

The Plantation as Hotspot

Capital, Science, Labour, and the Earthly Limits of Global Health

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Abstract

Central American sugarcane plantations have become ‘hotspots’ of chronic kidney disease (CKD). Although CKD is frequently caused by diabetes or hypertension, most sugarcane plantation workers who have it have no history of either condition. They are among a growing number of people worldwide afflicted by chronic kidney disease of nontraditional causes (CKDnt). The ‘hotspot’ concept resonates with those who study CKDnt in part because work-related heat stress has been the factor most strongly associated with the disease. Drawn from ethnographic research on CKDnt in Nicaragua and a close reading of scientific and policy documents, this research article frames the plantation as a health hotspot in three ways. First, plantations are sites of intensive, environment-altering capital investment. Second, public health research on the connection between heat stress and CKDnt remakes plantations as sites of intensive experimental scrutiny. Third, plantations produce innovative genres of political action. Nicaragua’s epidemic has given rise to a form of health activism, or ‘hotspotting’, in which workers and their allies use digital media to circulate evidence of environmental harm. This tripartite view of plantations as hotspots highlights what I suggest are some of the ‘Earthly limits’ of global health.

Keywords

Environmental justice, Heat, Toxicity, Sugarcane, Occupational health.

Introduction

Chronic kidney disease (CKD) is one of the three fastest-growing causes of death worldwide. Researchers have taken up the term ‘hotspot’ to mark places where rates of CKD are unusually high. The sugarcane plantations of Central America have been identified as one such hotspot. This article draws on ethnographic work carried out since 2015 with health activists on the sugarcane plantations of Nicaragua’s Pacific coast (see Nading 2019a). Rather than paint an intimate portrait of life with CKD, however, my aim is to understand what theoretical lessons the emergence of CKD on plantations might contain for medical anthropologists interested in conceptualising the embodied inequalities of the Anthropocene. Lessons from medical anthropology about the emerging science of climate health are helpful in this regard, as are ideas from beyond medical anthropology, including work in agrarian political economy and Black studies on the plantation. In addition to first-hand ethnography, then, I bring theory on how the persistence of plantation-style agriculture exacerbates economic and environmental inequality together with a critical reading of recent medical efforts to address the embodied impact of industrial monoculture. While the term ‘hotspot’ has become a rather narrow shorthand for geolocating sites of high disease incidence, I suggest that the hotspot concept offers scholars of inequality and embodiment a broader analytical purchase. The hotspot can be a tool for analytically linking the everyday lives of plantation residents, the machinations of agrarian investment, and the adaptation of medical sciences to the realities of an irreversibly changed climate.

Although CKD is frequently a result of underlying conditions such as diabetes or hypertension, sugarcane plantation workers with CKD, by and large, have no history of these conditions (Martín-Cleary and Ortiz 2014, 3). These workers are among a growing number of people worldwide afflicted by a new form of the disease known as chronic kidney disease of non-traditional causes (CKDnt). While the exact causes of CKDnt are unknown, studies suggest that kidney injury sustained during work is a contributing factor. One reason why the hotspot concept resonates with those who study CKDnt is that prolonged exposure to high air temperatures—a condition known medically as ‘heat stress’—has been the factor perhaps most strongly associated with the disease among plantation labourers, although exposure to toxic pesticides may be a cofactor (Johnson, Wesseling, and Newman 2019, 1843). As scholars of Latin America and the Caribbean have known for decades, in sugarcane plantation contexts, extreme heat is unavoidable for field labourers (Mintz 1961; Dabat and Rogers 2018). Heat in the fields may have reached some sort of tipping point due to global warming, but the advent of new agrochemicals in the landscape, particularly the ripening agent glyphosate, cannot be ignored as a factor. Ethnographic evidence from elsewhere in Latin America suggests that CKDnt is strongly correlated not just with heat but with

polluted environments and malign neglect of working people at the hands of states and corporations (Kierans 2020; Horton 2016).

To date, discussion of hotspots among critical scholars of global health has been relatively silent on the matter of labour. This is somewhat surprising, since farms, markets, food systems, and local foodways are so frequently implicated in global pandemics, from Ebola to SARS to influenza to COVID-19 (Benton and Dionne 2015; Brown and Kelly 2014; Zhan 2005). For example, high-density pig and poultry farms have facilitated the epizootic and zoonotic transmission of influenza and other viruses (Keck 2008, 198; Blanchette 2019; Porter 2019; Law and Mol 2008). The so-called 'wet markets' where animals are bought and sold have become associated (often erroneously, it must be noted) with superspreading events (Lynteris 2016; Chuvileva, Rissing, and King 2020; Segata, Beck, and Mucillo 2021). The disproportionate burden of the ongoing COVID-19 pandemic on racially and economically marginalised workers in the industrial meat and poultry industries serves as a sobering reminder that the global food system poses risks to health, in large part because of the gruelling and exploitative labour processes on which it relies (Lakhani 2020; Pachirat 2011; Steusse 2016).

The association between disease and plantation labour, of course, is far from new. As Michel-Rolph Trouillot (2002, 840) has shown, attention to the *longue durée* of plantation capitalism reveals that the bioecological change engendered by settler colonialism and chattel slavery was 'planetary from the start'. When enslaved Africans clear-cut forests to create sugarcane plantations in the Caribbean, they produced ideal conditions for the spread of yellow fever by *Aedes aegypti* mosquitoes (McNeill 1999, 178). The emergence of both modern tropical medicine and occupational medicine paralleled the rise of racial capitalism and the plantation complex, with sugar being frequently at the centre, from the U.S. South to Cuba to the Philippines (Anderson 2006; Battle 2021; Braun 2014). While Nicaragua's landscape was ecologically and demographically suited to cane production (the country's Pacific coast is its hottest, driest region, and its most populous), Nicaragua is something of a latecomer to the global sugarcane industry, with nearly all its plantations having been established in the 20th century. The Nicaraguan industry was built using the technical and managerial know-how of colonial Atlantic powers. For instance, its first sugar mill was incorporated by Italian immigrants who drew on English credit and established the mill as a British Sterling firm (Gould 1990, 22). By the 20th century, White or Creole oligarchs were consolidating land, pushing Indigenous and peasant farmers into marginal areas, and drawing their labour power into cash-crop production (Gould 1990).

For some, the term 'plantation' may evoke a bygone era of chattel slavery, but the plantation form is alive and well in the 21st century, defined by a highly stratified

production system devoted to monoculture (Besky 2014; Haraway 2015; Hetherington 2020). The modern-day plantations of the Americas constitute some of the world's most 'extreme environments' (Saxton 2015). In the sugarcane fields of Nicaragua, and elsewhere, soils are pushed to capacity, tropical forests are felled, water and air are saturated with agrochemicals, and vast stands of cane are burned just prior to harvest, releasing dangerous levels of smoke into the atmosphere. Labourers embody this extremity. Working long shifts in high humidity and amid temperatures that soar daily to above 90 degrees Fahrenheit (over 32 degrees Celsius), they are pushed to the limits of their endurance (Nading 2019b).

The term 'hotspot' is rooted in a biosecurity logic (Masco 2014; Segata and Mastrangelo 2020). Whether it is invoked metaphorically to describe pockets of insurgent violence, priority areas for conservation, or the epicentres of infectious disease outbreaks, the notion of the hotspot conveys a sense of speed and urgency. Critical scholarship recasts the hotspot as something more material: a slower-moving phenomenon, a more accretive form of both interspecies becoming and structural and environmental violence. As Hannah Brown and Ann Kelly suggest, the hotspot becomes useful as a critical tool when it connotes not immediacy but 'the persistent and shifting spatial, material, and historical co-presences that shape [disease] amplification. The hotspot does not provide the context of transmission but is rather a "context in action"' (2014, 284). CKDnt, then, might be considered a manifestation of the health consequences of what some scholars call the 'plantationocene', or a state of multiple and intersecting ecological and embodied 'inflammations'. This is a fallout from the sustained violence of colonialism, chattel slavery, and racialised labour flows, which construct Black and Brown people across Latin America as both 'essential' to food production and expendable in the quest to extract capital from 'land acquired through colonial violence and theft' (Marya and Patel 2021, 18; see also Aikens et al. 2019; Haraway 2015).

With this in mind, I would like to make the case for plantations as health hotspots in three ways. First, plantations have, from the beginning, been sites of intensive, environment-altering capital investment, premised on the right of colonial (almost always White) powers to subject ecologies and bodies to violence without recourse (McKittrick 2013; Restrepo and Escobar 2005). International investment in industrial monocultures has swelled globally since the end of the last century. Nicaragua's CKDnt epidemic, in fact, was 'discovered' by global health experts when such investments caught the attention of patient activists and workers living with the disease. Second, renewed recognition of the problem of occupational heat on plantations has brought both ecologies and labourers under intensified experimental scrutiny. The emergence of CKDnt has revived a longstanding relationship of mutual support between capital and science and between industrial

hygiene and efficiency. Third, plantations have historically been incubators, not just of oppressive monocultures but of innovative genres of political action. Nicaragua's CKDnt epidemic has given rise to a form of health activism which I call, following geographer Shiloh Krupar (2013), 'hotspotting', in which workers and their allies circulate narrative evidence of environmental harm through digital media. I conclude by suggesting that attention to plantations generally, and labour specifically, can help to highlight the 'Earthly limits' of global health.

Health hotspots and the 'Long Green Revolution'

The Nicaraguan CKDnt epidemic would not have reached the world's attention without the intervention of two very different kinds of entities: the International Finance Corporation (IFC, the development finance arm of the World Bank Group) and local health activist groups. Nicaragua's sugar industry has expanded at an unprecedented rate in the past two decades. According to the government's own estimates, agro-export investment exploded during the years following the 2008 financial crisis, and in 2013–14, sugarcane exports grew faster than those of any other agricultural product (Investment Promotion Agency of Nicaragua 2014).

For the IFC and the World Bank, greater investment in sugarcane might not only perpetuate the country's gains in food export but also develop its capacity to produce biofuels, including ethanol and energy generated from sugarcane pulp, known as bagasse. A report from the World Bank on the growing global interest in farmland (Deininger et al. 2011) proposes that the acquisition of land for monoculture should yield both environmental gains, by reducing dependence on fossil fuels, and development gains, by giving rural people living and working in 'inefficient' farm systems better-paying jobs (Deininger et al. 2011; Li 2011). In the name of closing what development policymakers have long seen as a 'yield gap' or 'productivity gap' between Euro-Atlantic and Latin American agriculture, the IFC supplied already-large Nicaraguan sugarcane firms with loans to acquire even more land (Nading 2019a; McMichael 2012, 687; Hollander 2009).

This strategy was embraced by Nicaragua's government, which, since the 2006 accession of Daniel Ortega and the left-leaning Sandinista National Liberation Front to power, has touted its commitment to alternative energy. Since 2005, the country's two largest sugarcane firms, Ingenio San Antonio (ISA, a privately held Nicaraguan company) and Monte Rosa (a subsidiary of Central America's largest sugar producer, the Guatemalan corporation Pantaleon) have received over US\$100 million in loans from the IFC to develop cogeneration facilities that burn bagasse to power sugar mills and the national electrical grid and to expand ethanol production. Ingenio Montelimar, the country's smallest sugarcane firm, was

awarded a US\$15 million loan from the IFC in 2014 to help launch its own biofuel subsidiary, Green Power.

Although the spike in investment in industrial agriculture in places like Nicaragua is relatively recent, it is best understood as part of a longer history. Efforts to make technical improvements in agriculture that would simultaneously improve human wellbeing are the calling card of what Raj Patel (2013) calls 'The Long Green Revolution' (see also Hetherington 2020). During the Green Revolution's first phase in the 1960s, the justification by proponents of industrialised agriculture of the consolidation of smallholdings for commercial crop production was based on the belief that growing economies through intensified agriculture was the only way to provide abundant food and thus stave off famine. The World Bank's more recent turn to investment in energy does not indicate an abandonment of concerns about health. One argument in favour of biofuel, in fact, has been that a reduction of dependence on fossil fuels could lower fuel prices and thus reduce overall food costs, reducing hunger and thereby improving health (Zubrin 2008).

Nonetheless, what transpired after the IFC made its loans to Nicaraguan sugarcane plantations highlights the weakness of such arguments. For a start, the expansion of sugarcane has intensified an already steady deterioration of Nicaraguan forests. During the early Green Revolution in the 1960s, the World Bank, the United States government and a variety of agro-industrial corporations supported the conversion of Nicaragua's Pacific region into a cotton-producing belt, destroying thousands of hectares of old growth forest (Faber 1991). Even after the cotton boom faded, the damage continued. According to the environmental watchdog Mongabay, between 1990 and 2010 Nicaragua lost 31 per cent of its forest cover, as sugarcane operations started to expand, as did peanut farming and cattle ranching (Butler 2020). Loss of land cover means an increase of carbon in the atmosphere and increased mean annual temperature. Instead of creating more salubrious environments, then, recent re-investments by states and supranational organisations in monoculture in Nicaragua and elsewhere have created even more extreme environments. Such environments are marked by decreased biodiversity, increased presence of toxic agrochemicals in air and water, and more intense heat—points highlighted in the 2015 report of the Rockefeller Foundation–*Lancet* Commission on Planetary Health (Whitmee et al. 2015).

Here is where health activism enters the story. Nicaraguan sugarcane workers have since the industry's inception been politically savvy, mobilising for labour and land rights, including access to healthcare (Gould 1990). For decades leading up to the explosion of Nicaragua's sugar industry in the 2000s, cane cutters seeking work on plantations had to report at the beginning of each year's harvest to the

private clinics owned by sugarcane firms. There, they would undergo blood and urine tests designed to determine their fitness for work. Tests on their blood serum revealed unusually high concentrations of creatinine, a waste protein secreted during muscle metabolism and, under normal circumstances, filtered out of the body by the kidneys. Elevated creatinine levels are a biomarker for compromised kidney function. Clinics also checked another key biomarker, the estimated glomerular filtration rate (eGFR). According to global diagnostic standards, kidney disease begins when the eGFR drops below 60. During the late 1990s and early 2000s, hundreds of would-be workers, some with more than 20 years of experience cutting cane, were determined to be unfit to work due to elevated creatinine and low eGFR. The first wave of workers to be dismissed received little to no support from the companies for healthcare, pensions, or food. Company clinics provided them with no further information about exactly what their medical condition was. As surviving workers frequently told me, they were simply ‘tossed off into the wind’. In the years leading up to the IFC’s multimillion-dollar loan schemes, hundreds of these dismissed workers died of what is now known as CKDnt.

In 2006, as the IFC was preparing its US\$55 million loan to Ingenio San Antonio (ISA), located in the northeast region of Chinandega, former workers still living with chronic kidney disease were alerted to a key provision in the loan procedure. Parties with reason to believe that the outcome of any IFC loan would be damaging to life or livelihoods could file a grievance with the Compliance Advisor Ombudsman (CAO), an independent office of the World Bank charged with monitoring the integrity of IFC-financed projects. The ISA workers’ grievance (filed in 2008) listed a wide range of problems, from soil erosion to cattle die-offs to a rise in respiratory illness, but it was the story of the mysterious kidney disease and the summary dismissals of workers that seemed to attract the CAO’s attention. In 2014, after the IFC approved a loan to Ingenio Montelimar in the department of Managua, one hundred kilometres to the south of the Chinandega region, former workers from Ingenio Montelimar with CKDnt formed the Asociación Montelimar Bendición de Dios (Montelimar Blessing from God Association, AMBED) and filed a similar grievance (CAO 2008, 2015).

While both ISA and the Montelimar Corporation were initially reluctant to countenance the workers’ grievances, they eventually agreed to an open-ended series of dialogues, mediated by the CAO. As a result of these dialogues, both companies agreed to playing a limited role in helping the most severely affected CKDnt patients get access to life-saving medical care, food subsidies, and assistance navigating Nicaragua’s social security system (Nading 2019a).

The IFC's creation of an investment hotspot in Nicaragua's sugarcane zone did not, by itself, cause deforestation, the overuse of agrochemicals, or steadily increasing mean annual temperatures. Nor did the IFC's investments cause the CKDnt epidemic. What the conversion of the sugarcane zone into an investment hotspot did do was make these ecological crises more extreme, and more visible. After all, a hotspot is not just a bounded site; it is a glaring emblem of a deeper set of systemic problems. As Brown and Kelly put it in their work on viral haemorrhagic fever hotspots, 'Disease risk is not ... "located," in the sense of being a feature of a particular kind of place ... Rather, it is locational ... arising from particular configurations of social, biotic, and material conditions' (2014, 287). That configuration of conditions can be traced back at least to the onset of the Green Revolution, whose central premise was that there was a productivity gap between farm workers in the so-called developing world and those in the developed world. The recent wave of investor interest in Nicaraguan sugar underscores how a decades-long push to provide people with, as the Bill and Melinda Gates Foundation slogan has it, 'healthy, productive lives', has reached what one group of CKDnt researchers calls 'a physiological limit ... at which acclimatization and behavioral modifications can no longer overcome the biologic stressors of unsafe working conditions and environmental exposures in ... hot spot communities' (Sorensen and Garcia-Trabanino 2019, 694).

It is the construction of sugarcane labourers under plantation capitalism as collectively expendable, rather than individually productive, that may have led to their illness. Field labourers work by the season. Each season lasts between six and eight months. Starting before dawn, they join crews headed by a field manager (*capataz*), putting new cane plants in the ground between April and June, before turning to fertilising and fumigating in the late summer and early autumn, leading up to the harvest (*zafra*) at the end of the calendar year. Most are paid not by the hour but by mass and area. To receive full wages for planting, cutting, or fumigating cane, workers must complete their designated daily assignment, or *tarea*. A *tarea* might be a given section of land, number of kilograms, or number of plants. Most workers return for multiple seasons, sometimes over the course of decades, subjecting themselves to potential kidney injury each day. This means that plantation labour, by definition, demands extreme and even dangerous levels of work. The identification of the bodily limits to this work, however, has not led to a deterioration of faith in the power of science to overcome them among policymakers and biomedical experts. Another early victory of the patient advocacy movements that filed the CAO grievances in Nicaragua in 2008 and 2014 was the signing of agreements by sugarcane companies to allow epidemiological research on CDKnt to take place on their plantations. Nicaraguan plantations have now become experimental as well as investment hotspots.

Spaceship in the cane: The plantation as experimental hotspot

A 2019 review of the state of the field of climate medicine alludes to what planetary health advocates call an ‘adaptation gap’ that divides medical and earth system science from corporate and public health policy (Haines and Ebi 2019, 268). The concept of the ‘adaptation gap’ points to a failure of applied sciences, like occupational health, to address the ecological problems caused by runaway accumulation (Ibid.; Farman and Rottenburg 2019). Closing the adaptation gap poses a grand challenge. One reason for this is that while industrial agriculture has been identified as a source point for the ongoing crisis of climate health, occupational epidemiology and agro-industry are deeply entangled. Plantation agriculture requires the close management of the lives and deaths of both humans and plants, yet monocultures are fundamentally unstable systems, meaning that what starts as a rational managerial decision may be the seed of a new outbreak, blight, or famine (Hetherington 2020; Blanchette 2020; Besky 2019). This instability is a source of both risk and power.

For example, Michitake Aso (2013, 427) describes how colonial rubber planters in French Indochina experimented on both labourers and the surrounding landscape to control the spread of malaria. French health authorities began pleading with planters to see the problem of malaria as ‘directly bound up with the question of native labor’ (idem, 427). While the Pasteur Institute advocated largescale environmental modifications designed to limit contact between workers and mosquitoes, rubber planters tended to see interventions targeting the individual behaviours of Vietnamese labourers, especially their hygienic practices, as more cost-effective. Colonial planters came to embrace an approach that couched the failure to avoid exposure to mosquitoes less as a technical or ecological failure than as a moral one (idem, 429).

When Nicaraguan sugarcane plantation workers first mobilised to address CKDnt, plantation companies vehemently denied that their labour practices were to blame for the condition (Nading 2019b). Company officials from both ISA and the Montelimar Corporation, the two firms who were the subjects of the CAO grievances, asserted that some combination of behavioural and genetic factors must be to blame. Perhaps, they suggested, the workers who were sick or dying with CKDnt drank too much alcohol after work or consumed too many sugary drinks to beat the heat while on the job. Perhaps they took too many non-steroidal anti-inflammatory drugs (NSAIDs) to dull the pain of over-exertion. (High doses of NSAIDs can compromise kidney function.) As in the colonial Vietnamese rubber context, latent in these corporate counterclaims was an implication that CKDnt stemmed in part from an individual moral failing.

Eventually, however, the sugar companies began making some concessions. Among other things, they agreed to activists' demands that occupational epidemiologists be allowed to study the impact of sugar production on workers. Initially, the results of these studies were equivocal. Comparative, population-based epidemiology identified a number of potential causes of CKDnt, from behavioural choices to genetic predisposition to heavy metal intoxication. Heat stress, however, was identified in studies carried out in the early 2010s as the factor most amenable to systematic experimental scrutiny (Brooks and McLean 2012). Based on this, a vocal group of occupational health specialists has taken the position that a search for root causes is ethically untenable without a parallel attempt to mitigate the onset of the disease in workers. They have convinced the owners of ISA to permit a second series of epidemiological experiments, which began in the late 2010s. Unlike the first round of studies, which were largely observational in nature, the purpose of this newer round is to test the hypothesis that an active intervention, in the form of the regular provision of water, rest, and shade to labourers throughout the working day, can stave off acute kidney injury caused by heat stress in the short term and prevent the onset of CKDnt in the longer term (Glaser et al. 2020; Hansson et al. 2019). A corollary hypothesis is that the provision of water, rest, and shade constitutes a worthwhile (i.e., remunerative) investment on the part of sugarcane companies (Prince 2020). These experiments thus seek to achieve a delicate balance. Their aim is not only to close the 'adaptation gap' between Anthropocene realities and occupational health practice but also to close the 'productivity gap' that keeps Nicaraguan agriculture lagging behind that of more developed countries.

Near the end of the 2010s, and in coordination with the multistakeholder trade organisation Bonsucro, a CKDnt-focused non-governmental organisation called La Isla Network joined with ISA to launch the Adelante Initiative. This initiative is an effort to test the theory that the provision of electrolyte-enhanced water and mandated rest periods in a shaded space could stem the onset of kidney injury (Bonsucro 2019; Glaser et al. 2020). The key experimental apparatus in the Adelante Initiative is the shade tent. One Adelante project report describes how, over a series of cane harvests, researchers iteratively adjusted the location of tents, their colour, the angle of their orientation relative to the sun, and the number of workers who could occupy them at any one time (Glaser et al. 2020, 3). Findings about the capacities of workers to avoid heat exposure were at the same time findings about the capacity of the tent and the electrolyte-enhanced water solution

to provide relief. The subject of the Adelante experiments is not just the body of the worker, then, but the water-rest-shade apparatus itself.¹

In the absence of definitive knowledge about what causes CKDnt, Adelante has moved in the direction of many ‘evidence-based’ humanitarian global health projects, ‘[proceeding] in such a way that project implementation becomes a form of experimental variable testing’ (Rottenburg 2009, 425; Adams 2016). The result will be familiar to those who have followed global health interventions elsewhere: what Richard Rottenburg (*idem*, 426), in his work on AIDS research in sub-Saharan Africa, calls an ‘archipelago’ of experimental sites that are territorially diffuse rather than corresponding to national or even regional borders. If the water-rest-shade experiments are successful, project leaders believe that lessons learned at ISA can be translated to other sugarcane plantations that are accredited by Bonsucro’s system for certifying ‘responsible’ sugar producers and promoting their products to socially conscious consumers (Bonsucro 2019).

What is *not* under scrutiny in this experiment is the plantation itself. In this way, the heat stress experiments exemplify the overlap between supply chain capitalism’s tendency to construct workable, simplified human and nonhuman ‘figures’ for intervention, and global health’s tendency to favour technological solutions to social problems (Tsing 2009). The plantation environment is still extreme. The construction of a microenvironment in the form of the tented refuge makes that extremity marginally more tolerable, or so goes the Adelante hypothesis. The shade tent is a space of exception. Like the microenvironment of a spacecraft, the microenvironment of the tent, in Valerie Olson’s words, ‘simultaneously normalizes ... bodies and the outer spatial milieus that they inhabit’ (Olson 2010, 172). At the same time, it manages workers’ bodies ‘not just as living bodies but as at-risk living systems seamlessly integrated with mechanical and environmental systems’ (*Ibid.*). The creation of what we might then call, following Goçke Günel, a ‘spaceship in the cane’, amounts to a ‘technical adjustment’ to the plantation, a means of making sugarcane production viable ‘without interrogating existing social, political, and economic relations’, including the embodied inequalities on which cane production depends (Günel 2019, 10). The water-rest-shade experiment acknowledges the reality of climate change and the human cost of sugarcane production while deferring direct action on it.

1 In this sense, these are excellent examples of what Hans-Jorg Rheinberger (1994) calls ‘experimental systems’. Rheinberger’s work in laboratory contexts can be extrapolated to the context of agricultural systems more broadly. For example, such experimentation formed the bedrock of modern medicine’s understandings of race. Historian Lundy Braun quotes Thomas Jefferson’s claim in *Notes on the State of Virginia* that one of the key differences between Black and White bodies was in ‘the pulmonary apparatus ... the principal regulator of animal heat’ (Braun 2014, 28). A few decades later, physician Samuel Cartwright used the spirometer to ‘prove’ that Blacks had inferior lung capacity and to justify forced labour as the only means of ‘vitalizing’ or oxygenating their blood (*Ibid.*).

The introduction of this technical adjustment partially bridges the adaptation gap between medicine and climate change. It does so by pursuing the Green Revolution-inflected dream of closing the productivity gap. According to a recent economic analysis of the Adelante project, ‘for every dollar spent on Adelante, ISA receives a return of approximately 22%’ (Prince 2020, 2). Like other recent small-scale healthcare and development initiatives, the Adelante experiment introduces a new, low-cost device for keeping human bodies alive that is also a device for accumulating capital (Scott-Smith 2019; Redfield 2012). In this way, the tent becomes what Gregg Hetherington (2020) has called an ‘agribiopolitical’ technology, one that ensures the value of human and plant life simultaneously. It is important to reiterate what lies at the root of the experiment: investments proffered by the IFC that saw the expansion of sugarcane monoculture as a pathway to human flourishing.

Hotspotting: Context in action

Occupational research projects like Adelante have generated a great deal of positive press for cooperating sugarcane firms, but among Montelimar workers and their families I have interviewed since 2017, increased research interest in the plantation has not allayed abiding concerns about its environmental impact. Most of them live in small villages, often surrounded by cane fields. Before sugar production was consolidated under the Montelimar Corporation, these villages would have been satellites of smaller sugar-growing operations, or *fincas*, whose owners sold cane to a central mill for processing. Ever since sugarcane production was introduced in this area by Nicaragua’s former ruling family, the Somozas, in the mid-20th century, people have made their living through a combination of seasonal work in the cane and in small farming. This entanglement of industrial capitalist with smallholder agriculture is a central feature of Nicaragua’s sugarcane complex (Gould 1990).

Ex-workers I met frequently turned our interviews into discussions of the dangers of a life lived in near-constant proximity to toxic pesticides and herbicides. Research on the role of such chemicals in causing CKDnt has been inconclusive (Wesseling et al. 2020), and while environmental toxicology is a notoriously imprecise science, targeted interventions like the Adelante experiments, which focus on heat and hydration, provide more tangible results. As a result of a concerted effort by the CAO and the local patient advocacy group AMBED, current and former workers and community members have come to understand why toxicology is so challenging, but they also point out that heat exposure has been a part of sugarcane labour for generations. What is new is the number and frequency of pesticides being used. For many current and former workers, the divergence between their continued anxiety about chemical toxicity and the narrowed focus of

scientific research on heat is a source of tremendous frustration. One particularly vocal member of AMBED put it this way in a November 2017 general assembly meeting:

I worked cutting cane for 40 years. And in one of my last years, I saw a group of students from the national university out here supposedly studying this disease that affects us ... And it pains me, and it's awkward to open my mouth and speak in such crude terms about people who supposedly are doing research, but they're researching to fool us! They think we're ignorant, but we're not ignorant.

Such statements reflect a concern that, in the absence of proof that toxic chemicals play a role in CKDnt, workers' worries about pesticides could be silenced. To scholars of environmental justice, this worker's sense that well-meaning researchers are dismissive of local concerns will sound familiar. Environmental health epidemics are frequently shrouded in uncertainty (Morello-Frosch, Brown, and Zavestoski 2011; Murphy 2013). And just as frequently, those affected by disease are asked to defer to the expertise of better-connected and better-educated researchers and doctors (Ottinger 2013). In global health terms, this is one side-effect of biomedical interventions that rely on the creation of experimental hotspots—small islands of attention and intervention, surrounded by vast spaces of status quo neglect (Rottenburg 2009). The evidence gleaned from occupational research does tend to have what Sara Wylie (2018) calls a 'synoptic' quality, in that synoptic evidence enables decision making that is detached from the lived experiences of communities.

In the face of synoptic evidence, people connected to AMBED have developed a form of narrative, place-based evidence, quite unlike the systematic, quantitative, and mobile kinds of evidence favoured by corporations and occupational health scientists. To address what they see as the plantation's dangerous levels of chemical toxicity, residents at Montelimar have begun circulating a form of place-based evidence that Rob Nixon calls 'imaginative testimony'. Such testimony has the power not to explain, but to force recognition (Nixon 2011, 13–14; Shapiro, Zakariya, and Roberts 2017). In her writing on nuclear toxicity in North America, Krupar calls this invitation to apprehension 'hotspotting', by which she means 'identifying, making visible, and keeping open the possibility that more can be identified' (2013, 281). At Montelimar, imaginative testimony often begins with a familiar visual image: a video, shared by WhatsApp or Facebook, that depicts a low-flying helicopter circling a village.

Just before the harvest each year—before people or machines come in to cut down the stalks of cane—helicopters douse sugarcane fields with what industry insiders refer to as a 'ripenner'. This chemical is, however, more properly a killer than a

'ripeners'. Although the Montelimar Corporation does not disclose what kinds of chemicals it uses, the industry standard for sugarcane ripening is glyphosate, a herbicide produced by Bayer Agricultural (formerly Monsanto) and known to domestic gardeners in its formulation as Roundup (Seneff and Orlando 2018). Glyphosate is one of the most commercially successful chemical products ever made, but it has been associated—albeit inconclusively—with a host of human health problems, including cancer, metabolic disease, and kidney disease (Adams 2023).

The homemade videos that residents at Montelimar circulate on social media depict ripener falling not onto fields but onto people's homes. Most current and former Montelimar labourers live with their families in one of the dozens of villages dotted in and around the plantation complex. Many of their houses are situated just a few metres from cane fields, and plantation roadways double as village thoroughfares. This pattern of settlement reflects a longstanding arrangement between plantations and those who work them. What Sylvia Wynter calls the subsistence 'plots' cultivated by enslaved Africans on Caribbean sugar plantations were sites of remarkable crop diversity. They provided ecological counterpoints to the surrounding monoculture (Wynter 1971). The cultural significance of these spaces for workers tends to be ignored in histories of the Euro-Atlantic economy generally and of the indenture of Black Africans specifically.

Although mechanisation has reduced the size of the Montelimar workforce somewhat in recent years, those who remain employed by the company still survive on a combination of cash wages from work in the cane and non-monetary yields from small farming. Within what a casual observer might see as an unyielding monochrome landscape, workers cohabit in intimate ways with a host of non-commercial plants: mangos, squashes, tomatoes, spinach, and many others. The plots on which they grow these plants are also the spaces where they hold religious services, send children to play, and celebrate birthdays and holidays. As mechanisation and CKDnt steadily dry up the labour pool, these plots have become even more important gathering points.

Wynter (1971) uses the term 'plot' in two ways: in its agricultural sense as the physical ground on which plantation labourers cultivate crops and in its literary sense as a structure for narrative. When Wynter was writing in the 1970s, most histories of capitalism told linear, progressive stories in which White figures like plantation owners and scientists were the protagonists (if not the heroes). In such histories, plantation labourers and their descendants were rendered minor, passive, even inhuman characters. This is history told from above, from the point of view of the architects of a gridded, ordered, modern monoculture. The counter-narratives (or 'plots') recirculated by labourers, by contrast, are views from

somewhere. These stories do not teach history in a neat, orderly, linear fashion. Much like garden plots, they can seem unruly and undisciplined because they evoke what Deborah Thomas (2016, 188) calls ‘co-relations’. By this she means both connections between people and the nonhuman world, and correspondences between events—the kinds of correspondences that cannot be apprehended by modernist history or modern science (perhaps especially epidemiology).

The dominant scientific story now being told through meta-analyses of CKDnt research is that, despite the known risks of glyphosate to kidney health, exposure to environmental toxicants is not a leading factor in the disease (Wesseling et al. 2020). The studies cited in these meta-analyses rely heavily, if not exclusively, upon self-reporting of exposure by officially contracted cane workers. In other words, they frame CKDnt (and pesticide exposure) as a problem that is limited to work, as defined by scientists, plantation owners, and management. In these narratives, the CKDnt hotspot appears to cool at the edge of the cane fields, just where the subsistence plot begins, and where the ripener sometimes accidentally hits the ground.

In fairness, residents around Montelimar do not object to the dismissal of their concerns about pesticides based on a reading of study methodologies. Rather, they feel ‘fooled’ because while the chemicals being dropped from helicopters may be somewhat new, pesticide drift is not a new form of environmental violence. Well before the kidney disease epidemic and well before the advent of glyphosate as a tool in sugarcane production, thousands of Nicaraguans were sickened each year by pesticides (Corriols 2010). Studies of CKDnt, in fact, almost never mention Nicaragua’s history of overreliance on toxic agrochemicals for the production of commodity crops, including sugar as well as cotton, peanuts, coffee, and bananas (Faber 1991; Bohme 2014). Pesticide exposure has become such an ‘ordinary concern’ in Nicaragua that it is slowly slipping out of the frame of the ‘more categorically minded experts’ who study CKDnt there (Biehl 2015, 264).

In August 2019, when the plantation’s pesticide helicopter dumped part of its load of ripener onto a patch of tomato plants in a village on the northern end of Montelimar’s land, the woman who owned those plants posted pictures of the aftermath on Facebook and repeated the longstanding claims that the pesticides were doing both acute and long-term harm to plants as well as bodies. A company representative came to the woman’s house and asked her to remove the Facebook post, promising to compensate her with cash. She refused.

To explain this refusal, it is necessary to understand the sharing of digital videos of pesticide drift as a kind of hotspotting, a form of narrative that opens, rather than closes, debate about the relationships among pesticides, plant health, and human health (Krupar 2013). The Montelimar Corporation recognises that sometimes the

ripeners miss their target, but the videos remain inconvenient. An American development worker I interviewed called the event depicted in such videos the 'shrivelled plant moment'. Many of the shrivelled plant narratives that circulated through the sugarcane zone included the observation that just before the plants started shrivelling, the kidneys of many of the people who worked in the surrounding plantations had also started to shrivel, evidenced in medical discharge papers containing grainy ultrasound images of damaged kidneys.

The linkage between shrivelled plants and shrivelled kidneys is an example of what Deborah Thomas (2016) calls 'co-relation', not linear causality. The shrivelled plant narrative obliquely, rather than directly, counters corporate and scientific claims about pesticides and CKDnt and suggests 'that more can be identified' (Krupar 2013, 281). This narrative circulates in disjointed chunks when the metaphorical 'hotspots' of internet and mobile telephone technology become available. As it does so, it 'invites apprehension', both of the continued threat that plantation production poses and of the possible obligations that owners and managers may have to villagers (Nixon 2011).

One of the more gripping retellings of the shrivelled plant narrative came in the summer of 2019, when AMBED members were invited by the Montelimar Corporation to a banquet at a local beach resort. There, a scientist from a U.S. university briefed them on the efforts that were being made to understand the epidemic. The upshot of his presentation was that no one knew for sure why so many people were getting sick, but that heat stress at work seemed like the main issue. During the question-and-answer period that followed, the subject of aerial herbicide spraying came up repeatedly. The American scientist expressed his sympathy over the destruction of people's garden crops, but he quickly reminded the audience that there was not conclusive evidence of a connection between the spraying and CKDnt. As far as I could tell, the scientist was telling the story as most responsible people in his field might. Epidemiologists are careful not to get ahead of their data. Then a woman from one of the villages took her turn to ask a question and said, 'I realise that you don't know if the chemicals make our husbands sick, but it does seem dangerous for the children to be showered when the helicopter comes overhead.' While some others had spoken at high volume and in impassioned tones, she addressed the scientist in a voice so calm that the once-raucous room seemed to grow quiet. 'Children are curious,' she explained, 'they want to go out and see the helicopter'.

People started to smile and nod. The low-flying, sleek helicopter was an understandably fascinating sight for young children. It was one thing to witness it on the tiny screen of a cheap camera phone, but quite another to see and hear it for yourself. She went on, 'But then you look at the plants and you think, this must

not be good for them. So, I accept that we don't know about the kidneys, but it seems like we should keep [the pesticides] from falling on our children's heads. We don't know when the helicopter is going to come, and we can't ask them to stay inside under the roof all the time.' The unspoken corollary to this, of course, was that you couldn't grow tomatoes or squash or mangoes or avocados indoors either.

The woman's point was simple, but powerful. The garden plots adjacent to Nicaraguan cane fields are not, strictly speaking, the property of workers and their families, even though multiple generations have occupied them. In legal terms, this land is neither under corporate control nor independent of it (Nading 2019a). This liminality is typical of most modern plantations. It is the messy outcome of a transition in Latin American cane production from the vertically integrated *hacienda* system, in which companies provided workers with land and housing in company-owned housing, to a 'new style' plantation in which labour was externalised (Wolf 2001; Besky 2017; Gould 1990). The shrivelled plant narrative invites us to think of the houses and gardens where workers live and raise children as part of the overall architecture of the plantation, along with more familiar components like irrigation systems, processing mills, and aerial 'ripening'. If plots are *of* the plantation and not beyond it, it becomes harder to dismiss the spraying of plants and children as mere accidents.

Those who told and retold the shrivelled plant narrative harboured what Wynter (1971, 102) calls 'a sense of justice which is separate from the abstract concept of the law of the plantation'. In this way, the shrivelled plant narrative was a method for pushing back against what Julie Guthman (2011, 17) calls 'problem closure', that is, 'the creation of solutions that are politically feasible or reasonably practical, so the ... tenable solutions define the problem'. For both plantation managers intent on turning a profit and for scientists intent on showing results, an emphasis on a solution that was mutually tenable—the reduction of occupational heat stress—certainly seemed like a win-win, especially if 'occupational' was defined narrowly by science and management. Meanwhile, people in Nicaragua affected by CKDnt remained attentive to the wayward flights of toxic herbicides not because they wanted to impugn the morals of scientists and managers but because they wanted to question the 'frugality' of interventions that promote safety for the bodies of field workers while leaving the broader plantation environment untouched and unquestioned (Biehl 2015, 266).

Conclusion: Plantations, hotspots, and the Earthly limits of global health

The plantation has lately gained traction in environmental humanities as a device for conceptualising the confluence of an unchecked impulse to promote economic growth, the endurance of racial inequalities, and climate change. It has even figured in calls by scholars in the health sciences to reimagine global health as ‘planetary health’. The title of the Rockefeller Foundation–*Lancet* report on planetary health is ‘Safeguarding Human Health in the Anthropocene Epoch’ (Whitmee et al. 2015). This report identifies biophysical limits to the growth-oriented logics of development, including the notion of an agricultural ‘productivity gap’ that remains the engine of the ‘Long Green Revolution’ (Ibid.; Patel 2013). Yet, despite the recognition that growth and health may no longer be reconcilable, there is no mention in the report of ‘capitalism’ or ‘corporate profits’, much less of embodied inequality—the accretive biological burden of capitalist growth (Farman and Rottenburg 2019, 2).

These omissions points to what I would call an ‘Earthly limit’ to global health, the continued push to equate healthy (human) bodies with productive bodies. While the ethical impulse of projects like the Adelante Initiative is admirable, the fact that its mission to adapt the bodies of vulnerable people to extreme heat has been so neatly grafted onto the drive to make those same bodies more productive rests on a liberal imaginary of voluntary, consenting individuals selling their labour freely, rather than a deeper historical recognition of the layers of ecological violence—violence that encompasses more than human bodies—on which plantation capitalism rests (Wynter 1971; McKittrick 2013). The attempt to reconcile productivity with climate adaptation has brought questions about labour more firmly into the conversation about global health, but it has also created a too-neat division between a recognisable ‘occupational’ hotspot and the ecologically and socially heterogenous world that surrounds it. Many Nicaraguan plantation workers affected by CKDnt are also small farmers, holding on to tiny plots of land for their own cultivation; others maintain home medicine gardens or tend livestock and birds. Even under harsh and exploitative circumstances, they maintain extended kin and political networks, deftly harnessing the tools of social media to expand the reach of those networks.

While plantations can seem like places where interspecies entanglement and human connections to Earth’s complex ecologies are violently severed, decades of plantation studies suggest otherwise. As Elizabeth DeLoughrey (2011, 58–9) explains, historical attention to sites such as plots and provision grounds yields empirical evidence that people who worked plantations in the past—even enslaved people—were not alienated from nonhuman nature but in fact deeply connected

to it. A narrow view of the plantation as hotspot severs questions about the durability of work in the cane from questions about the inhabitability of the plot. A more capacious understanding of the hotspot makes such a separation harder to uphold.

This leads to a second Earthly limit to global health, namely that despite the appeals to a globally universal humanity—a common ‘we’—that inspire health interventions, many people imagine their own lives in terms of a socially and ecologically reproductive ‘here’. The struggle to come to terms with CKDnt, then, requires not just adapting medical science to the realities of climate change with more rigorous epidemiological experiments, or more judicious distribution of development dollars, but the cultivation of what I would call, following Arturo Escobar (2019, 132), an ‘Earthly’ form of reasoning—the kind of reasoning that insists that ‘nothing preexists the relations that constitute it’. It is such reasoning that engenders shrivelled plant stories and keeps them circulating.

Such stories invite us, in the words of Abou Farman and Richard Rottenburg (2019, 3), to recognise ‘that it is impossible to identify the one and only right way of gaining knowledge of the world’. The implication of this recognition, they add, is ‘that we as humans cannot rely on the assumption that there is only one purchase on reality out there’ (ibid.), and that, as Wynter (1971) would have it, the attempt to do so is yet another form of plantation violence. Activist ‘hotspotting’ highlights that a socially just approach to global health cannot succeed unless it acknowledges that what counts as ‘health’ is often determined by a narrow range of technical experts—experts whose work is underwritten by the survival of the plantation itself.

The term ‘Earthly limits’, then, signals the need to face anew the longstanding anthropological conviction that problems emanate from and impact particular places as much as they do global systems. This is not just to recognise that damage to ecologies and bodies places limits on growth. It is also to attend to the kinds of imaginaries for a life otherwise that arise amid that damage. These imaginaries, too, are locational. They emanate from situated bundles of experience. That the plantation is a hotspot, then, is not in itself revelatory. As science, capital, and activism converge on the plantation, what becomes clear is that how hotspots are made and kept makes all the earthly difference.

Authorship statement

Alex Nading is the sole author of this article, and all analytical statements, as well as any factual errors, are his own. The author declares no conflicts of interest.

Ethics statement

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