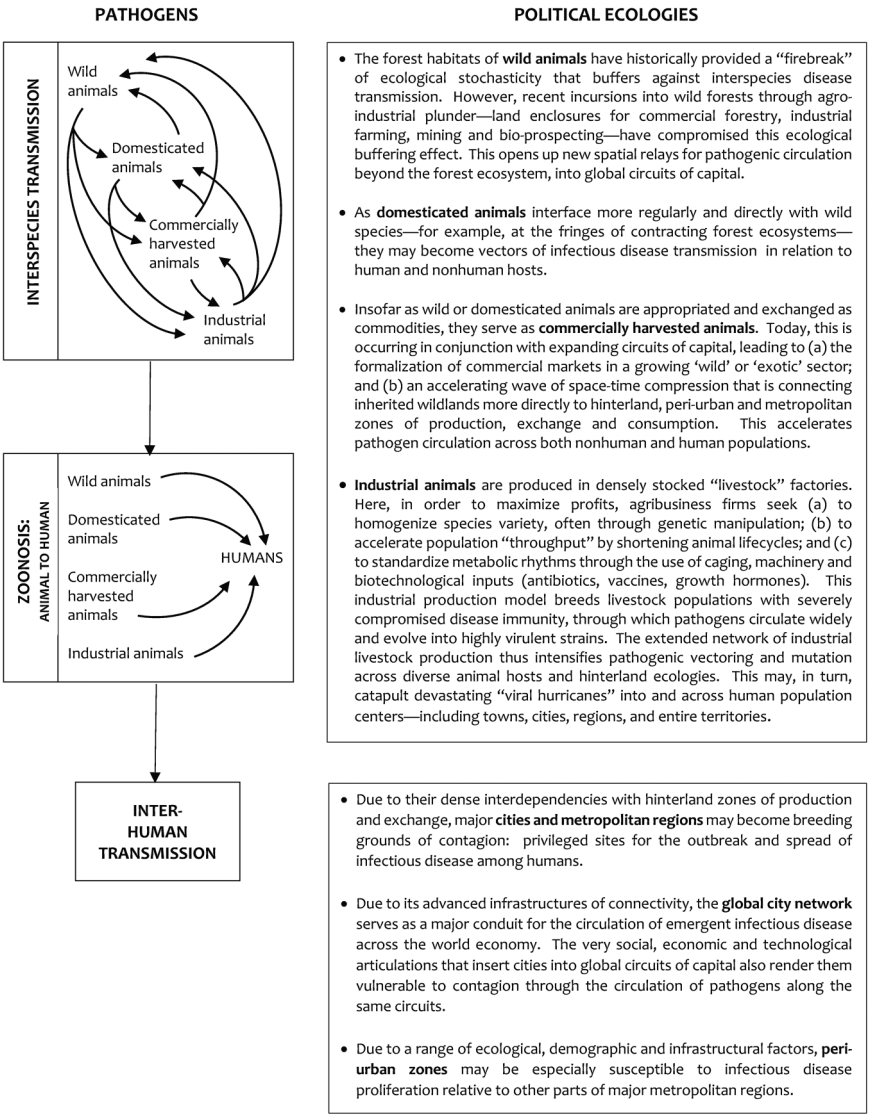

Figure 5. Toward a multispecies political ecology of emergent infectious diseases (EIDs) (2) (derived from, *inter alia*, Ali and Keil, 2006, 2007, 2008; Connolly et al., 2021; Wallace 2009, 2016; Wallace et al., 2020).

by Keil and his collaborators, as discussed in the preceding section. As noted, these arguments can be productively articulated to those of the Wallace group to offer a more comprehensive account of the urbanization/EIDs nexus in world-ecological context.

Plagues of planetary urbanization: Agro-industrial restructuring and spaces of catastrophe

The preceding considerations position us to revisit the nexus of urbanization and EIDs within a framework that supersedes the limitations of city-centric and city-extensionist approaches to this

problematique, while illuminating the spatially variegated, more-than-human web of city/non-city *relations* that have animated the major political-ecological transformations of early 21st-century capitalism. As we have seen, EIDs are not to be understood merely as an incursion into urban society from an exterior realm—rural, wild, or otherwise. Nor can EIDs be effectively illuminated on the basis of generic references to human–environment transformations such as deforestation, habitat destruction, or biodiversity loss under the Anthropocene. Rather, EIDs are direct metabolic consequences of contemporary capitalist strategies to appropriate and progressively capitalize historical natures (Moore, 2015), especially through processes of agro-industrial intensification. The intensively infrastructuralized landscapes of concentrated and extended urbanization may be understood as the cumulative spatial accretion of such strategies (Brenner and Katsikis, 2020). Their socio-ecological supports and impacts crystallize far beyond such landscapes to encompass variegated, more-than-human territories and political ecologies across the planet. In this sense, EIDs must be understood as plagues of the Capitalocene, and indeed, of planetary urbanization: they are produced within the unevenly extended spatial matrix of the capitalist urban fabric and its volatile, churning metabolism (Figure 6).

An essential politico-epistemological foundation for exploring the urbanization/EIDs nexus, as conceived here, is an attunement to the socio-environmental crisis tendencies of early 21st-century capitalism, in which inherited metabolic relays of cheap food, water, labor, and energy are increasingly being exhausted (Moore, 2015). For Lefebvre (2009 [1978]: 118, passim) the prospect of systemic breakdown and global ecological disaster—in his terms, the "space of catastrophe"—is immanent within the dynamics of planetary urbanization. The worldwide interdependencies forged through the capitalist form of urbanization are, Lefebvre maintained, shot through with horrifically destructive potentialities—"the most terrifying danger and terror"—due to, among other factors, the threat of nuclear obliteration, the violence of geopolitical warfare, the brutality of colonial enclosure, and ongoing forms of environmental plunder impacting the earth's atmosphere, oceans, soils, and forests (Lefebvre, 2009 [1978]: 287, passim). Despite the modern state's strategies to tranquilize its contradictions, the threat of irreparable cataclysm haunts the capitalist urban fabric, from the microbiological to the planetary scales.

Alongside intensifying environmental crises associated with accelerating climate change, deforestation, and biodiversity loss since the long 1980s, in close conjunction with the biophysical contradictions of capitalist agriculture (Weis, 2010), we suggest that EIDs are likewise major expressions of the "space of catastrophe" associated with a "planetarized" urban fabric (Lefebvre, 2014 [1989]). While not immediately produced within metropolitan or peri-urban regions, their pathways of proliferation are inextricably intermeshed with the historically and geographically specific forms of appropriation, capitalization, and environmental destruction (Moore, 2015) upon which an increasingly planetarized formation of capitalist urbanization has been grounded. Especially in the context of the COVID-19 pandemic, the planetarization of EIDs has also indelibly transformed the capitalist urban fabric: the internally differentiated, emergent whole mutates through the evolving, unruly, and contradictory relations among its parts. This is the dialectical conceptualization of urbanization around which the foregoing analysis has been framed (for further elaborations, see Brenner and Ghosh, 2022; on the concept of emergence in dialectical analysis, see Kangal 2020; Sève 2008).

In a recent analysis of the urban climate emergency, Cohen (2020) has emphasized the analytical and political centrality of carbon footprints beyond the city to the analysis of urban environmental dynamics. In contrast to the "snowglobe" ideology of carbon accounting which focuses on emissions rooted in arbitrarily bounded metropolitan territories, Cohen advocates for a dialectical-relational analysis that includes the extended operational landscapes "involved in making and moving the goods ultimately consumed in the city" (Cohen, 2020: 55; see also Wachsmuth et al., 2016). Just as Cohen rejects approaches that seek to "pin" carbon emissions to particular

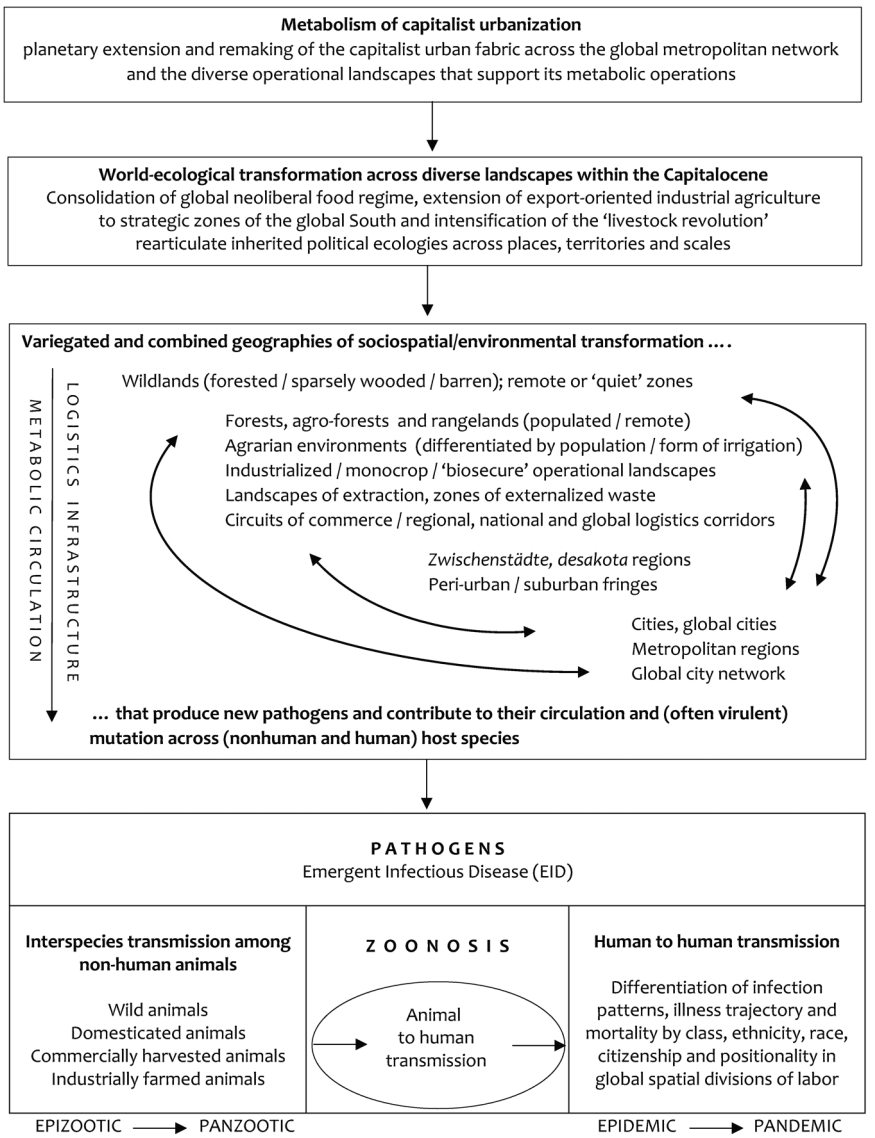

Figure 6. Urbanization and the political ecologies of emergent infectious diseases (EIDs)—synthetic overview.

locations—whether a field, a supermarket, a household, or a jurisdiction (see also Bergmann, 2013)—the approach to the urbanization/EIDs nexus proposed here similarly seeks to track a myriad of city/non-city relations within a "planetary geographic frame" (Cohen, 2020: 56). Such arguments are closely allied to those developed by Rob Wallace and his collaborators in their critique of the use of absolutist conceptions of space in mainstream epidemiological analysis, which similarly impose arbitrary territorial borders around multiscalar, territorially variegated, fluid, and emergent processes. Indeed, one of the key insights that follow from our reading of Rob Wallace's work is that the web of relations linking extended urbanization to EIDs is tightly articulated to the agro-ecological crisis tendencies of the neoliberal food regime. In other words, the web of city/

non-city connections from which EIDs are produced is woven through the volatile, crisis-riven political ecologies of neoliberal agro-industrial restructuring.[13]

The consolidation of the neoliberal food regime in the 1980s involved the geoeconomic reconfiguration of agricultural commodity chains, orchestrated in part through market disciplinary regulatory reform imposed under the General Agreement on Tariffs and Trade (GATT) and by the World Trade Organization (WTO). As a reconfiguration of the postwar, US-led developmentalist food regime, the neoliberal food regime has entailed an epochal transformation of agribusiness supply chains across strategic zones of the global South, especially through the expansion of export crop production and the concomitant intensification of grain import-dependency, accompanied by extensive expropriation and enclosure of land, and forced underconsumption among erstwhile peasantries. Among the most explosive consequences of these transformations, as Araghi (1995, 2000, 2009a, 2009b) has demonstrated, is the intensification of global depeasantization. This has entailed, specifically, a sustained contraction of smallholder-based forms of food production and associated regenerative agroecologies; the expanded semi-proletarianization of former peasantries; and the production of surplus populations that are increasingly displaced into the slums of southern megacities, where they subsist under conditions of extreme precarity and immiseration. Agro-industrial restructuring and the production of new urban spaces are thus intimately interconnected in the neoliberal period (Ghosh and Meer, 2021; Zoomers et al., 2017). Just as the enclosure of land and the concomitant expansion of agro-industrial investment in cash-crop hinterlands is generally financed through banks based in global cities, the dispossession and displacement of erstwhile peasantries from the global countryside are tightly articulated to the consolidation of a "planet of slums," many of which are situated in the peri-urban fringes explored by Keil and his colleagues (see also Davis, 2007).[14]

Since the late 1990s, the neoliberal food regime has undergone considerable crisis-induced restructuring, in significant measure due to declining productivity yields in industrialized sectors, intensified land-use competition from biofuels corporations, and proliferating, climate change-induced threats to cropland fertility. These trends are manifested in declining profit rates, rising food prices, and looming crises of social reproduction, generating major dislocations for both capital and labor. Strategic responses to the latter by states, banks, agribusiness corporations, and social movements appear to be animating a significant recomposition of the contemporary food regime itself (McMichael, 2020). One dimension of these shifts is a new "global land grab"—a combined outcome of state-aided capitalist strategies to mitigate and defer conjunctural crises associated with rising food and energy costs, impending climate collapse, and systemic financial volatility (Borras and Franco, 2012; Borras et al., 2012; McMichael, 2012; Zoomers, 2010).

In the aftermath of the 2007–2008 global food price spike and the ensuing food provisioning crisis, global land grabbing, along with concomitant waves of deforestation, have drastically intensified due to several distinct but converging factors, including (a) a geopolitical scramble to secure "offshore" supplies of food, feed, and biofuels and (b) the growing interest of predatory financial actors in agricultural land and associated infrastructures as an "investment frontier" (Fairbairn, 2020; McMichael, 2012). Under these conditions, "land is back on the investment agenda, but this time as a speculative venture and hedge against food and fuel supply shortfall" (McMichael, 2012: 985). Consequently, the last two decades have witnessed a drastic upswing in land enclosure, commodification, and consolidation, as well as a ratcheting-up of the metabolic disruptions associated with intensive capitalist agriculture, not only in staple export crops and oilseeds, but in the industrial livestock and agrofuel sectors. These disruptions include the ratcheting up of deforestation processes to establish large, highly capitalized plantations for export-oriented production (for instance, of livestock, palm oil, and soy), leading in turn to massive biodiversity loss, landscape fragmentation, and an enhanced risk of zoonotic pandemics (Malm, 2020: 36–81; see also Haddad et al., 2015).

Against the background of this web of connections, and the proliferating world-ecological crisis tendencies with which they are associated, it is possible to bring into relief the dialectical relations articulating the EIDs of our time to patterns and pathways of extended urbanization. The dialectical approach adopted here is reflexively attuned to the multiplicity of conditions—social, political-economic, and political-ecological—that are being produced across this variegated web of unevenly articulated, multiscalar, unruly, and volatile interconnections. At the same time, this method opens up a horizon through which such interlinked spaces may be treated, in methodological terms, as internally differentiated elements of an emergent whole—the capitalist urban fabric.

To this end, we suggest three arenas of investigation that may illuminate the interplay between extended urbanization and the formation of EIDs in relation to the agro-ecological crisis tendencies of neoliberal capitalism. Each of these spheres of investigation requires the construction of a concrete geohistorical totality "through analysis of the mutual conditioning of parts": the goal is to bring into relief the many-sided determinations that produce and transform an emergent web of relations, not to impose a rigid causal sequence upon sociohistorical dynamics (McMichael, 1990: 391; see also Hart, 2018). This methodological procedure is not intended to ossify a specific causal nexus or spatial pathway linking urban restructuring to EIDs, but to position the latter within the variegated, combined, and uneven geographies of the capitalist urban fabric—understood as a dynamically evolving planetary web of infrastructural configurations, political-ecological transformations, state spatial strategies, and cascading environmental emergencies. Through the continuous analytical juxtaposition of these processes in specific contexts of historical-geographical transformation, such avenues of inquiry may help illuminate the "unity in diversity without reifying either" (McMichael, 1990: 395; see also Moore, 2015: 292).

New mega infrastructures of agro-industrial production and circulation

The dialectical approach to extended urbanization proposed here connects the acceleration of forest destruction in Southeast Asia, Latin America, and other zones of the global South not simply to the operations of large-scale agribusiness enterprises, but to the rolling-out of new mega infrastructures of agro-industrial production and circulation, generally financed and constructed by national governments, to bolster food security within their most densely populated metropolitan regions. In addition to the massive land enclosures, infrastructural assemblages, processing and warehousing facilities, and logistics grids associated with emergent forms of export-oriented agribusiness in Latin America and Africa, key aspects of the Initiative for the Integration of the Regional Infrastructure of South America (IIRSA) project and, in more recent years, China's Belt and Road Initiative (BRI) may be interpreted in this light (Kanai, 2016; Kanai and Schindler, 2019; McMichael, 2020). Infrastructure projects associated with the IIRSA have facilitated a dramatic expansion of export-oriented primary commodity production in strategic regions of Latin America, including a surge in large agribusiness-led soybean and livestock production in Argentina and in the Amazon basin (Brent, 2015; Gordillo, 2019; Kaup, 2021; Oliveira and Schneider, 2016; van Dijck, 2013). Meanwhile, through the BRI, China is seeking to incorporate grain-producing regions in Western, Central, and South Asia into its own agrifood supply chains through massive new investments in agricultural land, regional agribusiness enterprises, logistics configurations, and agro-industrial infrastructure (McMichael, 2020; see also Belesky and Lawrence, 2019).

The point here is not simply that the leading states of the BRICS (Brazil, Russia, India, China, and South Africa) zone are mobilizing new geopolitical strategies in response to escalating, climate change-induced threats to regional food security, but that the latter are being pursued through an "infrastructure scramble" (Kanai and Schindler, 2019) that is dramatically remaking the political

ecologies of land use across the global South (see also Brenner 2019: 366–373). In this sense, the vision of EIDs emerging from the ruins of tropical forests that have been burned and bulldozed by large agribusiness corporations captures only one, rather generic layer of the *problematique*. Just as consequential, we suggest, are the large-scale patterns of territorial enclosure, land-use consolidation, colossal infrastructuralization, landscape simplification, and uneven ecological exchange that have emerged as states mobilize strategic responses to the "end of cheap food" (Araghi, 2009a; Moore, 2010) and associated agro-ecological crises. EIDs are, indeed, inextricably tied to deforestation, but that process is fully intermeshed with the new crystallizations of the capitalist urban fabric that are being forged through the ongoing recomposition of the neoliberal food regime.

The Global Industrial Feedlot Matrix (GIFM)

As discussed above with reference to the Wallace group's research, industrial livestock production contributes directly to the proliferation of EIDs and may also intensify their virulence. Central to this account is the role of confined animal feeding operations (CAFOs), especially in China and Southeast Asia, where ongoing dietary "meatification" has dramatically accelerated in recent decades (Schneider, 2014; Weis, 2013; see also Keck, 2019). From an extended urbanization-theoretical perspective, CAFOs are localized sites within a globalized, tightly networked assemblage of intensely capitalized livestock production complexes that include land-use grids, industrial equipment, processing and warehousing facilities, information/communications systems, and logistics infrastructures, as well as the many billions of animals—chickens, pigs, cows, and so forth—whose high-throughput industrial slaughter animates the contemporary "Livestock Revolution."

Just as global cities (Friedmann, 1986; Sassen, 1991; Taylor, 2004) represent localized nodes within worldwide intercity networks, CAFOs may be viewed as production sites embedded within the GIFM, a large-scale infrastructural configuration and political-ecological matrix whose proximate origins lie in the central role of industrial livestock within the US-led postwar food regime, but which has been now been globally rescaled in the context of neoliberal agribusiness operations (Ghosh et al., 2022). In addition to CAFOs, factory farms, processing units, and territorial amalgamations thereof, the GIFM includes the toxic metabolic circuits that support and result from industrial livestock production—including feed crop and agrofuel monoculture landscapes; zones of petro-capitalist extraction and energy processing for feedlot operations; customized logistical networks for commodity inputs and outputs; the degraded ecologies of soil, water, and air produced through discharges of effluence, biowaste, and industrial chemicals; and, of course, the wasting of human bodies through their deployment as gendered, racialized, and precaritized labor power in the hazardous environments of mechanized, high-volume animal slaughter (Weis, 2010; Pachirat, 2011; Schneider, 2017).

In contrast to the interhuman focus of most analyses of urbanization and EIDs, the framework proposed here directs attention to the multiplication of more-than-human connectivities that link regionally embedded CAFOs to interregional and transnational metabolic relays, at once through large-scale infrastructural configurations, microbiological circulatory pathways, and larger-scale socio-environmental externalizations. While these connectivities may involve mechanisms of interhuman pathogen transmission (for instance, via casualized labor pools circulating among regional production sites), they are also powerfully animated through the extension and thickening of nonhuman pathogenic pathways—including, among others, the inter-locational transfer of infected livestock or contaminated biowaste; direct pathogen transmission through the circulation of infected animal carcasses, processed meat, or fomites (inanimate pathogen-carrying objects) along interregional supply chains; and through epizootic spillovers that occur through the incursion of monoculture feed crops into previously remote, forested zones.

The consolidation of the GIFM thus illustrates how the ongoing recomposition of the neoliberal food regime has entailed the production of new political ecologies of extended urbanization. The systematic analysis of the GIFM as an expression of extended urbanization may help illuminate not only the circuits of farm-to-farm disease transmission that have begun to receive attention in epidemiology and public health scholarship (see, e.g. Bajardi et al., 2012; Rossi et al., 2017; Volkova et al., 2010), but also the variegated land-use systems, infrastructural configurations, and metabolic circuits that are associated with the contemporary proliferation of EIDs across global agribusiness environments. The operational landscapes of the GIFM form, in Rob and Roderick Wallace's (Wallace and Wallace, 2016b: 37) vivid phrase, an archipelago of "plague plantations." Their high densities of genetically homogenized industrial animals, their bio-enclosed processing facilities, and their practices of high-throughput production create hypertoxified environments in which "pathogen evolution rockets forward," where evolutionary selection privileges "greater pathogen deadliness in both livestock and people," and in which, consequently, extremely dangerous EIDs may proliferate (Wallace et al., 2020: 6, 16).

Multispecies virospheres of extended urbanization

The industrialization of livestock production produces new socio-ecological relationships between humans and industrially processed animals, as well as new biotic interactions between the latter and a range of nonhuman species, including previously relatively isolated wild animals in forest environments (see Figure 2 above). As Wallace and his collaborators have argued, the globalized intensification of high-throughput livestock and poultry production has entangled the metabolic rhythms and biotic environments of industrial livestock populations with those of a wide range of nonhuman species located in proximity to, and sometimes far beyond, the putatively "bio-secure" enclosures of CAFOs. Meanwhile, the massive intensification of deforestation propelled by the territorial expansion and proliferation of agribusiness plantations, including feed crop monocultures, has drastically reduced the "environmental stochasticity" of forests and traditional agroforests, which have typically offered functional and physical "firebreaks" against epizootic and zoonotic spillovers (Wallace et al., 2016).

These biotic realignments underscore the simultaneously planetary *and* microbiological dimensions of emergent forms of extended urbanization under the neoliberal food regime, as well as their thoroughly multispecies character. The concept of the "virosphere," recently introduced by Aronsson and Holm (2020), helps illuminate these multifaceted, multiscalar pathways of transformation. Building on the concept of a "virome," the "unique set of viruses that can be found inside a host organism," Aronsson and Holm (2020: 3) propose that a "group of hosts with related viromes possesses their own specific *virosphere* that […] may partially overlap with other virospheres or continue to develop in isolation" (2020: 3; italics added). In effect, *shared* virospheres emerge through the "multispecies entanglement […] between viruses and their unwilling hosts," and they may be reshaped and expanded through sociohistorical transformations that engender political ecologies for new interspecies interactions (Ibid., 3; passim).

Aronsson and Holm argue that the core transformations associated with the Anthropocene have heralded a "progressive homogenization of the virosphere." First, inherited human virospheres are now being more directly intermeshed with those of diverse nonhuman species. Second, the relative isolation of wild animal virospheres is being eroded as they are thrown more directly into contact with one another, with the rapidly evolving virospheres of industrially farmed animals, and with those of humans and their companion species (Ibid., 5). This blurring of boundaries—in particular, human/nonhuman; and domesticated/wild—is, on their account, an essential precondition for the replication of "identical viral genes" in diverse world-regional contexts as "sequences are

constantly being copied and pasted from virus to virus around a global DNA superhighway" (Ibid., 9, quoting Hamilton, 2008: 39).

While the concept of virosphere "homogenization" may produce an overly monolithic depiction of emergent biotic interdependencies and their political ecologies, it points toward an urgently important arena of research on the interplay between processes of extended urbanization and EIDs. Clearly, the infrastructural, territorial, and political-ecological transformations outlined above with reference to agro-industrial intensification under the neoliberal food regime have recast the metabolic circuits in which humans and diverse nonhuman species interact and co-evolve. As the Wallace group's investigations have exhaustively demonstrated, this produces new territorial arenas and spatial pathways in which EIDs may be produced and spread. The contemporary COVID-19 pandemic may therefore be understood less as a consequence of the generalized homogenization of anthropogenic virospheres than—like the other major EIDs of the neoliberal epoch—as an outgrowth of the specific multispecies virospheres produced through the uneven, emergent, and thoroughly crisis-riven political ecologies of planetary urbanization. It is in relation to these extended landscapes of agro-industrial production and circulation, and the multispecies entanglements they have produced across city and non-city spaces, that we can begin to decipher the proliferation of cross-species viral infections, their epizootic dissemination, and—most consequentially—their prospects for zoonotic spillover. If there is today a "global DNA superhighway" in which viral genes are increasingly circulating, we must look to the capitalist urban fabric to decipher the conditions of its production and planetarization.

Coda

The transformations outlined above with reference to mega infrastructures of agro-industrial production and circulation, the GIFM and multispecies virospheres are not simply background conditions for agglomeration dynamics, but are inextricably connected to their patterns, pathways, contradictions, and crisis tendencies under the neoliberal food regime. Since at least the late 19th century, the geographical configuration of successive food regimes has been shaped through the construction of vast infrastructures of agro-industrial production and circulation, including irrigation and hydrological systems, energy production and distribution grids, agro-processing units, storage facilities, and logistics networks, as well as through the large-scale appropriation and industrial recomposition of nonhuman organisms. Consequently, as Ghosh and Meer (2021: 15) have previously argued, the historical geographies of extended urbanization can be productively articulated to the "world historical periodizations of global agrofood arrangements" developed by food regime scholars.

Such an analysis is especially salient here because the agro-ecological transformations of the neoliberal epoch are not only tightly intermeshed with processes of concentrated urbanization, but have been directly materialized within operational landscapes of extended urbanization through a range of large-scale infrastructure investments, financial speculations, and associated political-ecological transformations. The extensively capitalized and financialized spatial infrastructures of agro-industrial supply chains have not received systematic attention in food regime scholarship, but they represent the socio-metabolic circuitry within which primary commodities are cultivated, harvested, and circulated from the soil, the field, and the warehouse to the shipping container and the world market, and through which the manifold political-economic and biophysical contradictions of those processes are articulated. It is here, in the forests, fields, extractive hinterlands, and logistics matrices of the global South, where new spatial strategies of land enclosure, infrastructure investment, landscape fragmentation, land-use simplification, and territorial

management have been elaborated, that the EIDs of the neoliberal era have been engendered and from which they have been projected into the global metropolitan network.

These considerations are not meant to imply that zones of neoliberal agro-industrial restructuring are subordinated to an encompassing planetary urban system, but to suggest that such zones, along with the global metropolitan network to whose financial and metabolic relays they are tightly articulated, constitute moments of an emergent geohistorical totality (McMichael, 1990; Moore, 2015). Its constitutive parts mutually condition and conflict with one another to form and—through proliferating crisis tendencies—continually transform the capitalist urban fabric. Insofar as "parts (as relational categories) reveal and realize the changing whole" (McMichael, 1990: 391), the analysis of planetary urbanization requires a dialectical procedure in which the multiple determinations underlying the appropriation and capitalization of historical natures—within and beyond cities; at once human and nonhuman, and financial, agrarian and extractive—are tracked, juxtaposed, and analytically articulated to one another (Moore, 2010). In this way, the capitalist urban fabric is revealed as an internally heterogeneous, concrete totality undergoing constant mutation through the conflictual, contradictory relations among its parts (for parallel analyses, see Levins and Lewontin, 1985; Moore, 2015).

The brutal, world-shattering repercussions of the COVID-19 pandemic underscore the urgency of developing concepts, methods, and cartographies that supersede the entrenched dualisms of inherited urban epistemologies—urban/rural; built/unbuilt; human/nonhuman; domesticated/wild—and thus grasp the combined and uneven geographies of planetary urbanization. In addition to their epistemological inadequacies in the face of epochal planetary crises, these categories yield analyses that foreclose the reinvented forms of comradeship, care, mutual aid, and repair that will be necessary for imagining and building a world beyond the Capitalocene (Ajl, 2021; Chuang, 2020; Estes, 2019; Dawson, 2016; Le Guin, 1974; Tsing et al., 2017). Pursuit of the agenda proposed here requires us to reconsider any number of non-city, more-than-human sites, processes, and transformations that have typically been treated as exterior parameters of urbanization, whether due to their apparent geographical remoteness, their microbiological scale, or their morphological divergence from inherited, city-centric imaginaries of the urban condition. Especially in the fields of urban, agrarian, and environmental studies, debates over the appropriate parameters of key categories of analysis are not merely academic, philosophical exercises. They are closely intertwined with struggles over the making and remaking of spatial arrangements in a world riven by capitalist plunder, rampant dispossession, and cascading socio-ecological crises. This is the political horizon—of devastating suffering, expropriation, exploitation, and violence, but also of emancipatory possibility—in relation to which critical urban theory must continue to chart its course.

Acknowledgments

For incisive criticisms and generative suggestions, we are grateful to Hillary Angelo, Martín Arboleda, Rodrigo Castriota, Kai Heron, Nikos Katsikis, Ayan Meer, Jason Moore, and Álvaro Sevilla Buitrago. We would also like to express our gratitude to Salma Abouelhossein and Will Conroy for intensive discussions about all of the issues under discussion in this article in the context of an ongoing Urban Theory Lab research project on the spatialities of capitalist metabolism. Finally, we thank the editors and reviewers for their deep engagement with an earlier draft and for a number of extremely productive suggestions.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Neil Brenner https://orcid.org/0000-0002-2257-6559

Notes

1. For a closely parallel exploration of the urbanization/EIDs nexus that likewise advocates an expanded conceptualization of urban space and urban environmental history, see Gandy (2021). Throughout this article, we use "Keil group" and "Wallace group" as shorthand designations for the two main streams of collaborative scholarship under discussion.
2. In a previous article, Ali (2004) explores such questions at length with reference to an outbreak of *E. coli* (O157:H7) in the "rural environment" and factory farm-based "agroecosystem" of Walkerton, Ontario. However, such considerations appear to have been relegated to the background in much of Ali's subsequent work with Keil and other collaborators on the inter- and intra-city circulation of EIDs.
3. The concept of extended urbanization was first developed by Brazilian planner Monte-Mór (2004) in the 1980s in the context of his Lefebvre-inspired investigation of the urbanization of the Amazon during the second half of the 20th century. The concept has subsequently been deployed by a number of critical urban scholars in conjunction with theoretical reflections on Lefebvre's (2003 [1970]) notion of "generalized" urbanization as well as concrete investigations of urban transformations around the world, from southern California to South America and Southeast Asia. For further overviews and conceptual genealogies, see the contributions to Brenner (2014)—including, in particular, by Monte-Mór himself (2014), Soja (2014), Soja and Kanai (2014) and Sevilla-Buitrago (2014), among others. Another important genealogy of this concept flows through Terry McGee's pioneering concept of the *desakota* region, which he elaborated in a volume he co-edited on *The Extended Metropolis* (Ginsburg et al., 1991; see also McGee, 2014 [1991]).
4. In a more recent publication, Keil and collaborators (Treffers et al., 2021) refer to "extensive" and "distended" urbanization, presumably as additional ways to characterize the processes they elsewhere describe under the rubric of extended urbanization. Each of these terms—extended, extensive, and distended—connote, for the authors, an areal stretching or horizontal spillover of city-like elements (variously described as forms, fragments, ways of life, or lifestyles) into surrounding zones, which are claimed thereby to become urban, albeit in a less densely settled morphological pattern than previous formations of urban life.
5. In an article that was published as the present text was being finalized (late 2021), several members of the Keil group consider the role of deforestation, extractive capitalism and (neo)colonial practices in the political ecologies of the 2014–2015 Ebola outbreak in West Africa (Treffers et al., 2021). Much of the article focuses on pathogen circulation through thickening networks of village-to-city mobility; the expansion of informalized, peri-urban settlement patterns in major coastal cities; and the key role of peri-urban zones in Freetown, Monrovia and Conakry in the Ebola outbreak and corresponding community-level responses. The authors suggest, however, that the latter issues are connected to the destructive encroachment of industrial and commercial activities into previously remote, forested regions of Guinea, Liberia, and Sierra Leone (they draw in part on the work of Rob Wallace and his collaborators, to which we turn our attention systematically below). In this way, the Keil group begins to transcend a strictly peri-urban demarcation of extended urbanization while addressing more directly the more-than-human dimensions of disease etiology. These generative lines of inquiry suggest a possible alignment of one stream of the Keil group's current research agendas with several of those we set forth in the remainder of this article. However, these recent research forays leave unresolved a number of meta-theoretical and methodological questions regarding the appropriate conceptualization of extended urbanization (on the latter, see Brenner, 2022).
6. In dialectical approaches to socio-environmental theory, the concept of "relations" has a specific technical meaning: it connotes not a simply a linkage between pregiven, externally connected entities, but their

reciprocal co-determination and co-evolution as parts of an emergent, internally fractured whole (Levins and Lewontin, 1985; Ollman, 2003). Accordingly, a key task for any dialectical investigation is to decipher the constitutive relations that underpin apparently self-evident objects or units—organisms, societies, cities, infrastructures, territories, and so forth—and, in the course of tracking their mutations, to embed them analytically within a larger, dynamically evolving and internally contradictory web of interdependence, or totality. For a further exploration of this conceptualization for the analysis of urbanization in the Capitalocene, see Brenner and Ghosh (2022).

7. For a closely parallel critique of such inherited cartographies, see Urban Theory Lab (2021).
8. For key methodological statements and technical interventions, see Wallace et al. (2007); Wallace and Fitch (2008); Wallace and Wallace (2002, 2015). For a broader statement on the epistemology and politics of epidemiology in relation to circuits of capital and their political ecologies, see Wallace et al. (2015).
9. This emphasis on the "foundational context" of disease emergence—that is, the complex causal nexus constituted by agro-industrial intensification, neoliberal policy regimes, and regional agroecological change—also underpins the Wallace group's Structural One Health (SOH) proposal for epidemiology and health investigations (Wallace et al., 2015). SOH offers an epistemological and methodological alternative to both mainstream approaches to public health as well as ascendant "One Health" and "Ecohealth" approaches to the investigation and management of disease threats. While the latter approaches productively embed disease emergence within broader ecosystemic contexts and analyze human health in relation to multispecies health conditions, the Wallace group argue that they remain insufficiently attuned to the socioeconomic and sociospatial causes of disease emergence insofar as they often confound the location of pathogen emergence with its broader "geography of causality" (2015: 70). By contrast, SOH outlines an "alternative science" which aims to analytically internalize the multivariate processes underlying health ecologies—including "the ownership and production, deep-time historical holdovers, and cultural infrastructure behind the landscape changes driving health threats" (2015: 71).
10. At the time of writing, the "origins" of COVID-19, including the origins of its causative agent SARS-CoV-2, continue to generate debate, disagreement and intrigue within and beyond the scientific community. In early 2021, a WHO-convened study on the origins of SARS-CoV-2 claimed that the virus originated in an animal host and spilled over to humans, likely through an intermediate animal host. A group of prominent scientists subsequently criticized this research for its failure to consider adequately the possibility that the virus may have been released accidentally from a laboratory. This led to renewed mainstream interest in the so-called "lab-leak" hypothesis, including from the US government. A July 2021 study, reported in the *New York Times*, supports the claim that SARS-CoV-2 has zoonotic origins and contends that the lab-leak hypothesis "may be near impossible to falsify" and "[…] is highly unlikely relative to the numerous and repeated human-animal contacts that occur routinely in the wildlife trade" (Holmes et al., 2021:12). These contentious debates aside, the precise locational origins of SARS-CoV-2 are not immediately material to the Wallace group's broader arguments regarding the epidemiologically volatile *context of contexts* constituted by global capitalism and its uneven, variegated geographies of enclosure, agro-industrialization, and extraction under conditions of generalized neoliberalization. This meta-context of sociospatial and political-ecological transformation is likewise our central concern here.
11. In an allied series of interventions, activist-scholar Bah (2015; 2017) has questioned the dominant, Western narratives of causation pertaining to the West African Ebola outbreak. According to Bah, mainstream accounts of Ebola in West Africa are grounded upon neocolonial, Orientalist ideologies and spurious forms of empirical evidence. Such approaches, he argues, exoticize and pathologize inherited subsistence practices and relations to nonhuman species, while ignoring the potential impact of US-funded "biodefense" research in creating new public health risks. Bah's account offers a powerful anti-imperialist critique of the epistemology and ideology of Western epidemiological research, and poses deeply troubling questions regarding current scientific discourse on zoonosis and "zoonotic spillover" (on the latter, see also Keck and Lynteris 2018; for a decolonial critique of global public health, see Richardson, 2020).
12. The Wallace group treat so-called "wild" food less as an expression of esoteric consumer preferences than as a historically mutating sector that is increasingly being embedded within larger-scale circuits of capital. Its rapid expansion in recent decades is inextricably connected to China's post-1980s liberalization

reforms, the explosive growth of the middle class and the "meatification" of its diet (Keck, 2019; Schneider, 2014, 2018; Weis, 2013), and associated transformations in the technical and spatial organization of animal-based commodity production (on the latter, see also Chuang, 2020; Schneider, 2017). It is also important to note that, while per capita meat consumption in China has increased fourfold between 1980 and 2017 to approximately 60 kg per year, it is still *less than half* of the per capita meat consumption in the United States (124 kg per year) and considerably lower than meat consumption in the high-income countries of the global North (Richie and Roser, 2017).

13. There is considerable debate among scholars in agrarian and environmental studies about the qualitative features of the neoliberal food regime (see, e.g. Bernstein, 2016; Friedmann, 2009, 2016; Jakobsen, 2021; McMichael, 2009, 2015). For present purposes, we follow Pechlaner and Otero (2010) and Tilzey (2018) in using this concept as a general reference to transformations in the geopolitical economy of global agriculture under post-1980s, neoliberalizing capitalism. As a "conjunctural form of the long-standing food regime through which historical capitalism has reorganized world agriculture" (McMichael, 2014: 109), the neoliberal food regime has deepened certain features, contradictions, and crisis tendencies of the preceding US-led, postwar food regime, including the institution of a new international division of agricultural labor, agribusiness-driven transnational linkages between regions of specialized agricultures, and the geographical expansion of energy intensive and fossil fuel dependent mechanized agriculture. Consequently, it has accelerated the biophysical contradictions and ecological crisis tendencies associated with modern capitalist agriculture (Moore, 2010; Weis, 2010). In this regard, each historical food regime is formed through the interaction of residual relations, inherited from prior food regimes, as well as emergent relations specific to a particular world-historical conjuncture (McMichael, 2020). This proposition also applies directly to the historical geographies of extended urbanization, which are likewise crystallized through path-dependent articulations among inherited spatial configurations and emergent spatial strategies (Brenner, 2019; Brenner and Schmid, 2015).
14. These links are, of course, not unique to the neoliberal period but have been robust and highly consequential over the *longue durée* history of global capitalism (Araghi, 2000; Sevilla Buitrago, 2014). The entrenched understanding of urban and agrarian/peasant studies as separate fields of study, each with its own distinct methods, concepts, and objects of analysis, continues to obscure such linkages and to block our collective capacity to decipher them.

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