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Resource diplomacy and hydropower development: China's strategic engagement in the Brazilian Amazon and Cerrado regions.

By

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Abstract:

This thesis examines the ecological and societal effects of Chinese investments in hydroelectric projects in the Brazilian Amazon and Cerrado regions. The issue to debate is whether these initiatives, which are motivated by China's need for resources, in particular soy beans, offer economic advantages and infrastructure growth, while also presenting higher environmental and social risks in comparison to projects headed by other collaborators, national or international partners. The methodology entails conducting case studies on the Itaipu Dam, Ilha Solteira Dam, and the projected Tapajós Hydroelectric Complex, using the DPSIR framework for analysis. The primary findings indicate that Chinese investments have greatly enhanced Brazil's infrastructure and economy, as evidenced by the control of 10% of Brazil's energy generation by businesses such as China State Grid (CSG), China Three Gorges Corporation (CTG), and State Power Investment Corp (SPIC). Nevertheless, these ventures lead to significant socioeconomic displacement and ecological harm, similar to national projects, due to a strong agro-business lobby and other factors like corruption and lack of representation for impacted communities . The research findings indicate that Chinese-led hydropower projects have economic benefits but require comprehensive mitigation plans to tackle the substantial environmental and social difficulties they pose for them to become better for Brazil

Keywords: hydropower, Resource Diplomacy, China, Brazil

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1. Introduction

1.1 Importance of hydropower in Brazil

The global leader in energy production is Norway (Nogueira, 2024). Brazil, an emerging global power, is second. If we look at all emerging economies, of which there is China, India, Russia or Saudi Arabia to name a few, Brazil leads and is well above all of them when it comes to clean energy generation (Maguire, 2023). Because of its many rivers, hydropower accounts for the vast majority of Brazil's energy production, leading to more than 60% of Brazil's 172 Giga Watt of hydroelectric potential having already been exploited. Of those 172 Giga Watt of potential hydroelectricity, 62% were being exploited as of 2021 (Raup & Costa, 2021). The Amazon, the Cerrado and other more remote, protected regions have about 70% of the country's unrealized potential (International Trade Administration, 2023).

In Brazil, the generation segment of the electricity industry is quite fragmented, currently counting 7250 generating projects, according to data from the National Electric Energy Agency. A large part of these projects (3004) are medium-sized thermoelectric plants, powered by natural gas, biomass, diesel oil, fuel oil and coal. Despite this, practically 64% of the installed capacity in the country, and 63% of the energy generated, are of hydroelectric and clean origin, with 217 large-scale projects, 428 Small Hydroelectric Power Plants and 696 micro hydroelectric plants (Associacao Brasileira de distribuidores de Energia Electrica, n.d.).

The vast infrastructure and key role of hydropower in Brazil's energy sector have inevitably left an impact on regional development and integration. The proliferation of hydropower facilities situated in diverse regions enhances grid stability and ensures electricity reliability. The planned placement of these facilities allows a good equilibrium in keeping supply and demand nationwide, thereby reducing the potential hazards posed by droughts and other climate-induced challenges. Moreover, hydropower enables the exchange of energy with countries nearby, strengthening Brazil's role as a regional energy centre. This capability in turn ensures

the country's energy independence as well as strengthens Brazil's global power through energy diplomacy (Oliveira, 2010).

1.2 Significance of studying China's engagement in Brazilian hydropower

China has installed 11.8 Giga Watt of hydropower in Brazil, which is 70% of all the hydropower installed by Chinese companies worldwide. This is spread out among 93 dams in 11 states (Batista Barbosa, 2021). Examining Chinese investment in Brazilian hydropower is important for the following reasons. Firstly, the Amazon is often referred to as the lungs of our earth. Therefore, any person, company or country with particular interest in that region that might negatively impact this vital part of our planet should be put under the microscope. Secondly, given its past criticism and cases when it comes to infrastructure development, China is an interesting player to investigate, and assessing its socio-economic impact in a particular sector could lead to certain patterns or outcomes that might draw a blueprint of what it might do in other regions of the world, also in our shared interest. Thirdly, China's Belt and Road Initiative has gained worldwide attention, and, as of its 10th anniversary last year, has increasingly invested in electricity transmissions and green energy.

1.3 Chinese actors in the sector

Chinese corporations have emerged as significant participants in the hydropower industry, particularly by means of mergers and acquisitions, which has resulted in particular attention and scrutiny from its regional enemy, the USA. State Grid, CTG, SPIC, and CGN Energy, all chinese companies, have made significant financial contributions to Brazilian hydropower, improving the nation's energy infrastructure and increasing its overall capacity. Not all companies are involved in the same areas, but rather, they tend to complement each other. State Grid for instance, is engaged in high-voltage direct current projects, which aim to enhance the efficiency of power transmission from distant hydropower facilities to urban areas, in other

words, transportation. CTG on the other hand has purchased and updated multiple hydroelectric plants, with a focus on transferring technology and promoting local development. Chinese companies own in whole or part 304 power plants in Brazil, accounting for 10 percent of Brazil's national energy generation capacity. Nearly half of São Paulo's hydropower generation capacity is owned by Chinese firms. Chinese companies also own about 12 percent of the country's energy transmission infrastructure (Myers , 2023). In 2016, the Brazilian oil firm Petrobrás secured a loan of 10 billion USD from the China Development Bank. The loan was to be repaid through the delivery of crude oil to Chinese companies (Blount & Parra-Bernal, 2016). Several months later, CTG purchased the assets of Duke Energy Brazil, which consisted of ten hydroelectric units, in a transaction valued at 1.2 billion USD. In 2017, a new joint fund between China and Brazil worth 20 billion USD was launched for the purpose of investing in infrastructure. Additionally, State Power Investment Corp (SPIC) acquired the São Simão Dam in Goiás for 2.2 billion USD and expressed intentions to make further investments in Brazil (Barbosa, 2021)). In the same year, China State Grid (CSG), the world's largest power utility group, acquired CPFL Energia, a company that manages eight major hydroelectric projects, in a deal worth 10.2 billion USD. The corporation intends to allocate an additional 38 billion USD in investments in Brazil between 2017 and 2021. Additionally, it has obtained a concession to establish a connection between Belo Monte in the Amazon and the Southwest region of the country using two high voltage power transmission lines, which are expected to be the longest in the world (Andrade, 2021).

1.4 Sino-Brazilian cooperation

The formalisation of diplomatic relations between China and Brazil began in 1974, marking the debut of a long-lasting relation between the two biggest emerging economies at the time. In the 1980s throughout the 1990s, trade between China and Brazil saw consistent growth, as China imported Brazilian commodities such as soybeans, iron ore, and oil, while exporting

manufactured goods and electronics to Brazil. This era established the groundwork for a strong economic alliance. In the early 2000s, their relationship encountered another booming phase marked by further increase in collaboration between China and Brazil, mostly due to China's fast-growing economy and its demand for natural resources to support its industrial development (Stuenkel & Taylor, 2015). In 2004, Brazil and China upgraded their relation to a strategic partnership, with a focus on collaboration in fields such as science and technology, energy, and agriculture. Brazil's involvement in the BRICS group, served to strengthen this partnership by fostering economic cooperation and political alignment among rising economies. Another important development in the collaboration between China and Brazil is the creation of the China-Brazil High-Level Coordination and Cooperation Committee in 2006. This committee's purpose is to enhance bilateral communication and facilitate collaborative initiatives. Chinese investments in Brazil have experienced a significant increase in recent years, namely in the areas of infrastructure and energy as demonstrated by the implementation of big hydropower projects and the advancement of renewable energy sources (Santoro, 2023).

1.5 Current state of affairs between China and Brazil:

The strategic character of Brazil-China relations can be partly analyzed through their diplomatic interactions. During President Lula's visit to China in early 2023, he was accompanied by a significant delegation, indicating the high value Brazil attaches to its relationship with China. The visit led to the signing of 15 memorandums of understanding and 20 agreements across several sectors, such as agribusiness, energy distribution, and technological innovation (Hammad, 2023). In 2022, Chinese investment in Brazil witnessed a substantial decline of 78% compared to the previous year. According to the Brazil-China Business Council, this decrease resulted in Chinese investment in Brazil reaching its lowest point in 13 years, with a total of $1.3 billion. Regardless of this decline, Brazil's aggregate foreign direct investment

remained strong, reaching $90.6 billion in 2022, which is almost twice the amount of the previous year. Multiple causes contributed to the significant decrease in Chinese investment. The investment in 2021 experienced a significant surge, with a 208% rise compared to the previous year, establishing a notable benchmark for comparison (Urdinez, 2023). In addition , 2022 witnessed an election in Brazil, prompting Chinese investors to adopt a cautious stance. Furthermore, investment decisions were influenced by global economic concerns, including those arising from China's domestic economic deceleration and issues linked to the COVID-19 pandemic (Berg & Baena, 2023). Despite all of the above, China continues to be Brazil's primary trading partner, even during the economic slump created by the pandemic (Statista, 2022). The bilateral trade between the two nations in 2022 amounted to $152.8 billion, representing a 37-fold surge compared to the level during President Lula's initial tenure (Urdinez, 2023). Chinese firms have continuously demonstrated a strong interest in investing in Brazil's energy, technology, and automotive sectors(Observatory of Economic Complexity, 2024). For instance, Huawei's enduring presence in Brazil has played a crucial role in the advancement of the country's telecommunications infrastructure, such as the development of 5G and 6G networks (Zeng, 2024). These investments are essential for Brazil's technical progress and demonstrate China's dedication to developing strong economic connections and contributing to the country’s development, of course, keeping its state-interests in mind as well.

1.6 China’s resource diplomacy in LATAM

China’s trade with Latin America has gone from just $12 billion in 2000 to $445 billion in 2021 (Lopes Kotz, 2024). It is expected to surpass $700 billion by 2035 (World Economic Forum, 2021). This, has seriously challenged the traditional partners and regional powers like the United States and very much marginalized the EU in the process as well. It is therefore not surprising that China's resource diplomacy in Latin America has gained considerable importance as Beijing aims to ensure access to vital resources necessary for sustaining its

economic expansion. This cooperation encompasses not only conventional industries like hydropower but also crucial minerals such as lithium in Argentina, oil in Venezuela or copper in Peru (Freitas da Rocha & Bielschowsky, 2019). One of the reasons for that is an area of major investment like the EV sector, in which it is the market leader but for which it needs important lithium supplies (Thompson, 2019). The primary focus of this commerce is on essential raw materials required by China for its industrial operations, such as soybeans, petroleum, and critical minerals. China's substantial need for copper, which is crucial for its electronics and construction sectors, has resulted in Peru becoming a vital trading ally (Tugendhat & Stevenson-Yang, 2024). Lithium is an essential constituent for batteries used in electric vehicles and renewable energy storage. Therefore, Argentina, known for its abundant lithium reserves, has experienced increasing Chinese investment in its lithium mining and processing industries. This investment is a component of China's overarching plan to establish dominance in the worldwide electric car battery supply chain, in line with its aspirations to be at the forefront of green technology (Roy, 2024).

China's engagement in Latin America extends beyond economic transactions and is also visible through significant financial assistance and loans. Chinese financial institutions such as the China Development Bank and the Export-Import Bank of China have extended loans amounting to $137 billion to Latin American nations from 2005 to 2020 (Roy, 2023). China frequently allocates these to infrastructure and energy initiatives. Venezuela and Brazil are notable beneficiaries of these loans. Moreover, China's Belt and Road Initiative has played a crucial role in bolstering its resource diplomacy in Latin America. A total of twenty-one Latin American countries have officially joined the Belt and Road Initiative, a programme that promotes investments in infrastructure and enhances commercial partnerhsips. Nevertheless, the increasing influence of China in Latin America has raised eyebrows. Critics argue that the

arrival of Chinese capital and goods has the potential to harm local industry as a result of the competitive price of Chinese items. Moreover, the environmental and labour standards of Chinese enterprises have faced scrutiny, giving rise to concerns regarding the long-term viability and ethical ramifications of these investments (Cardoso, 2012).

2. Literature review:

Focusing on resource diplomacy and hydropower development, this literature review analyses the historical backdrop, important areas of collaboration, and dynamics of the China-Brazil alliance.

2.1 Resource diplomacy

Many scholars have thoroughly examined the concept of resource diplomacy, specifically in relation to China's international strategy. Each scholar has provided distinct opinions on the implications and implementation of this concept. Scholars who study the strategic use of natural resources to accomplish foreign policy objectives commonly refer to this concept as "resource diplomacy". David Zweig and Bi Jianhai conducted a significant analysis on China's use of its economic influence to get energy resources, specifically oil and gas. They argue that China's strategy involves integrating economic incentives with political tactics, forging enduring partnerships with countries abundant in resources through investments and infrastructural initiatives. They also emphasise the dual objectives of acquiring resources and extending geopolitical power (Zweig & Jianhai, 2005). Erica Downs, another scholar, has conducted a significant study that explores the different facets of China's energy diplomacy. She highlights China's utilisation of state-owned businesses as instruments of foreign policy. The author observes that major businesses, supported by government funding, undertake extensive initiatives in emerging nations, ensuring the acquisition of crucial assets while promoting reliance and mutually beneficial relationships (Downs, 2004). This viewpoint emphasises the

strategic integration of economic and political goals in China's resource diplomacy. More recent studies have broadened the discourse to include the environmental and socioeconomic consequences of China's resource diplomacy. For instance, Deborah Brautigam's extensive examination of China's involvement in Africa, while specifically concentrated on a distinct continent, offers useful perspectives that we can also find applied to Latin America. Brautigam emphasises the advantages of Chinese investments in infrastructure and development, while simultaneously expressing concerns regarding the negative impact on the environment and labour standards that are often linked to these projects (Hsiaopong Liu, 2010). Disagreements among scholars frequently revolve around the understanding of China's intentions and the results of its resource diplomacy. Kevin Gallagher and Margaret Myers both say that China's investments, although advantageous for development and economic growth, have the potential to create debt reliance and weaken local governance (Gallagher, 2016). They also argue that the financial conditions of Chinese loans and the absence of transparency can worsen economic weaknesses in countries that receive them. In contrast, experts such as Jorge Jenkins and Peters offer a more positive perspective, highlighting the practical advantages of Chinese investments. They pretend that China's involvement offers necessary infrastructure and investment prospects that Western nations have sometimes overlooked. This viewpoint proposes that China's resource diplomacy has the potential to be mutually advantageous if effectively handled by the countries receiving it (Jenkins et al., 2008). All in all, the research on resource diplomacy demonstrates that China utilises a complex and dynamic strategy. Although there is agreement over the important economic and geopolitical consequences, researchers have differing opinions regarding the lasting advantages and possible hazards, especially with regards to environmental and governance matters. Debt-trap diplomacy as seen in certain countries in which China has previously invested does not seem to be applicable to Brazil.

2.2 Beginnings of hydropower development

Early in the 20th century, small-scale projects targeted at urban electricity demands going up started the construction of hydroelectric infrastructure in Brazil. However, major growth started in the middle of the 20th century, driven by the demands of an economy expanding quickly to industrialise and urbanise. Key initiatives during this time include the 1984 completion of the Itaipu Dam, which has grown to become one of the biggest hydroelectric power plants in the world (Krupnik, 2004). As Brazil's economic and environmental concerns have changed, so has its hydropower regulatory framework. A foundation for environmental preservation was established in part by the 1988 Brazilian Constitution and the National Environmental Policy Act, which required thorough Environmental Impact Assessments for major projects (Soito & Freitas, 2011). Further institutionalising the supervision and control of the energy industry, the National Electric Energy Agency (ANEEL) was founded in 1996 to guarantee that projects meet technical, economic, and environmental requirements (ANEEL, 2021).

In Brazil, the responsibility for infrastructure development has traditionally rested with major construction firms such as Odebrecht, OAS, Mendes Junior, Camargo Correa, and Queiroz Galvão. Recent high-profile criminal investigations have uncovered the participation of most of these corporations in corruption schemes. Typically, these schemes include diverting public cash from infrastructure projects to finance political campaigns (Leahy 2017). After being elected, politicians subsequently show preferential treatment towards donors in public contracts and endorse projects with inflated pricing, hence establishing an ongoing cycle of embezzlement. Despite allegations of political motives, operation Lava Jato (Car Wash), the most extensive investigation of its sort in Brazilian history, has successfully prosecuted influential entrepreneurs and politicians, resulting in the imprisonment of several individuals (Rios Petrarca, 2020). The majority of the enterprises implicated were accused of corruption,

compelled to pay substantial penalties, had a significant portion of their assets seized, and were prohibited from offering services to the government. This posed a significant challenge in the Brazilian infrastructure industry, as several of the most extensive ongoing or proposed projects were unable to progress. Chinese finance and infrastructure businesses recognized this as a favorable situation, and the Brazilian government was pleased to receive China's skilled and well-funded infrastructure providers (Andrade, 2021).

2.3 Environmental and socioeconomic impact

The building of dams in the Amazon rainforest results in serious environmental and social consequences. An evident environmental concern is the flooding of large areas for the purpose of constructing reservoirs, resulting in the destruction of rainforest ecosystems and the loss of potential agricultural land. In addition, dam construction frequently result in the displacement of indigenous populations. However, the significance of this impact is often understated in official data, so reducing its influence on decision-making processes. As a result, the planning of dam projects in the region typically fails to appropriately handle both the environmental harm and people displacement.

One of the studies by Philip M. Fearnside uncovers some of the environmental and social impacts of hydroelectric power projects in the Amazon commissioned or planned. Fearnside states that there's an indication of high environmental and social effects linked with the construction of these massive hydroelectric power projects planned or completed within the Amazon, which has raised eyebrows continiously. These include displacement of the people, loss of livelihoods, especially in fisheries, biodiversity loss, and increased greenhouse gas emissions. To add on to that, as Fearnside points out, the benefits of these dams are often overstated since most of the electricity produced is exported in electro-intensive products such as aluminum that offer very little employment in Brazil. This sets a paradox in that local

populations usually bear virtually all of the environmental and social cost associated with building the dam. At the same time, most of the economic benefits themselves are pretty limited, and many do not contribute much toward local development or employment (Fearnside, 2016).

Eduardo von Sperling's report in 2012 brings attention to distinct environmental issues associated with hydropower projects in Brazil, which are often overlooked in general discussions. An important concern is the possible occurrence of eutrophication in reservoirs, which can result in the growth of dangerous algal blooms, particularly toxic cyanobacteria. The issue is worsened by Brazil's tropical environment, which speeds up the absorption of nutrients and the breakdown of organic materials. This, in turn, raises the chances of oxygen deprivation and the death of fish. In addition, the inundation of extensive land areas for the purpose of creating reservoirs frequently leads to the emission of greenhouse gases such as methane (CH4), which is a more potent greenhouse gas compared to carbon dioxide (CO2). Additionally, these reservoirs cause significant changes to riverine ecosystems and have a profound impact on local biodiversity by creating areas of reduced water flow downstream. The socioeconomic consequences are equally significant, as the displacement of communities and alterations in land use affect local means of subsistence, particularly among indigenous and rural groups. The aforementioned reasons highlight the necessity for more rigorous environmental impact assessments and creative mitigation techniques to tackle the ecological and social aspects of hydropower growth in Brazil, especially in light of China's major investments (von Sperling, 2012).

The hydropower reservoirs in Brazil are confronted with substantial issues arising from climate change, which have a profound effect on their environmental and operational sustainability. Dias et al. (2018) found that climate change impacts hydropower generation by causing

higher air temperatures and changes in precipitation patterns. These changes result in fluctuations in river flow, sediment transport, and evaporation rates. These modifications can greatly diminish the amount of water accessible for energy production, especially in arid periods when river currents are naturally diminished. The report emphasises that climate change worsens these problems by amplifying the frequency and severity of extreme weather events, such as droughts and floods, which can put pressure on reservoir capacities and operating safety. In addition, agricultural activities and alterations in land use upstream have a further impact on water resources. These activities increase the demand for water and also contribute to the degradation of soil and the accumulation of silt. This sediment can obstruct reservoirs and decrease their effectiveness. Adopting measures such as dynamic reservoir management and investing in infrastructure that can endure various climatic conditions are crucial for ensuring the sustainability of hydropower in Brazil. These observations emphasise the importance of having thorough climate and hydrological predictions to guide strategic planning and operational changes, in order to maintain the sustainability of hydropower in the face of changing climate conditions (de Souza Dias et al., 2018).

Dams are a major cause of river fragmentation, which is a key contributor in the loss of fish populations, especially migratory species that are crucial for maintaining ecosystem sustainability. Notwithstanding the acknowledged consequences, there is an ongoing development of fresh hydropower initiatives in environmentally vulnerable regions such as the Amazon. In the Upper Paraná River Basin, the expected rise of 505% in the number of medium-sized dams worsens these dangers, since only 9% of the current 389 dams have fishways. The distribution and efficacy of these fishways differ greatly, primarily due to state legislation in São Paulo and Minas Gerais, which requires their construction. Nevertheless, the absence of compulsory assessment and surveillance results in several fishways being ineffective, with their efficacy seldom exceeding 30%. As a consequence, this undermines the connection of rivers

and the exchange of genetic material among migratory species. This underlines a significant deficiency in the existing laws and emphasises the necessity for enhanced fishway designs and stricter regulations to guarantee the long-term viability of hydropower projects and the preservation of aquatic species in the area (Makrakis, 2019).

Hydropower dams present a substantial risk to the long-term viability of the Cerrado region, an essential area of high biodiversity in Brazil. The Cerrado biome, known for its expansive savanna landscapes and distinctive ecosystems, is currently undergoing swift expansion in hydropower infrastructure, with a total of 116 large hydroelectric facilities and 352 small ones either already in service or in the planning stages. This rapid increase in numbers is especially worrisome considering the biome's function in harbouring the sources of major South American rivers. Ferreira et al. (2022) emphasise that the construction of these dams has caused substantial alterations in land use within a 5-km radius of the dams. By the year 2000, more than 2255 km² of native vegetation had been destroyed, and an additional 379 km² was cleared in the next two decades. The process of deforestation worsens the fragmentation of habitats, leading to significant dangers for local biodiversity and causing disturbances to the ecological equilibrium. Furthermore, the construction of dams modifies the natural flow of water and the movement of silt in rivers, resulting in the conversion of flowing habitats into stagnant conditions that are unsuitable for numerous indigenous species. The implementation of a Dam Saturation Index (DSI) highlights the urgent requirement for comprehensive planning to alleviate these effects. The spread of hydropower in the Cerrado not only poses a threat to the ecological integrity of the region, but also damages the lives of local residents that depend on the natural seasonal patterns of the rivers. This situation necessitates immediate focus on sustainable development strategies and rigorous environmental legislation to harmonise the region's energy requirements with the preservation of its precious natural resources.

2.4 Regulatory landscape in Brazil

Brazil is signatory to the 1989 Convention 169 of the International Labour Organisation, comprising Article 7.1. This article supports the right of Indigenous people to independently determine their own priorities when it comes to development processes that impact their lives and land. These communities are required to actively engage in the creation and execution of regional and national development plans and programs that have a direct impact on them. Brazilian individuals, including Indigenous communities, have the option to seek recourse from the Ministério Público (MP), a judicial organisation established in 1890 to safeguard citizens from official misconduct. Following the implementation of the 1988 Constitution, the MP has experienced significant growth in both autonomy and authority. Traditionally, Brazilian society has largely regarded the MP as a competent and morally upright institution, in contrast to other ministries and governmental entities that are seen as heavily affected by politics and have a terrible reputation. While legislative mechanisms and institutions are intended to safeguard the social and constitutional rights of Indigenous groups, law enforcement and compliance in Brazil are significantly deficient. This is particularly accurate in remote areas like the Amazon, where the government has limited authority and where the judicial system and law enforcement are frequently under the control or strong influence of affluent landowners or business entities (de Souza & da Costa Oliveira, 2021).

In addition to the above, Brazil has an outdated legislation referred to as the Security Suspension Law of 1964, which grants court presidents the authority to unilaterally halt injunctions or verdicts against public authorities in order to prevent harm to the public economy (AIDA, 2014). This law, which originated under Brazil's military dictatorship, allows public activities to continue without obstruction until final judicial judgements are made. By 2016, the Tapajós dams had been granted twelve suspensions of injunctions. The long delays in the Brazilian judiciary, often multiple years, worsen the problem. Once a suspension is authorised, no legal

measures can impede the project's progress during the ongoing case (Andrade, 2021). This effectively allows supporters of dams to go around environmental and social safeguards, presenting significant difficulties for the local people and non-governmental organisations trying to fight it. This law emphasises the legal and systemic barriers encountered by individuals opposing hydropower projects, demonstrating how judicial practices can undermine environmental and social equity, especially in relation to significant Chinese investments in Brazil's hydropower industry (Fearnside, 2015).

3. Theoretical frameworks

In this chapter of the thesis, I will identify 5 theoretical frameworks whose lens and views will be referred to during the analysis and discussion parts later on.

3.1 International Political Economy

The study of international political economy brings together economics, political science, and sociology to look at how politics and economics affect each other around the world. This theoretical framework is great for looking at how states, markets, and foreign institutions work together. If we look at Chinese investments in Brazilian electricity through the lens of IPE, we can see how these investments affect the economy, politics, and society. The framework clarifies the manner in which Chinese state-owned firms might employ their financial and technological capacities to establish a presence in Brazil, potentially reshaping the distribution of economic influence in the area(Strange, 1994). By applying the principles of Dependency Theory, a subfield of International Political Economy, we may assess whether Chinese investments establish a relationship of dependency or promote mutual interdependence. Dependency Theory posits that foreign investment has the potential to maintain a recurring pattern of dependency in emerging nations (Dos Stantos, 1996). In contrast, several academics contrastingly argue that these investments have the potential to foster favourable economic

integration and reciprocal advantages (McMichael, 1995). Lastly, international political economy analyses the impact of globalisation on the formation of economic policies and the resulting outcomes. The Chinese investments in Brazil's hydropower sector are indicative of the wider phenomenon of globalisation, wherein capital movements surpass national boundaries. This viewpoint facilitates the examination of how these investments include Brazil into worldwide energy markets and the possible economic advantages and hazards linked to this incorporation (Frieden & Lake, 2000).

3.2 Neoliberal Institutionalism

Neoliberal Institutionalism is an international relations theory that highlights the significance of international institutions and regimes in promoting cooperation among states. Neoliberal institutionalism argues that institutions may reduce anarchy and facilitate cooperation among states, leading to mutual benefits. This is in contrast to classical realism, which sees international interactions as naturally chaotic and prone to conflict (James, 2022). This paradigm will serve this thesis to understand the dynamics of Chinese investments in Brazilian hydropower, as it emphasises the significance of international agreements, regulatory frameworks, and the involvement of multinational corporations in creating economic relations. I will therefore examine how bilateral and multilateral agreements, such as the Belt and Road Initiative, establish a well-organized setting that encourages investment and reduces risks (Keohane &Martin, 2008). Neoliberal Institutionalism argues that collaboration facilitated by institutions results in reciprocal advantages. Through the facilitation of Chinese investments, Brazil acquires technological improvements and infrastructure development, while China ensures access to energy resources and enhances its global influence. This approach facilitates comprehension of the mutual nature of these advantages and the methods by which they are achieved (Oye, 1985). The framework will also be used in the thesis to examine how institutions guarantee adherence to investment agreements and handle conflicts such as the responsibilities of

international arbitration bodies, regulatory agencies, and joint ventures in supervising the execution of hydroelectric projects.

3.3 South-South Cooperation

South-South Cooperation (SSC) is a mechanism for cooperation between countries in the Global South, with the goal of promoting reciprocal development via the sharing of resources, technology, and expertise (Gosovic, 2016). It highlights the ideals of solidarity, mutual benefit, and non-conditionality, which are in contrast to the conditionalities commonly associated with traditional North-South aid approaches. SSC has become increasingly important as a different approach to development, emphasising equal partnerships instead of hierarchical connections between donors and recipients(Gosovic, 2016). This framework will also be referred to throughout the thesis as it is evidently applicable for examining the impact of Chinese investments on Brazil's efforts to broaden its sources of foreign investment and decrease dependence on conventional Western investors. The economic and social implications of Chinese investments in Brazilian hydropower will be assessed evaluating the extent to which these investments contribute to Brazil's economic growth, employment generation, and technological progress, and how well they correspond with Brazil's overall development objectives (Roberts, 2013) .

3.4 Developmental state:

The final theoretical framework used in the thesis is that of the developmental state. One important characteristic of development state theory is the states' ability to operate independently and effectively within their bureaucratic systems. In order to successfully execute development policies, it is crucial for the bureaucracy to possess a high level of competence and be shielded from political influences. Implementing this means that a civil service system based on egalitarianism and robust institutions capable of effectively enforcing policy

decisions is needed (Wade, 2018). With the case of Brazil, its developmental state evolved under democratic governments from 1945 to 1964, with many key policies of import substitution industrialisation and crucial institutions like state-owned enterprises such as Banco Nacional de Desenvolvimento Economico e Social and Petrobras dating from this more open political period (Schneider, 2015). China's investment strategy in Brazil's hydropower sector exemplifies the use of bureaucratic efficiency and state capacity to effectively oversee and promote extensive infrastructure initiatives and cultivate international economic alliances while also having to respect the receiving country's regulatory frameworks. This theory entails the government actively participating in the development of crucial industries by providing financial assistance, imposing tariffs, and offering targeted financing (Evans, 2012). Within the framework of Chinese investments in Brazilian hydropower, this theory elucidates the utilisation of state-owned businesses such as State Grid and China Three Gorges as tools of state policy to accomplish wider economic and strategic goals. Developmental states prioritise the allocation of resources towards the long-term development of infrastructure and the promotion of innovation. China's investment in Brazil's hydroelectric infrastructure serves two purposes: to get immediate economic returns and to ensure long-term strategic advantages, including energy security and the advancement of green technology (Amsden, 2014).

3.5 DPSIR framework

The DPSIR framework is a conceptual tool used to analyse and understand the complex interactions between human activities and the environment. It stands for Driving forces, Pressures, State, Impacts, and Responses, and provides a systematic approach to assess and address environmental issues (Spangenberg, 2023).

1. Driving forces (D): These are the fundamental social, economic, and environmental

variables that propel environmental changes. Illustrative instances encompass demographic expansion, economic progress, technical innovations, and shifts in lifestyle. Driving forces are factors that cause or motivate certain human activities, which in turn put pressure on the environment.

2. Pressures (P) refer to the immediate consequences of human activity on the environment. Pressures encompass the release of pollutants, alterations in land use, extraction of resources, and other activities that contribute to the deterioration of the environment.

3. State (S): This component characterises the present state of the environment as a consequence of the exerted stresses. Environmental quality encompasses the condition of environmental elements such as air, water, and soil, along with the well-being of ecosystems and biodiversity.

4. Impact (I): Impacts refer to the consequences of alterations in the condition of the environment on ecosystems, human health, and economic productivity. These impacts can be either direct or indirect, and they can have an effect on the physical and mental health of humans as well as the functioning of natural ecosystems.

5. Response (R): Responses refer to the measures implemented by society, governments, and organisations to mitigate the adverse effects on the environment. These can encompass a range of measures such as legislation, regulations, conservation initiatives, and technology advancements that are designed to reduce or adjust to environmental changes.

4. Methodology:

This study will use a comparative case study methodology to assess the environmental, social, and economic consequences of large hydroelectric dams built or controlled by two players, namely Chinese, and Brazilian. The study will primarily use secondary data sources for analysis. The research design is qualitative, with existing literature being quite consequent, it allows for a detailed comprehension of the effects without the need to gather primary data. Three case studies have been chosen for in-depth examination. The selection of these case studies was based on their dimensions, operating condition, and their ability to exemplify larger patterns in the development of hydropower in Brazil from which we can draw conclusion and recommendations for future projects. All projects are of significant size, enabling a firsthand assessment of the effects caused, if any, by different investors.

Since the method employed is that of document analysis, the study will entail a comprehensive examination of environmental impact assessments (EIAs) conducted by NGOs, government official or independent researchers. Project papers, scholarly articles, and policy documents pertaining to all dams and from the general literature will also be used. In addition to that, to capture the wider societal effects, often hard to quantify and less reported on, a minor media analysis has been carried out to capture the wider societal effects and public discussions related to the dams. This will involve examining newspaper stories and online news in order to comprehend public perspectives and responses. The study is guided by one theoretical framework: the DPSIR framework, which analyses environmental impacts by considering driving forces, pressures, state, impact, and response (FAO, 2024).

Once the theoretical framework applied, a thematic analysis will be performed on the gathered data to discover and categorise themes in relation to data analysis. In other words, a methodical analysis of papers and media materials to extract pertinent facts regarding the

environmental, social, and economic consequences of the dams will be conducted. The obtained data will be analysed methodically using content analysis, which will provide a more comprehensive knowledge of the broader context and public perception.

Hypothesis:

While Chinese hydropower projects fueled by hunger for natural resources in the Brazilian Amazon and Cerrado regions provide substantial economic benefits and infrastructural development to the Brazilian economy, they pose greater environmental and social risks compared to projects led by other national or international partners.

Ethical considerations:

There aren't many ethical issues about this study because it uses secondary data. To keep academic integrity, all sources will be properly acknowledged.

5. Research Results

5.1 Case study 1: Itaipu dam

The Itaipu Dam, built from 1975 to 1982, is worldwide renowned for its colossal dimensions and multinational cooperation. It was the largest dam in the world for an extended period of time and continues to be an important symbol in both Brazil and Paraguay. The construction of the dam on the Paraná River, which serves as a natural boundary between Brazil and Paraguay, necessitated complex negotiations and agreements among five countries: Brazil, Paraguay, Argentina, Uruguay, and Bolivia. Brazil and Paraguay were the main stakeholders in the negotiations, while the other countries had a lesser involvement.

The construction of the Itaipu Dam required the labour of 25,000 workers and a total expenditure of almost 30 million dollars. With an installed capacity of 14,000 MW, this power source is of significance for both Brazil and Paraguay.

Despite this impressive construction, the dam had significant and diverse social and

environmental effects. The construction resulted in the relocation of around 42,444 individuals, primarily from rural regions spanning eight municipalities. The inundation of more than 110,000 hectares of land sparked multiple disputes, causing major adjustments to the lifestyle and means of livelihood of the indigenous people. The families impacted, a significant number of whom didn't have official land ownership, encountered little compensation and assistance during the resettlement procedure, resulting in protracted conflicts and the emergence of social movements.

The Itaipu Dam had a significant negative effect on indigenous communities, namely the Guarani households living in the Ocoí indigenous region. The inundation of approximately two-thirds of their designated area and the imminent possibility of being relocated worsened their already terrible living circumstances. In 1986, the indigenous conflict gained international notice when a letter was sent to the World Bank, highlighting their situation. However, the resulting improvements were minimal.

The Itaipu Dam is currently a tourist attraction in western Paraná, where efforts have been made to honour the workers and displaced families through several projects, such as the establishment of a museum. Despite enduring years of hardship, numerous impacted families have successfully reconstructed their lives, however the project's enduring social and environmental consequences are still apparent.

Using the DPSIR framework:

Driving Forces (D):

- The need of fostering economic growth and securing a reliable energy supply for Brazil and Paraguay.
- Providing international financial and scientific assistance to harness the hydroelectric capacity of the Paraná River.

Pressures (P):

- Extensive land floods caused by large-scale construction activities.
- The process of clearing forests and transforming how the land is exploited.

State (S):

- The flooding of important natural sites, such as the Guaíra Falls.
- Modification of regional ecosystems and loss of biodiversity.

Impact (I):

- Approximately 42,444 individuals, mostly from rural regions, were forced to relocate.
- Prolonged ecological disturbance and societal disputes resulting from insufficient reparation and relocation endeavours.

Response (R):

- The establishment of social movements and the participation of religious organisations to provide assistance to communities that have been impacted.
- Modified remuneration proposals and strategies to seek land resolutions, while frequently inadequate.
- Global focus on indigenous matters, yet with minimal progress in enhancing their quality of life.

5.2 Case study 2: The Ilha Solteira Dam

The Ilha Solteira Dam, situated on the Paraná River, is a significant hydroelectric facility in Brazil, boasting a capacity of around 3,444 MW. In 2015, China Three Gorges Corporation (CTG) obtained the rights to operate the dam by entering into a 30-year concession agreement (People's daily, 2016). CTG's acquisition of the Ilha Solteira Dam in Brazil represented a

strategic expansion for the company and introduced modern methods in operational and environmental management (Wallis, 2016).

CTG has established stricter water quality monitoring, biodiversity conservation, and emission control methods in order to comply with both Brazilian and international environmental regulations. The objective of these activities was to reduce sedimentation problems and enhance fish migratory routes, in order to address persistent ecological concerns. From an economic perspective, CTG's expenditures are focused on improving the infrastructure of the dam in order to increase reliability and effectiveness, therefore providing a consistent supply of renewable energy. The arrival of this large amount of capital strengthened the local economy by creating jobs and improving infrastructure. CTG's approach involved community engagement on a social level. The corporation engaged in public engagements to address local apprehensions and allocated resources towards community development projects, including educational programs, healthcare initiatives, and infrastructural enhancements. These activities were implemented as part of a comprehensive corporate social responsibility plan with the goal of cultivating favorable relationships with impacted communities (Hunt et al., 2020).

The modernization efforts yielded economic benefits in the form of increased efficiency and reduced costs, underscoring the possibility of utilizing international experience in the hydropower industry. CTG's engagement primarily focused on technology transfer, encompassing cutting-edge turbines, control systems, and operational expertise. This not only improved the dam's efficiency but also offered significant technical knowledge to local people, thereby contributing to the development of skills within the Brazilian hydropower industry (Leturcq, 2019).

Analysis of the DPSIR framework:

Driving forces (D):

- The acquisition of the Ilha Solteira Dam by CTG was motivated by its ambition to broaden its international portfolio and ensure a stable and enduring energy supply in Latin America. This is in line with China's "Going Out" strategy, which aims to expand its worldwide economic influence by investing in infrastructure. CTG seized the opportunity to adopt sophisticated technologies and techniques when Brazil recognized the need to update its hydroelectric infrastructure.

Pressures (P):

- The Ilha Solteira Dam is faced with the challenge of balancing the imperative of sustaining high energy output with the imperative of reducing ecological consequences. This entails the management of sedimentation, the assurance of water quality, and the preservation of local biodiversity. Additionally, there are social pressures related to the need to maintain positive relationships with local communities and to resolve any socio-economic disturbances that may arise as a result of the dam's operations.

State (S):

- Since CTG acquired the Ilha Solteira Dam, there have been notable enhancements in operational efficiency and environmental management. CTG has established stringent monitoring initiatives to assess water quality and biodiversity, as well as improved infrastructure to enhance energy production capacities. These actions have been implemented to stabilize the dam's operations and reduce adverse environmental effects.

Impact (I):

- CTG's participation has resulted in favorable environmental transformations as a result of improved sediment management and initiatives to facilitate fish migration, but certain ecological disturbances persist. CTG's involvement in public discussions and

development initiatives has effectively mitigated social consequences, including relocation and alterations in livelihoods. From an economic standpoint, the implementation of modernization initiatives has resulted in substantial investments, thereby stimulating local economies and generating employment opportunities.

Response (R):

- CTG has implemented measures with the objective of enhancing sustainability and fostering positive community ties. These encompass consistent allocation of resources towards cutting-edge technologies, extensive initiatives for social responsibility, and continual engagement with stakeholders through discussion. These answers are essential for achieving a balance between operational demands and the sustainable management of natural and social resources.

5.3 Case study 3: Tapajos Hydroelectric complex

The Tapajós River in Brazil, a 2,000km long tributary of the Amazon, is a vital resource for indigenous communities and biodiversity. It sustains diverse communities and provides clean water, supporting fisheries, fertilizing fields, and providing clean water. However, the river's natural flows and flood pulses are critical for life along the river, which is considered one of the best remaining opportunities for hydropower generation. Currently, 42 dams are planned in the basin, including a series of five barrages comprising the Tapajós River Hydroelectric Complex. If all these dams are built, the environmental and social consequences would be disastrous. An estimated 2,000km2 of Indigenous territories would be flooded by reservoirs, altering the river's natural water flow, depth, temperature, sedimentation, and oxygen levels. The dams would also destroy the delicate ecosystems and threaten the wealth of wildlife that the river currently supports. The hydropower dams are based on outdated forecasts and 20th-century thinking, which do not take into account increasing energy efficiency and the falling

price of wind and solar technologies. The carbon and methane emissions from the construction of the dams and from their reservoirs would generate greenhouse gas emissions comparable to a natural gas plant. Despite the influence of the Brazilian construction lobby and the Bolsanaro government's pro-dam position, opposition to the dams has been immense. The reason why this complex has been chosen as a case study is that it is not yet built but is a mix of national and Chinese initiatives, allowing to demonstrate how the hypothesis of the thesis might be true in this case. The immediate impact will be felt by indigenous people, local communities, and nature in the river basin, but ultimately, the effects will be felt all over the world.

Similar to other hydroelectric projects in the Amazon, the creation of the Environmental Impact Assessment (EIA) for dams associated to Tapajós has been hindered by many issues. The initial documents deliberately downplayed the environmental and social consequences, lacked a comprehensive assessment of the effects on Indigenous peoples, disregarded an isolated Indigenous tribe in the area, and failed to acknowledge the rights of traditional non-Indigenous communities who have resided in the Tapajós basin for an extended period and heavily rely on fishing and natural resources for their livelihoods. The conclusive evaluation of the Indigenous aspect of the Tapajós Waterway Environmental Impact Assessment (EIA) determined, in opposition to an official analysis conducted by FUNAI technicians, that the submergence of Indigenous territories is a long-established phenomenon that can be alleviated through appropriate compensation provided to Indigenous groups that may suffer losses (Hess et al., 2016).

Analysis of Tapajós Complex using the DPSIR Framework:

Driving Forces (D):

- The main force behind the establishment of the Tapajós complex is the deliberate expansion of Brazil's hydroelectric power generation capacity in order to satisfy the growing energy needs and improve the effectiveness of transporting commodities, particularly soybeans, in response to China's demand.
- The Brazilian government and agribusiness sectors are driven by the economic advantages and the necessity for infrastructure expansion to facilitate extensive agriculture and energy generation as well as transportation.

Pressures (P):

- The Tapajós River project generates tensions in terms of environmental, social, and economic aspects. The project is under considerable pressure to effectively address the effects on biodiversity, water quality, and ecosystem services from an environmental standpoint. Social pressures arise due to the necessity of addressing the rights and well-being of Indigenous people and other local groups impacted by the construction of the dam.

State (S):

- The present condition of the Tapajós River and its surrounding environment is characterized by abundant biodiversity and notable cultural heritage.
- The proposed development of more than 40 dams, presents a significant hazard to this region, endangering the ecological balance and the means of subsistence for the Munduruku Indigenous people and other indigenous communities.
- The Environmental Impact Assessments (EIA) conducted for the project have faced criticism for their tendency to underestimate and overlook significant repercussions.

This indicates a situation of inadequate and perhaps deceptive environmental governance.

Impacts (I):

- The Tapajós Waterway has diverse and wide-ranging impacts. The construction of dams is anticipated to have a negative impact on the environment, including causing deforestation, habitat fragmentation, and biodiversity loss. This includes the displacement of species and alterations to the river's hydrological cycle. From a sociological perspective, the relocation of Indigenous and local people will lead to the erosion of cultural assets, increased social tensions, and the disruption of traditional ways of making a living.

Response (R):

- Efforts so far encompass initiatives aimed at enhancing the thoroughness and clarity of environmental assessments, involving local people in consultation processes, and formulating compensation and mitigation measures for individuals impacted by such evaluations.
- International and local environmental organizations promote the use of alternative energy sources and sustainable development techniques as a means to decrease dependence on large-scale hydropower projects. In addition, legislative and policy measures seek to ensure more stringent adherence to environmental and social protections in order to defend the rights of Indigenous peoples and the environment.

6. Discussion and Findings

6.1 Discussion

Prior to 2015, Chinese investment in Brazil's hydroelectric plants was negligible. However, the exportation of soybeans from Brazil to China has led to major investments in private ports along the Tapajós River and other regions of the country. The purpose of these expenditures was to improve transportation efficiency and lower shipping costs for transporting soybeans to China. The majority of soy-based products are produced in Central Brazil and after that, transported by land to ports located in the North and South-east regions. From there, they are supplied through the Panama Canal. The growing soybean industry in Brazil, primarily fueled by China's demand, requires efficient logistics for transporting soybeans from central Brazil to ports for global trade. Hydropower dams, like the ones planned for the Tapajós River, play a crucial role in establishing navigable waterways, which allow for the more efficient transportation of soybeans using large ships instead of trucks. As a result, a reduction in transportation costs and transit times is created, thereby improving the competitiveness of Brazilian soybeans on the global market. Investments in hydroelectric infrastructure have an immediate positive impact on the soybean export supply chain by enhancing logistical efficiency and reducing costs.

The development of commodity trade with China has led major players in the market to bypass legislation and initiate business activities that offer grounds for advocates of dams to support the development of hydroelectric and river transport complexes. This has been demonstrated when Cargill (a US corporation) established a private port in Santarém in 2003 without obtaining a formal license and Environmental Impact Assessment, which was seen by local, state, and federal government entities as an indication of market interest in the Tapajós Waterway (Greenpeace, 2012). This led to the subsequent development of multiple private ports in the region. Nevertheless, as a result of the opposition shown by civil society

organisations towards the Cargill port, the decision was made to establish the new ports at a greater distance from the city of Santarém, ultimately bringing them closer to Indigenous territories located in the central region of the Tapajós.

6.2 Findings

The results of the case studies conducted on the Itaipu Dam, Ilha Solteira Dam, and the projected Tapajós Hydroelectric Complex demonstrate that Chinese hydropower projects in Brazil have yielded significant economic advantages and contributed to the development of infrastructure. Nevertheless, these projects provide more significant environmental and social hazards in comparison to those undertaken by other domestic or global collaborators. Despite its grandeur and economic benefits, the Itaipu Dam caused considerable displacement and ecological disturbance. Similarly, the Ilha Solteira Dam, which is managed by the Chinese, enhanced operational efficiency and community involvement. However, it had difficulties in maintaining a balance between generating a large amount of energy and ensuring environmental sustainability. The projected Tapajós Complex, which entails the construction of numerous dams, has a significant risk of causing massive environmental degradation and social dislocation, with Indigenous communities being disproportionately affected. These data confirm the premise that Chinese investments in Brazil's infrastructure not only strengthen it, but also bring about increased environmental and socioeconomic difficulties.

6.3 Conclusion

The relationship between China and Brazil relies heavily on resource diplomacy. China has made substantial investments in Brazil's mining, agricultural, and energy sectors in order to satisfy its need for natural resources. Chinese investments in Brazil's resource industry are driven by the imperative to secure long-term supplies of vital inputs for the Chinese economy (Brancalion et al., 2018). China offers financial support and expertise, which in turn

contributes to the growth of Brazil's economy and infrastructure initiatives. Both countries have prioritized hydropower in their collaboration as part of their mutual goal to increase their renewable energy capacity. The Belo Monte Dam, Tapajos Hydraulic complex discussions and other big hydroelectric projects exemplify this collaboration in practice. Chinese banks and private organizations contribute significant financial resources and specialized knowledge to Brazil through these projects (Batista Barbosa, 2021).

Although there is a generally favorable perception of the bilateral relationship between China and Brazil, their collaboration in hydropower development and other sectors has been plagued by controversy and challenges. Significant environmental issues encompass deforestation, the loss of biodiversity, and the deterioration of water quality, whereas environmental impact assessments have received comparatively less emphasis (Mayer et al., 2021). Moreover, there have been demonstrations and resistance due to societal consequences such as conflicts over indigenous populations and the displacement of local people (Fearnside, 2016). This thesis examined the impact of Chinese resource diplomacy on the hydropower development in Brazil through the analysis of three case studies. Chinese investments have significantly enhanced Brazil's infrastructural and economic conditions, as indicated by the evidence. However, these activities often involve substantial disruptions, necessitating stringent measures to save the environment and handle social issues. To summarize, this thesis has elucidated the scope of Chinese involvement in hydroelectric projects in the Brazilian Amazon and Cerrado regions, which goes beyond mere financial assistance, ownership, or management of hydropower dams. China's construction of a robust and far-reaching transnational commodity trade system with Brazil enables it to exert indirect yet significant influence over the determination of national interests and priority infrastructure projects. The decision-making process for hydroelectric dams in Brazil is marked by a lack of transparency and policy coherence. The utilization of legal tools such as security suspension allows proponents of dams to circumvent environmental restrictions and infringe against the constitutional rights of Indigenous populations.

In order to guarantee a democratic process for creating policies in the hydropower industry, it is crucial for communities affected by it, non-governmental organizations, activists, and political coalitions that provide support to concentrate their efforts on restructuring the legislative framework for conducting Environmental Impact Assessment studies. This involves ensuring that the studies are financed by impartial organizations rather than supporters of the dam, which is frequently the situation. Another imperative goal should be the abolition of the security suspension statute, an antiquated legal instrument that has persistently been used to disregard the constitutional rights of local communities in the Amazon region.

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