

## CONTENTS

*Illustrations* · vii

*Acknowledgments* · ix

INTRODUCTION	Water and Empire	1
CHAPTER 1	Fluid Networks: Water, Mobility and the Infrastructure of Empire	21
	<i>Channels of Empire</i>	25
	<i>Waterways and Railways</i>	42
	<i>Coastlines and Commerce</i>	52
CHAPTER 2	Mastering the Monsoon: Seasonality and the Rise of Perennial Irrigation	65
	<i>Irrigation, Improvement and Improvisation in Colonial Asia</i>	68
	<i>Water, Welfare and the Costs of Irrigation</i>	84
	<i>The Rhythm of the Nile</i>	102
CHAPTER 3	Wastelands and Water: Hydraulic Frontiers and the Expansion of Imperial Power	122
	<i>Swamps and Settlers</i>	124
	<i>Making the Desert Bloom</i>	137
	<i>Canals and Colonies</i>	148
CHAPTER 4	Deluge and Disaster: The Colonial Politics of Flood Control	159
	<i>Floods, Property and Protection in Colonial India</i>	161
	<i>Deluges, Dikes and Dependency in Colonial Indochina</i>	182

CHAPTER 5	Under the Surface: Fisheries and Colonial Development	203
	<i>Control and Conservation</i>	205
	<i>Modernization and the Marine Frontier</i>	215
	<i>Cultivating the Waters</i>	226
CHAPTER 6	Water, Colonial Cities and the Civilizing Mission	241
	<i>The Origins and Emergence of Colonial Sanitation Works</i>	244
	<i>Environmental Adaptation and Social Opposition</i>	257
	<i>Sanitation, Fragmentation, Discrimination</i>	270
CHAPTER 7	Water and Energy: The Development of Colonial Hydropower	279
	<i>The Roots and Rise of Colonial Hydropower</i>	282
	<i>Scaling Up, Spreading Out: Colonial Hydropower between the World Wars</i>	296
	<i>Hydropowered Development</i>	310
CHAPTER 8	Ebb of Empire: Decolonization and the Hydraulic Remnants of Colonialism	328
	<i>Basins and Boundaries</i>	331
	<i>Dams and Development</i>	350
	<i>Water, Sanitation and the Post-Colonial City</i>	360
	<i>Decolonization and the Ocean Frontier</i>	367
EPILOGUE	Water, Climate and the Legacies of Empire	383

*Bibliography* · 393

*Index* · 439

## INTRODUCTION

# Water and Empire

THERE IS TROUBLE brewing in the world's waters.<sup>1</sup> Whether we consider its availability, quality, or the state of the life that lives within it, water is increasingly at the centre of a mounting global crisis. The lack of adequate fresh water amid rising economic pressures is causing widespread problems on every continent. Two-thirds of the world's population experiences severe water shortage at least one month of the year, with half a billion facing it year round. Throughout the 2010s and early 2020s, the World Economic Forum has regarded water scarcity as one of the greatest global risks over the coming decades.<sup>2</sup> While acute droughts and shortages often capture the bulk of media attention, the underlying problem of deteriorating water quality has simultaneously led to what the World Bank calls an 'invisible water crisis'.<sup>3</sup> In rich and poor countries alike, the combined impacts of industrial pollution, lax sanitation, agrochemicals and over-extraction pose a growing threat not only to human health and aquatic ecosystems but also to food security and efforts at poverty alleviation. Meanwhile, in the world's oceans it is estimated that almost 90 per cent of fisheries are fully to overexploited, depleted, or in a state of collapse, with many under additional strain from pollution, the loss of spawning habitats, or the effects of exotic species introductions. Unless urgent measures are taken, pessimistic predictions suggest that stocks of nearly all commercial seafood species could collapse by the middle of the twenty-first century (more conservative estimates suggest a similar outcome by the 2110s).<sup>4</sup>

The scope of these problems is worldwide, but the front line is undoubtedly in the Global South. Southern Asia, Africa and Latin America are where

1. Parts of the introduction are based on material first published in my 'Confluent Narratives', with the permission of the editor.

2. World Economic Forum, *Global Risks Report 2021*, 14, 87, 90.

3. World Bank, *Quality Unknown*.

4. Worm et al., 'Impacts of Biodiversity Loss'; Jaenike, 'Comment'; Wilberg and Miller, 'Comment'.

the human population is expanding fastest, infrastructure is least able to cope with extreme water and climate conditions, governance structures are often weakest, and food supplies are most precarious. Despite slow progress over the last two decades, in 2020 around 2 billion people still suffered from inadequate supplies of clean water, around half of them living in poor countries and four-fifths of them in rural areas. Meanwhile, sewage provision has improved even more slowly: 3.6 billion people still lack safe sanitation services, including 1.7 without even basic services, nearly half of them living in sub-Saharan Africa.<sup>5</sup> It is estimated that around 80 per cent of waste water worldwide is released untreated into the environment, a figure that climbs well over 95 per cent in many less developed countries. As a result, water pollution is increasing in most of the rivers of Asia, Africa and Latin America, causing hundreds of thousands of deaths annually, creating huge dead zones in coastal seas and adversely affecting around a quarter of a million square kilometres of marine ecosystems.<sup>6</sup> Fishery resources, both marine and freshwater, are in an increasingly parlous state owing not only to pollution but also to the effects of poor supervision, a lack of regulatory enforcement and financial pressures to boost seafood exports to wealthy markets, which create a direct linkage between consumption in the Global North and degradation in the Global South. And all the while, in parts of Asia and Africa in particular, tensions over the management of transborder rivers threaten to spark ‘water wars’.<sup>7</sup>

The stakes are high, and climate change is set to raise them yet further. Among climate scientists, meteorologists and much of the general public, there is no doubt that rising global temperatures are leading to more extreme precipitation patterns. Because warmer air holds more water vapour, downpours and floods have become more frequent and more intense. Global economic losses from flooding are nowadays around four times what they were in the 1980s, and the upward trend is set to continue as storms intensify and more people move into cities.<sup>8</sup> Once again, the problem is especially acute in poorer parts of the world. The fifteen countries with the highest number of people at flood risk are all in the Global South, which is suffering from the effects of greenhouse gas emissions that have emanated primarily from the Global North. Urban areas are especially prone to flooding because of their limited storage capacity and the prevalence of impervious paved surfaces. Worst off are the coastal megacities of southern and eastern Asia, where the risks from extreme rainfall are compounded not only by rising sea levels and storm surges, but also – for example, in Dhaka, Manila, Bangkok and especially Jakarta – by the added challenge of subsidence due to excessive

5. World Health Organization and United Nations Children’s Fund, *Progress*, 8, 9.

6. United Nations World Water Assessment Programme, *Wastewater*, v.

7. For an overview: Chellaney, *Water, Peace, and War*.

8. Marsh McLennan Ltd, *Sunk Costs*; see also R. Elliott, *Underwater*.

groundwater extraction.<sup>9</sup> Yet increased flooding is only part of the picture. Higher temperatures also lead to higher rates of evaporation, which increase the threat of drought. Indeed, many large rivers are shrinking as hotter, drier soils in catchment areas are absorbing more of the rain that falls on them, allowing less to run off into watercourses, lakes and seas.<sup>10</sup> To make matters worse, climate change is also rearranging the temporal availability of water by making periods of low precipitation drier than before, especially in warm climates. As wet regions (and wet seasons) become wetter and dry regions (and dry seasons) drier, the unequal distribution of water is set to exacerbate existing disparities of supply and access. Meanwhile, out at sea, rising atmospheric carbon dioxide concentrations have led to higher water temperatures and higher levels of acidity, causing widespread damage to reefs and the abundance of life they support, and prompting the migration of marine species into new waters as former haunts become less habitable.<sup>11</sup>

Despite the recent push to reduce global emissions, the response of governments and international agencies to this bundle of challenges has largely been to continue the long-standing quest for more effective technological solutions. Huge dams remain a favourite tool for dealing with floods, droughts and rising energy demands – despite the fact that they block the passage of the silt that keeps low-lying coastal areas above sea level. Throughout Asia and Africa, enormous canal schemes are being planned or built (often by Chinese or Western firms) to divert water flows hundreds of kilometres to arid lands. The Food and Agriculture Organization of the United Nations (FAO) has spent tens of millions of dollars helping cash-strapped governments acquire the necessary expertise and infrastructure to monitor and protect their fisheries, even as it has financially supported the mechanization of fishing fleets that deplete marine stocks further and the conversion of coastal land into fish farms that remove protective mangroves from low-lying coasts. A plethora of non-governmental organizations (NGOs) is engaged in efforts to improve access to clean water and sanitation, though municipal systems throughout the Global South continue to lag far behind the needs of rapidly growing urban populations.

All of these problems, and all of these purported solutions, have a long genealogy. They are the outcomes of a historic quest to conquer aquatic nature, one that has profoundly reshaped the societies and ecosystems of the developing world. If we wish to understand them, we must examine the earlier ideas, institutions and infrastructures from which they emerged and which still materially shape them today. Despite the unprecedented spike in water usage

9. Brecht et al., 'Sea-Level Rise'. For a detailed regional case study focusing on the temporary and mostly ineffective 'fixes' that state authorities and local residents have introduced, see *Ley's Building on Borrowed Time*.

10. A. Sharma, Wasko and Lettenmaier, 'Precipitation Extremes'.

11. Poloczanska et al., 'Responses of Marine Organisms', 62.

during the post-colonial era, tracing the origins of the various water-related crises that poor countries currently face requires us to look beyond the last few decades of acute shortages and collapsing fish stocks, beyond even the fixation of Cold War development experts and decolonizing elites on mega-dams, diversions and industrialized fishing fleets. We need to look at the history of water and Europe's modern empire, a history that we have too often neglected.

The dramatic spread of European power in the nineteenth century ushered in a far-reaching transformation of human relationships with the rest of nature. Across vast stretches of the globe, from the Americas to Africa and Asia, the rapid pace of Europe's imperial expansion marked an important environmental-historical watershed. These empires tied lands and peoples more closely into the global capitalist economy and exploited their resources on an unparalleled scale. The ravenous appetite for raw materials in industrial metropolises imposed huge demands on natural assets in the rest of the world, from soils and forests to energy, mineral deposits and water resources. At the core of European imperialism was an attempt to transform biophysical environments for human (above all, metropolitan) purposes, to render conquered territories into productive and legible spaces.

Controlling water was a crucial part of the process. At a material level, whatever the imperial powers sought to do by way of exploiting their colonies – whether by boosting agricultural output, generating power, improving health, enhancing fisheries production, or bringing swamps and arid 'wastes' under the plough – managing the hydrosphere was an absolute necessity. At a perceptual level as well, water and its availability lay at the heart of Europeans' understandings of the new territories they conquered. In the eyes of temperate-dwelling Europeans, the very challenge posed by nature in the 'torrid' and 'tropical' parts of the world was not only one of temperature but also a matter of water: that is, either too little or too much of it, in the wrong places at the wrong times, depending on the place and time of year. If one of the hallmarks of tropical regions was the relative lack of seasonal temperature fluctuations (which, according to contemporary theorists, reduced people's mental activity, work ethic and self-discipline), another was the highly seasonal nature of water, characterized by periods of heavy rainfall and flooding followed by long dry spells that saw little precipitation at all.<sup>12</sup> Wherever water was lacking, the prospects for economic development seemed dim. Wherever it was abundant, it was often considered a dangerous source of disease. Throughout Europe's empire, not only was water an object of material intervention, it also shaped contemporary understandings of colonial environments more generally. From

12. On Western ideas of 'tropicality', see Sutter's 'Tropics', Arnold's *Problem of Nature* (141–68) and Driver and Martins's *Tropical Visions*.

agriculture to transport and from public health to energy, the scope of efforts to subjugate water expanded accordingly.

Europe's empire builders were, of course, by no means the first or only rulers to regard water management as a source of wealth and power. Indeed, no other element of the natural world has been subjected to attempts at human control longer and more forcefully than water.<sup>13</sup> Across large parts of the premodern world, the quest to harness the seasonal flow of rivers reaches back millennia. Egypt's irrigation basins covered much of the lower Nile valley for thousands of years, and parts of what became China's Grand Canal (still the longest canal in the world) date back to the fifth century BCE.<sup>14</sup> South Asia was strewn with local tank systems long before Europeans arrived there, and early-modern Ottoman rulers built or sponsored extensive water distribution systems.<sup>15</sup> In addition to the control of water flows, stationary water bodies (seas, lakes, ponds) have likewise long attracted people's attention as a reservoir of goods and sustenance to supplement what their terrestrial habitats could provide.

Yet despite this long 'terraqueous' history, and notwithstanding the many continuities with premodern hydroengineering efforts, what was new in the empires of the nineteenth and twentieth centuries was the sheer scope and pace of transformation.<sup>16</sup> European imperialists transformed waterways into highways and fixed ever-shifting shorelines into serviceable ports on a literally industrial scale. Much like their Japanese or American imperial counterparts – with whom they exchanged many ideas about how to exploit water and aquatic spaces – they vastly increased both the number and size of barrages and irrigation systems in a bid to boost crop production and increase land revenues for state coffers. In their determination to tap the supposedly 'latent' resources of their colonies, they teamed up with land-hungry farmers to drain swamps, build flood defences and reclaim land on an unprecedented scale. They introduced entirely new water and sanitation systems for rapidly growing cities and eventually erected hydroelectric dams to illuminate their streets and power the industries located there. They sought to 'rationalize' marine fisheries off the coasts of their colonies and to enhance the catch from inland waters by deliberately altering their biological make-up. The global surge of European power in the nineteenth and twentieth centuries washed its way across the various elements of the hydrosphere, and the legacies it left behind for the post-colonial world persisted long after these empires had receded.

13. As emphasized by Tvedt in "Water Systems".

14. On the long history of water control in China, see Mostern's *Yellow River*; Elvin's *Retreat of the Elephants*, 115–64; and Marks's *Tigers, Rice, Silk*.

15. For a panoramic, water-centred history of pre-colonial India, see S. Sen's *Ganges*. On the Ottoman Empire, see Husain's *Rivers of the Sultan*; Mikhail's *Nature and Empire*, 38–81, 242–90; and Joseph's 'Islamic Law'.

16. Bashford, 'Terraqueous Histories'.

*Liquid Empire* tells the intertwined stories of water and Europe's modern imperial enterprise. It examines the multifaceted efforts to exploit the waters of the colonial world, the constraints that moulded them and the consequences (intended or otherwise) that resulted. It recounts how new ideas, technologies and institutions transformed human engagements with water, and how aquatic ecosystems – understood here as interconnected biophysical networks located in or around bodies of water – were themselves reshaped through attempts to control, alter and manage them. It does this by approaching the story from a global and trans-imperial angle, and by emphasizing how colonial interventions in the hydrosphere fitted within the broader political and ideological agendas that framed them. By reconsidering the history of European empire from an aquatic standpoint, it argues that water was an essential part of the story, one that literally flowed through the entire project of modern imperialism.

This is a different perspective from the terra-centric outlook that usually frames our understanding of Europe's modern empire. Although rivers, lakes and oceans have often featured in historical accounts of imperial expansion, for the most part they have been confined to the margins or appear as little more than contextual background. Indeed, the very 'terrestriality' of Europe's nineteenth- and twentieth-century imperial venture is broadly regarded as one of its defining characteristics. Among the chief factors that distinguished Europe's modern empires from their maritime forerunners was the penetration of huge swathes of the African and Asian landmasses beyond the coastal trading outposts to which they had largely been confined in the past. By the turn of the twentieth century, a series of transport, military and medical innovations had enabled a handful of European states to extend the territory under their control (however uneven, sporadic and intermittent this control was) by no less than twenty-three million square kilometres, around one-sixth of the entire global land surface. For good reason, the 'new imperialism' of the late nineteenth century, however much it grafted on to longer-term political transformations within Asia and Africa, is widely regarded as the largest land grab in world history.<sup>17</sup>

Even in the burgeoning field of environmental history, studies of Europe's colonial empire have long tended to cluster around a handful of terrestrial themes: the rise of 'scientific' forestry, the emergence and legacies of colonial wildlife conservation, the production of tropical commodities for global markets, and efforts to 'improve' colonial agriculture.<sup>18</sup> But if this terrestrial emphasis is understandable, it is nonetheless incomplete, for it overlooks the

17. For a survey of the literature, see Butlin's *Geographies of Empire*; on the 'scramble' for Africa as part of a longer pattern of regional political change that European imperial powers exploited, see Reid's 'Africa's Revolutionary Nineteenth Century'.

18. For overviews: Ross, *Ecology and Power*; Beinart and Hughes, *Environment and Empire*; Beattie, Melillo and O'Gorman, *Eco-Cultural Networks*; Ax et al., *Cultivating the Colonies*.



extent to which imperial power was immersed in water. As European empires transitioned from maritime enclaves to territorial domination, they encompassed not only rich tropical forests, parched deserts and teeming savannahs but also many of the world's mightiest rivers, largest lakes, greatest wetlands and most prolific coastal seas. These waters were more than just blue patches on the expanding imperial map. They shaped the history of European empire in numerous ways: as natural capital from which colonizers and colonized alike sought to profit in different ways, as vital conduits of mobility, as an important realm of scientific research and knowledge generation, and as key sites of social and cultural contestation. Just like the vegetal and mineral resources of the colonies, their waters were valuable assets that people sought to understand, control and exploit. After all, managing water was crucial for harnessing the productivity of colonized landscapes themselves, whether for keeping people fed, powering industries, or mitigating losses from floods and erosion. In this sense, *Liquid Empire* aims to reveal hitherto neglected aspects of Europe's imperial engagement with the people and environments of the colonial world.

The attempt to conquer water in Europe's colonies was, of course, part of a worldwide story of escalating human intervention in the hydrosphere. Historians of the United States have long emphasized the centrality of water control for continental settlement, industrialization and urbanization; more recently, they have also brought the country's fisheries into sharper focus.<sup>19</sup> Over the past couple of decades, scholars of Europe, China, Australia and the Russian/Soviet empires have likewise explored how water flows sculpted political, socio-economic and cultural developments, placing particular emphasis on 'enviro-technical' hydraulic systems as building blocks of the modern state itself.<sup>20</sup> Seas, lakes and rivers have also featured in the historiography of European empire, though their coverage has been patchy and uneven. To date, the bulk of attention has centred on water as an agricultural resource. We know quite a lot about the social and economic dimensions of irrigation works – the paramount tool of colonial agricultural modernization – above all in India and Egypt, and to a lesser extent in Sudan, the Middle Niger and the Netherlands Indies.<sup>21</sup> By contrast, the many other imperial engagements

19. Worster, *Rivers of Empire*; R. White, *Organic Machine*; Pisani, *Water and American Government*; Melosi, *Water*; Hundley, *Great Thirst*; Steinberg, *Nature Incorporated*. On fisheries: McEvoy, *Fisherman's Problem*; Chiang, *Shaping the Shoreline*; J. Taylor, *Making Salmon*; Bolster, *Mortal Sea*; Reardon, *Managing the River Commons*.

20. Pritchard, *Confluence*; Cioc, *Rhine*; Blackburn, *Conquest of Nature*; Pietz, *Engineering the State and Yellow River*; Peterson, *Pipe Dreams*; O'Gorman, *Flood Country*.

21. On India: D'Souza, 'Water in British India'; Gilmartin, *Blood and Water*; Haines, *Building the Empire*; Whitcombe, *Agrarian Conditions and 'Irrigation'*; I. Stone, *Canal Irrigation*; Mosse, *Rule of Water*. On Egypt and Sudan: Mitchell, *Rule of Experts*; Tvedt, *Economic, Political, Social and Age of the British*; Blocher, *Der Wasserbau-Staat*; Ertsen,

with water remain underexplored, despite some excellent works on particular topics and places. The impulse of colonial states to convert swamps and marshes into solid land has occasionally come into focus, most notably in southern Asia's river deltas.<sup>22</sup> Despite the propensity of monsoon-fed rivers to burst their banks, only a handful of studies (almost exclusively on India) examine efforts to mitigate, prevent or deal with the fallout from extreme flood events.<sup>23</sup> The history of colonial cities as nodes of exchange and cultural hybridization has been one of the liveliest areas of imperial historiography in recent years, but the fraught history of municipal water and sewage works has mostly remained local in scope.<sup>24</sup> Research on hydroelectric projects in Asia and Africa has focused overwhelmingly on the mega-schemes of the post-war period, to the detriment of colonial-era surveys and initiatives.<sup>25</sup> Meanwhile, the attempts of colonial states to improve the navigability of rivers for trade and communication purposes has remained a niche interest, and even less attention has gone to the transformation of coasts and marshes into modern port facilities.<sup>26</sup> With precious few exceptions, the history of colonial efforts to control fisheries, promote aquaculture and re-engineer aquatic ecosystems remains largely unwritten.<sup>27</sup> Rarest of all are studies that tackle the question

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*Improvising Planned Development*; R. Collins, *Waters of the Nile*. On the Netherlands Indies: Ravesteijn, *De zegenrijke heeren*; Ertsen, *Locales of Happiness*. On the Middle Niger: Van Beusekom, *Negotiating Development*; Schreyger, *L'Office du Niger*; Filipovich, 'Destined to Fail'. On East Africa: Bender, *Water Brings No Harm*.

22. Bhattacharyya, *Empire and Ecology*; Iqbal, *Bengal Delta*; Biggs, *Quagmire*; Brocheux, *Mekong Delta*; Adas, *Burma Delta*.

23. D'Souza, *Drowned and Dammed*; C. Hill, *River of Sorrow*; Mishra, 'Bihar Flood Story'; T. Ghosh, 'Floods and People'; Kingsbury, *Imperial Disaster*.

24. The best overview is Broich's 'Engineering the Empire'. The bulk of work on urban water systems focuses on India's main conurbations: Arnold, *Colonizing the Body*; M. Harrison, *Public Health*; McFarlane, 'Governing the Contaminated City'; Gandy, 'Landscapes of Disaster'; Prashad, 'Technology of Sanitation'; Mann, 'Delhi's Belly'; Klein, 'Urban Development and Death'; Dossal, 'Henry Conybeare'. For studies of colonial cities beyond India: Yeoh, *Contesting Space*, 177–89; M'Bokolo, 'Peste et société urbaine'; Ngalamulume, 'Coping with Disease'; Gandy, 'Planning, Anti-planning'; Nilsson, 'Unseeing State'; Ismail, 'Epicures and Experts'; Kooy and Bakker, 'Splintered Networks' and '(Post)Colonial Pipes'.

25. For overviews: McCully, *Silenced Rivers*; Adams, *Wasting the Rain*. On colonial-era hydroelectricity: Hoag, *Developing the Rivers*, 135–72; Lanthier, 'L'électrification de Bombay'; Kale, 'Structures of Power'; Isaacman and Isaacman, *Dams, Displacement*; Hart, *Volta River Project*.

26. On river navigation: Bernstein, *Steamboats on the Ganges*; Dewey, *Steamboats on the Indus*; Lacroze, *Les grands pionniers*; Lederer, *Histoire de la navigation*; Huybrechts, *Transports et structures*; Headrick, *Power over Peoples*, 177–225. On ports: N. Mukherjee, *Port of Calcutta*; Headrick, *Tentacles of Progress*, 32–35; Powell, 'Singapore's Lost Coast' and 'Harnessing the Great Acceleration'.

27. The few exceptions are Butcher's *Closing of the Frontier*; Medrano's 'Edible Tide'; C. Jennings's 'Unexploited Assets'; Reeves's 'Inland Waters'; and Reeves, Pokrant and McGuire's 'Auction Lease System'.

of how the circulation of water and its multiple uses connected such histories together.<sup>28</sup> This book accordingly follows a twofold rationale: to investigate some of the less familiar aspects of colonial water history, and to integrate them into a broader account of the multidimensional entanglement of water and Europe's imperial power.

Doing so requires us to break some long-standing historiographical habits. One is the tendency to focus mainly on the surface. Historians have long recognized the importance of waterways for imperial expansion; during the nineteenth century, steam-driven gunboats and ocean liners were among the key technologies that made the extension of European power into the Asian and African landmasses possible in the first place. Over the last two decades, a growing body of work on seas and oceans – sometimes referred to as the 'maritime turn', or 'new thalassology' – has recovered long-forgotten patterns of interconnection and exchange across vast nautical spaces. Partly inspired by earlier work on Mediterranean and Atlantic history, such histories have taught us to appreciate how water bodies of varying sizes – whether the Indian Ocean or the Suez Canal – can serve as useful categories of historical analysis. Yet in nearly all of these accounts, water itself features as no more than a medium of transport for the goods, people and ideas that drive history, a surface to move across between various pieces of land.<sup>29</sup>

Another habit to overcome is treating water mainly as an input. Clearly, water supplies were critical for agricultural production, urban growth and various colonial industries. During the droughts and famines that straddled the late nineteenth and early twentieth centuries, they were literally a matter of life and death for millions of people in colonial Asia. Previous work on the history of dams and irrigation schemes shows how the availability or absence of water in particular places was a key constraint that shaped human welfare, political calculations and economic activity.<sup>30</sup> But the relationship between imperial power and the hydrosphere was much broader than that. Water was not only a substance to divert and re-channel but also constituted a vast ecosystem itself, one that contained a multitude of potential resources as well as a host of microscopic dangers that threatened human life. Moreover, human actions and ideas also had profound effects on water, which in turn had far-reaching

28. The outstanding exception is Amrith's *Unruly Waters*, which focuses primarily on modern India through the lens of the monsoon. See also Heather Hoag's *Developing the Rivers* and Beattie and Morgan's 'Engineering Edens'.

29. Bose, *Hundred Horizons*; Huber, *Channelling Mobilities*; Tagliacozzo, *In Asian Waters*; Hofmeyr, Dhupelia-Mesthrie and Kaarsholm, 'Durban and Cape Town'; Armitage, Bashford and Sivasundaram, *Oceanic Histories*; Miller, *Sea*; North, *Zwischen Hafen und Horizont*; Buchet, *La mer*; 'Forum: Oceans of History'. Two noteworthy exceptions that incorporate aquatic environments into their analyses are Cushman's *Guano* and Amrith's *Bay of Bengal*.

30. See notes 21, 25.

consequences for human activities. All throughout the colonial era, a series of new technologies and initiatives – ranging from urban sanitation to electricity generation to fishery development – altered not only the flow and distribution of water but also its composition, ecology, flora and fauna, along with the cultural meanings that people attached to it. Although many of these issues have attracted scant consideration, they too were deeply enmeshed in the fabric of imperial power and became an integral part of its aqueous legacy.

Water is a unique substance, and its distinctive attributes make it a remarkably useful object of study for historians.<sup>31</sup> For one thing, its critical importance for human life and economic activity render it an ideal vehicle for examining the ‘political ecology’ of modern empire at large. The basic premise of political ecology is that the production and distribution of wealth and power are based not only on the social construction of human activities but also on the ability to transform the material world – not least the hydrosphere – and control it for particular purposes.<sup>32</sup> In many ways, the idea that water and power are inter-linked is far from new. In the 1950s, the sociologist Karl Wittfogel famously argued that ‘hydraulic societies’ such as ancient Egypt, China, Mesopotamia or India were fundamentally organized around the control of water for irrigation, which in turn gave rise to highly centralized bureaucracies and decidedly ‘despotic’ forms of government. Ever since then, scholars have questioned and criticized Wittfogel’s thesis, noting that the formation of centralized states often preceded large-scale irrigation works, that many of the absolutist tendencies he described were apparent in areas without irrigation, and that the day-to-day maintenance of irrigation networks was frequently organized on a local or communal basis.<sup>33</sup>

But regardless of such debates, we do not need to accept Wittfogel’s deterministic theories – or, for that matter, restrict our gaze to irrigation and agriculture – to recognize that human interactions with water are intimately bound up with questions of hierarchy, inequality and power. Who controls the flows and distribution of water both reflects and (re)produces social difference. Who defines how it is perceived, measured and valued is rooted in distinctions between different forms of knowledge. Who controls access to rivers, lakes and seas is best placed to profit from the resources living within them and to use them for religious or recreational purposes. Who gets to use water as a waste dump – and, consequently, who has to live with the detritus carried downstream or washed up

31. For a stimulating recent discussion, see T. Fernando, Physioc and Rider’s ‘Flows of History’.

32. P. Robbins, *Political Ecology*; Bryant, *International Handbook*; Peet, Robbins and Watts, *Global Political Ecology*; Stott and Sullivan, *Political Ecology*; Loftus, ‘Rethinking Political Ecologies’; Holt, *Water and Power*.

33. Wittfogel, *Oriental Despotism*; Ulmen, *Society and History*. On critiques of Wittfogel’s thesis: Peet, ‘Karl Wittfogel’; Ley and Krause, ‘Ethnographic Conversations’.

on shore – is shaped by social status. In brief, water and power are interrelated in a multitude of different ways and in a variety of different aquatic settings: from fresh to salt water; from surface to groundwater; from drainage, flood control and urban sanitation to navigation, irrigation and fisheries.

By weaving together a new fabric of infrastructures, rights and entitlements, and by regulating the conflicts that continually arose over them, modern states – including colonial states – did more than just govern the manipulation of water; they governed *through* the manipulation of water. Although these dynamics were by no means new to the modern era or unique to the history of European empire, in many ways Europe's imperial heyday presents us with an unusually illustrative case, a kind of historical exemplar of the deep and multifaceted interconnectedness of water, political power and social difference. Whether we look at the glaring disparities of water access in colonial cities, the deliberate displacement of traditional waterworks by expert-controlled megaschemes, or the skewed distribution of costs and benefits from colonial flood defences and reclamation projects, the inequalities on display were in each case amplified by the stark racial and civilizational hierarchies that structured colonial societies. The 'politics of difference' in Europe's modern empires gave them a somewhat distinct dynamic in comparison to other political entities characterized by asymmetrical power relationships.<sup>34</sup> Furthermore, the enormous scale of environmental change that modern colonialism wrought in the areas that it conquered ensured that these disparities have continued to suffuse the waterscape of the Global South well into the twenty-first century.

Water thus furnishes a powerful lens for examining the socioecological dynamics of imperial power. But to turn the perspective around, it also provides insights into the limits of this power. Water is a notoriously contradictory substance. It is at once the stuff of life and a purveyor of deadly disease. It is an indispensable necessity for human sustenance but also a destroyer of property and human life. It provides a cheap and efficient means of transport but also threatens communications infrastructure and can pose a major barrier to the mobility of people, goods and information. On a cultural level, it is simultaneously an object of veneration, subjugation and anxiety. And to complicate matters further, water also operates on multiple, overlapping timescales: the recurrent annual cycle of the seasons; the intermittent chronology of catastrophic floods or droughts; and the slow, creeping nature of long-term changes such as the silting up of rivers, sinking river deltas, falling groundwater levels, or the biochemical alteration of lakes and oceans.<sup>35</sup> For all the colonial assertions about 'mastering' water, it was never fully tamed – perhaps least of all in the volatile hydrographic regimes of Europe's tropical colonies. In this sense, water was both a source of imperial power and a challenge to it.

34. Burbank and Cooper, *Empires in World History*, 8–11.

35. A point eloquently highlighted by Amrith in *Unruly Waters* (9–10).

After all, the claim to conquer nature through superior know-how and technology was both a cornerstone of colonial rule and a crucial means of justifying it. Consequently, the failure (or perceived failure) to control water served to undermine European authority and open up spaces for opposition, whether from indigenous people who resented the threat to their economic interests and cultural sensibilities or from budding nationalist political movements that demanded a more rapid and thorough development of water resources than colonial states appeared willing or able to achieve.

A further benefit of focusing on water is that it reflects historical changes in so many different spheres. Schemes to channel and exploit water provide a measure of a state's political priorities, social ambitions and technological capabilities. How people use and abuse water, how they allocate and conserve it, tells us a lot about their relations with each other and with the rest of the natural world. Water is the lifeblood of a whole array of modern social and economic systems, from the circulatory networks of cities to agricultural development projects, electrical grids and mechanized fishing industries. Although water is, in a strictly chemical sense, a unitary substance (notwithstanding the different minerals, nutrients or contaminants that might be mixed with it), in the social world it comes in a variety of different guises. It sloshes through the imperial past as a resource for farmers, as a commodity for urban consumers, as a threat to floodplains and coastlines, and as a habitat in which living resources could be caught or cultivated.

The basic aim of *Liquid Empire* is to survey the breadth and diversity of imperial encounters with water. Tackling such a wide array of themes poses challenges, which helps explain why water-related histories to date have tended to focus on single topics or regions. It also entails certain drawbacks; it is no exaggeration to say that each of the following chapters could be turned into many books. But stepping back to take in the bigger aquatic picture also presents significant opportunities, because the various forms and uses of water were ultimately intertwined. The construction of vast irrigation systems unavoidably affected river navigation since their flow requirements often contradicted one another. Capturing run-off behind dams or using watercourses as refuse dumps impacted fisheries and other users downstream. Promoting industrial modes of fishing or draining swamps for agricultural use commonly had an adverse effect on artisanal fishers. Building flood controls or irrigation works in one area raised the risk of catastrophic inundation, waterlogging or water shortages in others. The world of water is literally awash with such interconnections and trade-offs.

My starting point is that all of these different 'waters' formed part of a single integrated hydrosphere, and that the period of European global dominance was one of momentous and enduring change in the long history of human interactions with it. Consequently, the chapters that follow not only cover a broad range of themes – water-based transport, irrigation, swamp

reclamation, marine and inland fisheries, lake stocking, aquaculture, flood control, municipal sanitation, hydropower – but also seek to tease out some of the linkages between them. Water connected upland farmers with lowland cities, the fisherman with the irrigator, the riverside cultivator with the electricity consumer. The basic rationale for placing water at the centre of the narrative is that we can gain new insights by looking at these topics together rather than focusing merely on one or the other. After all, any water that is ‘wasted’ or that escapes human control is never truly lost; whatever leaks, drains or evaporates away always ends up somewhere else. In this sense, *Liquid Empire* is a book about the fundamental interconnectedness of things – not only different parts of the hydrosphere but also the manifold ways in which humans are interwoven with the biophysical environment.

Exploring these interdependencies requires us not only to consider a variety of aqueous spaces but also to look across political boundaries. Water, like many other elements of the natural world, shows little respect for borders. Although there are sound political and geographic reasons to study water on a local or regional scale – whether at the level of a single river, state or physical watershed – taking a wider spatial view enables us to see how changes in particular places were linked to much broader processes, both natural and historical. Rivers link mountain rain and snow with drylands, deltas and the global sea. Water currents carry sediment, nutrients and contaminants from one place to another. Consequently, water challenges conventional understandings of territoriality.<sup>36</sup> The (rather arbitrary) lines that Europe’s imperial diplomats drew on the map were intended to delineate fixed domains of land. But flows of water across these frontiers muddled any neat distinction between different spheres of influence, and the concept of ‘international waters’ further confounded them when dealing with matters offshore. Moreover, the boundaries between land and water were themselves often indistinct and changeable. Deltas, littorals and low-lying river plains were mutable, half-liquid spaces characterized by the continual movement of mud and silt; in ecological parlance, they were ‘ecotones’, in which different biological communities meet and mix. Much to the frustration of state officials, engineers and investors, water had a way of turning firm territorial settlements into a physical and political mire.<sup>37</sup> To be sure, political boundaries affected the movement and uses of water (indeed, increasingly so as colonial and post-colonial states imposed new claims on it), but ideas about water and its exploitation travel as much as water itself does. So, too, did many of the people (engineers, administrators, hydrologists) who sought to control, regulate and re-channel it. To study water is to follow these currents.

36. See Maier, *Once within Borders*.

37. Von Hardenberg, ‘Knowing the Littoral’; Bhattacharyya, ‘Fluid Histories’ and ‘River Is Not’; O’Gorman, *Wetlands in a Dry Land*.

*Liquid Empire* therefore adopts a fluid sense of geography. Its primary focus is on colonial Asia and Africa, especially (though not exclusively) non-settler colonies, but it treats these regions as spaces whose edges were blurred by flows of water as well as by the circulation of ideas, technologies and practices associated with it. Tracing these cross-currents sometimes takes us beyond the bounds of European colonies and protectorates, whether to the fisheries of Japan, the watersheds of North America, or back to the rivers and harbours of the metropole. In this sense, our focus on the empires of Western European states is by no means intended to downplay the importance of other imperial projects (Japanese, American, Russian, Ottoman), which often pursued similar water-control aims, or to ignore the cross-border exchange of ideas, technologies and political impulses that bound them together. Rather, it is a reflection of Europe's dominant collective power throughout much of the period and the need to impose some practical limits on the subject.

Even within the spatial confines of European empire, studying water requires us to adopt a trans-imperial perspective that transcends the boundaries of individual colonies or regions of influence. One benefit of this approach is that it opens up areas that have attracted relatively little scholarly attention. Like so many aspects of the imperial past, histories of water control have hitherto centred predominately on the British Empire. Although British-ruled colonies feature prominently in the pages that follow, the story also encompasses the less familiar water histories of the other major European colonial empires, drawing on material in French, German, and Dutch. Another advantage of this trans-imperial viewpoint is that it allows us to draw comparisons and trace commonalities across frontiers. In spite of – and to some extent because of – their rivalries, Europe's empires are best understood in connection with one another. There were, to be sure, different ways of 'doing' colonialism: direct or indirect forms of rule, overriding or upholding local 'customs', private versus state-led resource exploitation. Colonial authorities also set somewhat different political and economic priorities, not least around the questions of profitability versus 'native welfare' or gradual change versus rapid economic development. As we will see, these various governing strategies and policy decisions influenced both the conception and consequences of hydrological interventions in different colonial territories, from irrigation to fishing and from flood control to hydro-power. Nonetheless, administrators, engineers and scientists faced many common challenges in their encounters with the waters of the colonial world. As a result, ideas about how to exploit them were the subject of imitation, adaptation and sometimes coordination across imperial boundaries and beyond.<sup>38</sup>

38. Hedinger and Heé, 'Transimperial History'; Kamssek and Kreienbaum, 'Imperial Cloud?'; V. Barth and Cvetkovski, *Imperial Co-operation and Transfer*; Adelman, 'Mimesis and Rivalry'; Streets-Salter and Getz, *Empires and Colonies*; Singaravelou, *Les empires coloniaux*; Jerónimo and Pinto, *Ends of European Colonial*.



Examining the interconnections and interdependencies of water also demands a fluid chronological framework. Our main focus will be on the nineteenth and twentieth centuries, starting with the consolidation of European power in southern Asia and early forays up Africa's rivers, and continuing through the age of decolonization after the Second World War. These temporal parameters will vary from one subject to another and will flex at both ends. From the very beginning, colonial waterworks in parts of Asia and Africa were powerfully shaped by pre-colonial practices and infrastructures, and are therefore best viewed as part of a longer trajectory of human hydraulic interventions. The same point holds true for the latter stages of the story: given the huge aquatic transformations over which Europe's empire builders presided, we will also explicitly consider the hydraulic legacies of European empire for the post-colonial world.

Although tackling two centuries inevitably involves a high degree of compression, taking a long view has significant benefits when dealing with the history of water. For one thing, most large-scale water management systems took decades to come to fruition. Schemes that began as colonial infrastructure projects often ended up being inaugurated as symbols of national independence by post-colonial governments. Moreover, a long temporal framework allows us to consider discontinuities within the colonial era itself, whether due to changing attitudes and political constellations, technological innovations or as a result of crisis moments such as famines, war or economic depression. By looking across this time span we can trace the gradual transition from a phase of improvisation and experience gathering in the early and mid-nineteenth century towards a more expert-based, scientifically oriented mode of water exploitation that became increasingly dominant in the twentieth century. Finally, the multilayered temporalities of water meant that the full environmental effects of hydrological interventions often took decades to manifest themselves, which meant that contemporaries frequently underestimated the long-term implications of what they were doing. This is, of course, a problem of more than just historical interest. In the twenty-first century, we still struggle to understand how our current uses and misuses of the hydrosphere will play out in the future.

Our focus on the era of 'modern colonialism' thus does not posit any neat historical breaks. As recent histories of empire have emphasized, there were many continuities and parallels between the imperial projects of modern Europe and empire-building processes in other times and places. Certainly there was little new in the basic idea that supposedly more advanced or 'refined' groups had a right to propagate or even force their own norms and institutions on to those whom they regarded as backward or brutish. Such notions were rooted in long-standing discourses of imperial providence, and informed Chinese notions of state-building as much as European self-imagination.<sup>39</sup>

39. Harrell, *Cultural Encounters*; B. Barth and Osterhammel, *Zivilisierungsmis-sionen*; Pagden, *Lords of All*.

Since ancient times, deploying the latest technologies to construct large-scale waterworks had been a favourite tool of imperial elites eager to demonstrate their beneficence, extend their influence and bolster the resources at their command. In these and many other ways, the colonial regimes of the nineteenth and twentieth centuries drew on a multitude of older ideas, methods and strategies to fashion their own ‘imperial repertoires’.<sup>40</sup>

But even so, there are several factors that make this period somewhat distinctive. At the most basic level, Europe’s modern empires were collectively larger; more populous; and more geographically, culturally and economically variegated than anything that earlier imperial powers had managed to assemble. Over time, the global supremacy of these empires was amplified by the ‘Great Divergence’ of economic growth between the Western powers and the rest of the world after around 1800, which meant that they were able to deploy more resources than ever before for the domination of subject lands and peoples.<sup>41</sup> In turn, this widening economic differential also reflected the unprecedented technological discrepancy that opened up over the course of the nineteenth century, which eventually furnished the ‘tools of empire’ that made it possible to penetrate large parts of Asia and Africa that had previously lain beyond European grasp.<sup>42</sup> Finally, these new industrial-era technologies did more than just enable imperial conquest; they also encouraged the deployment of European knowledge, capital and administrative practices for mobilizing the natural wealth and labour of subjugated territories on an extraordinary scale.

The overall result was a markedly interventionist approach to empire-building. Although the notion that Europeans should guide and educate what they regarded as more ‘primitive’ peoples had long formed the cornerstone of the so-called ‘civilizing mission’, over time their incursions were increasingly animated by visions of an enlightened form of colonialism spearheaded by engineers and scientists rather than by conquering armies, and geared more towards mutual benefit and moral advancement than coercion and suppression. It was an approach that resonated with other imperial projects in the nineteenth- and twentieth-century world, whether the extension of Japanese supremacy in East Asia, Russian expansion in central Asia, or the ‘internal colonization’ efforts of federal agencies in the western and southern United

40. See especially Burbank and Cooper’s *Empires in World History* (1–22, 287–329). I make no neat distinction in the text between ‘colonial’ and ‘imperial’, but rather use them as overlapping (but not identical) terms. On the advantages and disadvantages of the terminological options, see Kumar’s ‘Colony and Empire’.

41. Pomeranz, *Great Divergence*; Parthasarathi, *Why Europe Grew Rich*; Osterhammel, *Die Verwandlung der Welt*; E. Jones, *European Miracle*.

42. Headrick, *Tools of Empire*. On the importance of non-military over military factors, see Sharman’s *Empires of the Weak*.

States.<sup>43</sup> By and large, the results rarely matched the rhetoric. In the case of Europe's colonies, the 'shoestring' budgets of most colonial states were hardly conducive to progressive social reform, and nor was their heavy reliance on indigenous elites for the purpose of governing conquered territories. The introduction of new technologies often benefitted investors and merchants more than local people, and was often used to direct and control their activities more effectively. Nonetheless, from the late nineteenth century onwards, and especially after the fallout of the two world wars generated mounting pressures to justify the continuation of colonial rule, the core responsibility of European colonial states was (at least ideally) not merely to tax and exploit subjugated societies but rather to 'develop' their economies through the application of modern science and technology.<sup>44</sup>

The control of nature was critical to this undertaking. The markedly technocratic impulse of modern colonialism meant that subject territories were no longer viewed merely as spaces to govern but as places to be managed and improved – 'living laboratories' for social and environmental experimentation.<sup>45</sup> In this context, mastering flows of water and harnessing the productivity of aqueous spaces represented more than just a material means of exerting imperial authority (though it certainly was that). It also had a profound symbolic importance: in the eyes of Europeans, it justified their claims to colonial stewardship over natural resources that subject peoples were less capable of capitalizing on themselves.<sup>46</sup> Whether through the irrigation of farmland, the draining of swamps, the expansion of fisheries or the improvement of sanitation, the management of water lay at the heart of the colonial development agenda and indeed has remained a central focus of development initiatives ever since.

Yet for all the emphasis on developing colonial water resources, the imperial conquest of water was more than just a matter of imposing external power over subjugated territories and disseminating technologies from metropolitan 'centres' to colonial 'peripheries'. As the following chapters show, it often involved a lot of trial and error, adapting technologies to unfamiliar environments, importing ideas and practices from other colonies or national settings,

43. Peterson, *Pipe Dreams*; Mizuno, Moore and DiMoia, *Engineering Asia*; A. Moore, *Constructing East Asia* and 'Yalu River Era'; M. Jansen, *Making of Modern Japan*, 436–41; Beasley, *Japanese Imperialism*, 198–219; B. Barth and Osterhammel, *Zivilisierungsmissionen*; Downs, *Transforming the South*, 73–180; Worster, *Rivers of Empire*; Pisani, *Water and American Government*.

44. The most programmatic contemporary statements were Leroy-Beaulieu's *De la colonisation* and Kidd's *Control of the Tropics*. On interventionist colonialism and development: Cooper and Packard, introduction to *International Development*, 6–9; Hodge, *Triumph of the Expert*; Conklin, *Mission to Civilize*.

45. Tilley, *Africa*.

46. Adas, *Machines as the Measure*; MacLeod, *Nature and Empire*; Bennett and Hodge, *Science and Empire*; Marsden and Smith, *Engineering Empires*; Fischer-Tiné and Mann, *Colonialism as Civilizing Mission*.

and occasionally adopting or absorbing indigenous techniques that had been refined over generations to take advantage of local hydrological conditions. Colonial engineers and their projects will feature prominently, but large-scale hydraulic tinkering always involved a high degree of negotiation and alignment of interests between different social groups. This very much included colonized people themselves, who in some cases were among the primary drivers of transformation and who variously supported, opposed or repurposed imperial water designs for their own ends. In this respect, the story diverges from older diffusionist narratives of technology transfer, in which Europeans conveyed their own practices to seemingly passive colonized societies and territories.<sup>47</sup> Taking its cue from recent work on colonial infrastructures, knowledge and environmental history, it instead seeks to paint a more complex picture of mutual interaction, the circulation of ideas and practices within and beyond imperial boundaries, selective appropriation, unintended consequences, and the emergence of resistance to imperial innovations.<sup>48</sup> Such an approach not only has the advantage of capturing a broader spectrum of human agency beyond European colonizers. It also helps us to comprehend modern empire as the franchise venture that it was, a system of rule that forcibly bound places and peoples together, but one that could function on the ground only by opening up opportunities and incentives for non-Europeans as well. Despite all of the violence and the stark power asymmetries that characterized European imperialism, the actual exercise of colonial rule – including the management of water – fundamentally depended on practical compromises.<sup>49</sup>

As the following chapters will show, such accommodations extended well beyond the diverse social interests that had to be negotiated, for water was itself a powerful force to be reckoned with. Rivers, lakes and seas, like the rest of nature, were by no means merely a blank slate on which engineers and administrators could cast their designs, but rather played an active part in the story of modern empire. Although this book is very much a work of history rather than hydrology, one of its premises is that it is insufficient to focus solely on ideas about water or on the various things that people marshalled in order to control and profit from it (all of which feature prominently in any case). It is also important to pay attention to the water itself. After all, the various purposes that water systems were intended to serve were possible in the first place only because of the movements and properties of the actual fluid, which in turn affected how all of the other elements of such systems functioned. This becomes all the more apparent when we consider that flows and bodies of water often seemed to have ideas of their own about how to behave

47. Headrick, *Tentacles of Progress and Power over Peoples*.

48. For a recent overview, see Van der Straeten and Hasenöhr's 'Connecting the Empire'.

49. Cooper, *Colonialism in Question*, 153–203.

and where to move, and these inanimate actions frequently ran counter to human designs.

In short, water had its own form of agency. Its currents, movements, absences and overabundances powerfully moulded human activity, even as humans reconfigured the waterscape in a reciprocal process of transformation. To borrow from Bruno Latour, water was an ‘actant’ within a wider, co-evolving set of arrangements that bound together water, people, technologies, cultural practices, socio-economic structures, legal-political institutions and the wider biophysical environment, all for the human-led purpose of capitalizing on the productive potential of aqueous spaces.<sup>50</sup> Viewed from this perspective, modern imperialism was (among many other things) a ‘hydro-social’ enterprise, a process of expansion and subjugation that reordered relationships between water and human societies across large swathes of the globe, and that helped set the overall course of water management for decades to follow.<sup>51</sup>

Over the past two centuries, and especially since the twilight years of empire in the middle of the twentieth, modern societies have become an elemental part of the Earth’s water cycle. According to the UN, global water use has risen roughly sixfold over the past century (far faster than the rate of population growth), such that the vast majority of the world’s major rivers have already been dammed and diverted for various human uses.<sup>52</sup> Of course, the technological hold we now have on the hydrosphere has in many ways been a massive boon to human welfare, allowing us to produce more food, generate more power and contract fewer diseases than ever before. Yet as more and more of the planet’s waters have been transformed into artefacts of human engineering, people – especially poor people with the least ability to move from low-lying areas or to buy their way out of the effects of drought – have simultaneously grown more vulnerable to changes in the hydrological cycle itself. Although the challenge of striking a balance between the risks and rewards of hydrological tinkering is in many respects an age-old problem, in recent years its scale and implications have become ever-more alarming as demands on water resources have skyrocketed and as the disruptive effects of climate change have begun to take hold.

In this sense, our dealings with water in the modern era epitomize our changing relationship with the global environment at large during the age of the Anthropocene. Stripped down to its essentials, the overarching story is one of escalating human needs generating greater dependencies on nature’s assets, and greater dependencies in turn giving rise to increasingly elaborate

50. Latour, *Reassembling the Social*.

51. Linton and Budds, ‘Hydrosocial Cycle’; Schmidt, ‘Historicising the Hydrosocial Cycle’; Boelens et al., ‘Hydrosocial Territories’.

52. Kooncağıl, Tran and Connor, *United Nations World Water*, 1–3.

attempts to harness the resources on which we rely. As geoscientists have been warning us for some time, this spiralling pattern of human intervention can be observed across the entire biophysical environment: land, sea and atmosphere, as well as the nitrogen and carbon cycles that link them together. Yet nowhere are the inherent limitations of this perpetual growth strategy more apparent than in the hydrosphere. Water is arguably the ultimate constraint on economic growth. Directly or indirectly, fresh water is necessary for everything we do, but supplies are finite and already under severe strain from overuse and pollution, and there are no substitutes. In turn, the fact that freshwater supplies also pose a constraint on the productivity of land has prompted us to direct more of our attention to the oceans, though here too we have begun to push (and in some areas exceed) the limits of what marine ecosystems can provide.<sup>53</sup>

And so states around the world today find themselves bound by their own water histories, their hydrological options circumscribed by the visions and choices of previous generations. This is, with few exceptions, a global dilemma, one that applies as much to China, Australia or the American West as to post-colonial Asia and Africa. Yet for many states and societies in the Global South, it is important to recognize that their options are bounded not only by their own previous choices but also by those of European imperial powers that, for much of the modern era, took it upon themselves to make such decisions on their behalf. As things turned out, these choices had momentous social and environmental consequences, and their legacies continue to shape the fortunes of billions of people.

53. My thanks to Julia Adeney Thomas for highlighting to me the importance of these water-related limits.

## INDEX

- Abidjan, 353; port infrastructure for, 62  
Accra, 254, 263–64  
Africa Rice Center, 353  
Akosombo Dam 317–20. *See also* Volta River Project  
Alexandria, 111  
Algeria, 60; and desert reclamation, 139–47; French colonization of, 138–39; hydroelectricity in 285–86  
Algiers, 241, 253  
aluminium, 312, 315–17, 319–20  
Amherst, William Pitt, 29  
Annam, 68, 136, 186, 194, 199, 219  
Anthropocene, 19, 386–87  
aquaculture, 8, 13, 380–81  
Asiatic Society of Bengal, 209  
Assam, 26, 30, 164  
Association Internationale pour l'Exploration et la Civilisation de l'Afrique Centrale, 47  
Aswan Dam, 111–13, 121, 314, 348; and Egyptian irrigation, 119; environmental consequences of, 118–20; and hydroelectricity, 351; as territorial solution for Egyptian water security, 119, 345–47  
Atbara River, 345  
Atlantic Ocean, 33, 47, 60, 232, 306–7, 359; as category of historical analysis, 9; fisheries in, 221–23, 374, 376  
Atlantropa Scheme, 147, 306, 358; criticisms of, 308; expansion of, 309–10; motivation behind, 307–308; and racism, 309. *See also* Sörgel, Herman  
Australia, 7, 20, 66, 98, 137, 154, 157, 227  
  
Bagan Si Api Api, 217  
Baikie, William, 35–6  
Bali, 68  
Ball, John, 147  
Bangkok, 2  
Bangladesh, 124, 381, 385  
Bapat, Pandurang Mahadev, 295  
Batavia, 74, 219–20; as sea port, 54; urban sanitation in, 249, 254, 263–64, 273–75. *See also* Jakarta  
  
Bay of Bengal, 27, 29, 69, 71, 172, 209, 216, 252; and coastal flooding, 166–67, 176–77; and cyclones, 58, 127, 169–70, 172–73, 178; migration across, 127; trade across, 127  
Bazalgette, Joseph, 246  
Beas River, 148, 150, 336  
Beecroft, John, 35  
Bengal Famine (1943–44), 179–80, 199  
Bengal Pilot Service, 28  
Bengal, 25–6, 28, 30, 31, 43, 164, 175, 182, 210, 213, 215, 218, 219, 228, 245, 252, 275, 332, 350, 370; and famine, 179–180, 199; flooding in, 127, 162, 170–73, 176–179; irrigation in, 68, 100, 162–63, 165–67, 209  
Bentinck, Lord William, 29  
Benue River, 33–6  
Betwa Canal, 95  
Bey, Mazhar, 106  
Bhakra Nangal Scheme, 181, 335, 350  
bilharzia, 118–20, 320, 356  
Black, Eugene R., 336  
Blue Nile, 103, 113, 345–47, 350  
Bombay (Mumbai), 59, 95, 221, 241, 364; and hydroelectricity, 289–96, 302; port of, 52, 54–7; urban sanitation in, 249, 251–53, 257–60, 263–69, 272, 274  
Bor River, 348  
Borgström, Georg, 368–69  
Brahmaputra River, 31, 162, 172; and flood risk, 170, 174; as navigation channel, 26, 29–30  
Bulawayo, 303, 321  
Burma (Myanmar), 44, 179, 331; fisheries in, 206–8, 213, 218; British colonization of, 28–9, 132–133; land reclamation in, 124–29, 136; as member of Mekong Committee, 338  
  
Cahora Bassa Dam, 321, 323–26  
Caillié, René, 33  
Cairo, 111, 113, 117, 241, 254; urban sanitation in, 263, 268–69  
Caisse de la dette publique (Egypt), 108–9, 117

- Calcutta (Kolkata), 26-7, 29-30, 46, 57, 180, 241, 273; and cyclone damage, 172-74, 178-79; port of, 52, 54-55; urban sanitation in, 210, 249, 251-53, 262-63, 266-67, 276-77
- Cambodia, 38, 65, 124, 331, 338-39, 341-42; fisheries in, 206-7, 215; and river navigation, 38-9, 45
- Cameroon, 316-17, 319
- Canada, 154, 283, 298
- Canal Colonies (Punjab), 148-158, 181, 265-66, 332-34, 350; as development model, 154; environmental problems in, 154-57; social conflict in, 155-56, 166, 355
- Canal des Rapides, 191, 197
- Cape Town, 283
- Cautley, Proby, 80, 83, 101,
- Cauvery (Kaveri) River, 69-73; and anicut, 70-71, 102, 230; and hydroelectricity, 288, 291, 293, 300; and regional water disputes, 293-94
- Cavour Canal, 81
- Ceylon, 70, 219, 225, 259, 271. *See also* Sri Lanka
- Chadwick, Edwin, 245-46, 253
- Chadwick, Osbert, 253
- Chenab River, 148, 150-52, 154-55, 335-56
- China, 5, 7, 20, 25, 38-9, 40, 49, 94, 183, 186, 228, 338, 353, 358; fisheries in, 203, 220; as market for trade, 37-8, 45; and Opium Wars, 37; and Second World War, 198; water control in, 5, 10
- cholera, 134, 156, 173, 175, 189, 242, 245, 247, 260, 272
- Churchill, Sir Winston, 112, 279-80, 314
- Cirebon Residency (Java), 86
- Clapperton, Hugh, 33
- Clarke, Sir George, 291-92
- Clemesha, William Wesley, 258, 262
- Cochin China, 40, 45, 196, 371; agricultural frontier of, 131; French colonization of, 129, 133; migration to, 132. *See also* Mekong Delta
- Coleroon (Kollidam) River, 69-70
- Colombo, 259, 263, 265, 271
- Colonial Development Corporation, 311
- 'Columbian Exchange' (Alfred Crosby), 227, 232
- Colvin, John Russell, 84
- Congo Free State, 48, 345
- Congo River, 33, 47-50, 60-61, 306, 309; and hydroelectricity, 297-98, 301, 351, 358-59; navigation on, 48, 50-52, 64
- Congolese Hydrographic Service, 51
- Conrad, Joseph, 48
- Convention People's Party (Gold Coast), 317
- Conybeare, Henry, 251,
- Côte d'Ivoire, 320, 351, 356; and colonial development, 63; construction of port facilities for, 61-2
- cotton, 25, 30, 61, 152-53, 170, 282, 287, 290-91, 305, 312; and 'cotton famine', 107; in Egypt, 105-10, 114-19, 142
- Cotton, Sir Arthur, 43-4, 70-3, 83, 100, 106, 146, 209, 230
- Cremer, J. T., 91
- Cromer, Lord Evelyn Baring, 108-9
- Cultivation System (*cultuurstelsel*), 74, 87-9
- cyclones, 54, 57-8, 73, 160, 169-70, 171, 178-80; and flooding, 127; and meteorology, 173-74; 1864 cyclone, 172-74; 1876 cyclone, 174-76. *See also* Bengal Famine
- Dakar, 241; port of, 36, 52, 60-1; urban sanitation in, 254, 263, 266, 268
- Damodar River, 28, 162, 181-82, 350
- Dar-es-Salaam, 254
- Darjeeling, 46, 284
- Day, Francis, 210-12
- De Bruyn, H., 77-8, 87
- De la Blache, Paul Vidal, 186
- Doudart de Lagrée, Ernest, 38-9
- De Lesseps, Ferdinand, 120, 140-42, 144, 166
- De Meyier, J. E., 91
- Deakin, Alfred, 98, 274, 391
- Deccan, 181, 350; famine in, 71, 94; tanks and reservoirs in, 68, 95, 100
- decolonization, 15, 200, 328-30, 387, 389; and dam building, 120-21, 356; and fisheries, 367-81; and urban sanitation, 363-67; and water disputes, 331-37
- Delcommune, Alexandre, 48
- Delft (Technical University, Royal Academy), 63, 74, 87
- Delhi, 79, 241, 364; urban sanitation in, 254, 260, 265, 273. *See also* New Delhi
- Delta Barrage (Egypt), 106-7, 109, 111, 117
- Demak Regency (Java), 86, 91



- desiccationist theory, 86, 143
- Dhaka, 2, 26
- dikes, 187, 189, 194, 199, 329; debates  
about utility of, 167, 186, 190; deliberate  
breaching of, 168; and exacerbation of  
flooding, 168–69, 184; improvement of,  
191–92; proliferation of, 168
- Douie, James, 152–54
- drainage, 11, 55, 69, 74, 80, 82, 86, 101–2,  
129–30, 134–35, 149, 156, 167, 172, 178,  
194–95, 242–43, 245–46, 252, 260,  
267–68, 271, 337; lack of attention to,  
100, 117, 166, 176, 251, 273, 355; and  
land reclamation, 136. *See also* irrigation,  
salinization, waterlogging
- dredging, 23, 29, 129, 131–32; and port  
maintenance, 46, 53, 57, 61; and river  
navigation, 28, 41, 51, 55, 62. *See also*  
land reclamation
- drought, 1, 9, 11, 23, 64, 69, 71, 80, 84, 86,  
91, 94–5, 97, 100, 127, 159–60, 175,  
180–81, 194, 199, 223, 254, 286, 348,  
356; and climate change, 3, 19, 285, 389,  
392. *See also* famine
- Duperré, Victor Auguste, 130
- Durban, 53
- Dutt, Romesh Chunder, 97
- East African Fisheries Research Organiza-  
tion, 237
- East India Company, 25, 37, 68, 69–70,  
80, 163, 171
- East Indies Civil Service (*Binnenlands*  
*Bestuur*), 77
- Eastern Jumna Canal, 79–81, 101–2
- Ebrié Lagoon, 62
- Economic Commission for Asia and the  
Far East (ECAFE), 338, 340
- Edéa Scheme, 316–17, 319
- Egypt, 42, 98, 104–6, 112, 120, 127, 147, 187,  
282, 308, 313–14, 385; and cotton, 105–10,  
114–19, 142; and disputes over Nile,  
313–14, 343, 345–50; and irrigation, 5,  
7, 10, 65–7, 102–3, 156; and Nile Water  
Agreements, 114; and sanitation, 269
- Ellenborough, Lord Edward Law, 80
- Elliott, John, 174
- embankments. *See* dikes
- ‘Ethical Policy’ (Netherlands East Indies),  
91, 93, 97, 219, 273
- Ethiopia, 103, 113, 119, 343, 345–50
- ‘Eurafrica’, 305–6, 309
- Exclusive Economic Zones (EEZs), 376,  
378–79
- famine, 9, 15, 159, 256; and Famine Codes,  
94, 96; and ‘famine railways’, 95; in  
India, 71, 80, 84, 93–6, 180, 223; and  
irrigation, 67, 85, 103; in Netherlands  
Indies, 86–8, 91; in Vietnam, 197–202.  
*See also* Bengal Famine, Great Vietnam  
Famine
- Fashoda Incident (1898), 61
- First Anglo-Burmese War, 29
- First World War, 61, 219; and hydroelec-  
tricity, 296–97, 304, 308
- fisheries, 1–5, 7–8, 11, 13–14, 17, 29, 59,  
127, 205–10, 221–24, 318, 320, 322–23,  
342, 348, 367–68, 374–76, 378–82;  
and competing development models,  
204–5, 223, 370–72, 376; conserva-  
tion of, 210–15; and damage caused by  
dams, 12, 135, 209; mechanization of,  
216–20, 224–26, 369, 372–73; and  
species transfers, 10, 226–40
- flooding, 2–5, 7–8, 11–14, 23, 35, 39, 49, 62,  
64, 74–7, 90–1, 103–8, 110–11, 113–14,  
116, 118–19, 125–31, 137, 159, 206–7,  
209, 243, 285–86, 308, 314, 320, 325–26,  
330, 338, 347–48, 350; and climate  
change, 2, 385–86, 389; in India, 26,  
31, 45–6, 55, 70–4, 102, 125, 148–49,  
161–70, 174–82, 252, 259, 285–86, 290;  
and ‘lock in’, 178, 182–8, 191, 197, 199;  
and social consequences, 66, 133–35,  
155, 160–61, 174–76, 202, 356, 360,  
390–92; in Tonkin, 183–201
- Fonds pour l’investissement en dével-  
oppement économique et social  
(FIDES), 311, 316
- Food and Agriculture Organization of the  
United Nations (FAO), 3, 369, 372, 378
- Franzius, Ludwig, 51
- French Sudan, 36–7, 145, 157
- Front for the Liberation of Mozambique  
(FRELIMO), 324–25
- Furnivall, John, 44
- Gallieni, Joseph, 36
- Gandhi, Mahatma, 295, 388
- Ganges Canal, 82–4, 109, 150; construc-  
tion of, 80–83; design flaws of, 83, 101

- Ganges River, 25, 38, 46, 55, 174, 266; and irrigation, 79, 162, 170; as navigation route, 26-32, 64; pollution of, 262; seasonal fluctuations of, 31-2. *See also* Ganges Canal
- Garnier, Francis, 38-40
- General Irrigation Plan (Netherlands East Indies), 90
- Gezira Scheme, 157, 314, 345
- Ghana, 331; fisheries in, 370, 376; hydroelectricity in, 317-20. *See also* Gold Coast
- Godavari River, 71-3, 102
- Gold Coast, 63; hydroelectricity in, 315, 317; urban sanitation in, 263. *See also* Ghana
- Gold Coast Water Works Ordinance, 263
- Gourou, Pierre, 187, 197
- Graham, Michael, 233-34
- Grand Canal (China), 5
- Grand Renaissance Dam, 350
- Grand-Bassam, 62
- Great Vietnam Famine, 199-200
- 'Green Revolution', 137, 341, 353, 369; environmental consequences of, 355; and irrigation, 354; and social polarization, 355, 373
- Grobogan Regency (Java), 86
- groundwater extraction, 3, 253-54, 265, 354-55
- Gruvel, Abel, 222
- Guernier, Eugène Léonard, 306
- Guinea, 221, 315-16, 331, 376
- Guyana, 315
- Haiphong, 40, 42, 54, 191
- Hall, Sir John, 312
- Hanoi, 40-2, 184, 186, 189, 199-200, 241, 260-61
- Hausmann, Baron Georges-Eugène, 246
- Hickling, Fred, 322
- Himalayas, 68, 81, 148, 162, 228, 286, 386
- Hirakud Dam, 181-82, 350, 356-57
- Ho Chi Minh, 200-1
- Hooghly River Pollution Enquiry, 263
- Hooghly River, 57, 172; flooding along, 173; as navigation channel, 27-8, 54-5; pollution of, 249, 252, 262-63
- Hornell, James, 225-26, 371, 378
- Howard, Albert, 157
- hydroelectricity, 5, 8, 13-4, 147, 279-327, 330, 340, 351, 382; and electricity markets, 289, 301-4; and environmental consequences, 325-26, 337, 358-59; importance of minerals industry for, 300-1, 314-18; and inter-regional disputes, 342-43, 347; origins of, 282-84; and shortage of capital, 286-87
- Idenburg, A. W. F., 91
- India, 25, 29, 37-8, 67, 84, 86, 123-24, 126-27, 136-37, 157, 171-73, 181-82, 186-87, 190, 192, 201, 245, 249, 251, 257, 261-63, 266, 268, 273, 330-37, 361-63, 385, 388; fisheries in, 203, 207-15, 219, 223-26, 228-30, 369-72, 375, 381; flooding in, 8, 127, 161-70, 174-81, 183; hydroelectricity in, 282, 284-97, 299-302, 208, 312, 350-58; irrigation in, 7, 10, 68-84, 93-102, 109, 117, 120, 148-53, 156; and navigation, 26-28, 30-1, 42-47, 54-57
- Indian Famine Commission, 223
- Indian Industrial Commission, 287, 297
- Indian Irrigation Commission, 96-7, 151
- Indian Meteorological Department, 173-74
- Indian National Congress, 332
- Indian Ocean, 37, 321; as category of historical analysis, 9
- Indian Partition (1947), 332-37
- Indian Rebellion (1857), 93
- Indochina, 133-35, 250, 338; electrification in, 298, 302-3; fisheries in, 209, 212-15, 219, 228, 230, 375; flooding in, 129-31, 182-99, 201; French colonization of, 37-9; land reclamation in, 125, 131-32, 136-37; and Second World War, 198-200; transport in, 42-46. *See also* Cambodia, Cochin China, Laos, Tonkin, Vietnam
- Indo-Norwegian Project for Fisheries Community Development (INP), 371-72
- Indus River, 152, 334-37, 339, 347, 351, 385; and irrigation, 97, 148, 332; and navigation, 32. *See also* Punjab, Canal Colonies, Indus Waters Treaty
- Indus Waters Treaty (1960), 337
- Inga Falls (Congo), 301, 351, 357
- Institut océanographique de l'Indochine, 219

- Intergovernmental Panel on Climate Change (IPCC), 383–85
- International Institute for Tropical Agriculture, 353
- International Monetary Fund, 366
- International Rice Research Institute, 353
- International Rivers Network, 357
- International Union for the Conservation of Nature (IUCN), 341, 357
- Irrawaddy Delta, 40, 133–36, 166, 179, 206–7; land reclamation in, 127–29; migration to, 125–27, 137. *See also* Irrawaddy River
- Irrawaddy Flotilla Company, 44, 126
- Irrawaddy River, 38; as navigation channel, 29, 44, 127
- irrigation, 7, 9–12, 14, 17, 43–4, 56–121, 125, 149, 157–58, 167, 181, 206, 223, 243, 281, 287, 298–99, 302, 309, 312, 314, 320, 324, 326, 338–39, 354; and environmental consequences, 11, 100–102, 104, 116, 156, 209, 337, 342, 355–56; and famine relief, 84, 87–8, 96; and incompatibility with navigation, 80–1, 127; and political implications, 5, 10, 65, 93, 102, 120–21, 293, 332–35, 345–50, 352, 358; and ‘productive’ versus ‘protective’ works, 85, 94–5, 184, 194–95, 197; and profitability, 5, 65–6, 70, 88, 93–4, 97, 151, 156; and regional inequalities, 100; and social polarization, 99, 153. *See also* perennial irrigation
- Isma’il Pasha, 107
- Jakarta, 2, 52; urban sanitation in, 361–62, 364. *See also* Batavia
- Jamaica, 315
- James, Charles Carkeet, 258, 260
- Japan, 14, 339, 351, 354, 369, 375; as imperial power, 5, 16; as market for seafood exports, 373, 380; as model for fisheries development, 216, 223–26, 230; and occupation of Indochina, 128, 179, 198–200, 310
- Java, 42, 65, 213, 285, 298, 351; agriculture in, 68, 75, 86–88; famine in, 86–7, 199, 352; fisheries in, 207–8, 210, 212, 218, 220, 229, 375; irrigation in, 74–9, 85–6, 88–92, 120, 194–96, 352
- Jevons, William Stanley, 284
- Jhelum River, 148, 151–52, 335–36, 351
- Jonglei Canal, 348–49, 358
- Jumna (Yamuna) River, 26, 79–81, 83–4. *See also* Eastern Jumna Canal, Western Jumna Canal
- Kafue Gorge Dam, 351
- Kainji Dam, 351, 355
- Kalahari Redemption Scheme, 147
- Karachi, 52, 54
- Kariba Dam, 321–25, 356
- Kashmir, 228, 334, 336
- Kerala, 371–73, 378
- Khartoum, 103, 113, 346
- Khône Falls, 39, 338
- Khosla, Ajudhiya Nath, 181
- King Léopold of Belgium, 47–8
- Klunzinger, Carl, 103
- Koch, Robert, 247
- Kosi River, 27, 162, 164, 168
- Kossou Dam, 351, 355
- Krishna River, 71–3, 102
- Krishnarajasagar Dam, 293–94
- Kumasi, 254, 366
- Lagos, 33; port of, 62–3; urban sanitation in, 254, 263–65, 270–71, 361, 365
- Laing, Gordon, 33
- Laird, Macgregor, 33–6
- Lake Alaotra (Madagascar), 231–32
- Lake Albert, 235
- Lake Chad Replenishment Scheme (‘Transaqua Project’), 358
- Lake Chad, 33, 309, 358
- Lake Itasy (Madagascar), 232
- Lake Kivu, 238, 323
- Lake Nasser, 120, 348. *See also* Aswan Dam
- Lake Tanganyika, 238, 323
- Lake Victoria, 279–80, 344; and fishing, 233–40; and hydroelectricity, 312–14; and introduction of exotic species, 237–38
- Lamminga, A. G., 92
- land reclamation, 156–8, 175; in Burma, 125–29; in Cochin China, 129–33; for port construction, 54–7; in Punjab, 148–56
- Lander, John, 33
- Lander, Richard, 33

- Laos, 124; hydroelectricity in, 338-43, 358; river navigation in, 39
- Latour, Bruno, 19
- Lavoisier, Antoine, 245
- League of Nations, 230
- Léopoldville, 48-52, 241
- Leroy- Beaulieu, Paul, 304
- Lessepsian migration, 120
- Liberia, 60
- Lilienthal, David, 335-36
- Linant de Bellefonds, Louis Maurice Adolphe, 106
- Livingstone, David, 39
- 'lock in', 183; and flood defenses, 191, 197-99
- Lower Chenab Canal, 150-54
- Lower Ganges Canal, 83
- Lualaba River, 47
- Ludwig, Emil, 121
- Lufira River, 300
- Lyautey, Louis-Hubert, 273
- Mackenzie, Donald, 32, 145-46
- Madagascar, 229; fisheries in, 231-33; sanitation in, 276
- Madras Fisheries Department, 224-26, 230
- Madura, 42, 68, 219
- Mahanadi River, 181
- Malacca Strait, 53, 217, 220, 375
- malaria, 32-38, 49, 80, 101, 118, 134, 144, 156, 228, 271, 309, 320, 330, 356
- Mali, 298, 354
- Mangla Dam, 351
- mangrove, 3, 53, 171-72, 390; and aquaculture, 125; destruction of, 134-36, 172, 381; as flood defense, 32
- Manila, 2, 53
- Matadi, 47-52
- Matadi-Léopoldville Railway, 49
- Mauritania, 61, 354, 376; and fisheries, 221-22
- Mediterranean Sea, 120, 139-43, 306-9
- Meghna River, 172-74
- Mekong Committee (Mekong River Commission), 338-42
- Mekong Delta, 38, 166, 196, 338; and land reclamation, 129-37; migration to, 186-87
- Mekong Exploration Commission, 38-40
- Mekong River, 64, 125, 129-37, 183, 207, 219, 337-43; and navigation, 38-47
- Mesopotamia, 10, 65
- Messageries fluviales de Cochinchine (Messageries à vapeur de Cochinchine), 39
- Mettur Dam, 230, 293-94
- Mississippi River; and flooding, 183; as navigation model, 51
- Mobutu Sese Seko, 351
- Mombasa, 45, 254
- monsoon, 9, 26, 45-46, 56, 65-121, 125, 148, 159, 161, 166, 170, 206, 219, 252, 286, 290, 351-52, 391. *See also* seasonality
- Mougel, E., 106
- Mozambique; harbours in, 60; hydroelectric development in, 323-26
- Mughal Empire, 25-26, 79, 148, 163
- Muhammad 'Ali, 105, 116
- Mulshi Dam, 294-96
- Muslim League, 332
- Mysore, 287-88, 292-94, 302
- Nairobi, 45; electrification of, 304; water supplies of, 254, 285, 363
- Narmada Project, 357-58. *See also* Sardar Sarovar Dam
- Narmada River, 357
- Nasser, Gamal Abdel, 119-20
- navigation, 11-12, 130, 134, 140, 318; and incompatibility with irrigation, 72, 80-81; and railways, 44, 47-52; and river improvement, 23-24, 28-29, 40-41, 44, 55. *See also* ports
- Nehru, Jawaharlal, 330, 334, 350, 357-58
- Netherlands Indies, 7, 67, 85, 91; fisheries in, 375; hydroelectricity in, 302; irrigation in, 7, 68-9, 74-8, 85-93, 230. *See also* Indonesia
- New Delhi, 272-73, 334. *See also* Delhi
- 'new imperialism', 6, 21, 281
- Nguyen dynasty, 184
- Nguyen Van Huyen, 196
- Nicholson, Frederick, 223-26, 371
- Niger River, 60, 157, 351; European exploration of, 32-37; fisheries of, 206-7
- Nigeria, 33, 60, 64, 158; and dam-based development, 351, 354, 356, 361; hydroelectricity in, 300
- Nile Basin Initiative, 349
- Nile River, 32-33, 47, 66, 206, 235, 268-69, 279, 306, 313-14, 358; and Egyptian irrigation, 102-21; and international

- disputes over water, 61, 343–50; as single hydraulic unit, 113–14. *See also* Nile Waters Agreements (1929 and 1959), Blue Nile, White Nile  
Nile Waters Agreements (1929 and 1959), 313, 345–7  
Nira Canal, 95  
Nisbet, John, 135  
Nkrumah, Kwame, 317–20, 329  
Northern Rhodesia, 206, 300, 321  
Nubar Pasha, 102  
Nyasaland, 299  
Nyerere, Julius, 346–47, 351  
  
Office de recherches et d'organisation des pêcheries de l'Afrique occidentale française, 299  
Office du Niger, 157  
Office indochinois du riz, 195  
'Operation Noah', 323, 325  
Opium Wars, 37  
Orissa, 162, 164–7, 171, 173, 176–77, 179, 181–82, 230  
Orr, Charles, 72  
Owen Falls Dam; construction of, 280; disputes over, 314  
  
Pa Mong Dam, 339, 341–42  
Padma River, 31  
Pakistan, 124; dam building in, 351, 358; irrigation in, 331–37  
palm oil, 32–36, 61  
Panama Canal, 144–46  
Park, Mungo, 33  
Pasquier, Pierre, 131  
Pasteur, Louis, 247  
Péchiney Ugine, 316–17  
Penner River, 72–73  
perennial irrigation. *See* irrigation  
Permanent Settlement (1793); and flooding, 163–64; and land formation, 171  
Petit-Bassam, 62  
Philippines, 124; fisheries in, 375–76, 381; 'green revolution' in, 352–53  
Phnom Penh, 39, 338  
political ecology, 10  
Popular Front, 194  
Port-Bouët, 62  
Port-Etienne (Nouadhibou), 222  
ports, 8, 191, 208, 217, 391; in Africa, 36, 47–52, 59–63, 222; in Asia, 31, 40, 53–60; economic geography of, 52–53, 60; environmental requirements for, 53–60. *See also* dredging  
Post, C. L. F., 78  
Prost, Henri, 273  
Punjab Irrigation Institute, 156  
Punjab, 45, 94, 97, 166, 181, 265, 350, 355; canal colonies in, 148–158; and Indian Partition, 332–37  
  
quinine, 35, 101, 281  
  
Rabat, 273  
Radcliffe, Cyril, 332–35  
railways, 22, 41, 56, 95, 108, 130, 198, 280–81, 287, 302, 306; and river training, 41; and synergies with river transport, 23, 47–52  
Raj, B. Sundara, 225–26  
Rangoon (Yangon), 241, 255–56, 272  
Ravi River, 150  
Red River Delta, 40, 45; dike system of, 182–99; flooding in, 189; and irrigation, 195; population density of, 195  
Red River, 183–200; and navigation, 40–45; volatility of, 192–93  
Revelganj, 31  
rice, 179, 184–85, 230, 338, 352–55; and crop breeding, 110, 114, 162–63, 194–202; and irrigation, 68, 77, 85–87, 125–37, 189; and land reclamation, 71; and mutualistic relationship with sugar cane, 88–91; transport of, 45  
River Hooghly Survey Department, 55  
River Thames, 150, 246  
Rochussen, J. J., 77, 85–86  
Roorkee, 82–83, 109, 181. *See also* Thomason College of Civil Engineering  
Roseires Reservoir, 346  
Roudaire, François Élie, 139–47  
Royal Geographical Society, 39  
rubber, 48, 50, 196, 227, 305  
Russia, 7, 14, 16, 98, 138, 303  
  
Sahara, 59, 123, 138–47, 221, 306, 331, 373  
Saigon, 40, 42, 241; as navigation hub, 38–39; port of, 52–53, 131; urban sanitation in, 249, 254  
Sain, Kanwar, 350  
Saint-Louis, 60–61; water supplies for, 254, 259

- salinization, 101–2, 156, 308, 337, 355; and irrigation, 116–17
- Sambor Dam, 339
- Sampean River, 75–78
- Sanaga River, 316, 326
- sanitation, 2–3, 5, 10–13, 17, 155, 241–78; and commodification of water, 263–4; and competing forms of knowledge, 269–70; and environmental conditions, 258–63; opposition towards, 263–70; in post-colonial cities, 360–67; and social discrimination, 270–78
- Sardar Sarovar Dam, 358. *See also* Narmada Project
- Schwarz, Ernest, 147
- Scott-Moncrieff, George, 45
- seasonality. *See* monsoon, ‘tropicality’
- Second World War, 59, 63, 301, 328; and famine, 178–80, 198–201; as a spur for hydroelectric development, 315
- Seine River, 26
- Semarang Famine Commission, 91
- Senegal River, 36, 60–61, 354
- Senegal, 36, 157, 206, 221–22, 259, 354, 370, 376, 380
- Shanghai, 38
- Siam (Thailand), 38.
- Sieglwart, Bruno, 309. *See also* Atlantropa Scheme
- siltation, 57, 102; and accumulation in reservoirs, 70, 182; and flood control, 190–92
- Singapore, 124; port of, 52–53; urban sanitation in, 241, 249, 263–8, 272, 275–76
- Sivasamudram (Cauvery Power Works), 288–89, 293–94
- slave trade, 32–34
- Sobat River, 345, 348
- Société française d’entreprises de dragages et de travaux publics, 131
- Solani Aqueduct, 82
- Solo Valley Project, 90–92
- Sörgel, Herman, 147, 358; 306–10. *See also* Atlantropa Scheme
- South Africa, 147, 221; and hydroelectricity, 297, 299, 324–26; railways in, 42; sanitary divisions in, 272
- Southern Rhodesia, 299, 300, 303; electrification in, 321
- Soviet Union, 353; as development model, 305, 328; and long-distance fishing, 373
- Spengler, Oswald, 308
- Stanley Pool (Pool Malebo), 47–50
- Stanley, Henry Morgan, 47–48
- steamboats, 60, 281; military importance of, 29–30; and river transport, 32–35, 48
- Stockholm International Water Institute, 390
- Strachey, Richard, 93
- Strauch, Maximilien, 48
- Sudan, 7, 36–37, 157, 331, 343; invasion of, 112, 145; irrigation in, 111–14, 118–19; and Nile Waters Agreements, 346; and Owen Falls Dam, 313–14
- Suez Canal, 9, 55, 103, 108, 140, 314; and climate amelioration, 142; and Lessepian migration, 120
- sugar, 30, 114, 152–53, 210, 282, 285; and Cultivation System, 74–75, 85–91; and mutualistic relationship with rice, 88–89
- Suharto, 351, 364
- Sukarno, 351, 364
- Sundarbans, 172, 175
- Surabaya River, 87
- surfboats, 57, 62
- Suriname, 315
- Sutlej River, 148, 151, 336
- Syndicat d’études du Bas-Congo (Syneba), 301
- Tai Tam Reservoirs (Hong Kong), 253–54
- Tana River, 354
- Tansa Reservoir (Bombay), 251–52, 257
- Tarbela Dam, 351
- Tata Hydro-Electric Company, 291
- Technical Cooperation Committee for the Promotion of Development and Environmental Protection of the Nile (TECCONILE), 349
- Temple, Sir Richard, 94, 175
- Tennessee Valley Authority, 181
- Thomason College of Civil Engineering, 109. *See also* Roorkee
- Timbuktu, 33, 36
- Tonkin, 68, 299, 330; emigration from, 196; flooding in, 182–202; French colonization of, 40. *See also* Red River, Red River Delta

- Tonlé Sap, 39; as dam site, 337–38; fisheries of, 207, 209–10, 214–15  
Touzet, André, 188  
Travancore, 228, 371  
Triple Canals Project (Punjab), 151–52, 332  
‘tropicality’, 4  
Tulloch, Hector, 267–68  
Tungabhadra Dam, 181, 350  
Tunisia, 331; and desert reclamation, 139, 141, 144, 147
- United Nations Conference on the Law of the Sea, 376  
United Nations, 3, 312, 376, 383, 391  
United States Geological Survey, 300  
United States, 7, 66, 98, 154, 328, 337, 370–71; agricultural frontier of, 157; as cotton exporter, 107; and development assistance, 180–181, 337–40; hydroelectricity in, 283–84, 298, 312–13, 318–19; as model for economic development, 305; and transfers of aquatic species, 227  
‘Urabi Revolt (1882), 108
- Van de Putte, I. D. Franzen, 89  
Van den Bosch, Johannes, 74  
Van Deuren, Pierre, 301  
Van Thiel, C., 75–76, 86  
Varrentrapp, Georg, 245  
Vehar Reservoir (Bombay); construction of, 251; and environmental obstacles, 259  
Verne, Jules, 146,  
Vichy regime, 198  
Victoria Falls, 300  
Vientiane, 39, 338  
Viet Minh movement, 198, 200–201  
Vietnam, 124, 129, 132–33, 331; fisheries of, 375, 381, 385; and green revolution, 353; and Mekong Committee, 338–43. *See also* Indochina
- Villermé, Louis-René, 245  
Visvesvaraya, Mokshagumdam, 293–94  
Volta Aluminium Company Ltd (VALCO), 319  
Volta River Authority. *See* Volta River Project  
Volta River Project, 317–20, 351, 356  
Von Coudenhove-Kalergi, Richard, 305  
Vridi (Canal de Vridi), 62–64
- water hyacinth, 119, 179  
Water Power Committee of the Conjoint of Scientific Societies, 297  
waterlogging, 100–1, 117–18, 179; and flood defenses, 79–80; and irrigation, 81, 156, 243, 337, 355  
Western Ghats, 56, 71; and hydroelectricity, 290–94  
Western Jumna Canal; construction of, 79; environmental consequences of, 109  
Westlake, Charles, 313  
Wheeler, Raymond A., 339  
White Nile, 103, 113, 157, 279, 345  
White, Gilbert, 341  
Willcocks, William, 100, 102, 104–12, 117, 165–67  
Wittfogel, Karl, 10  
World Bank, 1, 318–19, 336, 341, 349, 357–58, 366, 372  
World Commission on Dams, 357–58  
World Economic Forum, 1  
World Meteorological Organization, 385  
Worthington, Edgar, 234–38
- Xayaburi Dam, 342–43
- Yangtze River, 39  
Yunnan, 38, 40, 42, 183
- Zambezi River, 232, 306, 309; and hydroelectricity, 321–26