Introduction

In 1968, the floodwaters of the recently completed Cocorobó Dam submerged the remnants of the site of the Canudos Massacre, one of the most traumatic and infamous episodes in Brazilian history. In the 1880s, a local preacher, Antônio Conselheiro, had amassed a large following and built a small settlement – which he named Belo Monte [Beautiful Hill] – near an area known as Canudos, an impoverished part of the semiarid interior of the northeastern state of Bahia. In 1889, military officers overthrew the monarchy that had ruled Brazil since independence (1822) and installed a republic. The new government soon came into conflict with the preacher and his followers, seeing them as a potential source of opposition.

In October 1896, after a dispute broke out between Conselheiro and a local lumber merchant, the state government sent troops to the town to forestall bloodshed. The troops, instead, moved against Canudos, but were repelled by its residents, prompting the state government to call on the federal government for help. Over the course of a year, the federal government sent four military expeditions to quash the previously peaceful dissidents. After three defeats, the heavily armed fourth expedition overran the town and slaughtered nearly all its inhabitants. Historians estimate the death toll was somewhere between 15,000 and 30,000, including both town residents and federal troops. The surviving residents fled the town, and the military retreated, leaving behind the ruined foundation of the town and the remnants of battle. The historic site sat mostly untouched for seventy years, when the rising floodwaters drowned it.[1]

[1] On Canudos, see the firsthand account of journalist Euclides da Cunha, who accompanied one of the military expeditions, *Os sertões: campanha de Canudos* (Rio de Janeiro:

The Cocorobó Dam was a long time coming. The reservoir was the brainchild of President Getúlio Vargas, who was famous for strengthening the federal government and promoting state-led economic growth. The National Department for Works to Combat Drought [Departamento Nacional de Obras Contra as Seca, DNOCS] designed and built the dam to provide irrigation water for farmers. Construction began in 1951, but soon stalled. The project was not even half complete in March 1964, when military officers orchestrated a coup that toppled the government and installed a dictatorship that lasted more than two decades. The generals accelerated construction. In December 1967, engineers and their teams finished the dam, and during the subsequent months, the reservoir began to fill.

The dam was controversial, though it was finished with little fanfare. The federal government maintained that its motivations for choosing the site were purely empirical. That is, the location was simply the best choice in technical terms, and the fact that it flooded a historic site was an unfortunate secondary effect. In contrast, critics argued that the government built the dam for the explicit purpose of inundating the site of Canudos, a tragedy in which the military and the republican government were the villains. Regardless of intent, the result was the same – the remnants of one of the country's most important historic sites were drowned.[2]

But the reservoir had an ironic twist. Although it erased the material remnants of the massacre, it breathed new life into the mythology surrounding it. During his time as a lay preacher, Conselheiro predicted that someday the desert would become the sea, and the sea would in turn become the desert. Of course, he expected that divine providence, not engineers working for the federal government, would be the architect of this profound transformation. But for Northeasterners familiar with the tales of Conselheiro and his prophecies, the effect was the same. His prediction seemed to be coming true; the desert was becoming the sea.

Laemmert Editores, 1902), translated in English by Samuel Putnam as *Rebellion in the Backlands* (Chicago: University of Chicago Press, 1944); Mario Vargas Llosa's fictionalized account, *La guerra del fin de mundo* (Barcelona: Seix Barral, 1981), translated in English by Helen R. Lane as *The War of the End of the World* (New York: Farrar, Straus and Giroux, 1984); Robert M. Levine, *Vale of Tears: Revisiting the Canudos Massacre in Northeastern Brazil, 1893–1897* (Berkeley: University of California Press, 1992); Marco Antônio Villa, *Canudos: O povo da terra* (São Paulo: Editora Ática, 1995); and Adriana Michele Campos Johnson, *Sentencing Canudos: Subalternity in the Backlands of Brazil* (Pittsburgh: Pittsburgh University Press, 2010).

[2] On Cocorobó Dam, see Comitê Brasileiro de Barragens (CBDB), *A História das Barragens no Brasil, Séculos XIX, XX, e XXI: Cinquenta Anos do Comitê Brasileiro de Barragens* (Rio de Janeiro: CBDB, 2011), 85–86.

The story has a second irony. The reservoir was part of a broader dam-building campaign carried out by the military government that recalled at least one notable characteristic of the infamous Canudos Massacre: its geographic dimensions. The origins of the historic conflict were tensions between the coast and the interior. In the 1890s, upwards of 80 percent of Brazilians lived on the coast, both in metropolitan areas and in the countryside immediately surrounding them. But coastal cities represented just a small fraction of the country's immense territory, and since independence, the government had been aspiring to integrate the country's distant hinterlands into the national fabric. For the republican government, its initial investment in the Canudos campaign was a means of demonstrating its authority in remote areas, though the repression thereafter transcended such logic. The government succeeded in showcasing its might, but at a huge cost: It revealed itself as a perpetrator of violence, which hardly qualified it for the respect and legitimacy it thought it deserved. Cocorobó's reservoir promised to expunge the material traces of this tragedy, but the military regime that built it was then planning a spate of big reservoirs – most to produce hydropower – that also engendered violence against marginalized communities in the interior.

The motivations for dam building were of a different nature than those that drove the Canudos Massacre, but other similarities make the comparison compelling. The percentage of Brazilians living along the coast had changed little between the 1890s and 1960s, and both offensives emanated from the federal government and were intended to integrate hinterlands into the national fabric. Although the Canudos Massacre was far more lethal than the dam-building campaign, reservoirs also entailed violence, displacing hundreds of thousands of people from their homes. Thus, there was tremendous irony in trying to erase the material remnants of one of the country's most tragic assaults on the interior with a tool that would also inflict violence against hinterland communities. While Cocorobó's reservoir was quietly covering the vestiges of Canudos, the administration that finished it was planning a series of even bigger interventions in the interior that would bring immense benefits for some and considerable suffering for others.

Between 1964 and 1989, the Brazilian military dictatorship and the civilian administration that succeeded it in 1985 built some of the world's biggest and most environmentally controversial hydropower dams, whose combined installed capacity totaled 45,000 megawatts. Most of the power and environmental controversies came from about twenty-five big dams with high output and big reservoirs (Figure I.1). Just five dams

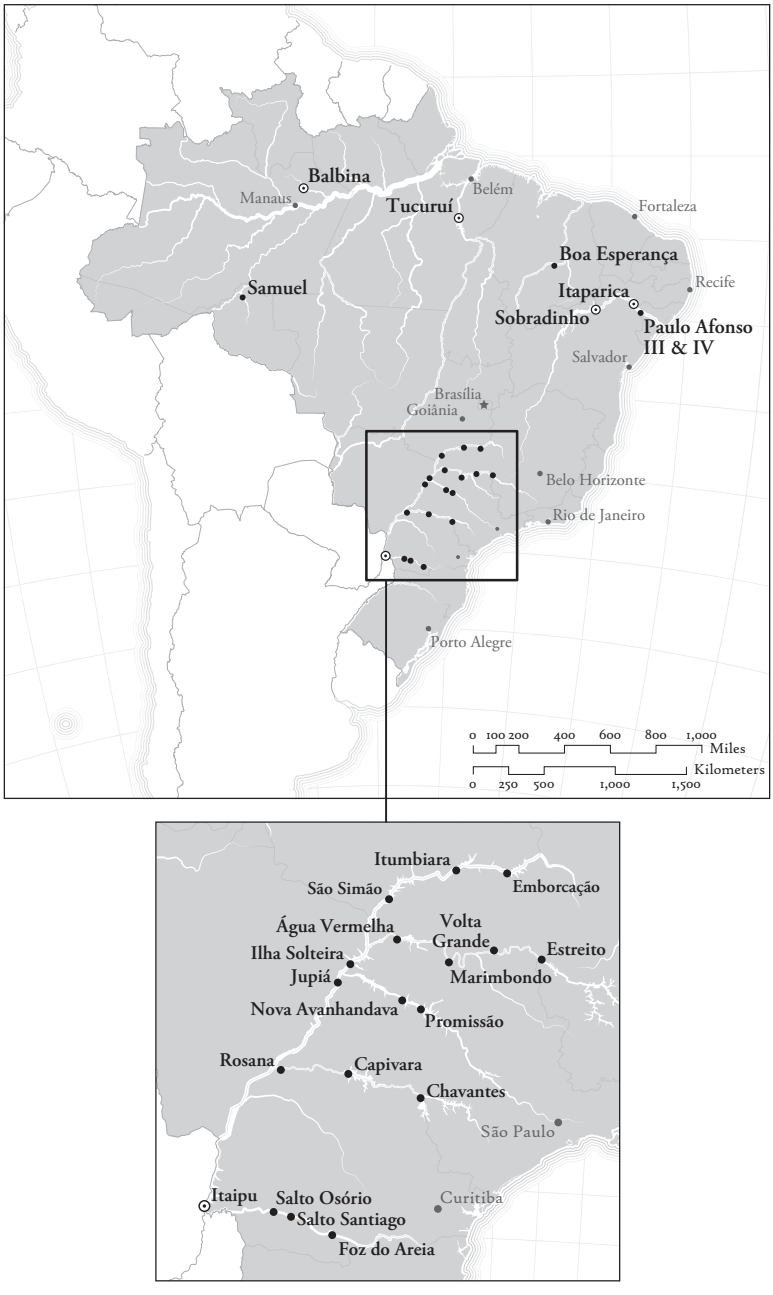

FIGURE 1.1. Brazilian hydropower dams, 1964–1989. Showing all dams built during this period with an installed capacity greater than 500 megawatts and/or a reservoir greater than 200 sq. km. The dams featured in this book are highlighted with circled dots. Map by Geoffrey Wallace(G. Wallace Cartography & GIS).

alone accounted for more than half of this installed capacity, and their massive reservoirs bore the brunt of criticism related to social and environmental impacts. They are the focus of this book.[3]

The first two are Sobradinho and Itaparica, two big reservoirs built on the São Francisco River, a long and voluminous river referred to as the Brazilian Nile because it flows south to north through the semiarid northeast of Brazil. Sobradinho (1971–1978)[4] was the dictatorship's first big dam, and it created the largest reservoir in South America. The military regime started construction on Itaparica (1975–1988) shortly thereafter, and the subsequent civilian government finished it.

The third featured dam is Itaipu (1973–1982), a binational dam on the mighty Paraná River, which forms a stretch of the Brazilian–Paraguayan border in the southwestern corner of the country. The dam was built in the remnants of the Atlantic Rainforest and was famous for being the world's then-biggest power plant in terms of installed capacity. Only China's Three Gorges Dam (1994–2003) has since outstripped it, and Itaipu remains the world's most productive power plant in terms of the cumulative electricity it has produced over its lifetime.

The final two featured dams are in the Amazon Rainforest. The fourth is Tucuruí (1975–1985), a big dam erected on the lower stretches of the Tocantins River, on the eastern edge of the rainforest. It was the first giant reservoir built in the Brazilian Amazon, and it was Brazil's second-most productive power plant after Itaipu. The fifth is Balbina (1981–1989), a big dam on the Uatumã River, a tributary of the Amazon, whose headwaters are about 150 kilometers north of Manaus. It was the last and most controversial of the military government's big dams, and, after a series of delays, the civilian government finished it – both Itaparica and Balbina were almost done when the military regime stepped down in 1985, and the civilian politicians that replaced the generals shared the commitment to finishing both dams.

[3] For further details and comparison with Brazilian dam building before and since, see Matthew P. Johnson, "Temples of Modern Pharaohs: An Environmental History of Dams and Dictatorship in Brazil, 1960s–1990s," (PhD Diss., Georgetown University, 2021), 17–31.

[4] The timelines listed here refer to the year that the government officially greenlit the dams and the year in which their reservoirs finished filling. In some cases, dam sites had been studied for many years prior to official authorization, and in other cases, construction was delayed for years after authorization. In most cases, reservoirs filled months or years before turbines began generating power, and in all cases, the government continued to install additional turbines to generate power in the years after the reservoirs filled.

In contrast to the reservoir that flooded the remnants of the Canudos Massacre site, which stored water for irrigation, these big dams were designed to generate electricity to power cities and industrial centers.[5] When the construction dust settled in 1990, hydropower provided about 93 percent of the country's electricity, and Brazil had become one of the world's largest hydroelectric producers (it remains second only to China).[6] Hydropower remains Brazil's main source of electricity, and the military regime's dams continue to account for a considerable portion of that grid, about 30 percent of the country's total electricity generation, and about 45 percent of the country's hydropower generation.[7]

Brazil's dam-building boom was in turn part of a larger regional trend. Hydropower has been instrumental in Latin America's rapid urban and industrial growth, and during the latter decades of the twentieth century, dams generated upwards of 60 percent of the electricity consumed in the region. Mirroring Brazil's own trajectory (discussed in Chapter 7), this percentage has dropped to roughly 40 percent over the last two decades, but Latin America remains well above the world average of 16 percent, and in some countries – such as Costa Rica and Colombia – hydropower still accounts for more than 60 percent of electricity consumed.[8]

The output of these dams supported industrialization and urbanization and did so with comparatively few greenhouse gas emissions. Reservoirs emit methane and other greenhouse gases, as discussed in greater detail in the chapters ahead, but most do so at much lower rates compared to fossil-fuel-powered electrification. Globally, hydropower spares the

[5] For more on DNOC irrigation dams, see Anthony Hall, *Drought and Irrigation in North-East Brazil* (New York: Cambridge University Press, 1978), and Eve E. Buckley, *Technocrats and Politics of Drought and Development in Twentieth-Century Brazil* (Chapel Hill: University of North Carolina Press, 2017).

[6] This figure comes from the International Energy Agency (IEA)'s webpage on Brazil's energy profile, https://www.iea.org/countries/brazil (last accessed April 2023). The Ministério de Minas e Energia's Sistema de Informações Energéticos and Brazilian energy expert Antônio Dias Leite list the figure at around 87 percent in the early 1990s, though their calculations include only the Brazilian half of Itaipu's output, despite the fact that Paraguay sells most of its share to Brazil. See Dias Leite, *Energia do Brasil, 3ª edição* (Rio de Janeiro: Editora Nova Fronteira, 2014), 296.

[7] Author's calculations.

[8] The latest regional-level data is from 2015. Paraguay gets almost 100 percent of its electricity from hydropower, most of which comes from the Itaipu Dam. In Costa Rica, hydropower accounts for roughly 75 percent of the country's electricity. In Panama, Colombia, Venezuela, Suriname, and Uruguay, the figure is 60 percent or higher. All countries in the region except for Mexico, Nicaragua, Guyana, and French Guiana are well above the world average. See World Bank Online Database, https://data.worldbank.org/indicator/EG.ELC.HYRO.ZS (last accessed April 2023).

Earth's atmosphere more greenhouse gas emissions than any other source of low-carbon (i.e., renewable) electricity. The annual carbon savings of the collective output of dams worldwide are somewhere between three and eight gigatons (global annual carbon emissions are about 40 GT).[9]

Most of the Brazilian military regime's dams were low-emission power plants, but they also unleashed a host of other damaging social and ecological impacts. Big reservoirs flooded the lands of Indigenous communities and farmers, erased cherished landscapes, and set in motion a series of ecological transformations with deleterious consequences for those nearby.

This book is an environmental history of this dam-building boom that explores the military government's motivations for building big dams, its efforts to mitigate their environmental impacts during the planning and construction stages, and the social and environmental consequences after reservoirs filled. It builds on and contributes to scholarship in the fields of energy and environmental history that focuses on past experiences with low-carbon energy, which offer important lessons for countries ramping up investment in renewables in order to mitigate the impacts of climate change.[10] The case of Brazilian dams suggests that building up an arsenal of low-carbon energy will come with its own social and environmental costs and that citizens will have to be attentive to holding companies and governments accountable for social and environmental justice.

This book also builds on and contributes to the scholarship on authoritarian environmentalism. The high stakes of a looming climate

[9] The lower figure comes from Luis Berga, "The Role of Hydropower in Climate Change Mitigation and Adaption: A Review," *Engineering* 2 (2016): 313–318, and the higher figure comes from author's calculations, extending the data presented in Chapter 3 to hydropower's worldwide installed capacity.

[10] Hydropower and nuclear energy – the two biggest low-carbon energy technologies to date – have deep historiographies, though most scholars have not framed their work in the context of the technologies' low-carbon properties. For a sampling of recent literature on other forms of low-carbon energy, see Marianna Dudley, "When's a Gale a Gale? Understanding Wind as an Energetic Force in Mid-Twentieth Century Britain," *Environmental History* 26, no. 4 (October 2021): 671–695; Jennifer Eaglin, *Sweet Fuel: A Political and Environmental History of Brazilian Ethanol* (New York: Oxford University Press, 2022); Thomas D. Rogers, *Agriculture's Energy: The Trouble with Ethanol in Brazil's Green Revolution* (Chapel Hill: University of North Carolina Press, 2022); James Morton Turner, *Charged: A History of Batteries and Lessons for a Clean Energy Future* (Seattle: University of Washington Press, 2022); and Elizabeth Chatterjee, "The Poor Woman's Energy: Low-Modernist Solar Technologies and International Development, 1878–1966," *Journal of Global History* 18 (November 2023): 439–460.

catastrophe and the desultory efforts of governments throughout the world to divest from fossil fuels have compelled some scholars to look to China's recent environmental actions as a model for "authoritarian environmentalism" and to probe past dictatorships for evidence of successful environmental interventions.[11] The case of Brazilian dam building provides more evidence for the environmental failures of authoritarian governments than successes, with two important points of emphasis.

First, dictatorships, democracies, capitalist and communist governments, and imperial and newly independent governments alike have all supported big dams. Thus, in Brazil, authoritarianism was not the paramount factor motivating dam building, but the regime's search for legitimacy did shape decision-making, and repression did forestall activism that might have mitigated social and environmental impacts. Scholars are right to point out that authors critical of authoritarian environmental management often overlook similar states of affairs in

[11] For scholarship that specifically addresses the desirability of an eco-dictatorship, see David Shearman and Joseph Smith, *The Climate Change Challenge and the Failure of Democracy* (Westport: Praeger, 2007); Mark Beeson, "The Coming of Environmental Authoritarianism," *Environmental Politics* 19, no. 2 (March 2010): 276–294; Bruce Gilley, "Authoritarian Environmentalism and China's Response to Climate Change," *Environmental Politics* 21, no. 2 (March 2012): 287–307; Dan Coby Sahar, "Rejecting Eco-Authoritarianism, Again," *Environmental Values* 24 (2015): 345–366; and Yifei Li and Judith Shapiro, *China Goes Green: Coercive Environmentalism for a Troubled Planet* (Cambridge: Polity Press, 2020). For scholarship that explores the environmental dimensions of past and present authoritarian regimes, see Murray Feshbach and Alfred Friendly Jr., *Ecocide in the USSR* (New York: Basic Books, 1992); Judith Shapiro, *Mao's War against Nature: Politics and the Environment in Revolutionary China* (New York: Cambridge University Press, 2001); Paul Josephson, *Resources under Regimes: Technology, Environment, and the State* (Cambridge: Harvard University Press, 2004); Franz-Josef Brüggemeier et al., eds., *How Green Were the Nazis? Nature, Environment, and Nation in the Third Reich* (Athens: Ohio University Press, 2005); Frank Uekötter, *The Green and the Brown: A History of Conservation in Nazi Germany* (New York: Cambridge University Press, 2006); Timothy Doyle and Adam Simpson, "Traversing More than Speed Bumps: Green Politics under Authoritarian Regimes in Burma and Iran," *Environmental Politics* 15, no. 5 (2006): 750–767; Jeannie Sowers, "Nature Reserves and Authoritarian Rule in Egypt: Embedded Autonomy Revisited," *Journal of Environment and Development* 16, no. 4 (2007): 375–397; Marco Armiero and Wilko Graf von Hardenberg, "Green Rhetoric in Blackshirts: Italian Fascism and the Environment," *Environment and History* 19, no. 3 (2013): 283–311; Stephen Brain and Viktor Pál, eds., *Environmentalism under Authoritarian Regimes: Myth, Propaganda, Reality* (New York: Routledge, 2019); and Miguel Angel Del Arco Blanco and Santiago Gorostiza, "'Facing the Sun': Nature and Nation in Franco's 'New Spain' (1936–51)," *Journal of Historical Geography* 71 (2021): 73–82.

democracies,[12] but the evidence from Brazilian dam building suggests that dictatorship only worsened social and environmental outcomes.

Second, it is not clear that the world has yet seen a regime built on the principle of "authoritarian environmentalism," or the mobilization of authoritarian practices for the purposes of environmental protection. There are, of course, many cases of forceful environmental policies that might be considered "authoritarian environmentalism." However, in such cases environmental care has not been either the motive for authoritarianism or a guiding principle of governance, and such individual policies do not often reflect a strong overall record on environmental affairs.[13]

Similar to other authoritarian governments of the time, the Brazilian military dictatorship's relationship with environmentalism was reactionary and fragmented. The military regime's principal concern was economic development at all costs, and its environmental efforts were its grudging answer to a burgeoning environmental movement that surged at home and abroad in the 1970s and 1980s. Furthermore, this reaction came in response to concerns from groups least subject to repression (such as the Catholic Church and multinational banks) and gained momentum only after the military regime began gradually restoring democratic freedoms in the late 1970s. Further still, the greatest environmental merit of the dictatorship's dams, their carbon savings, was not factored into the decision to build them. Engineers broke ground at dam sites long before the rise of popular concern over climate change in the late 1980s.

Thus, affirming what Yifei Li and Judith Shapiro argue for China, the better phrase to capture the Brazilian dictatorship's environmental actions is "environmental authoritarianism," or the use of environmental policies to maintain or entrench authoritarian rule.[14] The past provides no examples of virtuous eco-dictatorships and ample evidence that pursuing authoritarianism for environmental ends would entail dangerous trade-offs. Governments can implement and enforce stringent environmental regulations within a democratic setting, and history – Brazil's included – provides scant evidence that embracing dictatorship offers a solution to the planet's environmental problems.

[12] Brain and Pál, *Environmentalism under Authoritarian Regimes*, 3, 8.
[13] For an example of forceful environmental policies, see Heejin Han, "Authoritarian Environmentalism under Democracy: Korea's River Restoration Project," *Environmental Politics* 24, no. 5 (2015): 1–20.
[14] See Li and Shapiro, *China Goes Green*, 22–24, 188.

For the world's democracies, an informed citizenry is essential to addressing anthropogenic climate change and related issues of social and environmental justice. Most consumers in urban countries remain largely unaware of the people and environments in the distant hinterlands that sustain them. Since the nineteenth-century, much of the world has industrialized and urbanized, and most people now live in urban or suburban areas. Industrialization has also reached rural areas, and commodity chains increasingly connect these spaces to one another. The resource production chain is often rife with social and environmental injustices, and the first step toward responsible environmentalism is simply knowing what happens in distant hinterlands.

This disconnection is so entrenched that it has become the job of journalists and scholars of environmental history and related disciplines to illuminate the otherwise hidden pathways that connect city dwellers and suburbanites to the most basic resources that sustain them, such as energy, water, and food. Scholars have focused on water, foodstuffs, and building materials and have more recently turned their attention to energy.[15] This book builds on this tradition with the goal of familiarizing Brazilian consumers with the rivers that electrify their cities and factories and encouraging consumers elsewhere to think through parallels between hydropower and the energy sources that sustain their own livelihoods.

One of the most powerful transformations that Brazilian dams brought about for people living near them was the silence that followed the flooding of giant waterfalls. In one case, at Guaíra Falls, the roar was so loud that people in the adjacent town were accustomed to the sound at all times, and the subsequent silence after Itaipu flooded it was one of the reservoir's most disturbing features. This book's most fundamental goal is to bring back this noise, though not in dam-adjacent communities but rather in the minds of those in distant metropolitan areas consuming electric power. I want to replace the soft hum of electrified cities with

[15] For a classic articulation of this goal from an environmental historian, see William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: N.W. Norton & Co., 1991), which covers foodstuffs and lumber. On water, see Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Penguin, 1986); on food, see Sidney Mintz, *Sweetness and Power: The Place of Sugar in Modern History* (New York: Penguin Books, 1986); and Michael Pollan, *The Omnivore's Dilemma: A Natural History of Four Meals* (New York: Penguin Books, 2006); on energy, see Andrew Needham, *Power Lines: Phoenix and the Making of the Modern Southwest* (Princeton: Princeton University Press, 2014), and Christopher Jones, *Routes of Power: Energy and Modern America* (Cambridge: Harvard University Press, 2014).