6 HEAT, HEALTH, AND HUNGER

. . . I could sink my hand into the red earth, plant a seed and watch it grow like a promise of the future. That was before the sun had suddenly become unbearable and cracked the earth. Lines were drawn, deep and intersecting, creating a puzzle of the land that I had always known and loved. Refusing to read the signs, we had persevered. The first year broke our backs. The second year broke our hearts. The third year broke our spirits.

From 'What Becomes of the Broken-Hearted'
by Siphiwe Gloria Ndlovu, Zimbabwe[1]

Surendra Tamang receives kidney dialysis three times a week at a hospital in Kathmandu, Nepal. He's only 34. And he isn't diabetic. He should be fit and healthy, in the prime of his life. In 2015 when he was 25, Surendra moved to Qatar as part of a wave of migrant workers attracted by abundant work in advance of Qatar hosting the FIFA Football World Cup, to take place in 2022. There were multiple stadiums to be built and, with limited employment opportunities at home, Nepalis were especially keen to meet the demand. By 2016, $4 billion a year flowed into Nepal from migrant workers overseas, accounting for nearly one-third of the country's GDP.[2] Tamang himself sent the bulk of his $400-a-month salary to his family back home.[3] Until he fell sick.

'We got exhausted due to 12 hours shift in a day with no breaks at all,' he recalls, speaking in 2024. 'When they caught us taking rest we got scolded'. Qatari heat and humidity make for a deadly cocktail – one in which outdoor work can be seriously deleterious to health. But those sports stadiums

https://doi.org/10.1017/9781009605960.007

weren't going to build themselves. By 2019, Qatar's migrant worker population rose to 1.9 million, many of them young men from Nepal, India, Bangladesh, and Pakistan.[4] Humans are considered at risk of death just from being outside when the wet-bulb temperature exceeds 35 °C (95 °F). And 32.5 °C (90.5 °F) is considered the red line for any kind of outdoor activity. Wet-bulb temperatures aren't typically reported in weather forecasts, but we can calculate that an outdoor temperature reading of 44 °C would, combined with relative humidity of 45–55%, give a wet-bulb reading in the range of 33.5–35.5 °C. Such temperature and humidity levels are typical for a Qatari summer, when all locals will be safely inside with the air conditioner turned up to the max. Everyone, that is, except for migrant labourers, including Surendra. The highest temperature he remembers working in was 112 °F (44.4 °C). Nosebleeds, headaches, cramps, vomiting, and dizziness were common – dangerous in themselves when often working at height – and all attributable to heat stress. 'My shift was 12 hours. Only one hour lunch break was provided, there were no other breaks during the working hours,' he recalls. 'We were unable to take a rest . . . it was really difficult for me to work there for the first few months. I occasionally considered returning to Nepal, but I reasoned that there isn't much opportunity to make excellent money there.'

His experience was in contravention of Qatari law, which in 2007 (Ministerial Decree No. 16) stipulated that workers may not work for more than five hours outdoors during the summer months (15 June until 31 August). Yet Surendra's story is not a lone anecdote. In 2019, the Guardian reported that the implementation of the law 'appears patchy. In Doha this August, as temperatures reached 42°C by 11am, migrant workers told the Guardian they were being forced to work in the searing heat'.[5] But with the World Cup kick-off less than three years away, widespread construction continued. Adherence to labour laws or ethical practice was only paid lip-service by some employers. 'They used to tell us to work

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carefully and held some safety meetings in-between the working hours,' says Surendra. 'But they did not manage any facilities for us.'

After five years, Surendra started to notice he had lost interest in eating. Then blood began appearing in his urine. He remembers 'pain all over the body and cramps over my legs'. It got so bad that he was unable to work for a whole month. His employer suggested he return home to Nepal. When he eventually did, he received a diagnosis of acute kidney failure. He found the dialysis wards full of other overseas labourers like himself. By 2017, the *Nepali Times* had already reported a 'mysterious rash of kidney failures' with 'an alarming trend of kidney disease among its younger population, a significant number of them migrant workers, who are more vulnerable to renal failure because of tough physical labour in the desert, where they are often dehydrated.' Shakti Basnet of the Nepal Kidney Foundation explained, 'The conditions are difficult, they sweat a lot and do not drink enough water: that is why so many Nepalis are coming home with malfunctioning kidneys.'[6]

A former ICU doctor at Bir Hospital in Kathmandu, Sweta Koirala, interviewed for this book, sees the clinical cause-and-effect all too clearly: 'Kidney failure occurs because they work strenuously in stressful, hot conditions without sufficient water. Getting water or going to the restroom can be a lengthy process, so they avoid drinking to save time. They also don't get adequate rest, and the extensive use of painkillers for body aches further harms their kidneys. It's a vicious cycle.'

There's nothing unique about Qatar in the wider region. *The Monitor*'s projections for Saudi Arabia, the largest country in the Middle East, show that in a 'business as usual' scenario, Saudi sees an increase of 1,100 person-hours in heat stress risk (Figure 6.1). (Person-hours are calculated by determining the number of hours in a given day that combined temperature and relative humidity exceed at least the moderate heat stress

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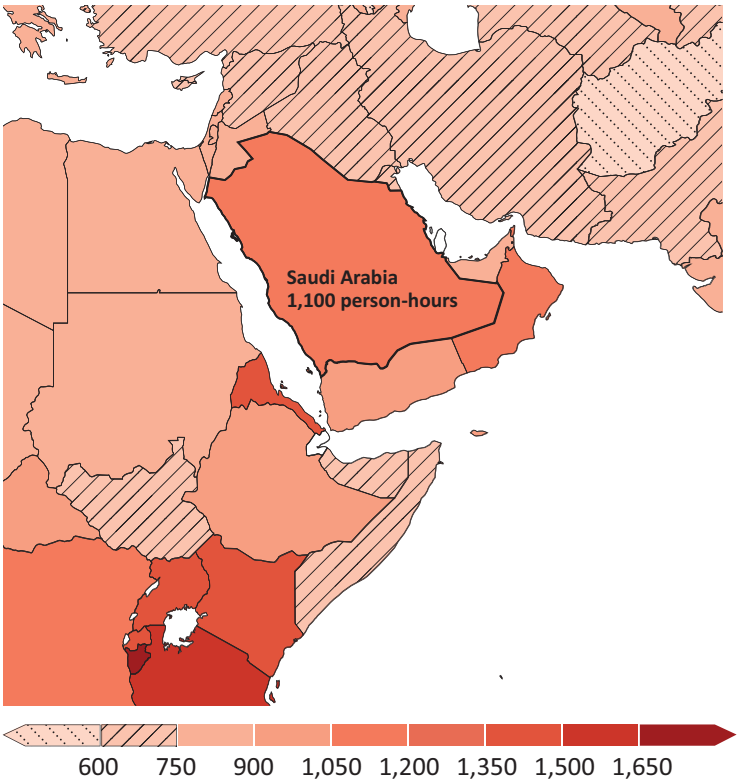

Figure 6.1 Health and physical activity, Saudi Arabia. Absolute change in person-hours between 2081–2100 with no policy action. (*CVM3* Health Data Explorer)[7]

risk threshold, multiplied by the number of people estimated to be exposed to those hours.)

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Jason Glaser first discovered in 2008 that sugarcane workers were dying from kidney failure in Nicaragua. Then a young, idealistic documentary filmmaker (in his own words 'a proto hipster from Brooklyn') chasing a story about striking workers, it was an unrelated side protest that caught his attention – and has held it ever since. 'I was like 27, there was a line of cops

with AK-47s and a line of people on both sides with bloody faces,' he recalls, speaking in 2024. 'But then beside them was this other quieter protest going on – a line of hammocks of young men dying, dying in the hammocks . . . In their 20s and 30s dying of kidney failure and nobody knew why.' The search for the answer led him to become the founder and CEO of La Isla Network, a US–Nicaraguan occupational health research organisation dedicated to ending heat-related illnesses, including 'chronic kidney disease from non-traditional causes' (which they give the abbreviation 'CKDnT').

When Glaser started investigating, he found that CKDnT sufferers were almost exclusively sugarcane cutters working out in the fields, primarily for the rum industry. As he began enlisting the help of researchers and epidemiologists, the true scale began to emerge – thousands of young men were dying this way. 'This stuff is structural, it doesn't exist in a vacuum,' says Glaser. He has described the situation he found as 'antiquated labour systems fundamentally based on slavery, that have not evolved with the protections we expect in other settings and sectors.'[8] By 2013, La Isla had uncovered evidence of 20,000 cases of CKDnT in a single decade in Central America alone.[9] The Nicaraguan sugarcane workers were working 8–12 hours a day, with few breaks, leading to core body temperatures often exceeding 38 °C, similar to endurance athletes or military personnel in war zones (see Figure 6.2). They needed regular shade and hydration but weren't getting it – and some were dying as a result. When La Isla started working with sugar suppliers to implement better conditions (namely regular shade and water), the workers' core temperatures went down, and they were far more productive, working fewer overall hours but cutting more tons of sugarcane overall because they weren't as fatigued or overheated (see Figure 6.2). And, crucially, the mortality rate decreased.

Glaser turned from idealistic hipster into an accidental academic. His 2016 paper in the *Clinical Journal of the American*

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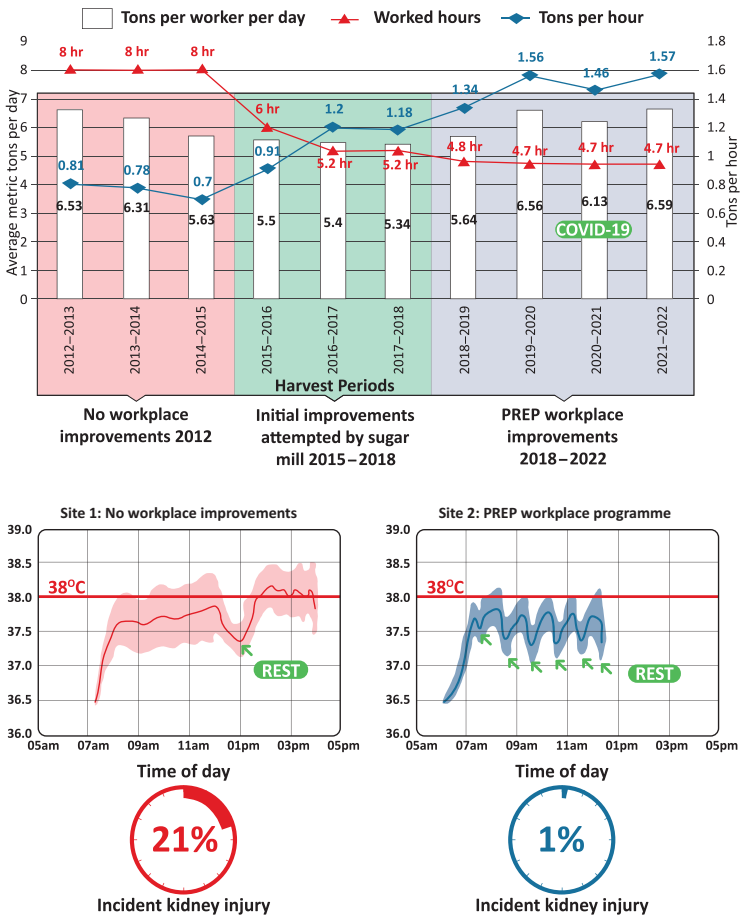

PREP = Prevention, Resilience, Efficiency, and Protection

Figure 6.2 La Isla Network heat stress data in outdoor sugarcane workers, Nicaragua. (Hansson et al. Impact of heat and a rest–shade–hydration intervention program on productivity of piece-paid industrial agricultural workers at risk of chronic kidney disease of nontraditional origin. *Annals of Work Exposures and Health*, May 2024)[10]

Society of Nephrology, co-authored with 17 global experts, on 'Climate change and the emergent epidemic of CKD from heat stress in rural communities', outlined the issue in stark detail:

> *Global warming has resulted in an overall increase of about 0.8°C during the last century, and is estimated to be responsible for 75% of the extreme heat events. Heat waves typically refer to sustained temperatures of >40°C, or temperature increases of >5–6°C over the normal maximum temperature of the region, or any time temperatures reach >45°C. One of the most intuitive effects of heat waves on human health is heat stroke and death … Recently, an epidemic of CKD of unknown etiology has been recognized in Central America (Mesoamerican nephropathy), which has been linked with recurrent dehydration and heat stress … and could be an example of a disease that is accelerated by global warming.*[11]

The year Glaser's paper came out, a heatwave in Pakistan resulted in 40,000 cases of heat stroke, while another heatwave in Andhra Pradesh caused 1,400 deaths in just one month. Heat stroke and heat-related deaths are both on the rise in a fast-heating world.

Glaser was starting to build a picture that wasn't purely region-specific, but regional climate *plus* heavy outdoor labour. Research by La Isla has shown that sugarcane cutters in the field are 12 times more likely to harm their kidneys than a supervisor in the same field, exposed to the same heat. It's the combination of hard work and heat that is so deadly. Heat-stress induced kidney failure has now been uncovered by La Isla in other occupations, including construction workers and miners, in all central American countries, as well as India, Sri Lanka, Thailand, Saudi Arabia, Egypt, Sudan, Mexico, the United Kingdom, and the United States.[12,13,14] New countries are being added to La Isla's list with each passing year, each hotter than its predecessor.

Glaser visited Nepal and met medical doctor Sweta Koirala in 2019. 'Many Nepalese, due to low employment opportunities at home, went to countries like Qatar and others in the Gulf,' explains Koirala. 'Jason's work led me to explore the impact of

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climate change on these health problems. Initially, as a medical doctor, I was unaware of the historical context of these diseases. Now, I've been studying how climate change has affected the health of the Nepalese, particularly in terms of kidney and cardiovascular diseases.' This has been a double tragedy for the country, as the loss of young male labourers meant 'the transformation of Nepal's fertile agricultural lands into barren fields … When their farms fail to produce sufficient crops or require more effort than they yield in income, they leave Nepal in large numbers.'

For many young men, unluckier even than Surendra Tamang, it is a one-way ticket. Phekan Thakur, 37, for example, left for Qatar to pay for his daughter's wedding and his son's school fees. He probably passed out from the heat and fell to his death in September 2022. The official cause of death on his Qatari death certificate is given, in English, as 'Acute respiratory failure for further investigations'. The documentary film *Trop chaud pour travailler* (Too Hot to Work) by French filmmaker Mikaël Lefrançois describes Pekan's story as 'woefully common in Nepal … In the last ten years, over 3,000 Nepalese workers have died in the Gulf region.' Jayram Kewat died aged 39 in Doha, in 2020, the official cause of his death given as 'Acute respiratory failure natural death'. Every day, some 1,500 Nepali migrant workers leave their country to work overseas, largely to the Gulf and Malaysia. The same airport they fly out from sees the return of two to three dead migrant workers per day in wooden boxes, Lefrançois estimates.[15]

'When working in the heat, they often do overtime – 16 hours instead of the mandatory 8 hours – to earn more money for their ageing parents, wives, and children,' explains Koirala. 'If Nepal had invested more in modern agricultural techniques, combining human labour with technology, perhaps these men wouldn't have to face extreme heat abroad, damaging their bodies to send money back home. It's all interconnected.' This in turn has a wider knock-on effect on

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food availability and nutrition. 'Nepalis used to grow crops like millet, buckwheat, and barley, which were traded with Tibet and China. Now, we import . . . Our agriculture has been replaced by buildings and real estate, leading to a loss in local food production and reliance on imports. We eat rice typically twice a day in Nepal . . . And now the rice is coming from India. What happened? We're not talking about 100 years ago, I'm talking about 15 years. I used to love the taste of rice from Nepal. Now, it's not available.'

And then dengue arrived. When Koirala worked at an ICU in Kathmandu between 2009–2015 she recalls 'only one case' of dengue fever, and the patient most likely contracted it in India. But less than a decade later, it is a common affliction. In 2022, Nepal witnessed the largest ever dengue outbreak in the country's history, with a total of 54,784 dengue cases identified. Kathmandu reported the highest burden of cases (26%).[16] One of the Kathmandu residents infected was Koirala herself. 'It was horrible, really horrible,' she recalls. 'Dengue was far worse than COVID for me. With COVID, I had fever, cough, and cold, and recovered in about five days, still able to move around the house. Dengue, however, was debilitating. I would faint even from the effort of going to the bathroom. I was extremely weak, had no appetite, and felt like I was losing consciousness even while sleeping. It was a terrible experience. Post-dengue, I developed thyroiditis, which significantly affected my thyroid gland, leading to abnormal thyroid hormone levels.' Speaking over a year on, she says, 'I'm still dealing with the aftermath of this thyroiditis.' It's not hard to imagine the economic impact on a small, vulnerable country of a debilitating disease that was once unheard of, now endemic.

This threat is coming to Europe and North America, too. In the absence of climate action, the European Mediterranean (including Greece, Italy, and Spain) is projected by *The Monitor* to be at risk of re-emergence of dengue fever, despite

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having long demonstrated its eradication. Meanwhile much as 100% of the Baltic coastline could become suitable for *Vibrio*, the food-borne bacteria behind gastrointestinal and skin infections that currently affect tens of thousands of people globally each year. If no climate action was taken, more than 1 billion people would be at risk of *Vibrio* transmission.

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Md Nannu Molla, a pedal rickshaw driver in Dhaka, Bangladesh, lies unable to work in the two-room shack he shares with his wife. Now 70, he finds it increasingly difficult to continue his work. The physical demands of rickshaw pulling – pedalling for long hours in bustling city traffic, often in extreme weather conditions – are challenging at any age. Molla explains to Asif Zabed from the NGO Terre des Hommes, in an interview conducted for this book, 'It has been a month and a half that I am not working . . . Here I am lying down as I am sick with cold fever . . . I can't earn my bread. I have no back-up support.' His job in the informal economy comes with no sick leave or healthcare. And even when he is working the income is meagre, making it hard to save for emergencies or healthcare, which in turn worsens his financial and health vulnerabilities.

Md Molla's life bears witness to climatic vulnerability. Born in Manikganj, a village on the banks of the Kaliganga, he saw the river that once provided nourishment and play during his childhood become a destroyer. 'The river took away everything that we had,' Nannu recalls of a series of devastating floods. 'We couldn't see the land that my grandfather had when we were young . . . it was taken away by the river.' Moving to the capital city Dhaka was borne of desperation, not choice. 'I came to Dhaka because of this river erosion, there was no work in our village,' he explains. Moving to the city in his early 20s, he survived first by working on a motorboat and then as a rickshaw driver, a job he continues to this day. This

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shift from rural life to urban survival epitomises climate displacement. He would still move back to the village in an instant if he could, he says. The shadow of his past and the ongoing challenges of the present weigh heavily. His father's death remains a particularly tough memory: 'I could not bury my father. I heard about it after the sunset, and travelling [to the village] after sunset is very difficult and it requires money. I did not have that at that moment, so I could not go.'

He looks down at his body as he lies in his sick bed. 'Today is the 20th of the month yet I couldn't pay the room rent. I don't have any money, not even a coin. We didn't even have our breakfast in the morning, for we had no money ... there are only a few betel leaves and betel nut. I have it all the time.'[a] Such stories played out on a national scale begin to look like Figure 6.3.

In Vietnam, informal waste workers or '*ve chai*', predominantly women, are a common sight in urban areas, working around the clock to find discarded items to sell for recycling. UNDP research describes the typical *ve chai* as 'a middle-aged woman on a bicycle going through neighbourhoods to pick up waste ... earning between 100,000–200,000 VND/day ($4.25–$8.50)'.[17] Their work has always been hard. But Nguyen Thi Nhật Anh at local NGO the Center for Social Research and Development (CSRD), who have worked to improve the standards and rights for the *ve chai*, explains that their work is made far harder by climate change. 'They face lots of challenges here,' says Nguyen. 'Because the weather in Huế is increasingly extreme ... they face a lot of health issues, physical health and even mental health.' Huế has only two seasons, the dry season and rainy season, explains Nguyen. 'The rainy season often lasts for three months. Every day for three months ... the waste pickers walk all day picking litter, their feet are always in the water and so they face problems with their feet. And

[a] The International Labour Organization (ILO) calculates that the impact of rising heat on exposed workers in Bangladesh reduces its annual economic output potential by approximately 4% of GDP.

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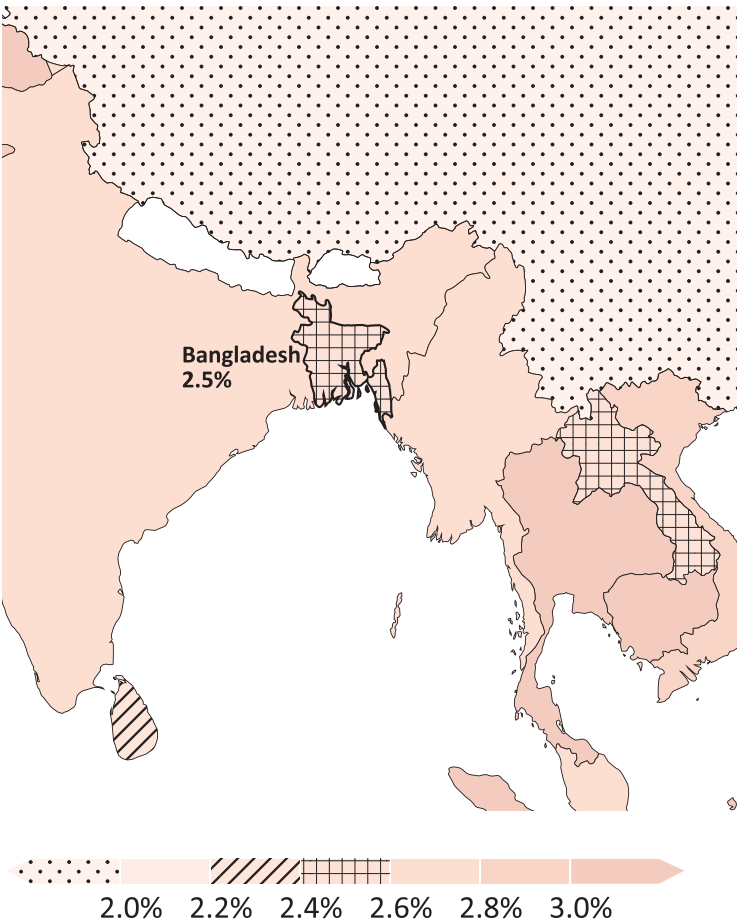

Figure 6.3 Loss of labour productivity, Bangladesh. Absolute percentage change between 2021 and 2040, 'below 2 °C' path, impacts at 1.5 °C. (*CVM3* Health Data Explorer. 2022)[18]

there is disease which comes from the water too. But the dry season offers no respite, as heat and humidity levels soar with climate change. 'In the dry season it is so hot. And the smell from waste is terrible . . . many women carry the waste on their back, and they face many problems with their back because of

this. They also face terrible headaches because of the heat, and a bad stomach, because they can't afford good food.' In the period 1971–2010, the rate of warming in Vietnam is estimated at 0.26 °C per decade, almost twice the rate of global warming over the same period. The frequency of 'hot' days and nights has also increased significantly since 1960.[19]

In Sri Lanka, the government has plans to protect 100% of workers from extreme heat stress by 2040. Sandith Samarasinghe, a former Member of the Parliament of Sri Lanka and now Regional Director for Pacific and Indian Ocean of the CVF-V20 Secretariat, was responsible for presenting Sri Lanka's first voluntary National Review at the UN in 2018. CVF-V20 Secretariat Secretary-General Mohamed Nasheed himself requested Samarasinghe to support the CVF agenda, and Samarasinghe subsequently became instrumental in driving Sri Lanka's Climate Prosperity Plan. 'In Sri Lanka there were typically three seasons, including rainy and dry seasons. Now it's hard to depend on these patterns,' explains Samarasinghe. The dry seasons have become ever hotter. In the first eight decades of the twentieth century, Sri Lanka's average mean surface air temperature hovered just above 26 °C. However, in 1980 it breached 27 °C for the first time, and has been trending upwards ever since. The year 2020 saw an average temperature of 27.64 °C.[20] Protection from the heat is increasingly 'important in our part of the world,' explains Samarasinghe. 'The labour force works without many of the protections found in places like Australia or Europe, against factors such as heat or cold. Initially, we plan to focus on farmers, creating a model to enhance their protection. Subsequently, we will expand this to other labour forces, collaborating with the health ministry to develop initiatives that safeguard workers'. The CVF, acknowledging the nexus between health and climate change, is addressing issues like malaria and other health concerns in the CPPs. The CPP includes projects to prevent the proliferation of mosquitoes by deploying mosquito traps across the capital Colombo and

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other community hotspots, to 'reduce mosquito population and prevent the spread of dengue and other vector-borne diseases which are bound to increase with raising temperatures'.[21] The programme investment level is costed at $2 million over seven years, 2023–2030. 'We are actively working on these areas and seeking funding for them,' says Samarasinghe. 'Despite our challenges, we will ensure that free healthcare is available to all.'

Health is intimately connected with food, nutrition, and the resilience of domestic agriculture. In Sri Lanka, says Samarasinghe, 'farmers previously had larger yields, but now, due to climate change, the harvests have significantly decreased . . . Crops have been severely impacted by extreme weather conditions like droughts and torrential rains, leading to flooding. In the past, farmers relied on predictable seasonal patterns for planting and harvesting, guided by time-tested methodologies. Historically, Sri Lanka was a major rice producer for Asia, exporting large quantities . . . However, current climatic challenges have significantly reduced the farmers' ability to produce crops at those historical levels.' Other major rice-exporting countries in Asia, such as Vietnam and Thailand, have faced prolonged drought, leading to higher prices for imported rice, too.

Both *The Monitor* and the Lancet Countdown report people increasingly unable to access the food they need. 'We perform econometric analysis to correlate these experiences with the frequency of extreme weather events,' explains Marina Romanello, lead Health Editor for *The Monitor* and Executive Director of the Lancet Countdown, 'and this analysis allows us to attribute changes in food insecurity to sudden exposure to these events.' The Lancet Countdown calculates that 127 million more people experienced food insecurity due to the increased frequency of heatwaves and droughts from 1981 to 2010. The obvious link is crop failure and reduction in crop productivity due to the yoyoing

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between flood and drought. The 'carbon dioxide harvest effect' also makes crops carbon-rich but nutrient-depleted, with experiments showing that crops grown under the predicted elevated atmospheric CO_2 concentration have an increase in yield, but a decrease in micronutrients (zinc, iron) and proteins.[22] The fast maturation due to higher temperatures causes crop height to be smaller. Additionally, environmental changes affect the flowering and pollination seasons of some fruits and vegetables, affecting harvest and crop maturation. 'These changes are destabilising food productivity systems,' confirms Romanello. 'The most affected are the poor farmers, subsistence farmers, and those without access to advanced agricultural technology or inputs for local production.'

For Michael Larbi Aburam, a subsistence farmer from a small village near Asikuma, eastern Ghana, it is a familiar story. 'We knew the seasons, the patterns, the times when we plant. But with climate change, the patterns have changed,' he says. 'Now, if you don't calculate your planting time properly, you might lose hope. Because when it's supposed to rain, it doesn't; the timing has changed.' Agriculture remains the largest sector of the Ghanaian economy, employing 45% of the country's workforce. Rural communities depend on agriculture for income, employment and food security, which is why the agricultural sector is also an important factor in poverty reduction. Maize cultivation, in particular, plays a critical role. But increasingly extreme weather due to climate change is damaging the crop. 'We end up losing a lot of maize,' says Aburam. 'This circumstance makes many things unpredictable, but still, we don't give up. We continue to plan and hope things will get better.'

However, Kamasa Dorothy Azimi, a Ghanaian agriculturist, who founded the Centre for Women and Food Security, suggests that things are unlikely to get better. 'By July and August, we are harvesting . . .. But climate change has altered this schedule. Now, you don't know when it's going to rain,'

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she says. 'Even during the farming season, rainfall is unpredictable. It might rain heavily one day, prompting you to cultivate, only for the rains to abruptly stop. As it stands, everything is disrupted. We don't understand the rainfall pattern anymore, it feels like we're always guessing.' Azimi recalls a community-supported vegetable-growing project she ran in 2021. Run by local villagers with the Chief taking a leadership role, it was, in many respects, a textbook case of building local agricultural resilience through community engagement. But climate change doesn't respect textbooks. One heavy rain came and swept all the crops away. 'Imagine losing five acres of cabbage, which required a lot of money and effort to maintain? The labour, all those investments, washed away. That is the devastating effect of flooding.' Maize harvests, too, have 'been terrible,' says Azimi. In turn, this also affects local protein sources. 'A lot of poultry farms have closed down because their major source of feed, maize, is failing,' explains Azimi. 'The addition of soya and other crops doesn't compensate for this.'

On the Caribbean Island of Saint Lucia, Jevanic Henry says that agriculture is facing similar challenges due to rising temperatures and changing rainfall patterns. 'It's not only unpredictable but also requires greater investment in irrigation systems,' he explains. 'These interconnections between water scarcity and intense heat are affecting food security. We're now forced to import more food due to climate change, even as we try to adapt.' Jameson Alphonse, for example, owns an organic farm in Bois D'Inde, a rural community in the island's hilly interior. He says that recent heavy rains caused flash flooding, destroying roads and crops. 'These drastic changes in the climate are not something we're used to,' complains Alphonse. 'Most of our farms are located in areas close to rivers, making them particularly vulnerable to flash flooding and heavy rains. [But] we also experience extended dry periods. We've lost the [climatic] balance we used to have.' Everyone on the island now faces frequent interruptions in

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water supply. And farmers, in a typically rain-fed agricultural system, are struggling to adapt in time.

Neron Thomas writes in *At a Glance – Addressing Climate Vulnerability in the Caribbean*: 'To put things into perspective, the estimated regional food import bill stood at $5 billion in 2018 compared to $2 billion in 2000. The United States of America continues to be the primary beneficiary [with] more than 47% of regional imports sourced from there ... This is despite [Caribbean Islands] having adequate arable lands to produce sufficient foods to meet domestic demands.' This has led to a scenario where 'for instance, in Haiti, undernourishment levels are estimated as high as 77%, while it is closer to 15% among other [Caribbean] States. This is due in part to states having to spend increasing amounts of revenues generated by exports to import foods, with the most populous nations (Haiti, Jamaica and Trinidad and Tobago) being some of the biggest net importers. Such dependencies foster vulnerabilities and food insecurity ... As climate change is expected to contribute to regional food insecurity by reducing food production and agricultural exports, higher domestic food prices will threaten the ability of citizens to afford a nutritious diet.'[23] Guyana is the only net food-exporter in the region, but still imports about 40% of its food, compared with Barbados and Grenada with food-import dependency ratios in excess of 80%.[24] Of five countries covered in a recent Caribbean Policy Development Centre (CPDC) report, all five countries had excessive availability of fats and sugars, while protein was deficient for Grenada and Jamaica (see GRE and JAM in Figure 6.4).

When Grenada was devastated by Hurricane Ivan in 2004, and Hurricane Emily just 10 months later in 2005, the island's banana industry was all but annihilated, losing its export market as well as local supply. Cocoa plantations weren't spared either, suffering extensive crop destruction as well as damage to essential infrastructure for propagation and storage. The impact on the nutmeg industry was also severe, with

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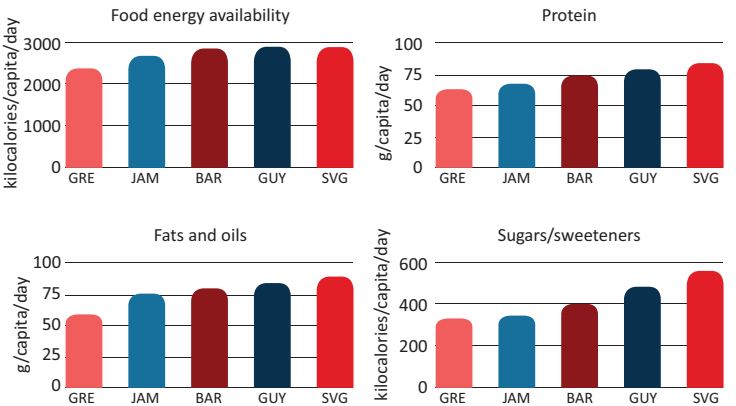

GRE = Grenada, JAM = Jamaica, BAR = Barbados, GUY = Guyana, SVG = Saint Vincent and the Grenadines
Notes: g = grams, Kcal = Kilocalories

Figure 6.4 Food energy in selected Caribbean countries, 2010–2020 period average. (Caribbean Policy Development Center. 2023)[25]

the hurricanes uprooting trees, breaking branches, and completely stripping many trees of their leaves; nutmeg trees require 7–10 years to bear their first fruit and more than 20 years to fully mature to achieve peak production, so there was no way for this industry to quickly 'bounce back'. The total rebuild costs amounted to 239% of GDP.[26] And as with Dominica, the long-term damage carried an even heavier toll. 'In Grenada, it took a long time to rebuild their spice industry due to the loss of forest and vegetation,' says Geneva Oliverie, Deputy Director for International Finance and Trade at the CVF-V20 Secretariat, who formerly worked at the Caribbean Policy Development Centre (CPDC). According to the V20's 'Climate Vulnerable Economies Loss Report', between 2000 to 2019, 55 V20 Economies lost 20% of their wealth (amounting to $525 billion) because of climate change: 'Many Caribbean countries are familiar with such statistics,'[27] says Oliverie. 'The talk about loss and damage often overlooks the slow recovery process. We need the spotlight to turn to countries like ours.'

The urban poor are the hardest hit by the heat and health impacts of climate change. However, recorded figures are likely to be underestimated. The UN Office for Disaster Risk Reduction (UNDRR) finds that 'the problem of missing public health data due to heatwaves is particularly acute and represents a barrier to estimating population-wide impacts of extreme heat.' In particular, there is a 'regional bias about reported heatwaves', including a reporting bias reflected by the fact that Europe has the 'lion share of the total number of heatwaves recorded'.

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Nisreen Elsaim has been a significant figure in youth climate advocacy since 2012. A member of the UN Youth Advisory Group on Climate Change and president of the Sudan Youth for Climate Change, Elsaim informs us that 'Sudan is one of the very vulnerable countries to climate change in terms of infrastructure, in terms of finance, and in terms of food: 70% of today's population depend on agriculture and pastoralism. And of course, these two things are very climate sensitive – they get impacted a lot with climate change. If we have too much water, too much rain, then it floods.' In September 2020, Sudan suffered devastating floods which affected 17 of its 18 states following extraordinary rainfall that raised the Blue Nile to its highest level in a century. The disaster significantly affected food production, flooding nearly one-third of the country's cultivated land. Approximately 2.2 million hectares of cropland were submerged, leading to the loss of 108,000 livestock and 1.1 million tonnes of grain.[28] The floods also severely damaged key commercial crops like bananas and mangos, hitting both the export industry and domestic food availability.

'We've had devastating floods before, but this one was the biggest,' explains Elsaim. 'It was the biggest flood in 100 years. If there is too little water, like what happened this year, for example, then it's a drought. And that leads to famine, too.'

https://doi.org/10.1017/9781009605960.007

The civil war in Sudan is another humanitarian disaster. But even regions with 'no ongoing conflict see huge food insecurity because the rainy season failed,' she says. 'And this, of course, impacts not only the food security of the country itself, but also the general economy because 35% of our GDP is agriculture. Meanwhile desertification is very fast swallowing up all of the fertile lands because of the heatwaves – we have huge, heavy heatwaves now. In the summer it reached 50–51 °C. As we are speaking right now, I think it's 48 °C. And farmers are complaining not only because the hot weather can destroy the good elements in the soil, but also because a lot of crops require cold weather. They only grow in winter. And if the winter didn't come, like is the case now, then they cannot grow.'

The civil war itself, suggests Elsaim, is inextricably linked to these issues. 'Climate change in Sudan leads to conflicts,' she argues. 'A lot of people are trying to avoid the linkages between climate change and conflict, or peace and security. But I've been witnessing this, I've been seeing how climate change can actually cause conflicts over [dwindling] natural resources . . . or indirect conflicts because of migration.' Now, she says, her country is suffering from 'both climate change and conflict, and it's even harder to make climate finance reach conflict-affected areas.'

Sudan's situation may seem extreme, but it is also a warning. A study in *Nature Climate Change* finds that over a third (37%) of all heat-related deaths can already be attributed to climate change, with increased mortality evident on every continent.[29] 'That's an enormous amount,' comments Marina Romanello. Her team at the Lancet Countdown ran a 'counter-factual' model of heat mortality without climate change. 'We saw that 2023 had an 85% increase in heat-related mortality since the 1990s for people who are 65 years of age, and more than half of that was due to the change in temperature.' Or, put another way, 'that was more than twice what we would have expected if temperatures hadn't changed. So, it

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does show that climate change is here and now, it's not a problem of the future.' This includes the increasing spread of infectious diseases such as dengue and malaria, as locations previously unsuitable for transmission become warmer. 'We also have [an extended spread] in chikungunya, Zika, West Nile virus, and similarly an increased environmental suitability for tick-borne encephalitis and tick-borne diseases,' says Romanello. 'There's a whole lot of vector-, water-, air-, and food-borne diseases that will become more suitable for transmission as the planet heats.' In Saint Lucia, for example, confirms Jevanic Henry, 'we're seeing an increase in vector-borne diseases, especially with dengue fever and chikungunya emerging.'

Generally, the pathogens that most affect humans are pathogens that thrive in warmer, humid conditions. What have traditionally been known as 'neglected tropical diseases' are breaking out of their tropical boundaries. 'We're finding suitability for transmission in places like Europe and North America,' states Romanello. 'And that is very dangerous, not only because they are deadly diseases but also because the health systems don't have this on their radar'. Speaking from her office in London, she says, 'We're not used to having a case of dengue come into emergency rooms. We're not used to diagnosing dengue unless that person has travelled to an endemic area. We're not used to diagnosing malaria.' Most health systems, she says, 'are funded on stability, on certainty, on having very good health information to tailor their activities. But the situation is changing so rapidly it's destabilising the health profile of populations. We have new diseases, we have new hazards, we have new risks, and our health systems have to learn how to act.' The ironic silver lining could be if developed countries finally wake up to the need for research and development funding for 'neglected tropical diseases' because of this.

Another neglected climate health risk is mental health. 'We focus a lot on physical health because it's much easier

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to diagnose and monitor,' says Romanello. 'But the flip side is the enormous impacts on mental health that every single one of the hazards of climate change brings. There's a whole spectrum of mental health impacts that we haven't begun to understand and are struggling to quantify and monitor.'[b] She warns that the next epidemic 'could be a mental health epidemic from the health impacts of climate change ... The mental health burden of these events is huge.' This includes migration and relocation: 'People who need to move to find safer places because the threats they're exposed to have grown too much. How that relocation happens has an enormous implication on their health' – as we saw in this chapter with Md Nannu Molla, the rickshaw driver in Dhaka, Bangladesh, ill in his bed and far away from a rural village he yearns to return to.

Within development circles, the mental health impacts of climate change are often hidden behind the euphemistic term 'non-economic loss and damage'. Christon Herbert at the CPDC talks about a 'non-economic loss and damage' project he's been working on: 'We're looking at providing psychosocial support, helping people through sessions on mitigating the impacts of climate disasters, whether at home, office, or community. It's about having a disaster preparedness plan, knowing your local shelter, safe spaces in an earthquake, and stipulating specific measures. After an event, there should be a plan to provide psychosocial support, like counselling or awareness hotlines for those affected. These aspects are not often discussed but are crucial.' In Trinidad's southern region, for example, a landslide displaced people who had lived there for generations. 'Displacement from land you know impacts you significantly,' says Geneva Oliverie. 'In the Caribbean,

[b] Romanello and her team have been instrumental in trying to change this. The Lancet Countdown 2023, for the first time, included the following data: 'extreme weather in 2022 was associated with a record 0.53 percentage point reduction in online positive sentiment expression during heatwaves and a 0.31 percentage point reduction in positive sentiment expression during extreme precipitation days'.

https://doi.org/10.1017/9781009605960.007

families live for generations in the same space, and when you're displaced, it's traumatic.'

When asked about such non-economic losses, Animesh Kumar, head of UNDRR in Bonn, responds, 'I think a better term for non-economic losses is "invaluable losses", because we cannot recover them. Hence, they are more important than something which we can compensate or pay for with dollars.' That said, such invaluable losses can be defined as referring to 'individuals, society, and environment,' suggests Kumar. 'Where it takes real shape is in terms of lost culture, language, cultural heritage, displacement-related loss, and so on . . . what exactly does it mean in terms of addressing such non-economic losses, which are so intangible? It needs more unpacking.'

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Climate health adaptation plans have been proven to work. Ghana's CPP, published at the time of writing this book, states that 'The first goal of Ghana's Climate Prosperity Plan is to secure the nation from climate threats. This plan aims to achieve this through concerted efforts in the energy, health, water, and built environment, together with making full use of financial forms of protection and maximising nature-based solutions.' In particular, it stresses the need to 'Promote population health by enhancing climate-specific health responses and capacities, and by building resilience and ensuring dietary reliance on sustainable foods.' These aren't mere words, however, but are backed up by specific time-bound targets – as outlined in Table 6.1.

In India too, heat action plans (HAPs) in various cities with urban heat island issues (i.e., paved surfaces that intensify the heat) have introduced early warning systems ranging from mild to severe; public awareness campaigns about risks and protective measures; and infrastructure improvements including enhanced water distribution, public gardens and shaded areas. Since the successful implementation of the first HAP in

https://doi.org/10.1017/9781009605960.007

Table 6.1 Ghana's Climate Prosperity Plan (CPP): Health Targets (created by author, data taken from Ghana Climate Prosperity Plan)[30]

Objective: Resilient health and water access	Timeframe
Training programmes for medical personnel on climate-specific health responses are piloted in 15–20 medical facilities.	2025
50% of all medical personnel have received training on climate-specific health responses.	2025
Programme to increase shaded areas and reduce heat island effect through the promotion of biodiversity corridors and touch points is implemented in Accra.	2025
Education campaign on rehydration regimes and heat stress prevention is piloted in Accra.	2025
400 communities achieving open-defecation-free (ODF) status.	2025
Medical centres, ambulance and paramedic services are expanded in at-risk rural areas to improve population access to basic health services.	2025
Programme to increase shaded areas and reduce heat island effect through the promotion of biodiversity corridors and touch points is implemented in all major cities.	2030
Education campaigns on rehydration regimes and heat stress prevention are deployed across 50% of urban and rural areas.	2030
95% of solid waste properly disposed of in the five major towns/cities (Accra, Tema, Takoradi, Tamale, Kumasi).	2030
1,400 communities (Accra, Tema, Takoradi, Tamale, Kumasi) achieving ODF status.	2030
Medical centres, ambulance, and paramedic services are expanded to ensure that 100% of the population has access to basic health services.	2030
90–100% of all medical personnel have received training on climate-specific health responses.	2035

https://doi.org/10.1017/9781009605960.007

Table 6.1 (*cont.*)

Objective: Resilient health and water access	Timeframe
Programme to increase shaded areas and reduce heat island effect through the promotion of biodiversity corridors and touch points is expanded to regional cities with more than 25,000 people.	2035
Education campaigns on rehydration regimes and heat stress prevention are deployed across 90–100% of urban and rural areas.	2035
100% of the country's grid infrastructure has been modernised, increasing efficiency, disaster resilience, and renewable energy supply.	2035

Ahmedabad in 2013, the programme has expanded to 23 of India's most heat-vulnerable states and is credited with saving thousands of lives.[31] The Climate Shelter project in the city of Barcelona, Spain, turned schools, parks, public facilities, and urban equipment into climate shelters. In addition, its Tree Master plan and Barcelona Nature Plan aim to increase urban green space by more than 160 hectares between 2020 and 2030, equal to an extra square metre of greenery for every resident. An EU project, Climate Adapt, finds that such urban-greening interventions are 'not very costly' and 'definitely alleviate people from the increasing health impacts of heat-waves due to climate change.'[32]

Yet without such intervention, many cities are heading in the opposite, further-asphalted direction. From 2015 to 2022, there was a notable decline within low-income urban areas with moderate or higher levels of greenness in low Human Development Index countries, falling from 18% to 13%.[33] 'Urban green spaces are fundamental to reduce our exposure to extreme temperatures,' says Romanello. 'They also serve as spaces for recreation and for social interaction. There are

https://doi.org/10.1017/9781009605960.007

strong epidemiological studies showing that exposure to urban green spaces reduces overall mortality and improves mental health outcomes.' A simple example of this is how gentrification comes with increasing urban green spaces in cities, suggests Romanello. 'Generally, greener parts of the city are sought after, with wealthier populations living there. It's almost seen as a luxury, but it should not be. We should have green space in absolutely every part of the city. We should be wary of interventions that increase green spaces away from cities, not within them, and particularly those that do not benefit populations most exposed to the harms of heat exposure. That's why we say we have to put health at the centre of all these conversations.' Compared with the approach to date, which has been to cram evermore people into concrete-covered parts of cities, causing enormous health problems, a health-centred approach 'would mean cities that are greener with more equitable access to green space for all.'

Increased domestic production of climate-resilient crops, and nature-friendly regenerative farming techniques, also need to be considered priority health interventions and adaptation measures. In a 2023 article by Tania Strauss and Pooja Chhabria for the World Economic Forum, the authors argue that climate-smart and regenerative food systems can 'put farmers at the centre, improve crop yields and turn farmland and pastures into carbon sinks, reverse forest loss, optimize the use of nitrogen-based fertilizers and rethink global and local supply chains to be more sustainable, reducing waste.' Such regenerative food systems have the potential to contribute up to 37% of climate mitigation, yet less than 2% of climate finance is directed to agri-food solutions. In the EU, greenhouse gas emissions could be lowered immediately by 6% a year if just one-fifth of EU farmers were supported to transition to net zero, boosting soil health and boosting incomes by €2–9 billion.[34]

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One solution proposed in Sri Lanka's CPP is 'a project called 'solar-powered irrigation' in Sri Lanka,' says Samarasinghe. 'This initiative involves working with 15,000 farmers. Each farmer will cultivate crops on one acre of land, thus totalling 15,000 acres. These crops are intended for a buyer, potentially in the Middle East. The project is well funded, and there is a market ready for the produce. The farmers are organised into a farmer organisation, ensuring direct economic benefits for them. The buyer also benefits, as they receive the crops they need and pay a fair price for them. The potential investor will provide each farmer with the necessary technology and funds . . . This is the mechanism we have established, it's one of our flagship projects.' It will, he says, achieve a triple-win of boosting national food security, green jobs, and export income. A similar example in Sub-Saharan Africa, the Program for Integrated Development and Adaptation to Climate Change in the Zambezi Basin, will lead to 400,000 farmers adopting climate-smart agriculture techniques and a 30% increase in adoption of digital climate information. The Ethiopia Food Security Resilience Project is also designed to support 2.4 million farmers in adopting resilience-enhancing technologies and practices, leading to a 15% reduction in food-insecure people in targeted areas, and a 20% increase in yields of targeted crops.

Yet too often, health and agriculture are still seen as separate issues – and separate government Ministries. Romanello and her colleagues are often confronted with this false distinction: 'It's almost amusing. Once, when speaking with a Minister of Health – I won't say from which country – we raised the issue of crop failure and food systems. They said, "That's the agriculture department, not health." But what about the crisis of malnutrition? You can't say it's not health. It's artificially separated. Any intervention, especially in food systems – a fundamental determinant of health – affects health. If food systems fail, the foundations of health and wellbeing start to crumble.' In fact, try to think of any government ministry that *isn't* connected with

health – from transport to finance to the arts, our health and wellbeing is, after all, the point of life, and the point of politics.

In Kibale, Uganda, Evelyne Ninsiima, founder of the small domestic charity Green Environment Promotion, has begun personally sourcing climate-resilient seeds for local farmers. 'Rural women often buy GMO maize seed, which doesn't reproduce, requiring them to buy new seeds each season,' she explains. 'I've initiated a programme with more resistant seeds, and that has a multiplier effect. This helps ensure food security and reduces reliance on [market-based] resources. There's a connection between food security and environmental conservation.' After a long dry season in 2023 led to significant crop losses, 'farmers who planted Irish potatoes, which require a lot of rain, lost their crops when it didn't rain,' says Ninsiima. 'We're working to identify which crop varieties do well in different regions to ensure productivity . . . Heavy rains also bring diseases and wash away crops like beans. Climate change is having a negative impact, especially in rural communities.' Older people in the community note a big change, she says: 'Years ago, they had more resistant crops and consistent food supply, which is not the case now. Soil erosion and landslides due to deforestation have worsened the situation.' Funders who come in with high-tech solutions such as drip-irrigation soon find they are 'not feasible for everyone. In my area and country, combining indigenous knowledge and high-tech methods seems best.'

A recent World Bank report on climate adaptation and resilience emphasizes the need to adapt agricultural practices to the impact of climate change. Its analysis suggests that 'investing $1.8 trillion globally in five target areas from 2020 to 2030 could produce $7.1 trillion in total benefits. The five target areas are early warning systems, climate-resilient infrastructure, improved dryland agriculture crop production, global mangrove protection, and projects to make water resources more resilient.'[35]

https://doi.org/10.1017/9781009605960.007

Amir Sapkota of the University of Maryland talks of his work to develop an early warning system in Nepal in *The Flow of Change*:[36]

> *[it] gives warnings one to three months ahead of time to help communities adapt to the threats of climate change. We take the historical disease data and we combine them with precipitation data, temperature data, and other environmental variables … Then we take the climate forecast and then we use artificial intelligence to figure out what the burden of disease is going to be like 30 days from now, 60 days, 90 days, and compare those predicted estimate of disease to the historical norm. Then we create a colour-coded map [where] red represents the area that we expect the risk to be high and green represents the area that we expect it to be lower than normal.*

Crucially, this looks out into the medium term, when there is still time to prepare and mobilize: 'It's really hard to mobilize public health resources within a short period of time,' he says. 'But if we have months, that allows ample time for reallocation of resources.'

Consumer choices have a part to play, too. In the context of food and agriculture, global agricultural emissions increased by 22% from 2000 to 2020, largely due to the global uptake of red meat and dairy products. Dietary shifts towards healthier, plant-based diets could prevent up to 12.2 million deaths annually. However, the transition towards these diets requires equitable and inclusive access to agricultural technology, promoting sustainable management practices, and protecting smallholder farmers and indigenous food systems. As Bogolo Kenewendo, UN Climate Change High-Level Champions' Special Advisor, Africa Director, writes, 'African farmers already use these practices across the continent in soil systems, cropping systems, and integrated systems. Moving forward, focus should be placed on recognizing the existence of these practices where they are in place, and further supporting their adoption and scaling.' Kenewendo gives examples such as incorporating crop residue

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as a mulch, an approach used by approximately 30% of South African farmers; and Fonio millet, perhaps Africa's oldest cultivated cereal crop, grown throughout Western Africa, including Senegal, Mali, Burkina Faso, Nigeria, and Chad: 'This extremely fast-growing grain is highly resistant to drought conditions. It is also more nutrient-dense than alternative grains like wheat.'[37]

In Tonga too, the MORDI (Mainstreaming of Rural Development Innovation) Tonga Trust works to secure for farmers the benefits of multi-cropping as opposed to monocropping. One innovation has seen the use of Vetiver grass, with root systems that go as deep as 2–5 metres underground, preventing run-off of vital topsoil and nutrients.[38] Other projects include the Fakaola 'Eku Kalofiama programme, designed to engage male at-risk youths in exploring agricultural and rural development opportunities; Homestead Gardens for women's groups in Vava'u, empowering women through gardening; and efforts to revive traditional fishing methods among the Ha'apai people by teaching them to build outrigger canoes. Ilaisaane Lieti Lolo at the Tonga Finance Ministry explains, 'In Tonga, food security is being threatened by shifts in seasonal patterns impacting growth of crops and reliant food staples for local Tongan communities. Governments are currently implementing such projects to address these growing issues. Usually, these funding are small-scaled such as the distribution of seedlings, chickens and other small community projects implemented by MORDI.' The impacts of climate change on health are best targeted, she says, through 'promoting circular economy projects, supporting local producers, and strengthening rural development.'[39]

All of which chimes with one of Romanello's key points: 'the most fundamental, most precious aspects to human beings is our mental and physical health. So, we want to put that at the centre of the conversation. The way we deliver climate action offers a huge opportunity for health.' The second Lancet Commission on climate change on health headlined with the message that 'climate change could be the biggest global

https://doi.org/10.1017/9781009605960.007

health opportunity of the twenty-first century,' she says, 'because we could save millions of lives [through] better quality food, healthier diets, more liveable cities, that improves our mental health, our physical health, more exposure to green space, stronger health systems, stronger health supportive systems. And that means an absolute transformation of public health for the better.'

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Back in Nicaragua, Jason Glaser still believes that heat stress 'is a manageable risk. However, current guidelines for managing core temperatures are inadequate, they're too permissive. We need to focus more on shaded rest, cooling, hydration, and sanitation.' With the impact of climate change becoming ever more apparent, 'Climate change not only brings personal tragedy and decreased productivity but also burdens public health systems. Countries are struggling to provide treatments like dialysis, it's really economically debilitating. The solution has got to lie in prevention ... That's the way forward here.'

His research collaborator in Nepal, medical doctor Sweta Koirala, believes that the tragedy of Nepalese workers dying from kidney failure developed overseas as migrant workers is easily solvable: toilets, shade, and water facilities on every level of a building site. 'It's a simple solution,' she says. 'It's not rocket science; it's about providing basic necessities like shade, water, and restroom facilities. These aren't costly demands. I believe it's entirely possible if we all have the willingness to make these changes.' This, then, as much as sea walls and water reservoirs, is what climate adaptation must entail. Yet it is something that many countries, including those traditionally not considered vulnerable, have yet to start taking seriously. 'We can learn from adaptations in the Global South,' Glaser urges. 'Bringing it home to Europe, bringing it home to the US [means] turning that development story on its head and saying: what we've done [in vulnerable

https://doi.org/10.1017/9781009605960.007

countries] is relevant to you, and we're way ahead of you. So listen up and we can help, it's in your interest!'

Koirala remains in touch with Surendra Tamang, the kidney dialysis patient who became ill when working in Qatar. Together with La Isla Network and Johns Hopkins University, he and Koirala attended a meeting at the Nepali Department of Labour in December 2023. They jointly presented research findings showing that one-third of current patients undergoing dialysis at the National Kidney Center are migrant workers under the age of 40; that 70% of individuals with kidney failure reported severe daily heat exposure and lack of adequate hydration and rest; and that one in three of these individuals suffered extreme workloads without adequate hydration and breaks. They called for each embassy to assign a health attaché, and work with overseas employers to implement adequate breaks, hydration, and education on early signs of heat stress.

Following up later over email, Koirala says that 'The meeting at Ministry of Labour went better than expected . . . They seemed to be moved by the data we showed. I even saw the [Labour] Secretary taking pictures from his mobile of Surendra, and Surendra briefed his experience while working in Qatar and the consequences of kidney failure and being on dialysis thrice a week now. There were representatives from medical associations, manpower associations etc. Around 40 people were present and all seemed to be interested in this issue.' In his concluding remarks, the Secretary 'said he will give orders concerning agencies/institutes for amendments in their policy.' Meanwhile Surendra remains 'full of life and hope, he stays positive,' Koirala says. 'His TikTok videos show that he likes to act and sing. Whenever I have met him, I have found him cheerful and not at all bitter. He is proud of having worked at GCC [Gulf Cooperation Council] countries,' she adds. 'He often looks on Google Images at the buildings he helped build.'

https://doi.org/10.1017/9781009605960.007