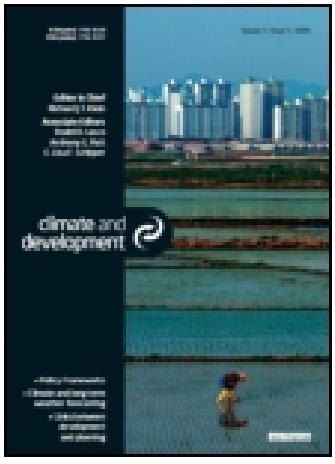

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CASE STUDY

The challenge of climate change adaptation in Guyana

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Climate change threatens to bring enormous infrastructural challenges for low-lying regions, and the capacity for adaptation is highly uneven on a global scale. Guyana, a developing country in South America, is highly susceptible to sea-level rise and flooding, because much of the population lives at or below sea level and depends upon old and decaying coastal infrastructure. This article examines the efforts of the Guyanese state to prioritize climate change adaptation, drawing from budgetary and documentary analyses and in-depth interviews with key informants in pertinent government ministries and non-governmental organizations. The Guyana government clearly recognizes the country's acute vulnerability to climate change – which has been accentuated by multiple recent flood events – and focuses on the need for vast infrastructural rehabilitation and enhancement as the main adaptation priority. However, while Guyana has emerged as a champion of climate change mitigation through averted deforestation, government investment in adaptation remains relatively small, and although a limited budget is one of the reasons for this, a number of other impediments complicate the issue. These include limited technical skills, low public awareness and the longer time-scale of threats relative to other national priorities. Ultimately, this case highlights some of the formidable challenges which poor countries face in prioritizing investments in adaptation.

Keywords: climate change adaptation; coastal infrastructure; Guyana; vulnerability

1. Introduction: uneven vulnerability to climate change

It is likely that global warming will increase the impact and risk from extreme weather events, posing myriad threats to lives, livelihoods, agricultural production, water availability, health and the built environment (IPCC, 2007, 2011). While no country is entirely immune from the risks of climate change, the degree of anticipated vulnerability varies considerably, with many of the world's poorest countries – which have the lowest per capita greenhouse gas (GHG) emissions – facing particularly acute threats from projected physical changes such as intensified heat waves, aridity and drought, rising sea levels, and coastal flooding. This vulnerability is magnified by disparities in financial resources and institutional capacity for assessment, preparation and response (Schipper & Pelling, 2006, IPCC, 2007, 2011; UNFCCC, 2007; UNDP, 2007),[1] and by inequalities *within* countries, as levels of poverty frequently affect the scope of weather-related disasters (Wisner, Blaikie, Cannon, & Davis, 2004; Kelman, 2008; Mutter, 2008).

There is a growing recognition that both climate change mitigation and adaptation overarch global inequality and prospects for human development, and failure to act on both is a 'prescription for a widening gap between the world's haves and have-nots' (Schipper & Pelling, 2006; UNDP, 2007, p. 167). One plain indicator of the uneven responsibility for mitigating climate change is that only 15 per cent of the world's total population account for almost half of all CO_2 emissions, a disparity that grows further when historical emissions are considered (UNDP, 2007). At the same time, the world is already committed to a certain level of climate change, and major investments in adaptation are needed in order to respond to the impacts of climate change.

The threats posed by sea-level rise highlight the uneven economic and technical capacities for adaptation on a global scale. Industrialized countries have tremendous capacity for large-scale, technologically advanced infrastructure, research, maintenance and operation, with the Netherlands providing a good example of an extremely sophisticated sea defence system (Bouwer & Vellinga, 2007). Meanwhile, sea-level rise is already threatening to destroy some small islands and inundate many low-lying coastal areas in the Global South, and the IPCC (2007, p. 339) warns that 'coastal flooding could grow tenfold or more by the 2080s, to affect more than 100 million people per year', much of this in densely populated mega-delta regions in Asia and Africa.

Because both the contribution to climate change and adaptive capacity of rich and poor countries are so very different, there is a convincing argument that major

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bilateral and multilateral development assistance for adaptation planning and investment is needed and justified. However, while this has been acknowledged in theory in a range of multilateral fora, in practice firm funding promises have paled before the scope of recognized needs (UNFCCC, 2007; Klein, 2010). Financing commitments are further complicated by the immense complexity of estimating the costs of adaptation, given the uncertainties of projected impacts and feedbacks (especially in light of undetermined commitments to mitigation), the heterogeneous nature of adaptation and the vast range of sectors affected, as well as global economic instability, financial sector bailouts and stimulus spending in industrialized countries. In short, there is much reason to fear that developing countries will continue to face serious challenges financing investment in adaptation, a trajectory which Desmond Tutu likens to 'adaptation apartheid' (UNDP, 2007, p. 13).

2. Clear present and future danger: Guyana's coastal landscape and recent flooding

Guyana illustrates the challenges and disparities associated with climate change adaptation. It is extremely vulnerable to sea-level rise and more intense tropical storms (EPA Guyana, 2002; ECLAC, 2005; Dalrymple, 2006; Oxfam Guyana, 2008; Dasgupta, Laplante, Murray, & Wheeler, 2009; Government of Guyana, 2010), and has one of the lowest per capita GDPs in the Western Hemisphere (under USD 3000 in 2010 according to World Bank figures). To appreciate Guyana's adaptation challenges, it is necessary to first establish how the coastal landscape was constructed, how it functions and how it has failed in recent years.

Guyana is a sparsely populated country. Less than 800,000 people inhabit 215,000 km^2, almost as much land area as the UK. However, this low population density is somewhat deceiving, as 90 per cent of the population and virtually all of the country's agricultural production are located on only 5 per cent of the country's land, a narrow coastal strip that is roughly 25 km (or less) wide and 425 km long, and which is intersected by three great rivers: the Essequibo, Demerara and Berbice (see Figure 1).

Much of this coastal strip sits below mean sea level and depends on an ageing and decaying infrastructure, having been claimed from the mudflats of the Atlantic from the 17th century onwards by sea-walls and a system of fresh water drainage and irrigation canals. This settlement pattern reflects Guyana's long colonial history,[2] as does the country's narrow, commodity-dependent economy and its predominant association with the Caribbean region rather than South America (Lakhan, 1994; Colchester 1997; Pelling, 1999, 2003). Four resources – sugar, rice, bauxite and gold – have long accounted for the lion's share of Guyana's export earnings (over 80 per cent in 2010) (Singh, 2011), and agriculture is roughly one-quarter of the national GDP (GOI, 2010). In spite of its history of mining, Guyana's interior possesses some of the world's largest tracts of undisturbed rainforests along with large areas of savannah, both of which are predominantly occupied by an indigenous population of roughly 60,000 (Colchester, 1997).

The most populous area of Guyana's coastal lowlands, between the Demerara and Berbice rivers, houses almost half of the country's population and the capital city, Georgetown, with settlements and agricultural land located between the sea and the East Demerera Water Conservancy (EDWC). The EDWC traps surface water flowing to the coast, both for use in irrigation and to protect against flooding when river levels are high, with canals serving as control structures allowing water levels to be managed behind the conservancy dam (ECLAC, 2005). Because inland water drains through rivers and canals by gravity towards the ocean, in areas where the land is below sea level there is a need to control water when it is expelled into the ocean. At the sea-wall, canals come to a koker (outflow or sluice gate) which is closed during high tide and opened when the tide is low enough to allow water to flow into the sea. Figure 2 shows a simple schematic diagram and map of this system.

Not only is some of this vital infrastructure very old, dating back well into the colonial period, it has also received limited investment over time. The EDWC dam is composed largely of peat and clay and is in poor condition, while key features such as kokers and canals are in critical condition and in need of large-scale rehabilitation. The deterioration of the canals limits the capacity to manage water levels behind the dam (ECLAC, 2005; UNDAC, 2005; Dalrymple, 2006; Oxfam Guyana, 2008). Thus, while projections of increasingly intense tropical storms and sea-level rise threaten the sea defences across much of Guyana's coastal lowlands, Georgetown and the East Coast Demerara are particularly vulnerable. This became dramatically apparent in early 2005, when a period of unprecedented rainfall coupled with a storm surge breached both the sea-wall and the conservancy dam.

The subsequent failure of the canal drainage system reflected both the magnitude of the flood (on a scale never before experienced in Guyana) and the history of poor maintenance. Large areas dependent on the EDWC, including parts of Georgetown, were inundated under up to two metres of water for weeks, in some places for as long as two months. A national state of emergency was declared, and more than one-third of the population was either temporarily displaced or suffered property damage or loss of income, while national agricultural production and exports declined precipitously, with total economic losses estimated at about 60 per cent of GDP (Government

Figure 1. Map of Guyana.

of Guyana, 2010).[3] The water conservancy was damaged by the flooding, and was subsequently seen to be 'at serious risk of failure', while drainage canals, kokers and sea-walls were deemed to need major repairs and reconstruction, without which the entire coastal region would be 'at risk from catastrophic flooding' (World Bank, 2005, p. 1). The tremendous vulnerability of the coastal landscape was further accentuated by smaller but still serious flood events in 2006 and 2008.

3. The approach of the case study

While the specific nature of Guyana's coastal vulnerability is relatively unique (i.e. its extreme dependence on an extensive and ageing infrastructure system), its general problem is more common: the government has limited capacity to make necessary investments in response to the heightened threats stemming from climate change. In this respect, the case of Guyana can be said to illustrate the great challenge of prioritizing state investment in adaptation, and by examining it we hope to provide deeper insights into a broad problem, as illustrative cases can accomplish (Guba & Lincoln, 2004; Yin, 2008). This case study focuses on the nation state, but this should not be taken to suggest that other units of analysis (e.g. regional or municipal governments, the private sector, communities, or individuals) are not worthy of attention with respect to adaptation. However, the nation state has a preponderate role in assessing threats, determining priorities, establishing plans and policies and making expenditures on public infrastructure, which makes it an essential unit of analysis for understanding the challenges of initiating action on adaptation.

In order to establish the basic context for this analysis, government budgets and planning documents and post-flood reports by governmental, non-governmental and multilateral agencies were examined. Yet there are limits to what can be understood from official expenditures and explanations, and to appreciate not only the financial but also the political challenges of adaptation, in-depth qualitative interviews were done with key experts both within the state bureaucracy and outside of it. Key informants

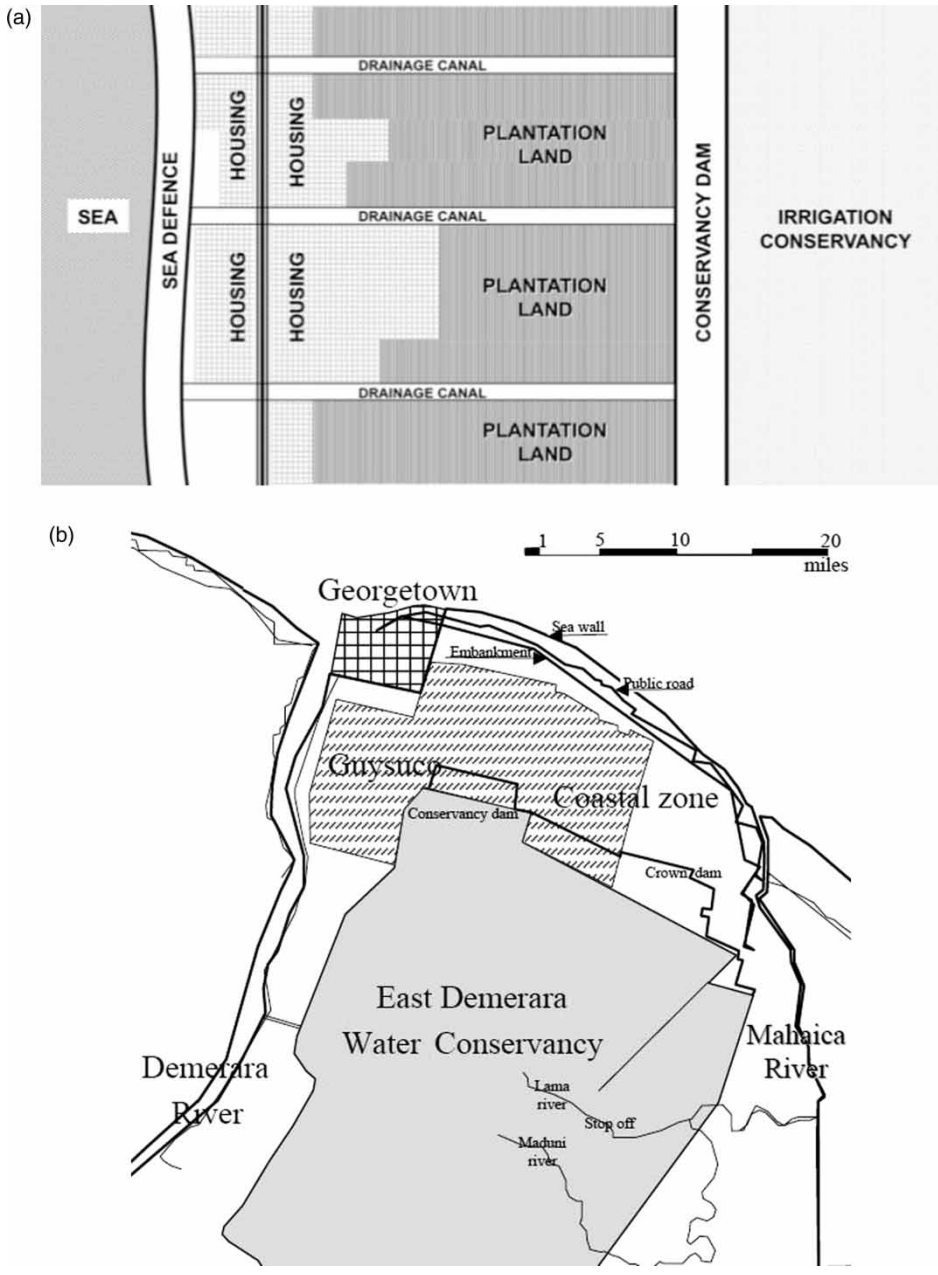

Figure 2. Schematic diagram and map of the East Demerara Water Conservancy.

($n = 16$) were purposively sampled for their specialized knowledge of Guyana's coastal infrastructure, hazards and disaster preparedness, climate change vulnerability and adaptation planning, which were often but not always overlapping areas of knowledge.

Respondents included senior and mid-level bureaucrats and technical specialists in relevant government agencies (the Guyana Sea Defences sub-division of the Ministry of Public Works; the National Climate Unit; the Civil Defence Commission; the National Drainage and Irrigation Authority; and the National Climate Committee), as well as those with a range of relevant expertise at the UNDP, the Caribbean Community (CARICOM), non-governmental and civil society organizations, and the University of Guyana. Interviews were conducted over a six-week period in June and July 2008, and where necessary were subsequently followed up via email. Interviews were semi-structured to ensure that important subjects were consistently covered, with open-ended questions used in order to encourage respondents to explain problems and priorities in their own terms and allow space for unexpected issues to emerge and be followed. Transcribed interviewers were then manually coded according to both emic and etic themes (Miller & Crabtree, 2004).

4. Perceived adaptation priorities

At present, 39 per cent of Guyana's population and 43 per cent of its GDP are located on land that is considered to be at significant risk of flooding (Government of Guyana, 2010), and our interviews all reflected the general sense expressed by one respondent, that climate change threatens 'to affect life as we know it in Guyana'. Guyana's Minister of Finance described the 2008 flooding as another 'unwelcome reminder' of the rising threats of 'extreme weather episodes', as 'overloaded drainage systems struggled to protect our homes and farmland' (Singh, 2009, 1.11). Both episodic floods and persistent saltwater intrusion threaten the availability of potable water along the coast, the viability of the irrigation system and the salinization of soils, which would endanger the sugar and the rice sectors, key pillars of the Guyanese economy, along with most crops grown by smallholder farmers.

The imperative of climate change adaptation in Guyana is overwhelmingly conceived in terms of the populous coastal strip.[4] The rehabilitation and enhancement of the sea and river defences are crucial adaptation investment priorities which, as Guyana's Minister of Finance puts it, 'can never be over-emphasised in light of the imminent threat of climate change and resultant rising sea levels' (Singh, 2010, 4.45). Throughout our interviews, these defences were frequently described as being old and in poor condition across large areas, and ill-equipped to handle higher water levels and more intense storm surges. Already, the ocean regularly overtops many areas of the sea-wall, and, in addition to waves cresting more frequently over the wall, rising sea levels would put it under greater general physical stress and compromise the effectiveness of the entire coastal drainage system.

Although chronic neglect of structures was widely noted as a key issue, in order to cope with sea-level rise and heightened storm surges Guyana will need to do more than merely rehabilitate and augment existing structures. Because laying concrete on top of concrete requires careful design and construction, and because some old structures along parts of the sea and river defences may not withstand added height and pressure, the even more arduous and expensive task of deconstructing what is there and rebuilding a larger structure will be required. Investments on this scale are prohibitive, and the lower-budget, low-technology response has been to set rows of very large boulders – dubbed 'rip-rap structures' – in the mud-flats of the Atlantic in order to break the waves and absorb their energy, with another advantage being that they can more easily be augmented.

There is also a need to rehabilitate and enhance drainage and irrigation infrastructure 'to adapt to the anticipated and ongoing impacts of climate change' (Singh, 2010, 4.49). This includes repairing kokers, dredging canals and fortifying the conservancy dam. In addition to these capital investments, the government has indentified the need for increased experimentation with more flood-tolerant crop varieties (Government of Guyana, 2010). Higher low tides mean that the timeframe when the water levels are low enough to allow gravity drainage from the rivers and canals becomes smaller, causing water to back up beyond the capacity of the canals, which leads to flooding. Over the long term, this could pose serious problems for the conservancy construction which, if saturated, could put the entire coastal plain at risk. These risks, as many respondents emphasized, should also be understood in the context of chronically neglected maintenance and upkeep. One glaring example of this is the widespread dumping of garbage in canals, which impedes drainage and was viewed by some respondents to have magnified the failure of the coastal infrastructure during the 2005 floods.

Another widely noted coastal threat relates to the conservation of Guyana's mangrove forests,[5] which in some areas are the sole protection from the sea, as well as providing essential habitats for many fish and income for small-scale community fisheries. Here, as with the drainage system, while sea-level rise magnifies concerns, human activities are also part of the problem. Guyana is a transshipment point in the drugs trade, and faces growing problems with gangs that operate in many coastal areas. These gangs use the mangroves as cover for launch, and some communities have cleared the forests in an effort to confront this criminality. People have also cleared mangroves in the hope of reducing mosquito numbers and hence the risk of malaria and other insect-borne diseases.

Interviewees rarely raised the issue of uneven vulnerability in discussions on disaster response capacity and long-term adaptation priorities. However, some respondents implicitly referred to the difference in resilience between different types of housing stock, as well as the importance of strengthening building codes. (One suggestion was to mandate the old practice of raised houses, which would entail additional costs, making it a difficult political challenge.) Although the poor might be more vulnerable to hazards in the short term, respondents with lower incomes consistently viewed responses to hazards, such as housing codes and zoning, as being secondary to action on coastal infrastructure. This 'do-or-die' nature of the coastal infrastructure points towards the most drastic possibility for climate change adaptation in Guyana, a proverbial 'plan B': massive-scale relocation inland 25 km or more, beyond the coastal strip. While this plan B is not currently seen as a serious possibility, and sits on the extreme fringe of public policy thinking, a few respondents did suggest that it might be the most logical adaptation strategy in the long run. In making this case, these respondents juxtaposed the momentous investments needed to enhance and maintain adequate sea defences and drainage systems – which could well be overwhelmed by the scale of sea-level rise

projected – against the role such funds could play in planning and organizing a coordinated relocation, rather than one that is desperate and chaotic. Such a move is not without precedent: in 1970 Belize moved its capital 80 km inland from Belize City to Belmopan, a decade after its Caribbean coast was devastated by a major hurricane.

5. Adaptation investments and the championing of mitigation

The government of Guyana has tried to estimate the scale and urgency of its adaptation imperative, calculating its adaptation costs at present to be in excess of USD 1 billion and projecting large annual losses in economic productivity on the coastal region by 2030 in the absence of adequate preparation (Government of Guyana, 2010). Still, in describing the threats posed by climate change, Guyana's Minister of Finance noted that 'any response to bring lasting relief from this challenge will involve *difficult fiscal choices* on our part' (italics added) (Singh, 2009, 1.11), which hints at the complex politics laden in prioritizing the massive infrastructure investments required.

Between 2008 and 2011, only 2 per cent of the annual national budget was devoted to rehabilitating or upgrading the sea and river defences (USD 13 million in 2010), while 4 per cent went to rehabilitating or upgrading the drainage and irrigation infrastructure (USD 25 million in 2010). Taken together, this adaptation-related expenditure was about half what was committed to Guyana's security forces, which command roughly 11 per cent of the national budget (including the upgrading of facilities, vehicles, equipment and a new forensic laboratory), and was also exceeded by the government's annual spending on road and bridge maintenance and expansion – dramatically so in 2011, amid a sizable road-building campaign (Singh, 2008, 2009, 2010, 2011).

Expenditure on sea defences has mainly been used for a combination of rip-rap and concrete structures. The government also initiated a mangrove management programme in 2009 (with a budget of roughly USD 6 million over three years). The programme established a mangrove nursery and worked to improve coastal monitoring (Singh, 2010), having been set up following a pilot project to educate communities about the importance of mangrove conservation (funded with EU development assistance). Drainage and irrigation investment has included such things as the rehabilitation of control structures and kokers, the digging of a new channel for the EDWC and the installation of increased pumping capacity, with pumps targeted for areas where excess water cannot consistently escape with gravity flow alone (Singh, 2008, 2009, 2010, 2011). In light of the shrinking low-tide window for gravity-flow drainage of inland water, pumping is likely to be increasingly necessary to enhance discharge capacity and hence flood control. Amid rising fuel prices it will also be increasingly costly.

In the wake of recent flood events, the government has also taken some steps to improve its disaster preparation and response capacity, with support from UN agencies, United States Agency for International Development (USAID) and other foreign assistance. This has included improved facilities; emergency supplies and heavy equipment for the Civil Defence Commission; work towards a national database on households and housing structures in communities in order to speed response times; and the installation of a Doppler Radar in 2009 at the international airport (60 km south of Georgetown), the country's first advanced hydro-meteorological monitoring and forecasting system.

At the same time as the government has been taking modest steps towards climate change adaptation at home, from 2007 onwards it began to move increasingly boldly on the world stage with respect to mitigation. The basis for this was its promise to protect almost the entirety of the country's tropical rainforests as a global ecosystem service in exchange for 'green' development financing, whether through official development assistance or investment funds and international carbon markets. At the multilateral level, this translated into Guyana playing a prominent role in the negotiations and advocacy surrounding Reduced Emissions from Deforestation and Degradation (REDD+), which has aimed at recognizing a market value for avoided deforestation and standing forests, and finding mechanisms to remunerate developing countries for their conservation.

At the bilateral level, the government of Guyana translated this concept into practice through an agreement with the government of Norway in 2009, which promised up to USD 250 million in payments by 2015 (contingent on conservation 'performance'), starting with USD 30 million in 2010. Guyana has committed these funds to implementing its low-carbon development strategy, which includes radical targets for its own energy-related GHG emissions reductions (Government of Guyana, 2010; Singh, 2010; Jagdeo, 2011). One indication of Guyana's growing profile in terms of mitigation is the fact that President Bharrat Jadgeo was named a 'Champion of the Earth' by the United Nations Environment Programme (UNEP) in 2010 (Singh, 2010; Government of Guyana, 2010, 2011; Jagdeo, 2011).

6. Barriers to adaptation

The Guyana government's seemingly different prioritization of climate change adaptation and mitigation can appear at the same time both contradictory and coherent. On the one hand, the government's mitigation efforts – which pivot on its sparsely populated interior – are bringing immediate financial rewards, some of which are targeted towards Guyana's indigenous peoples (Government of Guyana, 2010). On the other hand, adaptation entails a

prohibitive cost to defend against an imprecise future threat. One respondent insisted that the government simply 'does not have the resources necessary to adapt' to the anticipated extent of sea-level rise, and this was a theme that permeated many interviews. Related to this was a sense that adaptation is generally not a politically appealing expenditure, especially in a poor country like Guyana. As another respondent put it, politics tends to be heavily influenced by short-term attention cycles, and as a result adaptation investment will tend to get trumped by what was described as the 'mountain' of other immediate social and economic priorities (echoes of which might be heard in the Minister of Finance's attempt to situate adaptation needs in the context of 'difficult fiscal choices', noted above).[6] One illustration of this is Guyana's relatively large security expenditure, which occupies a much higher share of the national budget than in most countries, a fact that has strong political currency in the context of the drug trade-related violence that has risen over the course of the past decade. Recent flood events have also put pressure on finances by diverting resources towards relief, compensation and property reconstruction – a common knock-on effect associated with disasters that confront many developing countries (Mutter, 2008).

In the past, the government's heavy burden of external debt was a key reason for its emaciated public expenditure, and debt can be seen to have had a role in the historic deterioration of the coastal infrastructure. Guyana faced severe debt problems from the 1970s into the 1990s, and its total external debt stocks were roughly USD 2 billion in the 1990–1995 period (when it had a considerably smaller economy than at present), entailing a level of debt service that qualified Guyana for substantial debt relief through the heavily indebted poor country initiative (UNDP, 2000). Guyana's debt service has been far more manageable over the past decade, although in recent years its external debt stock has crept upwards, reaching USD 1 billion in 2010 and producing a level of debt service equivalent to 4.5 per cent of the national budget (more than double the expenditure given to sea and river defences that year).

Another financial barrier to coastal infrastructure investment stems from the fact that neither of the major export sectors on the coast – sugar and rice production – can afford the additional burden of subsidizing major rehabilitative efforts. Both were very negatively affected by the 2005 floods, and while rice production subsequently rebounded, Guyana's sugar production and exports have been mired in a long-term decline that is partly related to the loss of preferential markets in the EU. In 2009, the volume of Guyana's sugar exports was 30 per cent lower than that in 2000 (FAOSTAT, 2011).

In spite of the evident economic barriers to adaptation, respondents pointed out how constraints to adaptation run deeper than the financial incapacity of the state. A recurring theme in many interviews was that of a lack of popular awareness about the vulnerable condition of the coastal infrastructure, and how sea-level rise will magnify risks, something that was related to the challenge of political will noted above. One reflection of this awareness problem which some respondents pointed to is the damage inflicted upon the sea defences and drainage system through acts such as clearing mangroves and dumping garbage in canals.

Many respondents also pointed to a general shortage of technical capacity for research, planning and engineering in the country. For instance, an official within the Sea Defences Department explained that when funding for infrastructure projects has been secured, it has often been followed by a struggle to find people capable of managing the project and maintaining the infrastructure once constructed. The shortage of technical skills was regularly linked to both the limitations of the education system and Guyana's persistent 'brain drain', which describes the chronic emigration of skilled professionals and the fact that migration remains a widely prevalent aspiration, including for high-achieving young people who frequently follow educational opportunities abroad and don't return. This problem has plagued the Caribbean region for decades, and several respondents related it to serious deficiencies in research and technical training capacities in crucial adaptation-related fields such as engineering, climatology, oceanography, environmental management and geographic information systems. One Caribbean Community (CARICOM) representative lamented that the region does 'not have the critical mass of skilled personnel to really address the complexity of the issues associated with climate change'.[7]

7. Conclusions

Climate change adaptation is at once urgent and amorphous, the costs of which are especially daunting in developing countries, and differences in adaptive capacity threaten to be a growing feature of global inequality in the coming decades. This article has sought to examine the challenge of prioritizing adaptation in Guyana, a low-lying developing country where sea-level rise and the prospect of more intense tropical storms threaten the sustainability of the coastal landscape. The adaptation imperative in Guyana centres on rehabilitating and strengthening the crucial sea and river defences and drainage and irrigation systems, and will require massive infrastructural investments in the coming decades. The government has made modest commitments in these areas in recent years, at the same time as it has become a global leader in mitigation, impelling Global North-to-South compensation for averted deforestation. Economic limitations are clearly at the heart of this story, although barriers to adaptation cannot be reduced to this, and this

case provides insights into some of the domestic complexities of adaptation.

However, it also compels attention outwards to the scale of the global politics of climate change. As one respondent simply put it, adaptation for Guyana means struggling to respond to 'a problem that we didn't create'. To accomplish this, he continued, 'we need support' from international donors. Perhaps more than anything else, the Guyanese case underlines how much of the action needed to respond to climate change lies beyond the capacity of developing countries, and in the need for firm multilateral commitments to GHG emission reductions and in linking development funds to adaptation priorities (Klein, 2010). Retiring Guyanese President Bharrat Jagdeo expressed these concerns in unflinching terms in an address to the UN General Assembly in September 2011. He pleaded for the world 'to move beyond the global insanity that is our response to climate security', condemning both the failure to commit to aggressive mitigation targets and the 'anemic delivery' of adaptation financing. This course, he warned, is one that promises 'catastrophic climate change', where 'some states will face extinction', and which could well see a 'disastrous break down in trust between the developed and developing world' (Jagdeo, 2011).

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Notes

1. One indication of this is that between 2000 and 2004, on average roughly one in 19 citizens in developing countries were affected by a climate-related disaster – in contrast to only one in 1500 in OECD countries (UNDP, 2007).
2. Guyana was first colonized by the Dutch in 1616 and then ruled by the British from 1814 until Independence in 1966, and both established key features of Guyana's coastal landscape. The colonial enterprises of the Dutch and the British pivoted on sugar, first using African slaves, next (following emancipation in 1838) indentured workers from the Indian subcontinent, and finally low-wage labour of Afro- and Indo-Guyanese. Rice emerged as a second major agricultural crop in the 19th century, and logging and mineral exports become increasingly important in the 20th century (Colchester, 1997; Lakhan, 1994).
3. There were 34 fatalities, some related to water- and vector-borne diseases, but in light of the heightened disease risks as sewage, solid waste and dead animal carcasses co-mixed in relatively stagnant floodwaters, it was fortunate that more disastrous outcomes were averted (UNDAC, 2005; ECLAC, 2005).
4. Many respondents also pointed out that the rainforest and savannah regions in the interior are expected to endure increasingly variable, but overall less frequent and more intensive rainfall patterns, and hence greater risks of both drought and flash flooding and long-term ecosystem change. Although there is less clarity about these threats, the prospect of more variable rains and longer dry periods poses tremendous threats to the viability of rain-fed agriculture and pastures in the savannah regions, where productivity is already extremely low.
5. The coast has always experienced decades-long accretion and erosion cycles. In the accretion cycle, mud builds up into banks in front of the mangrove forests, providing an additional barrier to the sea, before being cyclically eroded. When the erosion cycle is heavy it can do great damage to the mangrove forests and reduce their effectiveness as sea defence. Rising sea levels are expected to intensify the erosive cycle, with the potential to permanently damage the forests.
6. One respondent also noted how there is also competition from what might be seen as more cosmetic signs of modernity and development, pointing out how there was a curious prioritization of installing traffic stop-lights in Georgetown in the years following the 2005 floods.
7. One response to this was the establishment of the Caribbean Community Climate Change Centre, designed to coordinate research, planning and training initiatives in the region.

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