Brazilian Amazon deforestation: systemic worldviews behind destruction

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Major Paper

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Abstract

This paper deconstructs the causes of deforestation in the Brazilian Amazon Rainforest using the Causal Layered Analysis framework to provide an overview for social businesses that wish to contribute to the mitigation of this problem. The objective of this deeper analysis is to find the systemic issues that are created by a diversity of environmental worldviews that coexist in the area.

With the current push to align conservation and technological breakthroughs, the project Amazon 4.0 presents a solution to deforestation at the intersection of the Fourth Industrial Revolution and mainstream Sustainability practices. However, this paper also identifies some of the risks this project presents for a modern type of colonization in the area by facilitating access to Big Tech companies. In the end, the main insights will be summarized in the conclusion, and recommendations for changing the narrative that drives deforestation will be presented.

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List of Acronyms

4IR	Fourth Industrial Revolution
APIB	Brazilian Indigenous People Articulation
BNDES	Brazilian Development Bank
BRICS	Brazil, Russia, India, China, South Africa
CBD	Convention on Biological Diversity
CIEL	Center for International Environmental Law
CLA	Causal Layered Analysis
COICA	Coordinating Body for the Indigenous Organizations of the Amazon Basin
COP	Conference of the Parties
CPR	Rural Product Identification
EMBRAPA	Brazilian Agricultural Research Corporation
GDP	Gross Domestic Product
GHGs	Greenhouse gases
IBAMA	Brazilian Institute of Environment and Renewable Natural Resources
IBGE	Brazilian Institute of Geography and Statistics
IP	Intellectual Property
IPAM	Amazon Environmental Research Institute
LDC	Least Developed Countries
LEED	Leadership in Energy and Environmental Design
NGGP	National Green Growth Program
OECD	Organization for Economic Cooperation and Development
PRODES	Amazon Deforestation Calculation Program

PTO	US Patent and Trademark Office
REDD+	Reducing Emissions from Deforestation and Forest Degradation
ROI	Return on Investment
TK	Traditional Knowledge
UN SDGs	United Nations Sustainable Development Goals
VUCA	Volatility, Uncertainty, Complexity, Ambiguity

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To my mother, Neide Magalhães, and my sister, Larissa Vaz:

Thanks for listening, for the countless breakfasts, and for believing in me even when I did not.

To myself:

Thanks for not giving up! I love you.

Foreword

As we travelled for over seven hours from Rio Branco to Tarauacá, in the northwest of Brazil, we saw countless cattle farms on both sides of the highway. The trip was sadly intense for me even though I finally was at the heart of the Brazilian Amazon for the first time. As we traversed the vast expanse of road I wondered where all the original forest had gone, only to find its remnants at Pinuya, one of the Huni Kuin Territories.

Once there, meeting the Huni Kuin people became a deep learning experience that challenged all the preconceived ideas I once may have had about living in the jungle. Furthermore,

I kept wondering throughout my stay: "what is it that they have that I am missing?" It was as if, through their senses, they knew more about me than I knew about myself. I observed with admiration how they walked around the rainforest with such confidence. Truly flowing amongst the trees, even at night when all was very dark. They didn't need lanterns as we did, they knew how to sense their way even in areas where the forest was denser. I, on the other hand, relying on my racing mind, felt as vulnerable as I ever had.

I understood certain things with my logical thinking, but I wasn't able - at first - to rely on my senses until I actually relaxed and trusted the experience. That only happened in the last couple of days of that life-affirming experience when I was finally able to walk around with no lantern by myself, as if, like them, I was dancing with the trees.

That was my first connection to learning by establishing a "spiritual, physical, emotional, and mental connection" to the experience (McGregor, 2018). However, I would only learn about McGregor's concept two years later, in an Indigenous Research Methods course that I took at York University with Professor Julian Robbins.

I applied for the Masters of Environmental Studies (MES) to understand how I could better serve the forest. I had already put together a couple of fundraisers to help the Huni Kuin People build a Traditional Medicine House. However, I quickly realized that fundraisers were not a permanent solution to help them or the deforestation problem. That was when a friend told me about his experience in the Amazon leading projects that focused on sustainability. He also suggested the business stream of the MES program would help me to see possibilities to effectively communicate my vision to companies.

Other than that, one of the issues I learned with the Huni Kuin was about Amazonian products and Traditional Knowledge that were patented in other countries. This inspired me to take the International Environmental Law course at Osgoode Hall with Professor David Estrin, where I wrote a piece on biopiracy (which was updated to be a key foundational section of this paper).

The MES classes in Ecological Economics with Professor Eric Miller helped me to improve my strategic skills. Learning about Economics was fundamental to understand the Western system from that perspective, which was definitely new to me. Even though I have been an entrepreneur for a great part of my career, that class improved my capacity to see the bigger picture and to acknowledge the difference between ecological and traditional economics.

My professional experience as a collaborator at the Project Climate Change helped me to understand that social projects need effective communication and collaboration to find a common ground for decision-making. I also learned there about the different perspectives on sustainability, and how these worldviews needed to be effectively communicated to prioritize strategic actions and budgetary allocations. As part of that project, I organized and collaborated with members in several workshops designed by me to help everyone involved understand their perspectives and worldviews. That professional experience inspired me to research in-depth

Causal Layered Analysis (CLA), which is the main building block for this paper. That methodology is often used in group settings to solve complex problems.

In my courses at Schulich School of Business, I learned how to measure companies' sustainability compliance based on Environmental, Social and Governance (ESG) indicators. Moreover, their course on Managing Ethics and Social Responsibility with Professor Dirk Matten raised issues of data governance in digital technology that were important in the critical analysis part of this paper.

The MES course on Education, Sustainability and the Ecological Crisis with Professor Steven Alsop helped me to understand other perspectives of the UN Sustainable Development Goals than the mainstream. That class was also important to develop a more personal connection to my critical writing.

However, the final piece of my MES puzzle only came in the last class I took in the program. The course Critical Theories of International Development with Professor Ilan Kapoor set me on the research journey for this paper. I (temporarily) moved to Brazil since the beginning of the pandemic, and here I could see what I was learning at FES in real time and right outside my door (sometimes, even inside my own door!). Here in Brazil, I finally understood how much work I still needed to decolonize my own mind in order to write the project that I believe chose me. And I still probably fall short from what actual decolonization really is.

When my last MES course ended, I found out about Amazon 4.0 at one of the countless Zoom meetings I attended during the pandemic from this online community on Regenerative Futures. The Amazon 4.0 project is located at the intersection of the Fourth Industrial Revolution and Sustainability, where there is a space of hope created to mitigate deforestation and to build a local economy that truly respects biodiversity and local people. Before this program, I worked

with education technology and my mentor of 10 years works with Augmented and Virtual Reality. She also inspired me in conversations about futurism and innovation.

And, just like this, I found what needed to flow through me...onto the paper. I have finally gone full circle...

This paper represents both a summary of all that I have learnt at FES in the last two years and also the start of my professional journey as a Brazilian-Canadian researcher committed to serve the Amazon and the many amazing people that have been living there since time immemorial.

Disclosure: I was born and raised in the southeast part of Brazil, the most industrialized area of the country. However, I lived most of my adult life in Canada where I became a permanent resident in 2009 and a citizen in 2016. The perspective that I offer is grounded in my experience with both realities.

1. Introduction

This Major Paper aims to bridge a gap in knowledge for social businesses interested in contributing to the mitigation of deforestation in the Brazilian portion of the Amazon rainforest. With the current economic and political push for innovative technologies to resolve global sustainability problems, the discussion has become very fragmented. This paper aims to create a comprehensive overview of the discourse layers relative to its potential impact in the Brazilian Amazon rainforest.

According to the United Nations, reducing emissions from deforestation and forest degradation (REDD +) is the major sustainability problem faced by many developing countries, where a large share of the economy relies on extractive activities. In the case of Brazil, many of today's social problems stem from European colonization (Cardoso et al., 1985) and are usually linked to economic problems. The conventional economic practice - still prevalent today in Brazil - is the assumption that by growing the economy most social problems will be (automatically) resolved through taxes and job creation (Harari, 2014), while perpetuating economic activities and pervasive policies that are inherently unsustainable for the environment.

With the purpose of reconciling economic development and forest conservation, the Amazon 4.0 project proposes a way to decouple growth from resource extraction through appropriate technology and agroforestry (Nobre et al., 2018; 2019; 2020). The name of the project is a reference to the technologies of the Fourth Industrial Revolution that are, according to Carlos and Ismael Nobre, ideal for the conservation of the forest. Meanwhile, the project also aims at

resolving many of the social problems in the area as proposed by the UN Sustainable Development Goals.

However, sustainable development is not a scientific consensus and the technologies of the Fourth Industrial Revolution can create additional social challenges, especially in developing countries. With the continuous rise in public and private investments in this intersection[1] worldwide, other alternatives become obfuscated and a true paradigm shift for effective social and environmental impact may not be achieved.

In the light of these challenges, the main questions addressed by this paper are:

What elements of the past and present discourse should be considered to stop the Brazilian Amazon deforestation scenario?

Can the project Amazon 4.0 create a real paradigm shift in the deforestation scenario?

What worldviews and narratives would be necessary to support and communicate this paradigm shift to the diverse stakeholders involved in the issue?

1.1. Chapters summaries

This work is divided into the following chapters:

Chapter 1 serves as an introduction to the topic and a construction of the problem this paper aims to discuss and the methodology used for the research.

Chapter 2 presents the spectrums of environmental worldviews and their application in the Causal Layered Analysis framework to deconstruct deforestation in the Brazilian portion of the Amazon rainforest. It also correlates the layers uncovered with the Amazon 4.0 project, which is contrasted with other available socio-economic approaches to test its vulnerabilities.

[1] Referring to the Fourth Industrial Revolution and the UN Sustainable Development Goals.

Chapter 3 identifies the main economic activities that cause deforestation in the Brazilian Amazon. This chapter also analyzes the national and international influences in the problem.

Chapter 4 defines sustainability as a threshold to regeneration, which is the perspective of this paper. This chapter also critically analyzes the mainstream discourse of sustainability and its impact in the Brazilian Amazon.

Chapter 5 defines the Fourth Industrial Revolution concept and identifies the main technologies that promise to cause an exponential change in our society. This chapter also analyzes the development discourse behind this revolution and the possible impacts in the Brazilian Amazon Rainforest.

Chapter 6 illustrates the discussion with a current case from COP 26 that is also analyzed from the worldview perspective and systemic context.

Chapter 7 concludes this paper and identifies areas that were beyond the scope of this work. It also provides recommendations for future work.

1.2. Paper methodology

This paper applies the Future Thinking methodology of Causal Layered Analysis (Inayatullah, 1998) to identify deeper and more inclusive solutions to deforestation. This framework consists of four layers of analysis:

Litany is the most superficial level or public description of an issue. Solutions at this level are also not ideal, since they rarely address the real cause of the problem.

Social/historic/systemic causes form the second layer that is determined by the short-term aspects of the problem. This level helps with contextualizing the problem to find appropriate short-term solutions.

Worldview is the third layer of analysis that identifies the mindset that causes the problem. This helps to identify solutions that need long-term planning. However, changing this layer is considered in this framework as achieving a paradigm shift.

Narrative/Myth is the fourth layer of analysis that identifies a recurrent symbol or archetype in the history of a society that may be causing the problem. Solutions at this level take longer than worldview shifts since the behavior that causes the problem is driven by emotional reactions that are not clearly identified by the individual.

To identify the Worldview layer, this paper also used three spectrums to understand environmental worldviews that offer similarities:

- The **first** is the one developed by Corbett (2006), which identifies the different types of environmental ideologies.
- The **second** one was developed by Reed (2007) and identifies the current environmental design from degeneration to regeneration, where sustainability is seen as a threshold on the path to regeneration.
- The **third** one was based on climate change opinions identified by Eisenstein (2018), which range from climate denial to an environmental view that is beyond greenhouse gases.

Other than that, this paper is based on a literature review in three main areas, which included: causes of deforestation in the Brazilian Amazon, Sustainability, and the Fourth Industrial Revolution.

The next chapter introduces the Causal Layered Analysis and the worldview spectrums to deconstruct deforestation in the Brazilian Amazon.

2. Worldviews for effective communication of a paradigm shift

> "In times of Change, 'What's in it for me?' is the question you need to answer" Roger D. Duncan

This chapter presents the spectrums that will help to analyze and correlate the different environmental worldviews that may create a paradigm shift in the deforestation scenario in the Brazilian portion of the Amazon Rainforest.

The limitations of our natural systems, the growth of the world's population, and the advancements of technological innovations are leading us to a time of unprecedented change. Futurists, scientists and leaders who are at the forefront of these changes state that we are living in a "VUCA" time (Johansen, 2007; Kotler et al., 2017; Mack et al., 2015; Lawrence, 2013; Sinha et al., 2020). VUCA stands for Volatility, Uncertainty, Complexity and Ambiguity and was first coined by the US military to describe the world after the Cold War (Lawrence, 2013; Sinha et al., 2020). To thrive in this world, according to Johansen (2007), we need to change our focus to Vision, Understanding, Clarity and Agility in order to harness the opportunities for innovation and collaboration. In short, in the VUCA world we need a vision that is clearly communicated to build understanding and propel action.

The UN Sustainable Development Goals (SDGs) are an attempt to create that type of vision by offering a clear shared vision to guide actions by businesses and governments . Moreover, the SDGs are based on the deeper assumption that development and economic growth may continue should they prove to operate in a sustainable framework. That worldview is, therefore, attractive to those operating and thriving within the system. Therefore, the importance of understanding the

perspective that is driving action is essential to find clarity in environmental communication (Corbett, 2006).[2] Figure 1 below provides a summary of Corbett's 2006 research.

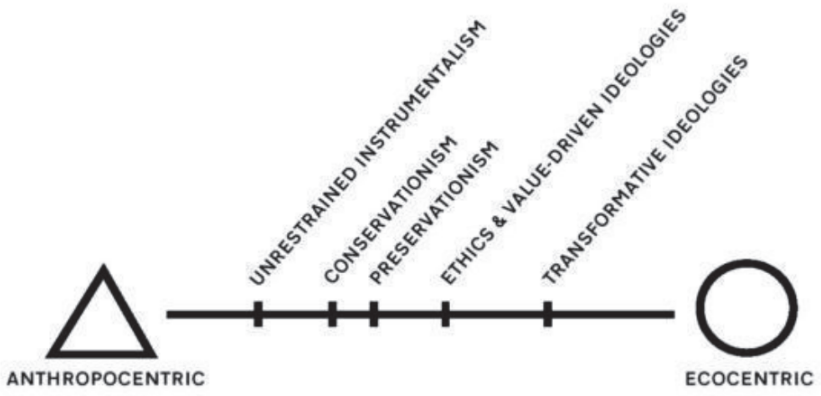

Figure 1: Spectrum of Environmental Ideologies (Based on Corbett, 2006)

Corbett (2006) affirms that beliefs originate in childhood experiences in nature, a sense of belonging to a place, or historical and cultural context. Therefore, there is also an underlying assumption that these moorings are not easily changeable, or that personal change will take longer than a change in the system[3]. A system's change, for example in the form of a regulation, is a top-down approach. It may change behavior by fear of punishment, but it may not change automatically how people really feel about that topic. For instance, there are regulations in many countries about discrimination toward minority groups. Most people may respect that out of fear of punishment, or even for recognizing that things are changing. However, they may not change how they actually feel or behave toward such groups just because a new regulation is in place.

[2] Julia Corbett (2006) created a spectrum of beliefs as a framework to analyze environmental messages.

[3] In this case referring to systems created by humans, not natural systems.

The shallow change enforced by a regulation may occasionally betray the individual through what Lacan named "slips of the tongue" (Kapoor, 2020). The idiom means that the unconscious (feeling, emotion) manifests in the form of linguistic miscommunication (Kapoor, 2020). Corbett' (2006) spectrum also correlates to the model created by Bill Reed[4] (2007) in his efforts to shift the conversation from sustainability to the regeneration of the environment. Both authors identify that the spectrum of views/practices goes from nature as a resource to serve humans toward a practice of systems regeneration, where humans and nature are part of a larger system. Moreover, the "sustainable" design part in Reed' (2007) spectrum also corroborates to what Corbett (2006) calls "conservationism" that aims at a "wise use of natural resources", but still commodifies non-human entities by considering them as resources, therefore, rendering them utilitarian or disposable.

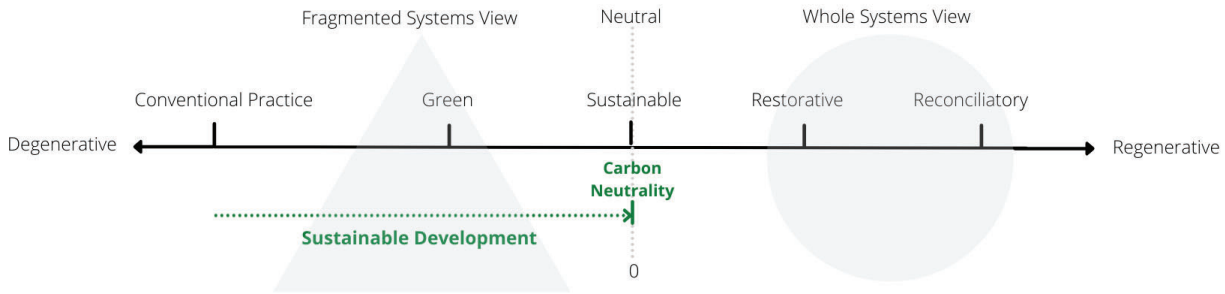

Figure 2: Sustainable Development in Reed's Trajectory of Environmentally Responsible Design (Adapted from Reed, 2007)

Reed (2007) argues on behalf of creating a whole system where humans and nature are not separate. In his perspective, conventional definitions of sustainability translate to doing "less damage" to the environment, and we are missing the opportunity to collaborate for our mutual gain (i.e., symbiosis instead of parasitism).

[4] The original Reed's model is in Chapter 3 of this paper (Fig. 7).

> "The shift from a fragmented to a whole systems model is the significant cultural leap that consumer society needs to make – through framing and understanding living system interrelationships in an integrated way." (Reed, 2007)

Like most scholars that advocate for degrowth (Norberg-Hodge, 2010; Demario, 2013), Reed (2007) proposes that a place-based approach is essential to implement a whole systems model that is key to regeneration. In his framework for living systems, sustainability is seen as a threshold, not an end in itself (as it is proposed by the mainstream discourse on sustainable development).

Eisenstein (2018) created a spectrum (Fig. 3) of mainstream opinions on the topic of climate change that he was able to classify, during his readings, to better understand the scenario.

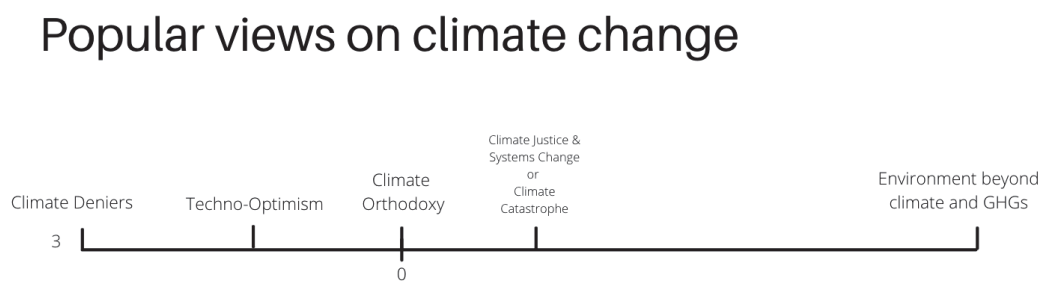

Figure 3: Popular views on climate change (Based on Eisenstein, 2018)

Eisenstein concluded that these opinions have underlying shared assumptions that contribute to the difficulties of solving problems (for example, placing all focus and effort on greenhouse gases and the rise in global temperature). Eisenstein recognizes that Climate Justice questions challenge the economic system that leads to the climate emergency and social oppression; however, he still affirms that:

> "All (perspectives) agree with the general consensus that puts climate change and carbon at the heart of environmentalism." (Eisenstein, 2018 p.56)

With this quote Eisenstein (2018) argues that climate change is a symptom of a system in degradation. Therefore, in his work he calls for a more holistic[5] approach to include the health of our ecosystems - conservation of wildlife, oceans, soil regeneration - in the discussion, since their degeneration may be the hidden cause behind climate change. This vision corroborates with Reed (2007), when he calls for a whole systems approach that goes beyond sustainability.[6] Moreover, Eisenstein (2018) spectrum also starts from a conventional or utilitarian view of nature (i.e., climate denial), which hopes to maintain the status quo by denying climate change is even happening.

The work by Reed and Eisenstein is useful to understand these worldviews may share common detrimental patterns that drive environmental policies and behavior. Furthermore, as Reed (2007) points out, the patterns on the spectrum are all currently coexisting. Therefore, the big challenge is to move from a fragmented worldview to a more holistic perspective.

2. 1. Application: Causal Layered Analysis and Amazon deforestation worldviews

The poststructuralist method of Future's Thinking, Causal Layered Analysis, offers a layered approach to understand complex problems. The idea of an iceberg is used in many illustrations to explain the method, where **Litany** is the ice tip above sea level representing the problem that we can see; **Causes** are the systems or historical views that are underneath; **Worldviews** are the

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[5] A tangible example of how the focus on GHG can be deceiving is hydroelectric power. Hydroelectric power is often promoted as a clean energy source, and that view dominates public perception (Fearnside, 2016). However, the ecological and social damage it creates with changing the course of a river should also be accounted for. An example of that is Belo Monte hydroelectric, located in the heart of the Amazon forest. The construction displaced about 20 thousand people, including indigenous and small farmers, risking sanitary collapse; changing the course of the river and fish reproduction, also causing deforestation by flooding the area.

[6] The mainstream reductionist approach - that only mentions GHGs to guide policies - is also incompatible with the SDGs discourse that actually call for an integrated approach to the goals in order to ensure sustainability (Folke, 2016).

deeper layer of discourse that is driving the causes; and **Myth** represents the narrative underlying it all (for details please see Fig. 4).

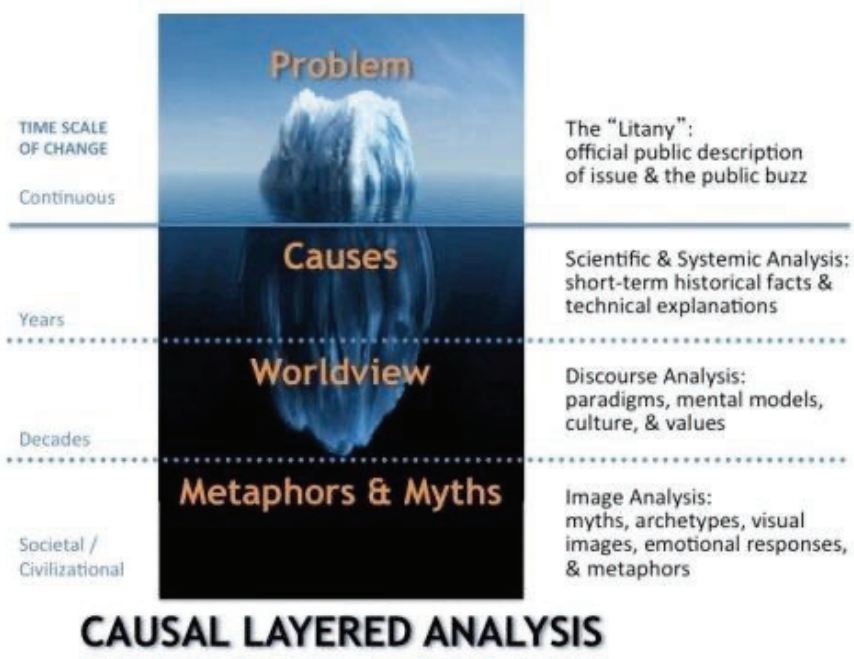

Figure 4: Causal Layered Analysis iceberg model (reproduced from Hsu, page 35, 2017)

CLA can be a great tool in the VUCA world to find solutions and plan future scenarios to mitigate complex problems. Moreover, as we can see in Figure 4 above, it can also help estimate the time it may take for change to happen in each layer. As noticed by Corbett (2006), environmental beliefs take time to effect change, since they are deeply rooted in childhood and cultural backgrounds. These beliefs will correlate to the CLA layers of "Worldview" and "Metaphors/Myths".

In the context of the Amazon rainforest deforestation, this tool is useful to understand the deeper layers of causes that drive the problem, and the time possible solutions may take to be implemented. For instance, solutions at the system's level - like the Carbon Market - may only take some years to implement, while solutions at the worldview level might require changing

mental models through revising/replacing key educational moorings. Even though the former is understood as a 'fixing tool' in alignment with the current system (Kapoor, 2021; Eisenstein, 2018), the latter will take much longer to implement but will effect real change. The importance of this deeper approach is that, more often than not, solutions are proposed and argued interchangeably. In other words, solutions to complex problems are proposed and discussed in an "either/or" scenario, when sometimes both are needed to plan effectively for the long term.

Layers	Current Issue	Proposed Solutions	
Litany (externalized reality)	Deforestation in the Brazilian Amazon Rainforest: GHG emissions increase; biodiversity loss; impact in other parts of the globe	Combining SDGs + 4IR technologies (Nobre, 2018; 2019; 2020)	Community-based solutions; decentralization; focus on local rather than global: Degrowth
Systems View	Monoculture practice mindset that started in the colonization period; Difficulties in monitoring/ fiscalization; Land grabbing conflicts; Illegal mining, cattle raising and agriculture; International investment in deforestation practices; multinationals that focus on extracting raw materials for the international market; lack of infrastructure (roads, transportation); extreme poverty; dry season (May to September).	Top-down orientation; Public-Private partnerships (Goal 17); ESG reporting; Carbon market & Amazonian Fund; Technologies of the 4IR to avoid deforestation for infrastructure, production and energy efficiency (Goals 7, 9, 12); engage communities (indigenous and local) in the cultivation of fruits that are more valuable than grain/cattle (Goals 1, 8, 9, 10, 11); Educate locals on the use of technology (Goals 8, 4)	Bottom-up orientation; Decolonization; sharing/gifting economy; local; solutions that respect traditions and costumes of the area; agro-forest; Ancient Futures; questions imperialism/capitalism production practices
Worldview (deeper assumptions)	Conventional practice that leads to degeneration (Reed, 2007); Climate denial (Eisenstein, 2018); Unrestrained instrumentalism (Corbett, 2006)	Green Growth & Sustainability (Reed, 2007); Techno-optimism & Climate ortodoxy (Eisenstein, 2018); Conservationism (Corbett, 2006)	Restorative/Reconcialiatory/Regenerative (Reed, 2007); Preservationism and Ethics & value driven (Corbett, 2006); Climate Justice or Catastrophe/ Climate beyond GHGs (Eisenstein, 2018)
Keywords	Progress/Development/Modernization	Development/Sustainability/Green Growth	Degrowth/Regeneration/Holism/Decolonization
Myth (deeper stories)	Humans above nature; Utilitarian view of natural resources; Fragmented Systems view (Reed, 2007)	Humans above nature; Utilitarian view of natural resources; Fragmented Systems view (Reed, 2007)	Humans as part of a larger system; Indigenous value-system; Earth as a living being (Corbett, 2006); Whole Systems view (Reed, 2007)

Table 1. Amazon deforestation Causal Layered Analysis. Information sourced from literature (Nobre et al., 2018; 2019; 2020; Eisenstein, 2018; Corbett, 2006; Reed, 2007; Demaria et al.,2013; Norberg-Hodge, 2010; Fearnside, 2006; 2019a; 2019b; Pereira et al., 2020)

Deconstructing the causes of deforestation helps with examining the deeper levels of the worldviews and myths that support the issue. The "Conventional Practice" (Reed, 2007) operates in the framework of regulations or lack of thereof. That worldview might include "Climate Deniers" (Eisenstein, 2018), who would even act under environmental regulations to not lose a license, for instance. The environmental belief here could be of "Unrestrained Instrumentalism"

(Corbett, 2006), which sees nature as mere resources for humans. Using Reed (2007) environmental design spectrum, we could place deforestation in the far-left side representing the degeneration of the system (Fig. 2).

The first solution proposed in the table (Table 1) is to combine the technologies of the 4IR with the UN SDGs to develop the Amazon area in a sustainable manner. This idea aims at reconciling economic growth with forest conservation, which is the main objective of the project Amazon 4.0 (Nobre et al., 2018; 2019; 2020). In the Reed (2007) spectrum that approach would be understood as moving from "Green Growth" toward "Sustainability". When applying Eisenstein (2018) view, this would fall under his definitions of "Techno-optimism", which sees technology as the answer to environmental problems, and also "Climate Orthodoxy", which is concerned with limits to planetary warming and carbon emissions (Eisenstein, 2018). In Corbett (2006) spectrum (Fig. 1) the above solution would fall under "Conservationism", which is still grounded in utilitarian beliefs; however, it is concerned with the intelligent or "wise" use for the resources that will benefit more people. Nevertheless, that approach would be a step up from "Unrestrained Instrumentalism" and will align with sustainability. Therefore, if we consider that in CLA the paradigm shift happens at the worldview level, this shift - from deforestation to sustainability - could be seen as such a shift. However, we can also notice that on the deepest level - the Myth - it remains the same as before. That happens because the narrative of nature as a resource remains the present in all the above scenarios.

Since the first strategy contains a 'top-down' approach from regulations and offers market-based profitable options for those operating (even) under a deforestation worldview, it might help with the paradigm shift to a green growth or sustainability focus. For instance, when companies or

governments *greenwash*[7], they might not be personally grounded in sustainability values, but they see it as either profitable or necessary - in the case of regulations. Therefore, their gains are clear[8].

On the other hand, to operate under a "Regenerative" (Reed, 2007) worldview is necessary to access a deeper level - Myth - of connection to nature. The latter would be more beneficial to the environment, but since potential profits are not at the center stage, this solution would be a 'hard sell' to people grounded in conventional practice (Reed, 2007). Not to mention a potential change in the economic system. Moreover, the 'bottom-up' orientation indicates that this option may arise from social movements (Norberg-Hodge, 2010), not from the people who are in charge of the current system.

However, as stated before, the point of this analysis is not to find either/or solutions, but to evaluate what is available to create new (future) visions for the current scenario with deeper clarity. Both proposed solutions could be useful to solve the deforestation issue if strategically applied in the right direction.

All this diversity of worldviews is currently present amongst the people that will decide the fate of the Brazilian part of the Amazon Forest. Therefore, to achieve positive change there it is necessary to have the flexibility to understand all the worldviews that are driving current destructive behaviours and to choose appropriate strategies that can increase active participation in paradigm-shifting solutions.

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[7] In the Delmas and Burbano (2011) definition, greenwash is "poor environmental performance and positive communication about environmental performance" (de Freitas Netto et al., 2020).

[8] As the quote in the beginning of this chapter illustrates, most businesspeople and governments will think in terms of "what's in it for me?" before taking any major decision, even the ones considering environmental impact. These decisions are usually based on either profiting or saving money in a given situation.

3. Problem analysis: Deforestation in the Brazilian Amazon

Even though Brazil is only responsible for less than 2% of annual global CO_2 emissions, the deterioration of the Amazon rainforest is a major national and international concern. [9]

The Amazon Rainforest is the largest and the most biodiverse biome on the planet. Home to many of the remaining indigenous peoples in South America, the Amazon also has an important role in regulating the planetary climate (Souza et al., 2021; Pereira et al., 2020). About 60% of the forest is within Brazilian territory, where it covers a total of nine states - an area that could fit the entire Western Europe. [10]

Deforestation in the Amazon region first increased exponentially in the 1970's, when Brazil was under military dictatorships. The goal of the military was to occupy the least populated territory in the country to protect its borders, invest in infrastructure, while clearing parts of the forest for agriculture and cattle raising. The expansion to the North and West regions of the country was justified as a strategy to also ensure food security at the time. [11]

In the years after Brazil signed the 1992 Earth Summit commitment to sustainable development, deforestation reached its peak. The graph below shows the rates of deforestation per year since 1988, when satellites started to monitor the area.

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[9] Brazil was responsible for 1.34% of the global CO2 emissions in 2020 (*Our World in Data*, 2020)

[10] The area is equivalent to 60% of the Brazilian territory as well.

[11] At the time, Saudi Arabia had proclaimed an oil embargo as a strategy to create a crisis in the countries that supported Israel in the Yom Kippur War. Their main target was the United States, which was Brazil's main supplier of essential food items.

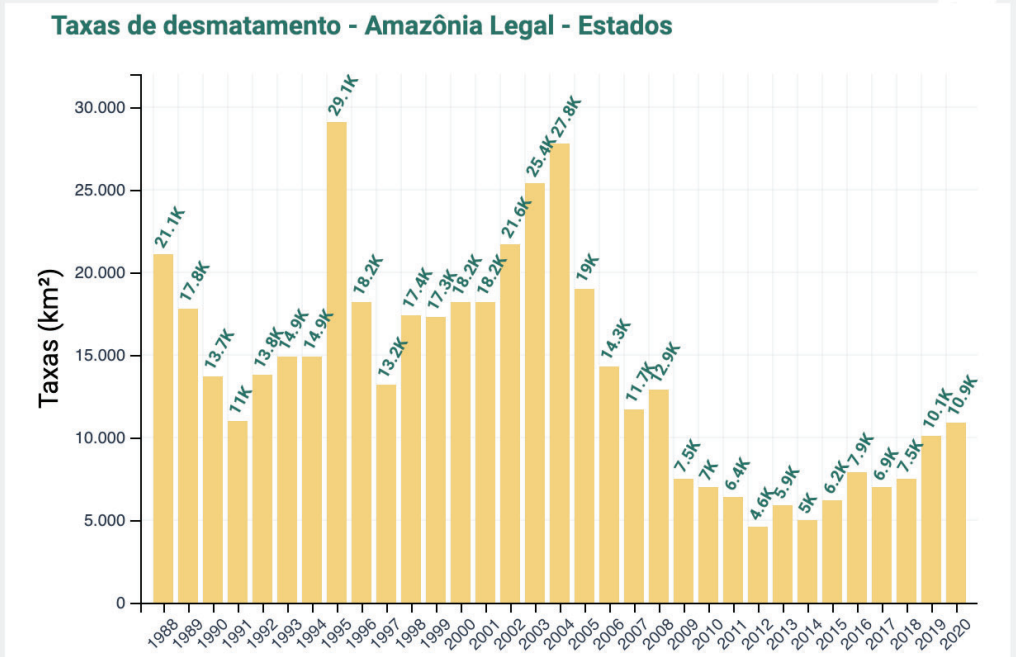

Figure 5 - Annual consolidated deforestation rates in km^2 collected since 1988 (PRODES, 2021)

After another acceleration in 2003 (Fig. 5), two categories of mitigation solutions were implemented in the years that followed (Nepstad, 2014; Nobre et al., 2018; Law 11284, 2006):

- Conservation by demarcating land on behalf of indigenous communities, creating conservation units and national parks as an effort to monitor the area.
- Sustainability in agriculture, cattle, mining and logging as an effort to maintain economic growth.

The results started to show in 2006 - according to the graph above (Fig. 5) - and were decreasing until 2012.

In August 2019, the fires in the Amazon rainforest became headlines in national and international newspapers. Scientists and journalists attributed the increase in deforestation to recent policies implemented by the new government's administration, which undermined the last 30 years of efforts to manage development and forest conservation in the area (Pereira et al., 2020; Fearnside, 2019a, 2019b). As a result, even the stalwart group that supported Bolsonaro's

election – i.e., the agribusiness sector - became concerned with the international repercussions of his policies (Gortazar, 2019).

3.1 Amazon deforestation dynamics: in-country causes

According to Phillip Fearnside (2006) illegal agriculture, mining, cattle raising, logging and infrastructure development still contribute the most to the deforestation of the Amazon. On the other hand, basic infrastructure is also needed for the local population, which due to the cultural moorings of infrastructure developers and finances gets translated into more roads that allow further deforestation deeper and deeper into the Rainforest. This 'cycle of destruction' continues as it opens vast areas to illegal economic activities[12].

It is also common for infrastructure projects in the area to be partially sponsored by multinational companies, which are interested in extraction activities and demand better logistical access deeper in the Amazon. Their promise is that development will generate economic growth and jobs for the populations in the area; however, those promises entail forest and biodiversity destruction as a byproduct.

Moreover, the Brazilian Forest Code (1965; updated in 2012) only allows landowners to deforest 20% of their own territory if located in the Legal Amazon region. However, in practice there are many problems with the Code's enforcement, which include delays in assigning land to people, appropriate documentation, and land grabbers that are also responsible for the illegal mining and logging in the area. Most deforestation happens through illegal economic activities and areas that are protected or undesignated. The map below showcases the land use of the area as of 2014 (Fig. 6), two years after the new Forest Code (2012) was instated:

[12] Hence my impression (shared in the beginning of the Foreword) of deforestation on both sides of the highway.

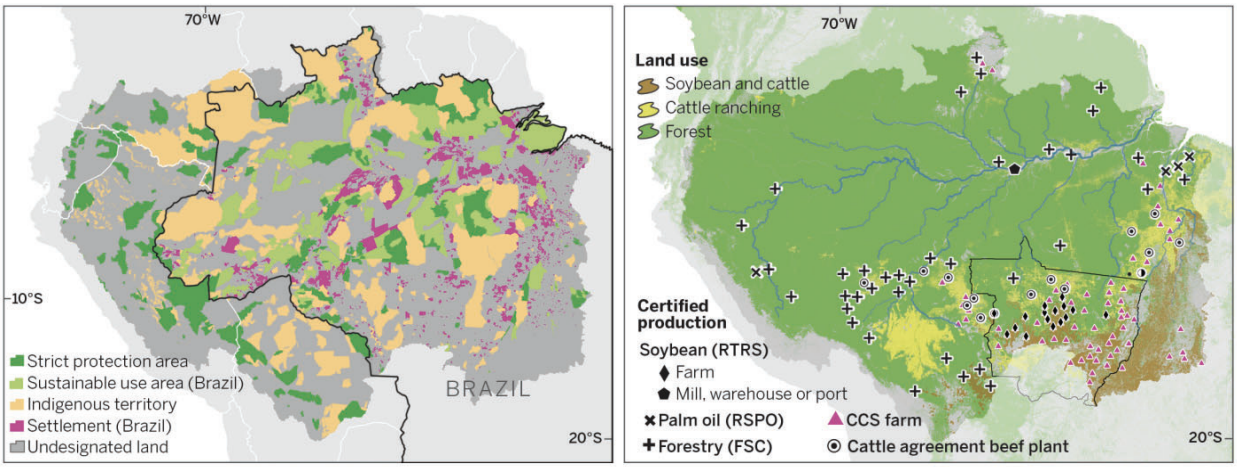

Figure 6 - Protected areas (*left)* and land use *(right)*. Source (Nepstad et al., 2014)

The area in grey on the left picture represents the undesignated areas. In total, there were 49.8 million hectares of undesignated areas in the Brazilian Amazon in 2020 (Azevedo-Ramos et al., 2020). That number corresponds to almost 10% of the Legal Amazon, which are areas owned by the federal or state governments. The Amazon Environmental Research Institute (IPAM) states that 32% of all illegal deforestation in 2020 happened in these areas (Alencar et al., 2020; 2021). They are called “lawless land”, and as such, prone to illegal exploitation and deforestation. (Azevedo-Ramos et al., 2020). According to the law (11.284, 2006), these areas were supposed to be destined to either conservation or sustainable production areas but have become instead quickly deforested.

As stated in a report from MapBiomas (Azevedo et al., 2020), over 99% of deforestation alerts in 2020 happened illegally. Since 32% of deforestation that year happened in undesignated areas, the remaining illegal deforestation (67%) were in assigned areas, which included indigenous territories, private properties, and conservation areas.

3.2 Deforestation dynamics: international investment

The NGO Amazon Watch, in partnership with the Brazilian Indigenous People Articulation (APIB) launched reports in 2019 and 2020 to identify the international investments made in deforestation activities, which included indigenous lands invasions (Amazon Watch and APIB, 2020; 2019). Their reports state that most production is destined to Europe, North America and Asia. The main Amazonian extraction activities identified are mining, agriculture, cattle ranching, and hydroelectric energy projects (*see* appendix 1[13]). [14]

International financial institutions play a major role as shareholders of the Brazilian and multinational companies that profit from activities linked to deforestation in indigenous lands. According to the same reports (Amazon Watch and APIB, 2020; 2019), the main financial institutions investing in these companies are: BlackRock, Vanguard, Citigroup, JP Morgan Chase, Bank of America and Dimensional Fund Advisors. All of them are headquartered in the United States.

The supply chain of these damaging extractive activities is often not transparent, which makes it very difficult to find the exact companies who are processing the products (traders, brokers) or the final distributors and buyers.

One example of that is soy, which is one of the main products Brazil exports today and that also is grown in the deforested lands of the Amazon. The Soy Moratorium (2006) was instituted to prevent purchasing the product from areas that were recently (illegally) deforested. However, the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) recently fined

[13] Appendix 1 link: https://docs.google.com/spreadsheets/d/1Ns62NqwfCR1uWOov7IlyXI7W4S_nV_cS_JTIl-pSkOk/edit?usp=sharing

[14] With the exception of the energy sector. This sector is mentioned in the report for causing major environmental destruction in indigenous lands across the country, by flooding areas and changing the course of rivers.

licensed soy producers who were cultivating in illegal areas (IBAMA, 2018). The operation called “Shoyu” - in a reference to the popular soya sauce - identified as culprits of Amazonian deforestation the following companies: JJ Samar Agronegócios Eireli, ABC Indústria e Comércio SA, Uniggel Proteção de Plantas Ltda, Cargill and Bunge Ltda (IBAMA, 2018). Cargill is also cited in the Amazon Watch/APIB reports (2019; 2020) as one of the companies that were accused of exporting soy in 2018 from Amazonian areas associated with recent deforestation and conflicts with indigenous peoples. The latter ranges from land disputes to polluting rivers with pesticides largely used in soy farms. Brazil is currently one of the biggest soy producers in the world, and exports most of its production to China, the European Union and other Asian countries (Gale et al., 2019). Part of the soy produced is also destined to feed cattle. China is one of the biggest importers of soy, iron ore and cattle from Brazil. According to the Amazon Watch/APIB reports (2019; 2020), China invested close to US$ 207 billion in Latin American mining, energy production, agribusiness, technology and to improve logistics infrastructure. Most of this money was invested in Brazil, where China also closed a partnership with the government of Mato Grosso - one of the Legal Amazon states - to develop the *Ferrogrão* railway (Teodoro, 2016). The term “*Ferrogrão*” literally translates to “Iron grain”, as a reference to the soy production and iron ore extraction in the region. The railway will facilitate the transport of these products to the Pacific Ocean - through Peru - and then shipment to Asia’s markets. In addition, the *Ferrogrão* railway infrastructure will also connect to ports in the South and North of Brazil that export to European and Middle East countries (Teodoro, 2016). The Ferrogrão route will also cut through indigenous territories and other traditional communities (Amazon and APIB, 2020). Although it is complex to determine the indirect environmental impact the railway may cause, since infrastructure projects tend also to attract more people to

exploit the newly accessible areas thereby increasing incentives to further local production and its accompanying ecological and socio-cultural degradation. Many infrastructure projects of this kind are partially sponsored by multinational companies for the benefit of their own production.[15]

It is also important to note that not all the agribusinesses in Brazil contribute to the recent deforestation rates. Improving transparency in the supply chains and ESG reports could help to mitigate part of the issue, while highlighting companies that behave well and can be favored by consumers and ethical investors.

On the other hand, when international politicians pledge money to contain deforestation, it is never *au pair* with the money invested in the opposite direction (Spring, 2020). That fact is especially true in the case of the United States, where most of the international financial institutions cited here as responsible for Amazonian deforestation are from. Perhaps more useful than lending or granting money to Brazil, would be to call for more responsibility and transparency from these institutions in their investments abroad. For instance, Larry Fink (2020; 2021), BlackRock's CEO, published impactful management letters that confirmed their intent to act on climate change mitigation; however, efforts in the direction of deforestation were not clearly stated.

3.3. Paradigm shift: Amazon 4.0

The Amazon 4.0 project was conceived by two brothers, Carlos and Ismael Nobre, who are Brazilian scientists that worked for many years in the Amazon. Their initiative aims at reconciling economic growth and conservation by implementing sustainable practices in the area

[15] Cargill is also building a port in the state of Pará (Amazon and APIB, 2020)

with the use of new technologies from the Fourth Industrial Revolution (Nobre et al., 2016; 2018; 2020).

The main solutions proposed by the Amazon 4.0 project are:

- Developing agroforestry reforestation: opportunity to cultivate and commercialize products from fruits like Açaí, that are already popular internationally and are more profitable and less damaging than soy and cattle. Focusing on fruits rather than trees/grains, aligned with the reforestation of certain areas with diverse plants/trees may help with deforestation.
- Establishing Creative Genomics labs: harness the biodiversity resources of the area with technologies from the Fourth Industrial Revolution (drones, gene sequencing, digital microscopes, etc) and biomimetics. The labs will also focus on providing learning opportunities for local people on these technologies.
- Developing local Manufacturing: focused on high value added to cosmetics, medicines, and food items.
- Creating local socioeconomic benefits: fair profit distribution, creating jobs and an inclusive and just economy.
- Attracting carbon market financing: apply REDD+ mechanism for potential economic benefits that will partially mitigate logging and other unsustainable practices.

These strategies are all steps that could potentially help with creating a more inclusive and sustainable local economy, while conserving the forest. However, there are key caveats that need attention, such as:

- Dependency on imported technologies: Brazil is not a leader in any of the innovations of the Fourth Industrial Revolution.

- Biopiracy risks: the use of these technologies can increase the potential for biopiracy[16].

Both of these key caveats are further discussed in the chapters below.

[16] Biopiracy is discussed in Chapter 5. It means taking advantage of the Intellectual Property system to profit from Traditional Knowledge.

4. Sustainability and Regenerative context

> "The power of abstract thinking has led us to treat the natural environment – the web of life – as if it consisted of separate parts, to be exploited by different interest groups. ... To regain our full humanity, we have to regain our experience of connectedness with the entire web of life. This reconnecting, 'religio' in Latin, is the very essence of the spiritual grounding of deep ecology." (Capra, 1996, p. 296)

The main focus of this chapter is to define sustainability as a path to more regenerative practices by explaining the different perspectives available. This chapter also critically analyses the mainstream discourse of sustainable development through the lenses of scholars that suggest other economic alternatives for the climate crisis, such as degrowth and/or circular economy. As suggested by Bill Reed (2007), sustainability could be placed in the context of a system's regeneration. In this perspective, sustainability occupies a neutral position in the energy efficiency of a system, as proposed in the figure below:

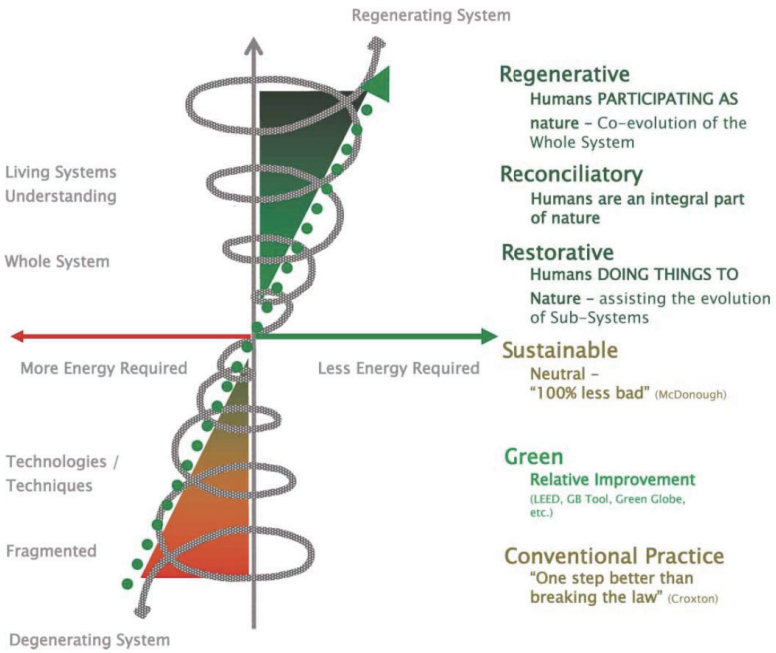

Figure 7: Trajectory of Environmentally Responsible Design (reproduced from Reed, page 676, 2007)

Sustainability, as represented in Figure 7 above, can be conceived of as a transitional stage between conventional practices and regenerative strategies. The lower end of the picture represents a ‘degenerating system’ that has a narrative (Myth) of separation between humans and the environment. It also shows that this approach requires more energy from resource extractions and inefficiencies that arise from fragmented systems. For instance, the Green approach is used in LEED certification for buildings, which is criticized for requiring only a modelling of energy and water efficiency without measurable performance goals after the certification is issued (Swearingen, 2014; Swanson, 2018; Bowers et al., 2020). The lack of a monitoring indicator can incentivize ‘greenwashing’ (Bowers et al., 2020). This detrimental practice is commonly used as a marketing strategy to align a company - in this case a building developer - with environmental sustainability values to thereby, illegitimately benefit from public appreciation (Corcione, 2020). The upper part of the diagram represents a progression toward achieving a ‘regenerative system’. The main difference between the lower and the upper part is the progressive alignment between humans and nature. In other words, once past the sustainability threshold (neutrality), the system eventually becomes whole. Sustainability is thus seen here as the balance between energy surplus (regeneration) and energy deficit (degeneration).

According to Reed (2007), the perspectives presented in Figure 7 are all currently co-existing on the planet. In other words, there are systems operating in the lower end - conventional practice - that may view sustainability as unnecessary spending, while those aiming to be in the upper end of the spectrum may see the efforts toward achieving sustainability as not enough. In Reed’s view, the upper end of the spectrum represents healing our relationship with all the living beings

and the planet, while the lower end is more about fixing the damages using an issue-based approach rather than integrated solutions.

Therefore, the sustainability view of this paper is not as an end goal, but an important milestone in the path of regenerating social, economic, and ecological systems.

Sustainability in the definition used by the United Nations is defined by,

> "Meeting the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, 1987, p.15)

This implies a similar neutrality as the one presented on the spectrum of the picture above (fig.1), where sustainability means to not extract more resources than the Earth has the capacity to restore for future generations. When this approach is applied to sustainable development, it expresses more tangibility and progression, as in Glavič & Lukman (2007) definition:

> *"Sustainable development* emphasizes the evolution of human society from the responsible economic point of view, in accordance with environmental and natural processes. Therefore, the political dimensions are central elements. Furthermore, in a sustainable development paradigm the limitations of economic, societal and environmental resources are considered in order to contribute to present and future generations' welfare and can be applied on local, regional, national and international levels, based on political will." (p.1884)

Therefore, sustainable development could be seen as an upgrade from the economic model of Milton Friedman[17](1962) in a spectrum toward more social and environmental inclusion (Tulder, 2018). To illustrate, the UN Sustainable Development Goals (UNSDGs) can be understood as strategies to achieve sustainability on a planetary scale. The language used in the UNSDGs for addressing the climate emergency concentrates on achieving as close as possible 'carbon neutrality' or 'net zero emissions', which correlates to reaching the neutrality that - under this perspective - equates to sustainability (please see Fig. 8).

[17] Milton Friedman affirmed that the sole responsibility of a company is with its shareholders. He also saw environmental and social costs as externalities, and therefore, not a responsibility for the company (Friedman, 1962).

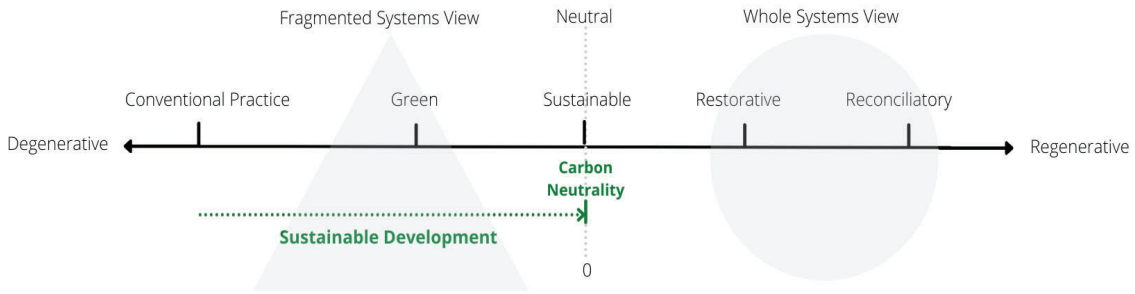

Figure 8: Sustainable Development in Reed's Trajectory of Environmentally Responsible Design (Adapted from Reed, 2007)

The mainstream discourse on sustainable development, supported by the United Nations, seems to convey a scientific consensus when talking about solving our current global environmental issues. However, critics, such as the degrowth movement, contest the sustainability of development itself (e.g., since many of the resources needed for production are non-renewable, while the social costs of development entail increased inequalities). The more radical view will even call sustainable development an "oxymoron" (Norberg-Hodge, 2010).

To illustrate, critics point out in the literature to the excessive focus on greenhouse gases (Eisenstein, 2018) and on the carbon market as a 'quick fix' to climate change (Kapoor, 2021; Eisenstein, 2018). Furthermore, critical analysts question the very fabric of the (liberal) capitalist system which is the larger context of the sustainable development discourse. To summarize, critical analysts see sustainability, as it is currently proposed by mainstream scholars, as not enough.

Even though Hickel (2018) will agree with the latter, he also notices that a degrowth approach will take time and foundational changes that society would collectively need to implement. With the urgency that issues like climate change require, we might be running out of time to avoid a climate catastrophe (Hickel, 2018).

Degrowth discourse[18] is mostly based on a decentralized, bottom-up approach (Norberg-Hodge, 2010; Demaria et al., 2013). For this reason, it offers solutions that respect community diversity, which although more aligned with their real needs, may not provide global-scale answers on its own for the urgent challenges of climate change. That is because it would require a massive change in worldview, which would need to include even those in (climate) denial to create a ripple effect on a planetary scale. The challenge with global issues may be that we need collective adherence and collaboration to make a real difference, even though the grassroot approach may be more effective in the long run.

On the other hand, sustainable development that offers market-based solutions are top-down and require multilateral agreements, which are also challenging to achieve (Gates, 2021). However, they might - at least in theory - be able to persuade through economic pressure the countries, companies and individuals who contribute the most to human-caused climate change.

In this paper, I focus on key elements of degrowth and sustainable development theory that could work in practice. Even though at first glance they might seem incompatible, there might be elements of both that could help to foster and fund community-based initiatives to mitigate deforestation in the Brazilian Amazon.

4.1. Critical Analysis of Sustainability

4.1.1. The UN Sustainable Development Goals implementation

In 2015, the United Nations launched the Sustainable Development Goals (SDGs) as an effort to achieve social, economic and environmental sustainability by 2030. The 193 chiefs of state of the UN General Assembly signed the agreement to adapt, implement and promote the goals established for 2030 in their countries. The main 17 goals were determined after a multi-

[18] Degrowth is also more discussed amongst scholars from industrialized countries.

stakeholder consultation process that lasted three years, which included governments, civilians, corporations, scientists, and organizations. Other than the goals, 169 targets were established to reflect the interconnected nature of the goals and to clarify what is needed in each area to achieve sustainability at a planetary scale by 2030 (Tulder, 2018; Sanders 2018). Following that, 231 unique indicators were created to measure the targets (UNstats, n.d). [19]

Figure 9 - The Sustainable Development Goals (*source:* UNESCO website)

The SDGs create a framework to address the greatest challenges of the world in this era. Even though they were signed by governments, their objectives are multilevel and all-pervasive. In other words, they impact fundamental areas of society, such as education, the health sector, and businesses. In the past six years that followed the goals launch, there were significant efforts for businesses and institutions to align with them. For instance, York University officially declared their support to the Goals in 2020 by incorporating them to the university's 2020-2025 Academic Plan[20].

[19] Due to overlaps between targets, some indicators were also repeated under more than one target.

[20] 2020 - 2025 York University Academic Plan https://www.yorku.ca/sustainability/priorities/york-university-academic-plan-2020-2025/

According to Tulder (2018) the SDGs represent a paradigm shift in sustainable development standards, because it challenges different actors in society to think about creating value, while serving the greater good, rather than just profit and the maintenance of a status quo.

Most agreements at a planetary level are difficult to achieve due to their voluntary nature[21], the wide diversity of interests between countries, and the lack of clear enforcement mechanisms. While the SDGs attempt to identify major issues that need attention to achieve sustainability for the planet, the agreement between countries is also non-binding (Sands et al., 2018). In other words, governments are not obligated by international law to implement them, and at the international level enforcement of any rules is difficult to operationalize or even measure. Nevertheless, there is significant international pressure to enforce agreements, which many times comes in the form of economic boycotts and public loss of international reputation.

Implementation of the SDGs requires a multidisciplinary approach to finding solutions that are integrated as a whole rather than isolated measures. In other words, it requires consulting with multiple stakeholders to set the standards for collaboration (UNSDG Goal #17) and also to determine any possible obstructions or compromises to sustainable development. For this reason, the organization Gaia Education (2020) affirms that there is a significant risk that the UNSDGs could be misinterpreted. The "wedding cake" graph designed by the science director of the Stockholm Resilience Centre, Carl Folke (2016), aims to address that valid concern.

[21] There are agreements also binding at global level, such as the Convention on Biological Diversity, or the ones issued by the Security Council (Sands et al., 2018)

Figure 10: UN SDGs: Society, Economy and Biosphere (Source: Azote Images for Stockholm Resilience Centre, 2016).

Folke's (2016) framework not only helps to understand the interconnectivity of the 17 goals, but also how society and the global economy are inserted in the larger system of the biosphere with the partnerships (Goal 17) required to implement the goals at the very top/centre.

This model also contributes to visually understanding the background area where each goal is focused, as in biosphere (environment), society or economy.

As a critic of the SDGs, Hickel (2018) notes that only four goals are directly focused on the environment, while most of the other ones are either on the wellbeing of society or economic development (*see* appendix 2[22]). In Hickel's perspective, this issue contributes to the fact that developed countries will inevitably rank higher when tracking the implementation of the goals,

[22] Appendix 2 link: https://docs.google.com/spreadsheets/d/18PL3GPgQVQVGsnSdBUR10emFt2e4hOQAn-XS0PuvHTg/edit?usp=sharing

since they have better infrastructure and a more stable economy. Developed countries are also linked to higher emission rates of GHGs and greater environmental destruction. Therefore, according to Hickel, the goals may privilege polluters while lowering the score of already vulnerable parts of the planet. A solution for that would be to implement a weighing system to address the problem, where environmental protection would have the same weight as economic and societal goals combined (Hickel, 2018).

4.1.2. The UN SDGs in the Brazilian context

According to the Sustainable Development Report 2021 - which ranks the performance of the 193 participating countries from the UN General Assembly that signed the Paris Agreement - Brazil occupies the 61st position, scoring 71.34 points in the overall ranking. The highest scoring country this year is Finland, with 85.90 points. If we use the Country Comparison tool developed by the University of Leeds (UK) that was based on the Doughnut Theory (Raworth, 2017), we get the following results:

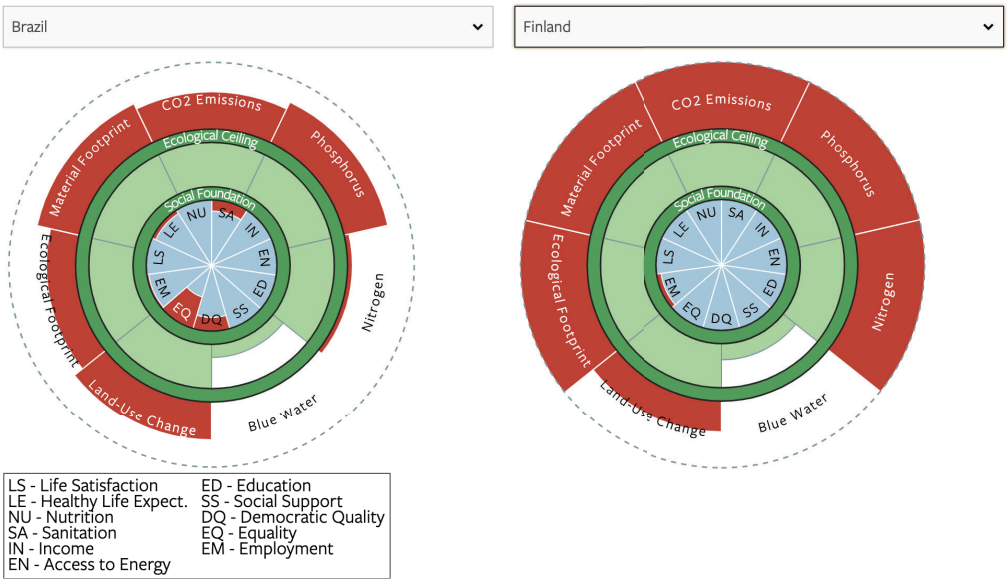

Figure 11: Comparison between Brazil and Finland (Source: *Country Comparisons*, n.d.)

Biophysical Indicator	Brazil	Finland	Per Capita Boundary	Unit
CO2 Emissions	3	14.7	1.6	tonnes CO2 per year
Phosphorus	1.8	6.5	0.9	kilograms P per year
Nitrogen	9.9	96.3	8.9	kilograms N per year
Blue Water	173	211	574	cubic metres H2O per year
eHANPP	5	4.4	2.6	tonnes C per year
Ecological Footprint	2.9	4.8	1.7	global hectares (gha) per year
Material Footprint	14.2	30.9	7.2	tonnes per year

Social Indicator	Brazil	Finland	Threshold	Unit
Life Satisfaction	7	7.4	6.5	[0-10] Cantril scale
Healthy Life Expect.	63.4	70.5	65	years of healthy life
Nutrition	3287	3285	2700	kilocalories per capita per day
Sanitation	80.8	100	95	% with access to improved sanitation
Income	95	100	95	% who earn above $1.90 per day
Access to Energy	99.5	100	95	% with access to electricity
Education	95.3	107.5	95	% enrolment in secondary school
Social Support	91.6	93.8	90	% with friends or family they can depend on
Democratic Quality	0.2	1.5	0.8	Democratic Quality Index
Equality	50.9	74.2	70	[0-100] Scale -> (1 - Gini Index) * 100
Employment	93.3	92.3	94	% of labour force employed

Table 2: Comparison between Brazil and Finland Social and Biophysical (source: *Country Comparisons*, n.d)

Although Northern countries will typically consume more energy per capita (IEA, 2021) and, therefore, emit more GHGs, the comparison above shows that the discrepancies in levels of emission per capita are quite high.

To illustrate, the ecological and material footprints of Finland are almost double the Brazilian ones. The latter also emits only close to 10% of the Nitrogen and 20% of the CO_2 emitted by

Finland[23] per capita. At the same time, socio-economic indicators are more favorable to Finland (the highest differences between Finland and Brazil are in the Sanitation, Equality and Democratic quality categories).

These results correlate to the affirmation made by Hickel (2018), mentioned in the previous section, that points out the need to reconsider the weight of environmental indicators in measuring and comparing the UNSDGs achievements of each country. Moreover, when comparing other countries on the Sustainable Development Report 2021 rank, there is a similar pattern between the most developed countries and the least developed, which provides further validation to Hickel's work.

However, this conclusion is not equal to affirming that if developing countries increase their GHGs emissions, they will automatically improve their socio-economic aspects. AsNorberg-Hodge (2010) notes, the industrial production in the South is usually aimed at Northern/Western countries' consumption. In her perspective:

> "Rising CO_2 emissions in the less developed parts of the world are not a sign of positive endogenous development, but rather a direct result of development and globalization policies." (Norberg-Hodge, 2010, p. 44)

Norberg-Hodge (2010) advocates for economic degrowth and affirms that current globalization policies are also responsible for much of the poverty in the Global South, while only benefitting a small elite. Growth does not necessarily meet the needs of the most vulnerable, which is also perceived in developed countries (Cerra et al., 2021). As we can observe in the Country Comparison above, Brazil has a significant problem with inequalities. Moreover, the country also offers lower social mobility (World Economic Forum, 2020) when compared to most developed

[23] Note that the comparison here is per capita. If the measure is the annual share of global CO2 amount, Finland accounts for only 0.11%, while Brazil is responsible for 1.34% (*Our World in Data*, 2020). Finland's population is only 5.5 million and Brazil 212.6 million.

countries, which might be a consequence of inefficient social support systems that stem from its colonial past (Fanon, 2004; Cardoso et al., 1985).

Escobar (1985) emphasizes the importance of a discourse that prioritizes a perspective on development that is not offered by developed countries as a way to further the domination over the Third World. Moreover, Escobar talks about the importance of social movements to create change and redefine the system. According to Demario (2013), Escobar is one of the scholars that openly criticizes the Western ideals of development.

In addition, Fanon (1963) - in his work about Africa - states that inequalities are common in countries that were colonized by Europe. According to him, after the colonization period ended, the countries in the Global South never ceased to provide Europe - and later the United States - with raw materials, while the colonizer's place in the higher ranks of government and military were occupied by local elites that acted in alignment with the interests of developed countries. Therefore, the ideals of the elites in developing countries are European ideals of development. Cardoso and Faletto (1985) confirm the validity of the above observations within the South American context, and they state that 'internal forces'[24] contribute to imperialist domination due to similar interests and worldviews.

Arguing in the context of the UN SDGs, Hickel (2018; 2019) also noticed the same misconception about the connection between economic growth (SDG 8) and lifting people out of poverty (SDG 1). Echoing the other scholars mentioned above, Hickel affirms that due to inequalities in capital distribution, the latter is not a direct consequence of the former. Moreover, endless economic growth is also deeply connected to environmental degradation.

[24] They are referring to Brazilian upper classes that align interests with international groups in what they call an "interiorization of external interests".

Even though target 8.4 calls for a "decoupling" between economic growth and environmental degradation, recent studies question how exactly it would work in practice (Hickel, 2018; Adelman, 2017; Ward et al., 2016). These authors affirm that without effective - or even absolute - decoupling, the SDGs will prove to be unachievable. There is no clear guidance on how this decoupling may happen in the indicators of the target beyond measuring material footprint (8.4.1) to compare with material consumption (8.4.2). Hickel (2018) mentions that for decoupling to work it needs to happen at a rate that surpasses GDP growth.

Meanwhile, Adelman (2017) raises the issue of target 8.1, which suggests an increase in GDP of 7% a year for low-income countries but fails to provide any limits to growth for developed countries. In his view, that approach could be a problem in case the economic and environmental decoupling proves to be unachievable[25]. The only viable solution, according to Hickel (2018) would be a path to degrowth. He argues that it would not necessarily decrease GDP but reduce energy and material depletion. Following this logic, an alternative for decoupling could be introducing a circular economic system, as suggested by Raworth (2017) in her book titled *The Doughnut Theory*. The challenge would be to educate people on circularity worldwide, while creating efficient ways to separate and recycle used materials without also contributing to CO_2 emissions as a byproduct. Another avenue for decoupling could be the technological innovations discussed in the next chapter.

To summarize, a key challenge in Brazil is to improve socio-infrastructure without increasing GHGs emission levels or destroying biodiversity. The latter might be the greatest asset for the country to fight climate change, since 60% of the Amazon rainforest is within its boundaries and

[25] This idea correlates to the fact that if developing countries consume as much as developed countries, we will not reach the environmental goals necessary to avoid a climate catastrophe. See Finland and Brazil in the beginning of this section.

also a total of six other important biomes, which include the Atlantic Forest, Cerrado, Caatinga, Pampa Gaúcho and Pantanal.

There is hope amongst Brazilian scholars that renewable energy and other technologies that are part of the Fourth Industrial Revolution may be able to take care of the development needed in countries like Brazil while also helping to improve the lives of the population[26] (Nobre et al., 2018). The brothers Nobre also believe that a global regulated carbon market could help to address local inequalities in the country, since Brazil is considered a carbon creditor (Nobre et al., 2020). As mentioned before, the carbon market might be seen as a superficial solution to the problem. However, it is a way to include environmental damage in the economic system by assigning value to it. Furthermore, activities that cause environmental deterioration can be calculated as part of the GDP growth of a country. For instance, a natural disaster that needs repairing will be computed as part of GDP growth in that year.

4.1.3. The International Climate Finance Opportunities

The Copenhagen Accord (2009) stated that developed countries would collectively allocate US$ 100 billion a year toward climate mitigation and/or adaptation in developing countries by 2020. In return, the recipient countries would reduce deforestation and forest degradation emissions, while also investing in technology and training to enable the implementation of the agreements made at COP 15 (Accord, 2009).

This agreement depended on individual contributions from each of the 23 countries[27] that committed in 2009 to climate finance aid. According to an assessment from the World Resources

[26] In 2020, Brazil occupied the 84th position in the Human Development Index (UNDP, 2020).

[27] Developed country parties that signed the agreement include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway,

Institute[28] (2021), it was based on the recognition that developed countries were responsible for most of the GHG emissions since the First Industrial Revolution.

Even though this first agreement was adopted in 2009 and was mentioned in the 2015 Paris Agreement and is considered during recent climate negotiations known as the Conference of the Parties (COPs), the 100 billion amount pledged in 2009 was never really met. Many countries, including the most polluting ones, fell short from the amounts that correspond to the size of their economies. Also, the OECD (2019) calculates that 70% of the contributions made in 2019 were in the form of loans rather than grants, especially the funds that come from the private sector. For this reason, the Least Developed Countries (LDCs) block is not considered to offer a good return on investment (ROI) and therefore is routinely excluded from international climate investment. At Glasgow's COP 26, climate negotiators agreed to postpone the deadline to meet the original 2009 funding target by 2023. In the COP 26 meeting, the LDCs argued to be already feeling the impacts of climate change, and they requested international funds specifically for climate adaptation. On the other hand, according to the World Resources Institute (Gonzalez, 2021), adaptation is harder to measure than mitigation strategies or technology implementation. Therefore, the funding countries prefer to allocate their money towards mitigation strategies, leaving the ones who need climate finance the most, once again, without the means to adapt. The irony in this narrative is that if these countries cannot adapt, their people will have to relocate at some point, which may generate a refugee crisis that will most likely impact the rich countries that were not willing to help while they still could. Cycles like this happen in many other areas of the climate discussion, including the deforestation issues that are central to this paper. The key

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Portugal, Spain, Sweden, Switzerland, United Kingdom of Great Britain and Northern Ireland, United States of America. (WRI, 2021)

[28] The assessment also indicates that over a dozen countries fell short from their individual share of contributions by 2020.

point of this section is to provide evidence that a more holistic view of the problems of sustainability in general and Amazonian deforestation in particular are necessary.

To illustrate the aforementioned conundrum, consider SDG 10, which aims to reduce inequalities. The target 10.6 states:

> "Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions." (*Goal 10 | Department of Economic and Social Affairs*, n.d.)

Note that the UN SDG 10.6 target is not about achieving a condition of equal voting rights to developing countries, but "enhanced representation". In other words, the largest economies are the ones who have more weight when voting for international financial agreements. The argument is that they are the ones contributing the most to the global economy, while aid money is also usually coming from these countries (Woods, 2006). This voting power inequality is present in the governance structure of organizations like the World Bank and the International Monetary Fund (IMF), since their conceptualization in the 1940's (Woods, 2006). As Woods (2006) notes:

> "By the end of the twentieth century basic votes that had once constituted more than 10 percent of total votes had dropped to represent less than 3 percent of the total votes in each institution. Weighted voting took over." (p.27)

The "basic votes" are allocated to all participating countries in the IMF. In the quote, Woods (2006) is referring to the weight that these votes originally had and how they decreased by the time she published her book. In 2008, the IMF increased the weight of these votes to 5.502 percent of total votes (IMF Quotas, 2017) and it has not changed since then. Therefore, at least in the IMF, nothing has changed in terms of enhancing the representation of developing countries since the Paris Agreement in 2015.

The next section provides further analysis on climate finance using a specific example focused on the deforestation of the Amazon Rainforest, and the current status of the Amazon Fund.

4.1.4. The Amazon Fund

Months before COP 15, the Brazilian Development Bank (BNDES) closed the first agreement with Norway to receive yearly donations to the Amazon Fund. The latter was established by the Brazilian Government (2008) to receive international and national aid destined to monitoring, preventing and mitigating deforestation in the Amazon rainforest. After the Copenhagen Accord, Germany also donated to the fund. In total, the Amazon Fund received about R$ 3.4 billion (approximately US$ 600 million) until 2018. From this amount, 93.8% was donated by Norway, 5.7% by Germany and 0.5% by Petrobras - the Brazilian oil company. Therefore, this money was destined to mitigate deforestation not as a loan, but as a grant. Even though Brazil had the obligation to show results to Germany and Norway, the donor countries could not directly interfere on the choice of projects that would be locally benefitted by the fund. According to their website, the money helped to support 102 projects, which followed the criteria established by the fund.

After the rise in deforestation in 2019 and divergences with the current government, Germany and Norway decided to put a halt on the donations. The governance of the fund was dismantled, and the remaining balance was suspended in the BNDES. The reason given by the Ministry of Environment at the time was that Germany and Norway were trying to interfere in the choice of projects. However, the Ministry also wanted to allocate money from the fund to compensate rural producers that owned land in conservation areas (Rodrigues, 2019).

The following chapter will change the discussion to analyse the context of the Fourth Industrial Revolution and how this may impact the Brazilian Amazon.

5. The Fourth Industrial Revolution context

> "We must develop a comprehensive and globally shared view of how technology is affecting our lives and reshaping our economic, social, cultural, and human environments. There has never been a time of greater promise, or greater peril."
> Klaus Schwab

This chapter introduces the Fourth Industrial Revolution (4IR) concept to provide context to the use of new technology in conservation projects. It also raises questions on data ownership consequences and Traditional Knowledge protection.

The Fourth Industrial Revolution - or Industry 4.0 - is a relatively new concept developed by Schwab (2015) to define the digital era. Even though history books only mention one Industrial Revolution, Schwab defined major innovations that were able to change society for good (please see Table 3 below)

Industrial Revolutions	Main Technologies	Social Effects
First	Steam engines (energy)	Job loss, rural evasion and formation of urban centres, family/community change to state/market
Second	Electricity (energy)	Job loss, mass production
Third	Computers/internet	Job loss, connectivity, internet-based entrepreneurship
Fourth	5G, Renewable Energy, 3D printing, quantum computing, biotech, nanotech, Artificial Intelligence, gene sequencing	Massive job loss expected, task-based jobs, VUCA world, address global issues with technology

Table 3: Industrial Revolutions, technologies and social impact (adapted from: Schwab, 2015)

With the development and implementation of steam engines, technology was able to replace human and animal power utilized in agriculture. The disruption caused by that led to the formation of urban centers and an increase in population. New jobs were created, while others disappeared as they were taken over by steam-powered machines (Rashied et al., 2020; Schwab, 2018). Those patterns seem to be characteristic of the following industrial revolutions: the second one brought electricity, which made mass production a reality; and the third one came with the innovative computer technology and internet. All these great innovations for humanity came about with cycles of job loss and entirely new industries emerging, which also created new jobs and economic development opportunities.

However, according to Schwab, the Fourth Industrial Revolution (4IR) is capable of a massive disruption to all our current social systems. In this new iteration, the digital, biological and physical systems are converging, which accelerates technological breakthroughs and also the pace of disruption in the job market (Schwab, 2015). Artificial Intelligence, 5G, 3D printing, quantum computing, nanotechnology, biotechnology, and the quest for renewable energy sources are all part of this new era. Even though these technologies have separate functionalities, when combined they offer exponential possibilities for creativity and disruption (Ismail et al., 2014).

Gordon Moore - Intel's co-founder - predicted in 1965 that the growth of microprocessors is exponential, and doubles in capacity on an average of two years. That became known in the technology world as Moore's Law, which is referred to by many authors when talking about the digital revolution (Kurzweil, 2005; Ismail et al., 2014; Diamandis, 2016). However, the exponentiality predicted by Moore also affects the infrastructure of systems created in the previous

material era. According to Salim Ismail[29] (2014), the digital era needs companies that are prepared for this exponential disruption:

> "Rather than using armies of people or large physical plants, Exponential Organizations are built upon information technologies that take what was once physical in nature and dematerialize it into the digital, on-demand world." (p.19)

The dematerialization brought upon by digital technology is only possible through data extraction, which is processed to become information. Therefore, data is the main raw material of this era. This fact is observed by an article in The Economist that declared data is already a more valuable resource than oil (2017).

In the context of the Amazon rainforest, collecting data could theoretically help with mitigating and monitoring deforestation, creating new jobs, and discovering new medicines (Nobre et al., 2020). However, a set of complex questions arise:

- Who owns this data?
- How can we ensure a fair share of profits to the local communities?
- Can we legally protect Traditional Knowledge (TK)?

All of the above challenges were foreseen in the Brazilian Biodiversity Law (L13123, 2015), while this and other international agreements also offer legal guidance on biodiversity and TK disputes based on the Convention on Biological Diversity (1992). However, implementation of a solution is complex in an area that has difficulties monitoring illegal activities that are far more visible than genetic materials, such as mining and logging.

The next section provides more insights on these questions, while critically analysing the current scenario of the Fourth Industrial Revolution and its potential impact in the Brazilian Amazon.

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[29] For consistency in definition, it might be important to note that in his 2014 book, Ismail names this digital era "Information Revolution", not Fourth Industrial Revolution, since the concept was created only a year later by Klaus Schwab.

5.1. Critical Analysis of the Fourth Industrial Revolution

This part is a critical analysis of the mainstream discourse associated with the Fourth Industrial Revolution and the potential impacts in the Amazon Rainforest.

5.1.1. Techno-optimism: addressing global issues in the 4IR

"What if the techno-optimist position on the spectrum of climate change opinion is right—that climate change is just a technical hurdle in humanity's race to its glorious destiny?"
Charles Eisenstein

This topic addresses the techno-optimism worldview as (critically) defined by Eisenstein (2018), which assumes that for every problem there is a technological solution. Amazon 4.0 relies on technology to solve economic and social problems; therefore, this analysis argues that technologies are just powerful tools to boost well-designed strategies.

The concept that technology is capable of solving most world problems is attributed to nuclear physicist Alan Weinberg in the 1960's (Rosner, 2004; Larsen, 2019). In Weinberg's perspective, even economics and social sciences - that are not technological in nature - could have a technical solution to their problems. In 2000, the computer scientist Jaron Lanier wrote a piece for Wired magazine where he equated this faith in technology to a form of dogmatic religion, calling it "Cybernetic Totalism" (Lanier, 2000). In his critique, he talks about the "campus imperialism" of the technologists that think everything can be reduced to "cybernetic patterns of information", including humans and everything else in nature. He argues that it is not possible to fully understand something just because it can be digitized. In addition, computer systems are not flawless, and software has glitches (Lanier, 2020).

The real question might be if technology is capable of solving the problems it also creates (Eisenstein, 2018; Kapoor et al., 2021). The perpetuation of this idea could be because

technology provides a "quick fix" to the system[30] (Kapoor et al., 2021). In other words, if technology alone can prove to solve massive global issues like climate change, we will not address the root (systemic) causes that could create real change[31]. Within that view, the collective social and ecological problems caused by the system are treated as mere technical glitches or hurdles (Eisenstein, 2018) that can be solved by improving efficiency (Hickel, 2018). Technology is seen here as a powerful tool to address certain issues, but it should not be viewed as the ultimate solution. Otherwise, there is a risk to find suitable solutions to symptoms instead of causes. Kapoor and Zalloua (2021) mention that the carbon market as a mechanism for trade, and the geoengineering - proposed by big tech billionaire, Bill Gates (2021) - are an example of that.

The next topic will provide more insights on the new technologies that are coming up and how they may affect the current global hegemony.

5.1.2. Global politics and hegemony in the 4IR

This topic connects development theories to technological advancement and how this may affect the global hegemony and the Brazilian portion of the Amazon in the next few years.

Modernization theory implies that traditional societies could enjoy the wealth of the developed countries if they implement their values and technologies, while ignoring or suppressing tradition in favour of innovation (Gilman, 2018). Hence the concept of 'developing' countries or 'emerging economies', in which the use of gerund implies movement, while not quite reaching the target to be considered developed.

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[30] System here is referring to liberal capitalism.

[31] Similar to the carbon market.

When Immanuel Wallerstein (2004) divided the world in different regions that together constitute a world-system, he recognized the interdependence between global areas. Wallerstein aggregated nation-states in units to study the issues that affect more than one country in similar ways, these are:

1. Core: dominant capitalist countries that are industrialized and invest in technological development to scale production and increase profit.
2. Semi-periphery: countries that have elements of both core and periphery. These ones have some elements of industrialization, but not enough to be considered developed.
3. Periphery: these were usually former colonies that concentrated on exporting primary products to developed countries.

According to Wallerstein (2004), these structures were formed in the XVI century, during the Age of Discovery and colonization.

Wallerstein's (1974) main critique to Modernization theory for development studies was that it concentrates on nation-states, while ignoring the global areas that are economically interdependent in unequal trade arrangements. Wallerstein also noticed the underlying structures that were an impediment for national development, which were also inherited from the colonial era. Therefore, modernization seems to be a way to perpetuate this global hegemony beyond colonization through economic interdependence - a realization that provides an important additional piece of the puzzle required to understand deforestation in the Amazon.

Since the First Industrial Revolution, human development has been directly linked to technological innovation. Technological developments, mainly in manufacturing, were used as justification to force people to move from the countryside to urban centres, to thereby ensure the

accumulation of capital for the continuation of technological innovation and also creating the need for mass education, a historical process known as the enclosure movement (Boyle, 2003). In that 'modernization drive', development is expected to raise the standards of living in a population, which implies that all nation-states should strive for that 'ideal' approach. However, if we consider the historical results and the interdependence of economies - as Wallerstein noticed – that type of wealth accumulation comes at a high cost for periphery and semi-periphery areas. Those areas provide most of the raw materials and labor that are needed for the technological development of core nations, while importing - many times - outdated technology from these countries.

Therefore, the previous industrial revolutions were first led by technological conglomerates of European merchants/traders and subsequently led by developed/core countries, which were the main source and proponents of technological innovations, intellectual property holders, and patent issuers. When technologies were implemented in the semi-periphery and periphery countries, inequalities increased both within and between countries. This dynamic can also be seen as the continuation of the colonial system that survived political independence (Rashied et al., 2020).

However, in the Fourth Industrial Revolution, innovation is also coming out of countries that were previously considered semi-periphery. The endurance of US hegemony since the end of the cold war, is now challenged by the rise of Asian countries - such as Japan, Indonesia and South Korea - and especially China. That newer international hegemonic dynamic might also affect the countries that were, up to now, considered part of the core group (e.g., Western European nations). Table 4 below illustrates the countries which are leading the technological development in the 4IR.

Technology	Global leader		Sector
	Global north	Global south	
Renewable energy	Germany		Energy
Artificial intelligence and machine learning	USA[b]	China[c]	Pervasive[a]
Gene sequencing	USA		Genetic Engineering and medicine
Nanotechnology	USA[b]	South Korea[c]	Materials, manufacturing, energy, electronics, medical/biomedical etc.
Quantum computing	USA		Computing
Biotechnology	USA[b]	Singapore[c]	Medicine agriculture, food production etc.
5G		China	Information and communication technologies
Robotics	Germany[c]	Japan[b]	Manufacturing, agriculture, automotive, medical, military/defence etc.
Additive manufacturing	USA[b], Germany[c]		Manufacturing

[a]Pervasive is used to indicate that a technology that is across numerous sectors to the point where it is growing to be all-encompassing
[b]Global leader
[c]Second place global leader

Table 4: 4IR technology global leaders (Rashied at al., 2020)

This table also shows that China is a leader in two key technologies created in this era: Artificial Intelligence and 5G. The former is all-pervasive, and the latter is the platform that will enable most of the other technologies to roll out.

During the recent G7 summit (June 2021), Joe Biden's efforts to convince the other leaders of the forum to reprimand the Chinese Government could be seen as an attempt to maintain the American hegemonic position amongst the core nations ("China's Communist Party at 100," 2021; Ponciano, 2021). China is today one of the US biggest competitors in Artificial Intelligence (as seen on Table 4) - showing clear signs that China aims to surpass the US in the near future - and also a global leader in 5G technology. Technology innovation in China is controlled by the Communist Party.

Therefore, the concerns of the US addressing the G7 leaders also have to do with the worldview behind the programming of these technologies that might not be in congruence with Western values. As President Biden states:

> "I know this is going to sound somewhat prosaic, but I think we're in a contest—not with China, per se—but a contest with autocrats, autocratic governments around the world to see whether or not democracies can compete with them in a rapidly changing 21st century." Joe Biden (as cited in Ponciano, 2021)

This democracy versus autocracy discourse has been used by Biden on several occasions when referring to China. According to The Economist, this view is preventing the US from building actual allies in Asia. Instead of looking for co-existence with China, the US seems to be more concerned with the loss of their own hegemony. The analysis also mentions that, at least economically, China is bound to become a powerful force ("Biden's New China Doctrine," 2021). Therefore, China might rise from a semi-periphery - and part of the BRICS (Brazil, Russia, India, China and South Africa) - to the core group of global leaders.

The importance of this competing dynamic between the US and China for the environmental discourse is that these are the two biggest CO_2 global emitters (*Our World in Data*, 2020). Both countries also exert major economic influence in the Brazilian Amazon[32], as mentioned in Chapter 3.

Therefore, their decisions may also affect our collective capacity to meet the 2030 goals for the environment. Moreover, their trade and tech war are a constant impediment in multilateral agreements on fossil fuels. The latter seems to be taking a different direction at COP 26, where both countries declared the intent to cooperate on climate change solutions (Valcovici et al., 2021).

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[32] When China and the US engaged in a trade war in 2017, after Trump was elected, China increased meat imports from Brazil. In the year after, China was the biggest importer of Brazilian cattle fresh meat. As a consequence, the cattle exports almost doubled between 2016 and 2020. (Brazilian Beef Exporters Association, 2021)

According to an article in the World Economic Forum, hegemony will be distributed amongst a group of leading countries, which include China, Germany, India, Japan, Russia and the US (Muggah, 2016). These countries could be defined as the new core, which is relatively consistent with the leaders of technological innovation in the 4IR, with the exception of Russia and India. In their perspective, from the semi-periphery BRICS block only Brazil and South Africa are not on track to become part of the core.

However, Rashied and Bhamjee (2020) mentioned the possibility of Brazil becoming a global power in this new scenario, even though they fall short of explaining how it would actually happen in this paper. According to the brothers Nobre (2018; 2019; 2020), Brazil could become a leader in biodiversity. However, following the logic of the previous revolutions, where global power is correlated to technological innovation, Brazil might fall behind since they are not leaders in any of the technologies of the 4IR. The next topic will provide more insight on this issue.

5.1.3. Patterns of technology implementation in developing countries

This topic provides a perspective on technology implementation in developing countries that resembles colonization patterns. This correlates to the affirmation made on the last topic about the difficulties for Brazil to become one of the leaders in the 4IR.

In his recent book, Bill Gates (2021) mentioned the need for companies in the developed world to invest in climate change solutions. According to him, global leadership should arise from industrialized countries not only because they have responsibility in the issue, but also because that strategy represents a major new economic opportunity. When referring to energy breakthroughs, Gates (2021) affirms:

> "Whoever makes big energy breakthroughs and shows they can work on a global scale, and be affordable, will find many willing customers in emerging economies." (p. 35)

What this quote represents is a common view about technology development and deployment that is quite useful to understand the challenges that Brazilians may face when confronted with the imperative of protecting the Amazon with imported technology.

The rich countries have more overall support for innovation (Gates, 2021), while developing countries are usually providing the raw materials (Nobre et al., 2020) and buying outdated versions of the technologies, as already mentioned before. This cycle is partially responsible for deforestation and social issues in low and middle income countries. Mining is needed even for 'green' technologies, and a lot of the metals come from developing countries, where the practice is also associated with social problems like child labor, prostitution, and conflicts with indigenous peoples (Amazon Watch and APIB, 2020; 2019; Kapoor, 2021). For instance, Google, Tesla and Apple were associated with child labor issues in Congolese cobalt mines that are part of their supply chain (Meisenzahl, 2019).

Other than that, most people on the planet live in developing countries. Aside from selling directly to governments, designing technology with the purpose of acquiring new users from these countries correlates with what Gates (2021) called a major economic opportunity.

Another similar issue for developing countries is the possibility of digital colonialism in the 4IR. The issue was raised by Michael Kwet (2019) in relation to South Africa. In his paper he discussed a government project in collaboration with the World Bank that improves access to digital technology in the public schools. At first glance, the project seems to be bridging the inequalities in access to technology by the majority black population in the country. However, according to Kwet (2019), most of the technology used is coming from US Big Tech companies that will have access to data from the students. In his view:

> "By controlling the digital ecosystem, Big Tech corporations control computer mediated experiences, giving them direct power over political, economic and cultural domains of life – imperial control." (Kwet, 2019)

Moreover, outsourcing this power to foreign corporations could be seen as colonial dispossession in digital form. Considering that data is the most important raw resource in the 4IR, data extraction and monitoring provides information on the behavior of a population. Therefore, it leaves the population vulnerable to control and manipulation for profit purposes and increased governmental power.

The next topic will explore how this vulnerability may impact the Amazon biodiversity and indigenous communities.

5.2.4. Intellectual property: Biopiracy and the 4IR in the Brazilian Amazon

This topic will introduce the Biopiracy concept from a law perspective to analyze the potential impact the technologies of the 4IR may have in the Amazon and Indigenous Traditional Knowledge.

Biopiracy is a term to define the practice of taking advantage of the Intellectual Property system to profit from Traditional Knowledge[33] (TK), plants and other resources, without establishing fair - or any - reciprocity (Mgbeoji, 2006). The term was created by developing world scholars mainly in reference to industrialized countries. Mgbeoji (page X, 2006) clearly notes:

> "Oftentimes, these patent laws result in a net economic gain for the industrialized nations, and a net economic loss for the developing countries. Some scholars even blame the patent system for the slow rate at which these nations are developing."

[33] The World Health Organization (WHO) defines Traditional Knowledge as "the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illnesses" (WHO, 2000).

However, it is difficult to clearly define the boundaries for biopiracy. That is because crops have been transplanted from one area to another since the beginning of agriculture (Halewood, 2013). Therefore, the concept of modern biopiracy is directly linked to the exploitation of Traditional Knowledge. According to the World Intellectual Property Organization (WIPO), Traditional Knowledge is defined as:

> "Knowledge, know-how, skills and practices that are developed, sustained and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity" (Traditional Knowledge, n.d.)

A key challenge is that plants alone do not qualify as TK, even though their application and/or uses do. This reality may create a double-standard when considering plant innovations as candidates for patent applications, especially with the rise of the biotechnology industry in the 4IR.

The Brazilian Biodiversity Law (L13123, 2015) states that genetic patrimony and Traditional Knowledge from the country that is used for research, technology development or commercial profit need a special authorization and appropriate legal regulation. According to the Fiocruz Foundation, Brazil was also one of the first countries to create a law that regulates genetic patrimony, Traditional Knowledge, and establishes a fair share of profits that also benefits indigenous communities (MP 2186-16, 2001). This law - first created in 2001 - was based on the Convention on Biological Diversity (CBD) international treaty signed at the 1992 Earth Summit. However, the application of it has many challenges, which include effective monitoring and agreements with international patent offices.[34]

A clear signal of the implementation challenges is that Brazil had to update the law in 2015, since it was also hindering important scientific discoveries. Another example is that the United

[34] See the Cupuaçu and *Banisteriopsis caapi* cases below.

States was one of the few developed countries that opted out of the CBD agreement in 1992 (Sands et al., 2018), even though they signed it a year later (*List of Parties*, n.d.).

On a more positive track, consider that India developed a comprehensive database that was also translated to other languages for their Ayurvedic medicines. This is not accessible by the general public, but it is available in the patent offices of Australia, Canada, Germany, the United Kingdom and the United States[35]. The database is helpful as a protection mechanism to ensure TK is known internationally, and therefore, cannot be subject to another country's patent law (*Protecting India's Traditional Knowledge*, n.d.).

The main challenge to apply a similar method to Traditional Knowledge from indigenous communities in Brazil is that this knowledge is passed on through generations orally, while Ayurveda is present in the Atharva Veda texts. Moreover, there are 305 indigenous ethnicities in the Brazilian Amazon that speak 274 different languages (IBGE, 2010). The latter would be a huge problem to identify the plants and mixtures, since they have different names depending on the ethnicity.

In addition, a study on the concept of innovation and intellectual property in the informal economy (Beer et al., 2013) recognizes the difficulties to define what exactly are "activities based on Traditional Knowledge, indigenous peoples and local traditional communities". This happens because of the limitations in available literature, and for the fact that it can be found in a variety of different sectors (Beer et al., 2013). Lastly, the study also recognizes the difficulties to incorporate TK into the current IP system, as follows:

> "Often, traditional knowledge is regarded as collectively originated and held, so that any rights and interests are vested in communities rather than individuals. As such, it is not easily protected by the current IP system, which grants protection to inventions by named

[35] According to WIPO, they are also negotiating with Japan and New Zealand.

> individuals or companies, except if particular persons such as healers are regarded as the holders of the knowledge." (WIPO, 2012b; Beer et al., 2013)

Therefore, the main question remains on how to clearly define the differences between real innovations and Traditional Knowledge.

Examples of Amazonian biodiversity products that were patented/trademarked abroad include:

1. Cupuaçu/Copulate Trademarked by ASAHI Foods

The name "Cupuaçu", which is a fruit from the Amazon and was trademarked by a Japanese company. The trademark was probably a strategy to have commercial exclusivity, since fruits cannot be patented. The company also patented "Copulate", which is a chocolate made with the seeds of the Cupuaçu fruit and previously registered at EMBRAPA[36]. As a result, Brazil could not export the Copulate or any products with the name Cupuaçu in the formula, which is originally an indigenous name from the Tupi language that means "big fruit".

The trademark and patent were retrieved in 2004, using the argument that the name is protected under Traditional Knowledge, and therefore, cannot be trademarked. However, this was only discovered when they tried to export the chocolate, exposing the vulnerabilities of the system (Figueira, 2015).

2. The *Banisteriopsis caapi* patent by Loren Miller

In 1986, a patent was issued in the United States in favor of Loren Miller, who was the director of the International Plant Medicine Corporation based in California. He collected the original vine (*Banisteriopsis caapi*) in the Amazon Forest and claimed to have asexually reproduced a version of the plant - therefore patentable - which he then named 'Da Vine' (Miller, 1986). The

[36] EMBRAPA stands for Brazilian Agricultural Research Corporation.

vine is one of the plants used in the Ayahuasca decoction. The latter is used by different indigenous ethnicities as a form of sacrament in their spiritual practices.

Indigenous peoples from the Amazon were not aware of the patent up until 1996. On the occasion, they filed a lawsuit with the U.S. Patent and Trademark Office (PTO), represented by lawyers from the Center for International Environmental Law (CIEL), the Coordinating Body for the Indigenous Organizations of the Amazon Basin (COICA), and the Coalition for Amazonian Peoples and Their Environment. They won what was called a 'precedent setting victory' that cancelled the patent (CIEL, 1999). However, their victory was only temporary, since Miller gained rights to appeal the initial PTO's decision and the patent was reinstated (PTO, 2001). Patents under the U.S. jurisdiction expire in seventeen years, so in 2003, Miller lost the patent for his alleged invention. The patent, as it was originally filed, cannot be renewed.

Even though Miller was not able to do much with his 'invention' during the validity of the patent, his lawsuit opened the discussion about patents and traditional knowledge/medicines.

The next chapter will discuss a case scenario that offers further insight on how technology deployment and environmental worldviews come together in the current Brazilian context.

6. Case scenario: The National Green Growth Program for COP 26

This case scenario illustrates the plans of the current Brazilian government for the environment and technology deployment to help on the Amazon conservation efforts. This practical example also gives more insight into the environmental worldviews behind the plan.

A week before the COP 26 meeting, the Brazilian government revealed a plan to mitigate the effects of climate change in the country while stimulating economic growth. The National Green Growth Program (NGGP) is an effort developed by the Ministries of Environment, Agriculture, and Economy.

The program focuses on carbon emission reductions, forest conservation, and efficient management of natural resources that also hope to generate “green jobs”. They also believe the solutions should be a holistic effort amongst ministries. The president also mentioned that “Brazil is part of the solution for climate change and not part of the problem”, as a response to international criticism received since the beginning of his administration. The sentence was also repeated during his recorded speech at COP 26 since the president chose to not attend the conference that mainly discussed world targets for climate change.

However, the plan is rather vague on how they aim to achieve what they promise. Also, this collaboration amongst ministries for climate change already exists, and critics were quick to

notice that this program is actually an “editing” of a previous one that was already active in previous administrations.

Paulo Guedes, the Ministry of Economy, took the opportunity of the program launch to mention the importance of breaking up the oil monopoly of the federal company, Petrobrás. Privatizing Petrobrás is an old discussion that is constantly used as a political scapegoat by different political parties. One of the promises of Bolsonaro’s 2018 campaign was to privatize the company, which was a subject of corruption scandals in the previous administration. Guedes' reason to bring up the issue during the launch of the NGGP was to affirm that the company will not be worth much in 30 years if the world phases out fossil fuels. Therefore - according to him - it is of utmost importance that they sell it while it is valuable and invest the money in technology and education. He also mentioned that the buyers would probably extract the oil at a faster speed than a company that is run by the state ever could. The contradiction is that this “speed” may cause other ecological disasters, not to mention jeopardizing all the other goals of the program they just launched. In addition, most of the Brazilian oil is found offshore in the depths of the ocean in the Campos Basin.

The greenwash in Guedes' speech was not mentioned in the press, which polarized the discussion between those who are in favor or against the economic consequences of Petrobrás privatization. At COP 26, Guedes also talked about the importance of the carbon market for conservation efforts. Paulo Guedes and Joaquim Leite, the Ministry of Environment, talked about a digital platform to facilitate payments to small rural producers that help to maintain the forest standing. The program that is called CPR (rural product identification) qualifies farmers to receive voluntary donations from companies that wish to offset their carbon emissions.

In addition to carbon trade solutions to finance the rainforest conservation, Paulo Guedes also mentioned the possibility of creating a "Selva do Silício" (Silicon Jungle) as a reference to Silicon Valley. He talked about attracting 'green' companies like Google, Tesla, Amazon, and Apple to the rainforest to help with the economic growth of the area by offering 20 years of fiscal incentives.

Two weeks after COP 26, Elon Musk - Tesla CEO - met with the Brazilian Ministry of Communications in California to discuss the opportunity to bring satellite internet to the Amazon Forest. Even though no formal agreement has been published yet, forest conservation seems to be the main goal of the partnership.

The next topic will deconstruct the information in the case based on the discussions raised by this paper.

6.1. Case Analysis

This topic deconstructs the information in the case scenario above to analyze the worldview behind it, additional system context and foreing technology implementation in the Brazilian Amazon area.

Worldview

This part connects the information from the case with the frameworks for environmental worldviews provided in chapter 2.

As the name suggests, the National Green Growth Program is grounded in a 'green' worldview. According to Reed (2007) spectrum, a green design principle focuses on specific issues, but is not applied to the whole. That was the issue with the possibility of Petrobrás privatization, which could also be characterized as a "development slip of the tongue" (Kapoor, 2020), where the unconscious intention is manifested in the speech.

It is widely known that this current government is rooted in ‘conventional practice’ (Reed, 2007) and ‘climate denial’ (Eisenstein, 2018). However, due to increasing international pressure, they are trying to change the discourse to a ‘green’ approach. This move also reinforces the idea that when economic solutions are available even people in ‘climate denial’ might find ways to adapt. However, the latter could be just plain greenwashing, since they are not grounded in real values. This illustrates how top-down resolutions work in practice, which suggests that these on their own are not enough to create real change in the climate scenario.

The next topic will provide more context to the measures the government is proposing for this program.

CPR (rural product identification)

This part provides context for the type of environmental protection based on carbon market tools that the National Green Growth Program proposes to implement.

As mentioned in the case, these payments will be made to small rural producers to stimulate environmental conservation. At first, this is confusing since it seems they are benefitting the ones who are also deforesting. In practice, people who work in the frontlines of mitigating deforestation know that many of the farmers causing the problem will not stop with an environmental speech. Therefore, financial compensation for maintaining the forest standing could be a solution. However, we might need to consider the value of carbon credits and the value of the tree, soy, cattle, etc. For instance, there are trees in the Amazon on the brink of extinction, like Mogno (*Swietenia macrophylla*) that might be worth over a million US dollars in the international market (cite). Also, a lot of deforestation is done in areas that are not officially documented - either undesignated or with other irregularities - so these payments are not an end-all solution.

These are all things to consider ensuring that the plan can work in practice. The next topic will provide insight on the intersection of environmental conservation and technology deployment.

The Silicon Jungle

This topic connects to information already discussed in this paper about the challenges of implementing imported technology to environmental conservation.

The pattern identified in the 'Silicon Jungle' idea is already described in topic 5.2.3 of this paper: bringing satellite internet to remote areas is quite similar to what Michael Kwet (2019) called digital colonialism by Big Tech. Other than that, incentives to multinationals are usually based on investments made in a given area and job creation. However, the trend in Big Tech is to replace low and some mid-level jobs, which are usually the ones offered to the local communities, with robots and AI. Therefore, 20 years of tax free in the country for these companies seem out of purpose.

The fact that Google, Tesla and Apple are ideal to help on the coservation of the Amazon is also questionable, considering the issues mentioned in topic 5.2.3 about child labor in Congolese mines. In Reed (2007) definition 'green' design is exactly that: solving one problem, while creating others. As mentioned before, the latter happens because the solutions are focused on symptoms rather than causes.

The discussion around this issue and the solutions presented at COP 26, seem to treat the Amazon rainforest as a problem on the way of development. Even the name of the environmental program has "growth" in it: the only possibility to maintain the forest standing. Even though there are similarities with the Amazon 4.0 project, it is important to mention that the project views the forest as a solution, not as an obstacle.

The next chapter will conclude the discussion and suggest ideas for future studies in the topic of the Amazon conservation.

7. Discussion and Conclusion

"These wider changes will never emerge, however, until we have a culture that demands them. So first and foremost, the revolution that is needed is a revolution in consciousness." Samuel Alexander

This chapter concludes this work by summarizing the ideas presented in this paper. It also correlates environmental worldviews and narratives (myths) to the Amazon 4.0 project and the need to reevaluate implementation within indigenous communities to ensure respect and recognition for Traditional Knowledge. It also leaves suggestions for future research on the points that were not conclusive in this paper.

The Brazilian Amazon conservation is commonly seen by people in power as an impediment for development. This mindset comes from an endless economic growth perspective, which aims to model the Global North/Western ideals of progress and modernization. The exploitation of natural resources for international trade is prioritized over solutions that would tend to local social issues and opportunities to keep the forest standing.

Brazil has a long history - over 500 years old - of participation in extractive cycles that export raw materials to import more complex manufactured products, an economic model that stems from the

colonization era. Most times, these trade agreements are not necessarily on behalf of the population or the environment, hence the inequalities in the country. However, they keep perduring since there is huge national and international investment[37] in this development model. For that matter, the APIB and Amazon Watch (2019; 2020) reports call upon the attention of international politicians to pressure these companies. Furthermore, when politicians talk about international aid to help adapt/mitigate climate change in the developing world, it is important to also connect to the fact that developed countries companies[38] also invest much larger amounts in the opposite direction of climate solutions. For instance, during the trade war between China and the US, Brazil increased exports to China, which became the main importer of soy, cattle and iron ore. All of them are amongst the main activities that cause deforestation[39].

According to Brazilian researcher Carlos Nobre (Design, 2019), there is enough land for these activities that would be enough to supply the national and international buyers without the need to deforest. His project, Amazon 4.0, proposes an innovative solution that combines economic growth and forest conservation. The idea aims at changing this structure of agromineral exploitation to a model that takes advantage of the forest biodiversity by implementing technologies associated with the Fourth Industrial Revolution. This is based on a sustainable development perspective, where the UN Sustainable Development Goals are the framework to achieve this objective.

Even though the Amazon 4.0 is considered a paradigm shift[40], it stays within the current narrative (myth) that still has a utilitarian view of nature and perpetuates the colonial system. In this new

[37] Chapter 3 explains the deforestation dynamic in further detail.
[38] Including China.
[39] Important to mention that this cannot be generalized, since there are also producers that are not cultivating or mining in recently deforested areas.
[40] Paradigm shifts in Causal Layered Analysis occur at the worldview level.

development model, the colonial system may endure on a more sophisticated level. While Amazon 4.0 aims to sell manufactured products, it still needs to buy or create partnerships with Big Tech to access these new digital technologies.

Since this is still the predominant model of our era, it might take generations to change it[41]. For degrowth scholars, the Amazon 4.0 solution might seem superficial in the sense that the narrative of exploitation and domination of nature remains the same. This view may prove problematic especially when dealing with indigenous communities. In one of his interviews (Design, 2019), Carlos Nobre mentioned a special training for indigenous communities that wish to participate in this new economy, where they would learn about "biological assets" and "biomimicry". However, many indigenous peoples that still live-in territories already have a wide knowledge of their local biodiversity and have been performing biomimicry in their own terms for centuries without the scientific names. Therefore, this possible "development slip of the tongue" (Kapoor, 2020) could further indicate a disregard for Indigenous/Traditional Knowledge in favour of a Western/scientific/commercial view, which would be based on the same old domination narrative. Moreover, when analysing Amazon 4.0 from this perspective, there were fundamental gaps that - even though raised in this paper - have also proved to be beyond the scope of this current work:

1) Collecting genetic materials from plants, trees or animals and taking advantage of Traditional Knowledge might infringe the Convention on Biological Diversity and the Brazilian Biodiversity Law when profits are not clearly stated and shared accordingly. Blockchain for fair profit distribution is mentioned in some of the Amazon 4.0 papers; however, it is not very clear how it will work in practice. In other words, the question remains on how to determine intellectual property ownership in indigenous communities.

[41] This affirmation is based on CLA assumptions.

Especially because some of the Amazonian traditional medicines are used by more than one ethnicity.

2) Even though Amazon 4.0 aims at creating more complex manufactured products to also compete in the international market, it still depends on foreing technologies that may cause a new form of digital colonization. Therefore, data ownership is one of the biggest issues that need to be addressed by this project.
3) Brazil needs to properly plan for the Fourth Industrial Revolution and how this will impact society and the environment. Also, a lot of the mining done for these new technologies come from developing countries.

The Causal Layered Analysis framework was ideal to analyze and conclude that top-down solutions at the system level are not enough to change the underlying narrative in this case. However, the top-down solutions are still necessary to move away from the deforestation paradigm worldview (from conventional practice to a green/sustainable one) in time for the pressing issues of climate change. Following Reed (2007) spectrum's definition of sustainability[42] - as a threshold rather than a final solution - the Amazon 4.0 project can be seen as a first step in the direction of a more regenerative system, if the points mentioned above are resolved.

Moreover, the deforestation in the Brazilian Amazon impacts multiple communities that have very diverse worldviews. Therefore, the use of CLA in combination with the worldview spectrums (Reed 2007; Corbett, 2006; Eisenstein, 2018) were necessary to understand the complexity of the issue. The layering method to manage complexity also helped with analyzing the solutions in relationship to the problem. The worldview spectrums can also be used to analyze case scenarios as demonstrated in this paper. This helps to gain perspective on how environmental projects should

[42] Chapter 2 and 4 explain Reed spectrum in more detail and the application for this work.

be communicated with different people. As illustrated in the first epigraph of this paper, “what’s in it for them?” is the main question to ask in problems that affect multiple stakeholders and moves them in the direction of the collaboration.

The next topic provides suggestions for solutions to deforestation by combining the two main approaches presented in this paper.

Recommendations

This final topic proposes the idea to combine top-down (Amazon 4.0) solutions with bottom-up (education for regeneration) to mitigate deforestation in the Brazilian Amazon Rainforest.

Given the climate urgency, we need solutions within the current system that will address the causes of the Brazilian Amazon deforestation. The project Amazon 4.0 offers this possibility, even though there should be careful planning on how this will impact the indigenous communities and their Traditional Knowledge, along with the open question on data ownership.

A combination between this solution and educating children and adults for the regeneration of the systems (economic, environmental, social) would be ideal, in my view, to create awareness and provide tools to change the narrative (myth) of nature as a mere resource for humans. Furthermore, education that creates bridges between sustainability and the regeneration of the systems could be adapted to different areas to find solutions to the climate crisis and deforestation that balance the relationship between humans and nature. Even though this solution might take long to create ripples worldwide, sites of translation for this possibility already exist in the Gaia Education system. The latter focuses on the integration of social, economic, ecological and worldview perspectives to create change within the sustainability framework.

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