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Brazil: A Climate, Nuclear, and Security Hotspot

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Introduction

Brazil is the largest country in South America, characterized by its abundant land, natural resources, extensive coastline, and robust economy. Over the last several decades, it has cemented its status as a global renewable energy leader through its ethanol production and hydropower generation. Recognized for producing a modest amount of its electricity with nuclear power, Brazil is actively pursuing its goal of building conventionally armed nuclear-propelled submarines, while continuing to abide by nonproliferation commitments not to acquire nuclear weapons. It also has an enormous base of talent, advanced technological capabilities, and a vision of an emerging world order, led -- to a much greater extent -- by South-South cooperation among Brazil, South Africa, and India.

Brazil asserts its influence in multilateral governance, not only to remind nuclear-weapon states of their commitment to disarm, but also to lead progress toward sustainability. Its success in advocating for the Millennium Development Goals (2000-2015), the precursor to the Sustainable Development Goals (SDGs), led to Brazil holding a seat on the UN High-Level Group monitoring implementation of the SDG Agenda 2030; stated goals include ending poverty and hunger, taking urgent action to address climate change, promoting sustainable use of natural resources, and reducing inequality within and between countries.¹ Brazil has firsthand experience with these maladies. It has been navigating environmental challenges such as higher rates of deforestation and destructive fires while bracing for climate change impacts like extreme weather events, hotter temperatures, and sea level rise. Climate risks in Brazil are likely to manifest in the forms of fresh water stress, higher rates of disease, destructive flooding, and more. Alongside these threats, Brazil has been struggling to manage growing political turmoil, uphold democratic governance, bolster its economy, and navigate its recent federal corruption investigation. Covid-19 is already exacerbating these pre-existing national conditions.

¹ Presidency of the Republic of Brazil: Brazil Debates Sustainability Goals, April 2017, <http://www.brazil.gov.br/about-brazil/news/2017/04/brazil-debates-sustainable-development-goals>

This brief, part of CSR's series on hotspots experiencing unique combinations of climate, nuclear, and security challenges, examines Brazil's nuclear developments, environmental challenges, climate change impacts, and socioeconomic landscape. The magnitude of Brazil's geographic footprint, natural resources, and population helps define the nation as a global power. Yet a growing sense of agitation is rooted alongside the strengths: its pushback against global climate goals; a general public disconcerted by government corruption and increasingly authoritarian actions; a gnawing dissatisfaction with the handling of the pandemic; and a bold assertiveness to prioritize an expensive, indigenous nuclear-powered attack submarine while overlooking what are regarded as perhaps more pressing humanitarian needs. While the country is attempting to manage a multi-layered crisis, it could eventually sink beneath the convergences of these issues and become an alarming case study in what might occur if current institutions are not bolstered to address its growing security threats.

Background

The Amazon rainforest, the largest in the world, traverses the northern and western swaths of the country, and almost 60% of it falls within Brazil's borders. Its importance to the Latin America region (LATAM) and Brazil cannot be overstated. Beyond containing 10% of the world's biodiversity, the Amazon is also multi-functional, acting as a massive heat sponge that creates much of the area's fresh water supply through evaporation. It regulates much of the region's temperature and produces up to 50% of the area's rainfall and 20% of global freshwater resources.² In addition to its vast environmental value, an estimated 30 million people live within the Amazon region.

Agriculture is a powerhouse sector for Brazil and it is considered the largest agricultural exporter in the world. Brazil is a top soybean, sugar, beef, coffee, wheat, cotton, maize, and beef exporter and in 2017, total agricultural exports accounted for almost \$80 billion.³ China is by far its principal market; in 2018, Brazilian exports to China comprised a partner share of almost 27%.⁴ Brazil's agricultural prowess has grown in large part thanks to growing Chinese demand. In 2016, the agricultural industry made up 5.5% of its Gross Domestic Product (GDP). A year later, it employed around 18 million people, or about 15% of the formal economy's workforce. Future projections indicate more growth: Brazil's share in total world exports is expected to reach 14.7% in less than 10 years' time.⁵

Brazil is also a global leader in generating low-carbon power. Renewable energy, mainly from biofuels like ethanol and hydropower, comprise almost 45% of the country's primary electricity mix.⁶ To put this number in perspective, the global average is 14%. The country's transition to ethanol in the 1990s was rapid and extremely successful from an economic perspective. Today, it is the second largest ethanol producer, and more than 70% of the cars driven in the country are able to use an ethanol and gasoline mixture. Brazil is also a major hydroelectric producer, second only to China. In 2018, the energy source met over 70% of the

² United States Agency for International Development (USAID), Climate Risk Profile Brazil: Fact Sheet, April 2018, https://www.climatelinks.org/sites/default/files/asset/document/2018-April-30_USAID_CadmusCISF_Climate-Risk-Profile-Brazil.pdf

³ Food and Agriculture Organization of the UN (FAO), OECD- FAO Agricultural Outlook 2019-2028: Chapter 2. Latin American Agriculture: Prospects and Challenges, 2019, http://www.fao.org/3/CA4076EN/CA4076EN_Chapter2_Latin_American_Agriculture.pdf

⁴ World Integrated Trade Solution (WITS), Trade Summary for Brazil, Brazil top 5 Export and Import partners 2018, last updated September 28, 2020, <https://wits.worldbank.org/CountrySnapshot/en/BRA/textview>

⁵ FAO, Latin American Agriculture, 2019

⁶ International Energy Agency (IEA), Brazil -Countries & Regions, last updated September 27, 2020 <https://www.iea.org/countries/brazil>

country's electricity demand.⁷ It is also exploring wind and solar power sources to bolster its domestic energy production.⁸

Brazil is also keen to transfer technologies or develop domestic wherewithal to produce high-tech goods and services. This includes, for example, a recently-launched electric train, use of satellites to monitor the Amazon, and a new conventional submarine that is longer and heavier than its French counterpart.⁹ Perhaps stung by the memory of historic terms and conditions attached to importing essential commodities (for example, fuel for its nuclear reactors) or outright foreign interference in procurement, Brazilian leadership reminds its audience at every turn that it belongs to an elite group of nations that are capable of enriching uranium. President of *Industrias Nucleares do Brasil* (INB) Gonzaga put it this way: “we are increasingly consolidating ourselves as a technological reference in the nuclear sector on a global scale.”¹⁰

Nuclear Developments: Technology and Sovereignty-Flexing

Over the last 60-plus years, Brazil has engaged in building its nuclear industry. Brazil was an early supplier of natural uranium to the United States (1940s) and participated in the Atoms for Peace program. The nation went about procuring elements of the nuclear fuel cycle, only to have this effort thwarted at various times by the nuclear powers who wished to retain control over the technology and its potential use to develop weapons-usable materials. Brazil rejected the notion that only certain nations could have full fuel cycle access (as codified in the 1968 Nonproliferation Treaty, which Brazil did not sign until 1998). In order to have a reliable nuclear power supply, Brazil learned it would need to do so on its own territory, and asserted that right. It has navigated importing equipment, transferring and developing technology, and creating domestic infrastructure, all while finessing its international posture. Brazil's credibility today derives from its participation in bilateral and multilateral fora (and conversely, it loses credibility when it falls short of expectations in such fora, such as the Paris Agreement). Currently, Brazil is urging global powers to acknowledge that today's circumstances far exceed those envisioned by the drafters of the NPT.

Brazil was an early member of the United Nations (1945) and the International Atomic Energy Agency (1957). It agreed not to place nuclear weapons in outer space (1967) nor on the seabed (1972), and participated in negotiations (1986) to create a Latin America weapons-of-mass-destruction free zone.¹¹ In the early 1980s, Brazil produced small quantities of plutonium in a US-supplied 5-megawatt reactor at Brazil's Nuclear Energy and Research Institute; the reactor was under safeguards per the Atoms for Peace agreement with the United States, but Brazil refused to put the plutonium under safeguards because it had built the small reprocessing facility and fuel fabrication facilities without assistance.¹² This caused concern that Brazil might pursue an atomic weapon, but Brazilian leadership emphasized the small quantity of material produced in an experimental setting. This example typifies the tension between Brazil's sovereign approach and perceived U.S. overreach in the desire to restrict the nature of Brazil's---or any non-nuclear-weapon state's---nuclear program.

⁷ US Energy Information Administration (EIA), “Brazil plans to add more solar to its hydro- dominated electricity generation mix,” May 31, 2019, <https://www.eia.gov/todayinenergy/detail.php?id=39692>

⁸ N.B. Carvalho, et al, “How likely is Brazil to achieve its NDC commitments in the energy sector? A review on Brazilian low-carbon energy perspectives? A review on Brazilian low-carbon energy perspectives,” *Renewable and Sustainable Energy Reviews* vol. 133, 2020, 110343. doi:10.1016/j.rser.2020.110343

⁹ Roberto Valadares Caiafa “Prosub: el submarino S-42 Tonelero está listo en un 69%,” *Infodefensa* July 8, 2020, <https://www.infodefensa.com/latam/2020/08/07/noticia-prosub-submarino-tonelero-completado.html> Note: The Brazilian Riachuelo is 5.22 meters longer and 153 tons heavier than the French Scorpion class.

¹⁰ World Nuclear News: “Brazil increases uranium enrichment capacity,” August 31, 2018 <https://www.world-nuclear-news.org/Articles/Brazil-increases-uranium-enrichment-capacity>

¹¹ Roland Timerbaev and Meggen Watt, *Inventory of International Nonproliferation Organizations and Regimes*, 1995 edition, Center for Nonproliferation Studies, 1995.

¹² Milton R. Benjamin, “Brazil Takes Step Toward Developing Nuclear Weapons Potential,” *The Washington Post*, February 3, 1983, <https://www.washingtonpost.com/archive/politics/1983/02/03/brazil-takes-step-toward-developing-nuclear-weapons-potential/f609c253-0284-4487-80fc-3737d682ad03/>

In 1988, Brazil adopted a new constitution which included specific language on nuclear developments:

“The Union shall have the power to ... Operate nuclear services and installations of any nature and exercise governmental monopolies over research, mining, enrichment, reprocessing, industrialization, and commerce in nuclear ores and their by-products, in accordance with the following principles and conditions: (a) all nuclear activity within the national territory shall be allowed for peaceful purposes...”¹³

In the mid-1980s, in close coordination with Argentina (as both countries were transitioning from military to civilian leadership) Brazil shifted its nuclear focus from arms to integration, paving the way for mutual confidence building, peaceful nuclear programs, and more broadly, a common market.¹⁴ Brazil’s final ratification of the Treaty of Tlatelolco (which prohibits nuclear weapons in Latin America) occurred in 1994. Brazil is one example of a country that took steps toward pursuing nuclear weapons in the past (1970s-80s) but chose not to proceed. Though such countries may remain fully committed to solely peaceful nuclear pursuits, this past influences perceptions regarding their nuclear actions and statements by their leaders.

The trend of a peaceful nuclear path has continued, with Brazil occasionally asserting its right to protect its commercial technology, for example when in 2004 Brazil prevented the International Atomic Energy Agency’s inspectors from full access to its uranium enrichment equipment, provoking the question, “why?”¹⁵ The Brazilians continue to maintain that development of and access to the technology itself is entirely legitimate (given the national commitment to a peaceful program), a notion on full display in 2010 when Brazil and Turkey worked to mediate a fuel swap deal to prevent further sanctions against Iran.¹⁶ That deal failed, but Brazil (which had enforced the UN Security Council ban on nuclear technology exports to Iran in 2007) demonstrated a willingness to seek solutions that may redefine “acceptable” behavior in the nuclear realm. Indeed, Brazil has long sought a permanent seat on the UN Security Council, urging an expansion of that body that would more accurately represent UN membership, and in its case, with a nuclear-capable non-nuclear-weapon state perspective.¹⁷

By their own admission, Brazilians are proud to celebrate nearly three decades of the Brazilian-Argentine Agency for Accounting and Control (ABACC), during which about 3,000 inspections at the two nations’ respective nuclear facilities have taken place. Brazil and Argentina are the only nations in South America producing commercial nuclear energy, with this bilateral nuclear relationship regarded as a present source of trust. Dr. Marco Marzo, secretary of the Agency on the Brazilian side, noted in July 2020:

“ABACC, with its technical credibility and the political support of Brazil and Argentina, is an institution that guarantees mutual trust between countries and, therefore, contributes to strengthening regional and international security. It is a concrete demonstration of the commitment of both nations to the nonproliferation of nuclear weapons and the peaceful character of their peoples. My expectation is that, despite all the difficulties that Brazil and Argentina face, now aggravated by the pandemic, ABACC will continue to be a priority for both states, given the enormous contribution that peace has made in our region.”¹⁸

¹³ Constituteproject.org, Brazil’s Constitution of 1988 with Amendments through 2014.

¹⁴ A integração bilateral Brasil-Argentina: tecnologia nuclear e Mercosul, [Revista Brasileira de Política Internacional](https://www.researchgate.net/publication/250053094_A_integracao_bilateral_Brasil_Argentina_tecnologia_nuclear_e_Mercosul), June 1998, https://www.researchgate.net/publication/250053094_A_integracao_bilateral_Brasil_Argentina_tecnologia_nuclear_e_Mercosul

¹⁵ Leonardo Bandarra, “Brazilian nuclear policy under Bolsonaro: no nuclear weapons, but a nuclear submarine,” *Bulletin of the Atomic Scientists*, April 12, 2019, <https://thebulletin.org/2019/04/brazilian-nuclear-policy-under-bolsonaro/>

¹⁶ “Iran, Brazil, Turkey sign Nuclear Agreement,” *UPI*, May 17, 2020, https://www.upi.com/News_Photos/News/Iran-Brazil-Turkey-sign-Nuclear-Agreement/3318/

¹⁷ Ministry of External Affairs, Government of India, “IBSA Joint Ministerial Statement on Reform of the UN Security Council,” September 16, 2020, <https://www.mea.gov.in/bilateral-documents.htm?dtl/32989/IBSA+Joint+Ministerial+Statement+on+Reform+of+the+UN+Security+Council>

¹⁸ Daniela Bentivoglio, “La agencia nuclear que contribuye con la paz en la región,” ABACC, July 7, 2020, <https://www.abacc.org.br/en/news/abacc-participates-informal-workshop-good-practices-lessons-learned-respect-existing-nuclear-weapon-free-zones-virtual-7-9-july-2020>

Energy

Self-sufficiency in nuclear energy---even for a sector that generated just 2.7 percent of Brazil’s electricity in 2019---requires the full suite of technology and heavy industry from uranium mining to enrichment, fuel fabrication, and handling used fuel. Brazil has cultivated this significant civilian nuclear infrastructure, and continues to add to it, envisioning four new reactors and additional enrichment cascades.

By the 2019 numbers: Brazil’s two reactors with a total capacity of 1,884 megawatts produced 16 terawatt-hours (TWh).¹⁹ For context, Argentina produced 7 TWh in that time frame with three reactors and 1,664 MWe capacity; the United States produced 809 TWh with 95 reactors and 97,154 capacity. State-owned Eletrobras Eletronuclear operates the reactors, which are under international safeguards.

Proponents of nuclear energy hold a bigger vision for the nation’s nuclear capacity. Construction of Angra 3 nuclear power plant resumed in 2010 after approval of the government’s return-to-construction policy; lack of funds had halted progress since the 1980s.²⁰ Brazil completed the business model for Angra 3 (identical to Angra 2, a Siemens design but with upgraded digital controls) in June 2020. Eletronuclear president Leonam Guimarães said that while they had hoped to find a partner to help finance and operate Angra 3 by 2023, the coronavirus pandemic and related drop in demand for electricity, and a lower value of the Brazilian real, could push that out to 2027.²¹

Meanwhile the industry has taken steps to prolong the life of the first reactor, including signing a letter of intent with Westinghouse (Unit 1’s designer) to work toward meeting national regulatory requirements for the reactor to operate an additional 20 years, extending its life to 60 years. Brazil anticipates that the power grid may gain input from an additional two reactors in the northeast and two more near Angra. These projects stretch across decades: construction of Units 1 and 2 started in 1971 and 1976, respectively, with Unit 1 connecting to the grid in 1982 and Unit 2 in 2000.

The existing reactors’ used fuel pools are nearing and will reach capacity in 2021.²² Brazil regards its used fuel not as waste, but as a candidate for recycling, therefore a secure dry storage facility for used fuel is under construction. Holtec Brasil and Eletrobras Eletronuclear have begun to install modules to store spent fuel at the Angra Dry Storage Project; irradiated fuel elements are scheduled to be transferred from the pools to the dry storage beginning in December 2020. An indicator of Brazil’s leadership in nuclear matters is that used fuel management is a requirement before Angra 3 can be brought online.

Despite the relatively small size of its nuclear energy production, Brazil’s nuclear infrastructure is well-established and speaks to the desire for technical sovereignty. While the enrichment and fuel fabrication facilities at Resende have since 2015 enriched uranium (to 4%) and produced a modest quantity of fuel (about 14% of annual requirements for Angra 1 and 2), Industrias Nucleares do Brasil (INB) anticipates self-sufficiency by 2022.²³ In 2018, upon celebrating the 7th cascade of centrifuges entry into operation, INB’s President hailed it as “a milestone for the national nuclear sector,” adding, “It represents yet another step

¹⁹ IAEA.org PRIS database, accessed 2020-09-15

²⁰ “Angra-3 PWR Nuclear Reactor Project, Brazil” Power Technology, <https://www.power-technology.com/projects/angranuclear/>

²¹ David Dalton, “Brazil / ‘Business Model Approved’ For Angra-3 Nuclear Plant,” NucNet, June 11, 2020, <https://www.nucnet.org/news/business-model-approved-for-angra-3-nuclear-plant-6-4-2020>

²² “Brazil’s Angra plant receives first fuel store modules” World Nuclear News, April 6, 2020, <https://www.world-nuclear-news.org/Articles/Brazilian-used-fuel-store-set-for-year-end-complet>

²³ “Our Activities, Nuclear Fuel Cycle: Enrichment,” INB, September 2020, <http://www.inb.gov.br/en-us/Our-Activities/Nuclear-Fuel-Cycle/Enrichment>

towards self-sufficiency in the production of nuclear fuel for nuclear power generation.”²⁴ Its 8th centrifuge cascade went into use in November 2019.²⁵ Provided that funding and political will continue, the Resende facilities will likely attain sufficient capacity to satisfy reactor fuel requirements for Angra 1, 2, and 3, upon completion of Phase 1 (10 centrifuge cascades) and onward to Phase 2 (30 cascades).

Beyond the grid, and furthering the nation’s nuclear prowess, Brazil’s Nuclear Energy and Research Institute (IPEN) operates four research reactors and is developing a Multi Purpose Research Reactor (RMB) for production of pharmaceuticals. The design of the RMB was contracted with Argentina. Brazil operates six nuclear research centers, and is active in the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), which is coordinated by the International Atomic Energy Agency.²⁶ The Brazilian Navy is also developing a nuclear reactor for propulsion in one of its five new submarines. A 2008 technology transfer agreement with France for the submarine design excluded the nuclear components, making these entirely Brazilian.²⁷

Nuclear energy is accepted as part of the energy mix: it enjoys political support but occasionally has met with protests among the public. Some are haunted by safety concerns, stemming from memories of nuclear accidents at Chernobyl in 1986 and Fukushima in 2011. Even remembering Hiroshima and Nagasaki: Brazil is home to the largest population of Japanese people outside of Japan, and some in this demographic protest nuclear expansion.²⁸ Protestors conflate nuclear energy with nuclear weapons to drive home the point. The community at Angra near the nuclear reactors has seen some violence, including an attack on trucks carrying uranium fuel in 2019. At the time, Eletronuclear reassured the public that the uranium was in a natural state and would not pose a radiological risk.²⁹ In short, the small amount of energy produced via nuclear reactors carries with it the possibility of polarizing public opinion.

Submarines and Safeguards

The Brazilian Navy has long promoted the need for a strong presence including submarines, in particular subs with nuclear propulsion which allows an extended range of operation. Brazil is the first non-nuclear weapon state to embark on building a nuclear-propelled submarine. The *Álvaro Alberto* is slated to be commissioned in 2029, delayed due to budget cuts and corruption scandals involving construction.³⁰ Noteworthy for continuity during economic distress, the Brazilian company Itaguaí Construções Navais (ICN) recently celebrated its 11th anniversary by calling attention to its successes in implementing the technology transfer from France, and progress toward manufacturing four conventional submarines prior to the nuclear-propelled *Álvaro Alberto*.³¹ Sea trials with the first of these subs, the *Riachuelo* (slated for entry into service in December this year), are ongoing as of this writing.

²⁴ “Brazil increases uranium enrichment capacity,” World Nuclear News, August 31, 2018

<https://www.world-nuclear-news.org/Articles/Brazil-increases-uranium-enrichment-capacity>

²⁵ Roberto Valadares Caiafa, “Brasil aumenta el enriquecimiento del uranio en un 20%,” *InfoDefensa*, November 30, 2019, <https://www.infodefensa.com/latam/2019/11/30/noticia-brasil-aumenta-enriquecimiento-uranio.html>

²⁶ IAEA Country Profiles, Brazil (2019) <https://cnpp.iaea.org/countryprofiles/Brazil/Brazil.htm>

²⁷ Leonardo Bandarra, “Brazilian nuclear policy under Bolsonaro: no nuclear weapons, but a nuclear submarine,” *Bulletin of the Atomic Scientists*, April 12, 2019, <https://thebulletin.org/2019/04/brazilian-nuclear-policy-under-bolsonaro/>

²⁸ Julia Glum, “Brazil Hiroshima Atomic Bomb Survivors Protest: Nuclear Power Expansion Should Stop, Group Says.” *IBTimes*, August 5, 2015 <https://www.ibtimes.com/brazil-hiroshima-atomic-bomb-survivors-protest-nuclear-power-expansion-should-stop-2039880>

²⁹ “Brazil gunmen shoot at convoy carrying nuclear fuel in Angra dos Reis,” *BBC*, March 20, 2019

<https://www.bbc.com/news/world-latin-america-47635706>

³⁰ Pilar Olivares, “Brazil take first step in program to join nuclear-powered sub club,” *Reuters*, December 14, 2018, <https://www.reuters.com/article/us-brazil-submarine/brazil-take-first-step-in-program-to-join-nuclear-powered-sub-club-idUSKBN1OD2CV>; “Head of Brazil’s nuclear energy development sentenced 43 years in jail for corruption,” *Mercopress* (online), Aug. 9, 2016, <http://en.mercopress.com/2016/08/09/head-of-brazil-s-nuclear-energy-development-sentenced-43-years-in-jail-for-corruption>

³¹ “Prosub: el submarino S-42 Tonelero está listo en un 69%,” *InfoDefensa*, July 8, 2020,

<https://www.infodefensa.com/latam/2020/08/07/noticia-prosub-submarino-tonelero-completado.html>

Brazil's planned conventionally-armed submarine, with nuclear propulsion, is within its carefully-worded international nonproliferation obligations. Experts today point to a long-standing "loophole" in the Quadripartite safeguards agreement between Brazil, Argentina, ABACC and the International Atomic Energy Agency (IAEA), which allows for material to be withdrawn from safeguards for non-explosive military uses under "special procedures."³² (In 2015, the Nuclear Suppliers Group accepted this same agreement as a legitimate substitute for the IAEA's Additional Protocol.)³³ How the nation handles safeguards on the fuel for the submarine will be worth watching, as it may establish a precedent for other nuclear-savvy non-nuclear weapon states that may wish to pursue a nuclear-powered submarine in the future.³⁴ Brazilian academics have strongly suggested involving ABACC and the IAEA early in the design and construction phase, so that remote monitoring systems and procedures can be developed in tandem with the submarine itself.³⁵ The intricacies of maintaining continuity of knowledge and transparency in a military program - meeting international criteria - while also ensuring Brazil's state proprietary information are among the many challenges facing the nuclear submarine program. The aim: by the time the *Álvaro Alberto* is ready to splash, the matter is known, and settled, rather than a gaping open question that could taint the success of the first indigenous nuclear submarine of a non-nuclear weapon state. The Brazilian government has included funding for its Defense programs including the submarine program (PROSUB), in the 2021 budget proposal, indicating its priority even during present economic difficulties referenced in this paper. There is a high-level group that meets regularly to discuss nuclear-related issues, but we are not aware if, and to which extent, the specific issue of safeguards for the nuclear submarine have been specifically addressed.³⁶

Nuclear-propelled submarines are, but nuclear weapons are not, a stated goal of the Brazilian government; elements of a former weapons program were made public and shut down in 1990.³⁷ The advances in nuclear technology developed within the Navy have benefitted the energy sector. When asked why Brazil is pursuing the robust nuclear submarine program, Guimarães is cited as saying, "why not?"³⁸ A corollary question as the nation and world look to the future, is how to verify (in a satisfactory manner) peaceful use of fissile material in a non-weapons military program.

The Nuclear Submarine in a National Security Context

The strategic decision to renew its fleet of conventional submarines and pursue the nuclear-propelled vessel extends Brazil's reach well beyond its 7,500-kilometer shoreline and aquatic territory. The nation views the natural resources on the seabed of the continental shelf, extending 200 nautical miles beyond the coast, as its own. Brazil applied to the UN Commission on the Limits of the Continental Shelf (UNCLOS) to extend the definition of its continental shelf beyond the original and received confirmation of 80% of its request.³⁹ The Brazilian Navy calls this aquatic zone "*our* Amazonia Azul," an area about two-thirds the size of the nation's land mass. Exploration and exploitation of natural resources on the outer edges of the continental shelf

³² Pilar Olivares, "Brazil take first step in program to join nuclear-powered sub club," *Reuters*, December 14, 2018, <https://www.reuters.com/article/us-brazil-submarine/brazil-take-first-step-in-program-to-join-nuclear-powered-sub-club-idUSKBN1OD2CV>

³³ Brazil Ministry of Foreign Affairs press release, June 24, 2011 <http://www.itamaraty.gov.br/en/press-releases/10272-nuclear-suppliers-group>

³⁴ Frank von Hippel (2019) Mitigating the Threat of Nuclear-Weapon Proliferation via Nuclear-Submarine Programs, *Journal for Peace and Nuclear Disarmament*, 2:1, 133-150, DOI: 10.1080/25751654.2019.1625504

³⁵ Eugenio Pacelli Lazzarotti Diniz Costa, "Brazil's Nuclear Submarine: A Broader Approach to the Safeguards Issue" *Revista Brasileira de Política Internacional*, e005, 2017. https://www.researchgate.net/publication/320506192_Brazil%27s_Nuclear_Submarine_A_Broader_Approach_to_the_Safeguards_Issue

³⁶ Eugenio Pacelli Lazzarotti Diniz Costa, emails with writer (Petersen), Sept 19-23, 2020.

³⁷ "Brazil to Close Shaft Suited for Nuclear Test," *New York Times*, September 19, 1990, <https://www.nytimes.com/1990/09/19/world/brazil-to-close-shaft-suited-for-nuclear-test.html>

³⁸ Togzhan Kassenova, "Brazil's Nuclear Kaleidoscope, An Evolving Identity," CEIP 2014.

³⁹ Brazil Continental Shelf Survey Project (LEPLAC), Continental Shelf and the United Nations Commission on the Limits of the Continental Shelf Article 76, Executive Summary, 2015

would warrant active military protection - a deterrent, *and* require phenomenal logistical support so far from land.⁴⁰

Brazil has a relatively peaceful neighborhood, remote from most of the major armed conflicts of the last century.⁴¹ This is not to say it is immune to internal political instability or regional crises; these simply have not devolved into declarations of war on the continent. Political and humanitarian crises related to migration and the erosion of democratic governance are discussed below.

Political Turmoil and Erosion of Democratic Governance

In recent years, Brazil has been embroiled in political crises that have eroded national stability. Its most recent presidential election pivoted the country towards authoritarianism and hyper-nationalism, part of a larger global political trend.

A decade ago, the country appeared to be going down a very different path. In the 2010s, Brazil was a rising player in BRICS, a group of countries exhibiting rapid economic growth that were expected to reach top tier development levels. For several years, it appeared Brazil would do just that. It garnered sufficient soft power gravitas to host the soccer World Cup in 2014 and the Olympics in 2016. Between 2003 and 2014, more than 25 million Brazilians rose out of poverty.⁴² However, a recession in 2015 and 2016 slowed down its economy, reversing its improvements in closing the gap on inequality levels and it has not been able to recover its rapid rate of growth ever since. Corruption issues have also plagued the federal government, most recently a national investigation known as Operation Carwash.

One of the largest and ongoing corruption scandals, Operation Carwash began in 2014 with federal charges of money laundering against an extensive web of politicians and executives who had participated in granting inflated contracts for kickbacks. As investigations progressed, the nation and region experienced widespread business slowdown, especially in the construction industry (and at the heart of it, the submarine-related industry⁴³). In addition to the economic impacts, public trust in governance is likely to have suffered especially considering a revered former president was arrested and charged, as was a long-time proponent of the nation's nuclear program. Emerging from this experience, Brazil put into place the Clean Companies Act in 2014 and governance and compliance rules for state companies in 2016. Many companies experienced a profound shift and began to install anti-corruption compliance and ethics practices. Observers note these may require continuous efforts toward a cultural shift, and most may not yet recognize the benefits of good governance.⁴⁴

Public desire for accountability has proven to be something of an irritant to Bolsonaro, who recently threatened to shut down Operation Carwash because it brings political allies to account.⁴⁵ As the country attempts to explore further nuclear technology while managing its growing economic, health, and climate

⁴⁰ Note. In a parallel endeavor, and with the approval of the UNCLOS, Argentina in 2016 extended its continental shelf boundaries beyond 200 nautical miles up to 350 miles, which places the Falkland Islands within Argentina's territorial waters. [<https://en.mercopress.com/2016/03/27/argentina-on-a-un-decision-expands-continental-shelf-area-by-35-to-350-miles>] While claiming its sovereignty over the continental shelf and the minerals within it, Argentina also determined not to interfere with the Islands' territories and their maritime waters which the UK has administered for more than 187 years.

⁴¹ Togzhan Kassenova, "Brazil's Nuclear Kaleidoscope, An Evolving Identity," CEIP 2014.

⁴² "The World Bank in Brazil: Overview," The World Bank, last updated October 1, 2020, <https://www.worldbank.org/en/country/brazil/overview>

⁴³ "Brazil's DCNS Submarine Contract," World Peace Foundation, updated October 23, 2018, <https://sites.tufts.edu/corruptarmsdeals/brazils-dcns-submarine-contract/>

⁴⁴ Andres Schipani, "Brazil's Car Wash scandal puts pressure on companies to obey clean up rules," *Financial Times*, May 14, 2018, <https://www.ft.com/content/9965c05c-3cc7-11e8-bcc8-cebcb81f1f90>

⁴⁵ Travis Waldron and Grasielle Castro, "Jair Bolsonaro Is Pushing Brazil's Democracy To Its Breaking Point," *Huffington Post*, August 11, 2020, https://www.huffpost.com/entry/jair-bolsonaro-coronavirus-brazil-democracy_n_5f3165aec5b6fc009a5b7a20

issues, public trust in federal governance becomes a graver concern. As these risks intersect, how will the Brazilian populace be assuaged by a government that has been so loudly plagued by corruption?

Another marker of a shift toward authoritarianism is the president's appointment of active-duty military officers to cabinet-level positions more extensively than is common in most democracies.⁴⁶ This should not be construed as institutional support of the Armed Forces for the president; his "erratic behavior" is prompting a desire among part of the military for clearer boundaries. This point is generating discomfort, especially among career officers who may cherish the image of the military as a defender of democracy, or at the very least, may yearn for a chain of command not diluted by politics.⁴⁷

The U.S. has been urging Brazil to join the 30 nations in the Clean Network,⁴⁸ a system meant to ensure the present and future 5G network passes through "trustworthy" nations with "intellectual property protection, privacy, security, human rights and trusted collaboration."⁴⁹ The concern stems from ever-increasing reliance on equipment procured from China and how data flowing via that network could potentially benefit the Chinese government. This could stress some broader priorities: China is Brazil's largest trading partner.⁵⁰ Plus, Brazil does not like to be pushed around, whether the topic is economic cooperation or nuclear capabilities.

Brazilians are concerned about several sociopolitical issues in their country. According to a poll from 2019, residents ranked health, unemployment, corruption, public safety/violence, and education as the most pressing national issues.⁵¹ It is therefore not surprising that the informal economy is critical for many Brazilians. In late 2019, around 40% of the workforce held informal jobs.⁵² This was a record at the time, and this number could continue to grow as the global economy contracts due to the long-term impacts of Covid-19.

Its greatest social and economic challenge at the moment can be broadly pinned on inequality. Today, around a third of Brazilians are food insecure not because of a lack of national food supplies, but due to conditions rooted in systemic inequality.⁵³ Climate, health, or economic impacts can exacerbate social conditions in environments where there have been higher instances of violence and social inequality. Deeply rooted inequalities plus degradation due to a combination of anthropogenic activities and climate impacts are pulling at traditional structures. These intersections could further heighten tensions across local, national, and regional boundaries, and in a worst-case scenario, push local governance systems to the brink.

⁴⁶ Anthony Broadle, "Brazil's Bolsonaro militarizes his inner Cabinet," *Reuters*, February 13, 2020, <https://www.reuters.com/article/us-brazil-politics-idUSKBN2072S5>

⁴⁷ "Bolsonaro's Erratic Behavior Is Making His Military Backers Nervous," *Newsmax*, October 1, 2020, <https://www.newsmax.com/newsfront/bolsonaro-behavior-erratic-military/2020/08/01/id/980074/> and Antonio Jorge Ramalho da Rocha, Professor, IREL, Universidade de Brasília, in emails with writer (Petersen), October 2-3, 2020.

⁴⁸ "Brazil Can Join the Growing Clean Network by Banning Huawei," August 29, 2020 <https://www.state.gov/Brazil-Can-Join-the-Growing-Clean-Network-by-Banning-Huawei/>

⁴⁹ "Brazil may face 'consequences' if it gives Huawei 5G access, says U.S. ambassador," *Reuters* July 29, 2020 <https://www.reuters.com/article/us-huawei-tech-brazil-5g-idUSKCN24U20X>

⁵⁰ Malcolm Moore, "China Overtakes US as Brazil's Largest Trading Partner," *Telegraph*, May 9, 2009 <https://www.telegraph.co.uk/finance/economics/5296515/China-overtakes-the-US-as-Brazils-largest-trading-partner.html>

⁵¹ "Datafolha aponta que 18% dos brasileiros consideram saude como principal problema no pais," *Globo*, September 5, 2019, <https://g1.globo.com/politica/noticia/2019/09/05/datafolha-aponta-que-18percent-dos-brasileiros-consideram-saude-como-principal-problema-no-pais.ghtml>

⁵² Akemi Nitahara, "Informal jobs in Brazil reach new high," *Agencia Brasil*, November 1, 2019, <https://agenciabrasil.ebc.com.br/en/economia/noticia/2019-11/informal-jobs-brazil-reach-new-high>

⁵³ USAID, Climate Risk Profile Brazil: Fact Sheet, April 2018

Environmental Security Risks

Further adding to this stress are a range of ways in which Brazil's environmental systems are straining to hold. Over the last several years, for example, fires have burned across South America, particularly in Brazil, Bolivia, Chile, and Argentina. In most cases, fires are ignited by a combination of strong winds, high temperatures, and drought-like conditions. Their spread is exacerbated by deforestation---a practice that impacts local weather patterns and introduces even drier conditions. In 2019, Brazil and Bolivia battled massive fires throughout their territories. Brazil received far more global attention for the images of the Amazon in flames during the same time period, and the President even addressed the controversy at the United Nations, further detailed below. Fire is a core element of the widespread slash and burn technique, utilized in agriculture and other development endeavors. By cutting down vegetation and burning the remains, farmers seek to fertilize land for crops and livestock. However, over the longer term, this practice leads to deforestation and soil erosion---and feeds into a problematic fire feedback loop. The drier the land left behind, the more likely it will be for fires to spread. As some areas in the region shift towards hotter temperatures and protracted drought, analyzed later in this brief, fires will likely increase in quantity and destruction. These events are devastating to local infrastructure and livelihoods and long-term exposure could lead to respiratory issues in the exposed communities.

Closely related, after experiencing a decline in the early to mid-2000s, deforestation in Brazil has been on the rise since 2012. In 2018, pro-development candidate Jair Bolsonaro was elected President and the following year, deforestation rates in the Amazon were at their highest level in over a decade. Mining, and illegal logging, and land grabs are principally blamed for the increase, as are Brazilian political leaders who have actively promoted exploitation of forest resources and reportedly punished scientists who released corresponding data. More recently, deforestation rates rose by 30% in March 2020 compared to the same month in 2019--and many suspect the Covid-19 pandemic is allowing illegal miners and others to operate under even fewer restrictions.⁵⁴ In most cases, illicit actors conduct environmental crimes on protected indigenous lands.

The current Brazil government argues that it is caught between an irreconcilable desire for growth and preserving its forest ecosystem, though this dichotomy is disputed by many in the region. Although the current administration is clearly pro-development, President Bolsonaro, facing domestic and international pressure, has asked the armed forces to protect some parts of the Amazon. Earlier this year he created the Amazon Council, a body of military officials tasked with managing the sustainable development of the at-risk area. He also deployed the military to the region in order to curb illegal environmental activities.⁵⁵ It is unclear how impactful these actions will be, especially considering the current government's combative stance on deforestation.

Climate Security Impacts and Implications

These pre-existing environmental challenges are and will continue to be exacerbated by climate change. Overall, the country's future will involve a general decrease in precipitation averages, higher temperatures, drought, fires, and extreme flooding events. By 2060, temperatures in Brazil are projected to rise by 1°C to 2.2°C. In the Amazon, that number could reach 2° to 3° C an entire decade earlier.⁵⁶ This would signal a tipping point in which precipitation patterns over the Amazon would drastically shift, causing forested sections of the region to potentially turn into savannahs. Natural processes such as evapotranspiration would be disrupted, sabotaging the local freshwater system. If such an ecological transformation were to occur, local

⁵⁴ Jake Spring, "Illegal loggers uncowed by coronavirus as deforestation rises in Brazil," *Reuters*, April 10, 2020, <https://www.reuters.com/article/us-brazil-environment/illegal-loggers-uncowed-by-coronavirus-as-deforestation-rises-in-brazil-idUSKCN21S111>

⁵⁵ Herton Escobar, "Illegal deforestation in Brazil Soars amid climate of impunity," *Science Mag*, August 5, 2020, <https://www.sciencemag.org/news/2020/08/illegal-deforestation-brazil-soars-amid-climate-impunity>

⁵⁶ USAID, Climate Risk Profile Brazil: Fact Sheet, April 2018

ecosystems and more distant urban areas (including São Paulo) that rely on the Amazon's water supply and weather patterns would likely suffer irreversible damage.

Climate forecasts predict higher instances of drought and over all drier conditions in the Amazon and north eastern Brazil. The country also has an extensive coastline that may experience a sea level rise of anywhere from .2 to 2-meter increase by the end of the century.⁵⁷ The Amazon river delta is expected to see higher rates of sea level rise compared to the global average and more than 600,000 Brazilians may be grappling with flooding due to rising seas between 2070 and 2100.⁵⁸

As such, Brazil, like many of its regional neighbors, will be grappling with a wide range of climate stressors that will have widespread impacts on its population, economy, and natural resource security. Issues such as sea level rise, flooding, drought, and saltwater intrusion could lead to freshwater stress, energy interruptions, health crises in densely packed urban areas, and more. The country is a signatory of the Paris Agreement and was slated to host the COP25 conference in late 2019, but plans were canceled following President Bolsonaro's election. Climate negotiators from the country have been adamant that developed countries must play a larger role in bearing the brunt of developing nations' financial burden in limiting greenhouse gas emissions. As of late 2019, Brazil has not altered its Paris commitments or plans, even though the President had threatened to do so.⁵⁹

Climate change is expected to throw a major wrench in Brazil's agricultural predictability and productivity, and there is already evidence that it has begun to negatively affect the industry. São Paulo endured its worst agricultural output in over five decades because of a drought in 2014.⁶⁰ By 2030, some forecasts estimate that 11 million hectares of current agricultural land will be rendered obsolete because of climate impacts. Wheat, maize, and the beef industry are some of the most lucrative exports and they also happen to be the most sensitive to climate change. Around 85% of the 5 million farms in the country are considered "small family" farms which means that any shock to the industry would be devastating to local livelihoods. A recent study published in *Nature* estimates that a temperature increase of 1 degree Celsius in the state of Mato Grosso---a highly productive agricultural area---will result in at least a 9% decline in national soybean and maize production.⁶¹ Any reduction will have far-reaching implications considering the state is responsible for the cultivation of 10% of the global soybean supply. This could also lead to a cyclical and destructive pattern: As certain agricultural yields suffer in part because of climatic factors, farmers will search for more land to accommodate losses which will inevitably lead to higher rates of deforestation.

What would the federal or local government do if large swaths of the rainforest do turn into a savannah in the near future? How would they navigate impacts on the ecosystem, their freshwater security, and the inevitable impacts on their economy? The domino effects could intersect with rising instability in a nation that has nuclear reactors and at the same time, is expanding its footprint in nuclear military technology.

Brazil's marine life is also at risk; even at the minimal increase in global temperature, coastal populations will be severely impacted by ocean warming, particularly those that are dependent on fish stocks for their livelihoods and food security.⁶² In the northern part of the country, a \$700 million fishing sector could be

⁵⁷ *ibid*

⁵⁸ *ibid*

⁵⁹ Jake Spring, "No longer the host, Brazil still takes aim for key role at U.N. climate talks," Reuters, October 15, 2019 <https://www.reuters.com/article/us-climate-change-brazil/no-longer-the-host-brazil-still-aims-for-key-role-at-u-n-climate-talks-idUSKBN1WU2YF>

⁶⁰ Rachel Glockhouse, "Brazil Update: Historic Drought Takes Toll on Agriculture," Americas Society/ Council of the Americas (ASCOA), February 18, 2015.

⁶¹ A.Cohn, L. VanWey, S. Spera, *et al.* "Cropping frequency and area response to climate variability can exceed yield response," *Nature Climate Change* 6, 2016, <https://doi.org/10.1038/nclimate2934>

⁶² Guy, Kate *et al.* "A Security Threat Assessment of Global Climate Change: How Likely Warming Scenarios Indicate a Catastrophic Security Future." Product of the National Security, Military, and Intelligence Panel on Climate Change. Edited by Femia, Francesco and Werrell, Caitlin. The Center for Climate and Security, an institute of the Council on Strategic Risks. Washington, DC. February 2020.

slashed significantly due to ocean warming and other marine changes. The maximum fish catch potential could decline anywhere from 16 to 50%.⁶³

Brazil has to not only consider its own climate change risks; it must also take into account greater regional climate security dynamics. According to the Center for Climate and Security's National Security, Military, and Intelligence Panel on Climate Change (NSMIP), at just 1-2 degrees of warming, shifting precipitation patterns and acute water shortages will force communities to migrate throughout the region. As the largest country in South America, Brazil stands to become a destination for these migrants fleeing climate disasters and/or other destabilizing events. In 2014-2016, political turmoil, economic fragility, government mismanagement, an energy crisis, and a drought converged in Venezuela, spurring residents to leave in droves. As of late 2019, approximately 225,000 Venezuelans had fled to neighboring Brazil.⁶⁴ This wave contributed to tensions in Brazil, in large part because nationalist Brazilian political forces erroneously argued that valuable resources were being directed at the migrants at the expense of local residents. It also raised geopolitical pressures between Brazil and Venezuela.⁶⁵ As climate change affects Brazil's regional neighbors, it is very likely that migration issues will increasingly knock on the country's proverbial door. Transnational criminal groups and human traffickers could capitalize on destabilization and significantly erode local security institutions.⁶⁶

Health Security

As of the summer of 2020, Brazil and its neighborhood has been pummeled by Covid -19 — cases are soaring in Brazil, Peru, and Chile. The region's economy is bound to take a hit; the International Monetary Fund projects that Latin America and the Caribbean's GDP will constrict by 9.4% in 2020.

As in many parts of the world, residents are grappling with the stress of infection, death, and rising unemployment. The impacts of COVID-19 could plant additional seeds of discord and there are key factors that exacerbate the situation in Latin America. First, most national healthcare systems were fragile to begin with — now they could collapse entirely under the immense strain. There is a shortage of life-saving personnel, equipment, testing, ventilators, and other critical resources. As the pandemic hit Europe and the US in the spring of 2020, some LATAM governments were caught in a global tussle with regards to securing their healthcare supplies. In some cases, countries like Brazil claimed that their orders were overtaken by the US government.

Second, the informal economy is critical to the workforce in Brazil and the rest of the region and it is arguably getting hit the hardest from the shutdowns. Many have or will lose their jobs and may turn to illicit activities to make ends meet. Inherent competition over resources could also deepen tensions around inequality. Migration may also increase, as residents from countries or areas that are drowning under COVID-19 seek better living conditions elsewhere. Third, criminal groups could flourish with counterfeit medicine and cyber schemes as well as extortion of COVID-19 related aid. A recent global Interpol operation confiscated fake "coronavirus packages" and "coronavirus medicine," proving that this is already a problem. There will be fresh opportunities for new actors to control food, medicinal supplies, and security. At the onset of the pandemic, non-state groups based in favelas imposed curfew and social distancing when the central government was lagging behind on a coherent response. These are just a few of the ways in which this

⁶³ USAID, Climate Risk Profile Brazil: Fact Sheet, April 2018

⁶⁴ "Venezuelan Migration: The 4,500-Kilometer Gap Between Desperation and Opportunity," The World Bank, 26 Nov. 2019, <https://www.worldbank.org/en/news/feature/2019/11/26/migracion-venezolana-4500-kilometros-entre-el-abandono-y-la-oportunidad#:~:text=Venezuelan%20migration%20is%20not%20abating,Latin%20American%20countries%20like%20Peru.&text=According%20to%20the%20UNHCR%2C%20between,leave%20the%20country%20every%20day>.

⁶⁵ Jade Nune, "Mourão descarta intervenção militar na Venezuela," 04 September, 2019, Plano.news, <https://pleno.news/brasil/mourao-descarta-intervencao-militar-na-venezuela.html>

⁶⁶ Guy, Kate et al. "A Security Threat Assessment of Global Climate Change: How Likely Warming Scenarios Indicate a Catastrophic Security Future." Product of the National Security, Military, and Intelligence Panel on Climate Change. Edited by Femia, Francesco and Werrell, Caitlin. The Center for Climate and Security, an institute of the Council on Strategic Risks. Washington, DC. February 2020.

health crisis could permeate throughout the region and result in long term economic and governance repercussions.

One could substitute a climate shock for this pandemic, and expect similar results. The convergence of these threats, for example, an extreme climate event superimposed on a widespread health crisis that has eroded public resources, could be catastrophic for any nation, including Brazil.

Urban Risks

Higher temperatures and rates of floods are the ideal petri dish environment for infectious and vector borne diseases such as dengue, malaria, chikungunya, and others. According to some estimates, up to 168 million Brazilians could be at higher risk of malaria by 2070 because of shifting climatic conditions.⁶⁷ Biodiversity loss due to deforestation and other development related activities are also linked to increases in zoonotic disease spread.

The areas where diseases can flourish are expanding, including to dense city centers. This is particularly concerning considering Brazil's recent experience with Covid-19 and its history with Zika. As of late August, Brazil had tallied 3.85 million Covid-19 cases and over 120k deaths. Several years before, the Zika outbreak -- a mosquito borne virus -- caused more than 1,600 microcephaly cases in northeastern Brazil from September 2015 to April 2016 due to a particularly damaging strain present in that area of the country.⁶⁸ Researchers also identified an association between higher microcephaly rates and poor living conditions.⁶⁹ A similar trend is unfolding with Covid-19: residents with limited resources, in many cases living in more crowded zones, are being hit the hardest by the pandemic.

In addition to detrimental health impacts, infectious diseases can also impact economic security as the world is currently witnessing due to the pandemic. The Zika crisis was a major reason why Brazil's lucrative tourism industry suffered a \$5-8 billion loss between 2015 and 2017.⁷⁰ This downturn occurred in tandem with general stagnation and inevitably, contributed to a constriction in the national economy.

It is not unlikely, considering that zoonotic diseases are increasingly on the rise, that Brazil becomes a future pandemic hotpot due to a combination of factors related to deforestation and climate change. Like many other nations including the United States, Brazil has suffered greatly under the weight of Covid-19. Higher rates of rainforest development and changing weather patterns encourage higher chances that a natural pathogen makes the jump from vector to human. Brazil's institutions, already under strain, could have an extremely difficult path ahead of them. The question becomes: is the country capable of navigating a ground zero pandemic event layered on top of a fractured governance system? And if not, will other actors fill the void?

Brazil is considered one of the most vulnerable countries in the region to sea level rise because of its extensive and infrastructure laden coast. A 1-meter rise would have significant repercussions for the numerous urban centers stretching along the Atlantic. Coastal Rio de Janeiro has identified climate hazards that are most relevant to city dwellers which include flooding and the heat island effect.⁷¹ Informal settlements, a major part of urban environments, are extremely vulnerable and susceptible to landslides.

⁶⁷ USAID, Climate Risk Profile Brazil: Fact Sheet, April 2018

⁶⁸ Washington University School of Medicine, "Why Zika virus caused most harmful brain damage to Brazilian newborns: Findings help explain why microcephaly cases less common in other Zika outbreaks," *ScienceDaily*, February 18, 2020, www.sciencedaily.com/releases/2020/02/202018163106.htm

⁶⁹ Lisa Schnirring, "Brazilian studies highlight Zika microcephaly patterns," University of Minnesota Center for Infectious Disease Research and Policy, January 16, 2018 <https://www.cidrap.umn.edu/news-perspective/2018/01/brazilian-studies-highlight-zika-microcephaly-patterns>

⁷⁰ USAID, Climate Risk Profile Brazil: Fact Sheet, April 2018

⁷¹ COPPE UFRJ / Rio Prefeitura: Meio Ambiente/ Centro Clima, Climate Change Adaptation Strategy for the City of Rio de Janeiro, December 2016, <http://centroclima.coppe.ufrj.br/images/Noticias/documentos/estrategia-ing.pdf>

Water stress is also a major concern for urban areas like São Paulo. The water system in place is inefficient, losing up to 30% of water ready for consumption due to undermanagement.⁷² The city relies on a reservoir system, Cantareira, that was built to accommodate the needs of a much smaller population. In 2015, it almost ran dry. That same year, a historic drought pummeled the metropolitan area, leading to panic and agricultural losses. A giant beef producer furloughed hundreds of employees and residents attempting to collect rainwater led to an outbreak of dengue.⁷³ An El Niño season replenished the southeast, but the episode is indicative of what is to come. Although Brazil has one of the world's most abundant freshwater supplies, the future may bring higher instances of water and energy rationing due to climate impacts. Deforestation aggravates the situation; Amazon trees are a critical factor in a predictable water cycle. Higher rates of deforestation will add to substantial decreases in precipitation which will not only affect the local freshwater supplies, it will also directly impact the country's ability to maintain its hydroelectric grid.⁷⁴

Even amongst a volatile precipitation backdrop, Brazil continues to pursue and bolster its status as a major hydropower producer. In 2019, the region experienced the third fastest hydropower growth rate in the world.⁷⁵ Brazil has the highest total installed capacity in the area and it recently inaugurated the mega Belo Monte plant, estimated to eventually supply 60 million people with electricity.⁷⁶ The country is already the home of the largest hydropower facility in the world, Itaipu. Drier conditions can threaten power generation if reservoirs dwindle to unsustainable levels. Excessive precipitation events can also be destructive; landslides damaged a hydropower site in Peru in 2017, forcing it to temporarily shut down for two years.⁷⁷ Instances like this give impetus to increase the energy produced by nuclear power plants.

Conclusion

Brazil's recent history is characterized by developmental success, marred by economic reversals, deep-seated political and economic challenges, and erosion of democratic governance. It has a sophisticated nuclear energy program and is forging ahead with plans to build a nuclear-powered submarine. As the first non-nuclear weapons state to do so, it is in uncharted (international regulatory) waters. How Brazil handles this expanding role is a matter of consequence in the global community: its actions indicate an acceptance - and self-endorsement - as a world power. Although Brazil is frequently associated with its ecological importance, the country is also a longstanding leader in renewable energy, and cutting-edge technology as seen in its energy generation, growing 5G telecommunications, and satellite observation of the Amazon.⁷⁸

However, Brazil has been plagued by a corruption scandal that has permeated public trust, the national economy, and the seat of a former president, and is currently struggling with hyper-nationalism and authoritarianism. Indeed, some argue that the post-military government transition to democracy is incomplete. At the same time, it has the eyes of the world watching how it proceeds with development in the Amazon rainforest. Over the last few years, the Brazilian government has been irked by the attention, asserting national sovereignty and taking issue with any calls to boycott or intervene with its plans. This theme is also present in its quest for a nuclear submarine to help it govern the vast and changing Amazonia Azul.

⁷² Caroline Stauffer, "Drought ends in Brazil's Sao Paulo but future still uncertain," *Reuters*, February 18, 2016, <https://www.reuters.com/article/us-brazil-water/drought-ends-in-brazils-sao-paulo-but-future-still-uncertain-idUSKCN0VR1YJ>

⁷³ *ibid*

⁷⁴ https://climateandsecurity.org/wp-content/uploads/2020/02/world-climate-security-report-2020_2_13.pdf

⁷⁵ Region: South America, International Hydropower Association, last updated May 2020, <https://www.hydropower.org/country-profiles/region-south-america>

⁷⁶ *ibid*

⁷⁷ *ibid*

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"China-Brazil satellite launched into space to monitor Amazon rainforest", *Reuters*, December 20, 2019, <https://www.reuters.com/article/us-china-space-satellite-idUSKBN1YO0JO>

The South American giant is facing climate threats, political instability, a rise in authoritarianism, socioeconomic stress, a health crisis, inequality, and a vulnerable population that is reliant on the informal economy. The pervasive impacts of Covid-19 are likely to exacerbate the convergence of these issues, and its long-term stability is a significant concern. Brazil's complex systems were fraying before the pandemic, and are likely to be eroded further through the next year. As these impacts worsen, it continues to prioritize its civil and military nuclear desires, which in turn elevates risk. Multiple parallel failures ranging from the environmental to economic could eventually trigger pervasive insecurity. Brazil has teetered on the brink before, experiencing social upheaval, protests of government austerity policies to address inflation and a dramatic deficit; it yet to be determined how its future will unfold.

Brazil is a key player in the future international order. It controls a massive rainforest, vital to mitigating climate change, and it is actively developing its nuclear fuel cycle capabilities. Its presence in global nuclear and climate discussions is critical to ensuring comprehensive policies and norms. The climate, nuclear, and security nexus must be at the forefront of future plans and considerations in the country---and in how other countries manage their relationships with Brazil. Brazil's institutions are approaching a crossroads in terms of converging risks; they should be bolstered heavily in order to withstand the intersections addressed in this brief.

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