EUROPEAN UNION AND BRAZIL

Innovative and Sustainable Strategies for Cooperation

Diego Trindade D´Ávila Magalhães
Laís Forti Thomaz
Marcelo Fernandes de Oliveira
(Organizers)

Funded by the European Union

CÁTEDRA JEAN MONNET

UFG UNIVERSIDADE FEDERAL DE GOIÁS

OFICINA UNIVERSITÁRIA

CULTURA ACADÊMICA Editora

EUROPEAN UNION AND BRAZIL

Innovative and Sustainable Strategies for Cooperation

Diego Trindade D'Ávila Magalhães
Laís Forti Thomaz
Marcelo Fernandes de Oliveira
(Organizers)

EUROPEAN UNION AND BRAZIL

Innovative and Sustainable Strategies for Cooperation

Marília/University Workshop
São Paulo/Academic Culture
2025

Funded by the European Union

CÁTEDRA JEAN MONNET

UFG UNIVERSIDADE FEDERAL DE GOIÁS

OFICINA UNIVERSITÁRIA

CULTURA ACADÊMICA Editora

UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"
Campus de Marília

Director
Dra. Ana Clara Bortoleto Nery
Vice-Director
Dra. Cristiane Rodrigues Pedroni

Cover and back cover image
Cairo José Alves Guimarães

Translator
Marcel Jacobus de Weert

International Cataloguing in Publication Data

Scientific Council
Angélica Szucko (Pontifícia Universidade Javeriana e UnB)
Carlos Gustavo Martins Hoelzel (UFG)
Diego Trindade D'Ávila Magalhães (UFG)
Drielli Peyerl (University of Amsterdam)
Ema Cláudia Ribeiro Pires (Universidade de Évora, UE, Portugal e UFG)
Laís Forti Thomaz (UFG e Ministério de Minas e Energia)
Marcelo Fernandes de Oliveira (UNESP)
Noemia Ramos Vieira (UNESP)
Roberto Goulart Menezes (UnB)

Translation of the book: "União Europeia e Brasil: Estratégias Inovadoras e Sustentáveis para Cooperação"

CIP – Catalogin-in-Publication

E89 European Union and Brazil : innovative and sustainable strategies for cooperation / Diego Trindade D'Ávila Magalhães, Laís Forti Thomaz, Marcelo Fernandes de Oliveira (organizers). – Marília : Oficina Universitária ; São Paulo : Cultura Acadêmica, 2025.
86 p. : il.
Support: European Union, Jean Monnet Chair at UFG
Includes bibliography
ISBN 978-65-5954-581-0 (Print)
ISBN 978-65-5954-580-3 (Digital)
DOI: https://doi.org/10.36311/2025.978-65-5954-580-3

1. European Union. 2. Brazil. 3. International cooperation. 4. Sustainability. 5. Environmental protection. I. Magalhães, Diego Trindade D'Ávila. II. Thomaz , Laís Forti. III. Oliveira, Marcelo Fernandes de.

CDD 327.17

Telma Jaqueline Dias Silveira – Librarian – CRB 8/7867

Affiliate publisher:

Associação Brasileira de
Editoras Universitárias

Academic Culture is the publishing imprint of UNESP Publishing
University Office is the publishing imprint of UNESP - Marília campus

Table of contents

Introduction

This book seeks to provide a comprehensive in-depth reflection on cooperation between the European Union (EU) and Brazil, especially in the field of sustainability and environmental governance. Although the project is funded by the European Union, the views and opinions expressed here are the authors' alone and do not necessarily reflect those of the European Union. The work explores, through different contributions, the complex political, economic and scientific relationships that shape the environmental policies of these two regional blocs. At the heart of these discussions, the Jean Monnet Chair (JMC) at the Federal University of Goiás (UFG) has presented itself as a structure that pursues the innovation and integration of academic knowledge and public policies, thus creating practical solutions to global challenges, with a focus on promoting sustainability.

The first chapter, "European Union and Brazil: a brief analysis of the application of artificial intelligence in environmental protection and its global impacts", by Marcelo Fernandes de Oliveira and Victória Eduarda Flauzin, deals with one of the most innovative tools in the fight for environmental protection: artificial intelligence (AI). The authors discuss how the EU has used AI to monitor and mitigate environmental problems such as deforestation, pollution and climate change, using technologies

https://doi.org/10.36311/2025.978-65-5954-580-3.p7-11

like satellite monitoring, predictive modeling and real-time data analysis. The research highlights how these technologies can be applied in Brazil and how, through closer cooperation, it is possible to transform these tools into solutions for the country's environmental challenges. In a global scenario where environmental denialism is gaining traction, especially with the rise of political movements like the one led by Donald Trump, the contribution of AI has become crucial. The chapter discusses the interaction between the practices of the European Union and the possibility of these serving as a model for Brazil, with an emphasis on the global impact of such innovations. The JMC-UFG fits into this context, as its objective is to promote exactly this type of integration of scientific knowledge with public policies, while expanding international collaboration.

The second chapter, "Environmental Regulatory Strategies as a Basis for the Agricultural Trade Agreement Involving the European Union and Mercosur", by José Neto Cassiano de Camargo and Karla Emmanuela Ribeiro Hora, delves deeper into the impact of environmental policies on the negotiation of the trade agreement between the European Union and Mercosur. The study reveals how the EU has introduced environmental provisions into trade negotiations, with the aim of ensuring that products imported into Europe do not come from degraded or deforested areas. This approach reflects a growing concern for sustainability, but also reveals the tensions that arise due to the different economic and social realities of the countries involved. This chapter discusses how Brazil may benefit from strengthening its environmental policies through these negotiations, especially with regard to the monitoring of protected areas and the inclusion of new actors in environmental regulation. Within the scope of the JMC-UFG, the analysis of how the European Union uses environmental practices and regulations in its foreign policy becomes even more relevant. The JMC-UFG aims to study these commercial and political dynamics, in order to understand how EU best practices can be applied in the Brazilian context, while promoting the development of sustainable solutions and the adaptation of local policies to global demands.

Chapter three, "Climate Governance in Perspective: A Comparison between Brazilian and Spanish Policies for Climate Adaptation and

Mitigation," by Diego Tarley Ferreira Nascimento and Javier Martín-Vide, offers a comparative analysis of Brazil and Spain's respective climate policies, with a focus on climate change adaptation and mitigation. The analysis reveals that, although both countries face similar challenges, there are important lessons to be learned. Spain, with its consolidated experience in regional and local climate policies, offers a model that can be adapted by Brazil, especially with regard to the integration of local, regional, and national spheres in climate governance. The authors suggest that Brazil, inspired by Spanish practices, could more effectively integrate its climate governance policies, thus ensuring climate finance and social justice, as well as facilitating an inclusive and sustainable energy transition. In this context, the JMC-UFG has encouraged the debate on climate governance, promoting an exchange of experiences and the development of public policies that are both effective and adaptable to local realities. The training of students and researchers through undergraduate courses, events and workshops, and the Climathon itself, as proposed by the JMC-UFG, constitutes an effective strategy for engaging society and public policymakers in the process of adapting international best practices to the Brazilian reality.

The fourth chapter, "On the European Union's Deforestation Regulation: Sustainability Policy or Economic Protectionism?", by Filipe Prado Macedo da Silva, examines the new 'Regulation on Products Not Associated with Deforestation' of the European Union, included in the European Green Deal. The analysis details the impact of this regulation on global trade, questioning whether it represents a true sustainability policy or a form of economic protectionism, especially in relation to Brazil, one of the world's largest exporters of agricultural products. The regulation aims to ensure that products imported into the EU are not associated with deforestation practices, through a rigorous system of monitoring and tracking of supply chains. The chapter discusses the challenges for Brazil, but also points out opportunities, provided there is a joint effort to improve traceability and transparency in agricultural practices. Along these lines, the JMC-UFG seeks to assess the impact of international regulations and how they can be implemented effectively in Brazil. Therefore, integration

of European and Brazilian sustainable policies is one of the main lines of action of the JMC-UFG, which promotes a dialogue between academics, the government and civil society in order to apply these practices.

Finally, chapter five, "Sustainable Transformation: The Role of INYAGA/UFRJ in the Brazil-European Union Connection", by Kelyane Silva, Fabiana dos Santos e Souza Frickmann, Thalissa Pádua Gilaberte, Eliane Ribeiro Pereira, Ana Paula Sperling Mendes, Antônio José Barbosa de Oliveira, Rosário Mauritti, Vicente Antônio de Castro Ferreira and Rodrigo Antunes Malvar Hermida, highlights the work of Inyaga, a socio-environmental impact incubator at the Federal University of Rio de Janeiro (UFRJ). Inyaga is a concrete example of how innovation and sustainability can be incorporated into the academic environment and engage both the public and private sectors. The chapter explores how the collaboration between the UFRJ and ISCTE (University Institute of Lisbon) has generated significant results in terms of scientific research, social innovation projects and the development of sustainable solutions. Inyaga acts as a link between Brazil and the European Union, promoting the exchange of knowledge and experiences and contributing to the formation of an innovation ecosystem that integrates sustainability. The role of the JMC-UFG in supporting this international collaboration is reflected in its commitment to training students, academics and other stakeholders and, as such, prepare them to apply the EU's sustainability practices in the Brazilian context.

The JMC-UFG has set a goal to integrate knowledge acquired in the different chapters and transform it into concrete action. By promoting the exchange of knowledge between Brazil and the European Union, and by supporting the adaptation of European policies to the Brazilian context, the organ not only contributes to the construction of a more sustainable future, but also trains the next generation of leaders and experts in environmental governance and sustainable innovation. Its main purpose is to build a bridge between the two realities, helping to create solutions for shared global challenges like combating climate change and preserving ecosystems.

This work, together with other activities developed by the JMC-UFG, represents an attempt to deepen and expand cooperation between the European Union and Brazil, not only in the academic field, but also in the political, economic and social spheres, with the aim of promoting a transition to a greener and more sustainable global economy.

We would like to express our sincere gratitude to the authors of this book, whose dedication and intellectual input form the foundation of this project. We also thank the scientific committee and the organizing committee of the seminar who, through their commitment and competence, made this event an important milestone in the dissemination of knowledge. Furthermore, we extend our gratitude to Editora UNESP - Cultura Acadêmica, represented by Prof. Marcelo Fernandes de Oliveira, for their indispensable partnership and support. Finally, we thank everyone who contributed directly or indirectly to the activities of the JMC-UFG from 2023 to 2025. Without the collective effort and commitment of each, we could not have achieved the proposed objectives and achievements of this academic journey.

Laís Forti Thomaz

Coordinator of the Jean Monnet Chair at UFG

The European Union and Brazil:
a brief analysis of the application of artificial intelligence in environmental protection and its global impacts

Marcelo Fernandes de Oliveira
Victória Eduarda Flauzino

Abstract: This research explores the potential of using artificial intelligence (AI) in environmental protection. It investigates how third sector institutions, government agencies and private corporations have implemented these technologies for ecological purposes in the European Union, and how they might be applied in Brazil. The study sought to understand how AI can be used to monitor and mitigate environmental problems, including deforestation, pollution and climate change, through techniques like real-time data analysis, satellite monitoring and predictive modeling. Furthermore, the research analyzed the impact of these initiatives on the relations between the European Union and Brazil, and how the production and application of AI technologies can influence global regulations and guidelines in a context of rising environmental denialism during Donald Trump's second term as president of the United States.

Keywords: European Union-Brazil; artificial intelligence; environmental protection; and global impacts

Introduction

Artificial intelligence (AI) has already become part of contemporary society, impacting various sectors of daily life. Generative AI tools exemplify the transformative potential of these technologies, by providing near-human interactions and innovative solutions to complex problems like environmental issues.

https://doi.org/10.36311/2025.978-65-5954-580-3.p13-27

Generative AI is designed to create new content, using advanced models to produce texts, images, music and various data autonomously. It is capable of simulating human creativity and create new content that can be used in various contexts, including environmental protection.

With this in mind, the private sector has been investing heavily in the development and improvement of AI algorithms. The report "Global Artificial Intelligence Study: Exploiting the AI Revolution", by PricewaterhouseCoopers (PwC) projects global investment in AI at US$ 15.7 trillion by 2030. This magnitude of investment indicates that AI will become a centerpiece in the innovation and sustainable growth strategies of corporations seeking competitive advantage.

Nevertheless, the application of AI in the public sector to date has been slow. This research aims to help fill this gap, mainly by exploring the potential of using AI for environmental purposes. In this sense, we seek to understand how this technology can be applied to monitor and mitigate environmental problems, such as deforestation, pollution and climate change, using real-time data analysis, satellite monitoring and predictive modeling. The research will also examine the impact of these initiatives on global environmental regulations and guidelines, and was carried out in light of the Philosophy of Information.

As for the structure, section one presents the employed methodology. Next, we demonstrate the quantitative results obtained from surveys of public opinion on environmental issues using the Brand24 tool. The third section addresses the theoretical foundations of the Philosophy of Information that underpins this study. In the fourth section, we report on the experiences of the European Union (EU) in using AI for environmental protection and its potential for application in other parts of the world, more specifically in developing countries like Brazil. Finally, our conclusions are presented.

1. Methodology

The qualitative approach of this research was chosen for its suitability in exploring the impacts of AI on environmental protection

and its international repercussions. We combined a quantitative analysis, including statistics on the adoption of AI in environmental practices and indicators, with a solid theoretical and practical foundation. In summary, the methodological strategy consists of a literature review complemented with case studies and quantitative data.

The literature review was carried out in IEEE Xplore and Google Scholar, where we prioritized scientific articles, systematic reviews and technical studies related to the application of AI in environmental protection and its ethical and political implications. The remaining documentary research focused on reports, official documents, publications of non-governmental, governmental and business organizations, as well as international regulations and treaties related to the topic.

The case studies analysis centered around ongoing EU efforts, such as the Emissions and Pollution Monitoring System; the Environmental Data Platform; Artificial Intelligence and Water Resource Management; Data Analytics for Environmental Policy; and Early Warning and Intervention Systems. All of these are integrated and supported by the EU's Copernicus Program.

In terms of quantitative data collection, we used the Brand24 media monitoring tool to track in real time public opinion and discussions about the use of AI in environmental protection in the EU and Brazil. This tool made it possible to identify contemporary trends and debates on social media, blogs and news sites, thus complementing the academic analysis with data from public and commercial discourse. The data collected through Brand24 was triangulated with the results of the bibliographic and documentary research, ensuring a comprehensive and well-founded analysis on the issue.

2. Results of the Data Analysis on Keywords in the Brand24 Tool for the European Union and Brazil

The results obtained from the application of the Brand24 media monitoring tool on public opinion, using the keywords "artificial

intelligence (AI)" and "environmental preservation" in the context of the EU and Brazil were:

- 58,369 mentions of the keywords, 19,397 on social media and 38,972 outside those platforms;
- On X, we found 2,358 mentions, while TikTok had 1,665 mentions;
- The remaining mentions occurred on blogs specialized in technology and the environment, news sites (BBC, CNN, Reuters), Podcasts (272) and Forums (227).

The reach of the mentions on social media was 144 million people; outside of these, another 238 million people were reached. Sentiment analysis of the keyword mentions resulted in:

- Positive sentiment: 5,192 mentions highlighted benefits or positive impacts of using AI in environmental protection;
- Neutral sentiment: 36,309 mentions; and
- Negative sentiment: 2,868 mentions associated with concerns, criticisms or problems related to the use of AI in environmental issues.

The trends identified in the material were: a) increased interest in the use of AI in sustainability initiatives like monitoring deforestation and pollution; b) discussions on ethics and privacy in the use of environmental data collected by AI; and c) expansion of the debate on the application of AI in environmental conservation projects and the prediction of natural disasters.

The main emerging themes found were: a) monitoring deforestation in the Amazon using AI; b) smart city projects that employ AI for urban environmental monitoring; and c) AI as a tool for predicting natural disasters and monitoring climate change.

The key actors involved in the discussions are: a) technology companies (Google, IBM, Microsoft); b) environmental NGOs (Greenpeace, WWF); c) academic and research institutions; and d) governments and regulatory agencies (UN, EU, Brazil).

Upon analyzing the collected data, it can be stated that they demonstrate a clear convergence between the growing use of AI in environmental monitoring and an increase in the volume of mentions of this topic. This suggests a growing interest and relevance of the subject, both in public discussions and in practical initiatives.

The positive sentiment analysis indicates a favorable perception regarding the use of AI for environmental purposes. The emerging themes and the main actors involved reflect a growing integration of AI technology in sustainability and conservation projects, as well as a focus on regulations and ethical guidelines within the EU.

To contemplate this quantitative content, in the next section qualitative analysis methods will be used, applied to information on concepts from the Philosophy of Information, such as ethics, social implications and human-machine interaction. This analysis will allow for an in-depth assessment of AI-related practices and policies, highlighting both the benefits and the ethical and social challenges. Issues such as data privacy, algorithmic bias and trust in automated decisions will be briefly examined in light of the ethical principles established by authors like Floridi (2019) and Ganascia (2010). Human-machine interaction will be explored to understand how collaboration between humans and AI systems may be optimized to achieve sustainable and fair environmental outcomes in both the European and Brazilian contexts.

3. Theoretical Foundations

Philosophy of Information is an emerging discipline that seeks to understand and articulate the role of information in different contexts. According to Floridi (2019), it investigates the nature of information,

how it is processed and used, and the ethical and social implications of these processes. This field of study is essential in analyzing how AI systems organize and interpret data, and how these interpretations impact society and the environment.

Ganascia (2010) explored the epistemology of AI from the perspective of Philosophy of Information, emphasizing that AI should be considered as an informational phenomenon that interacts with the human information ecosystem. He argues that AI can transform the way information is created and used, and that it is essential to adopt an ethical approach to ensure that this transformation is beneficial and fair.

Information ethics refers to the moral issues that arise in the collection, use, and dissemination of information, especially involving AI. This concept encompasses the responsibility to ensure that information is treated with respect and that AI systems do not perpetuate injustices or inequalities (Floridi, 2019).

Mittelstadt *et al.* (2019) and Savin (2020) discussed how information ethics should guide the development and implementation of AI technologies, ensuring that they are designed and operated in a manner that respects privacy, avoids algorithmic bias, and promotes equity.

Algorithmic bias may result in the amplification of existing inequalities by making decisions based on historical data that reflect prejudice and social injustice. This is particularly critical in environmental contexts where the application of AI affects vulnerable communities. For example, if environmental monitoring systems do not adequately consider socioeconomic data from local communities, it can result in policies that inadvertently disadvantage these populations. Therefore, it is critical that AI implementation incorporates mechanisms to identify and correct biases, thus ensuring that decisions made are fair and equitable.

Regarding data privacy, the collection and analysis of large volumes of environmental data often involves capturing sensitive information about human activities, such as consumption patterns and mobility. The way in which this data is managed, stored and used can significantly impact individuals' privacy and data security. Ethical guidelines should ensure that

data is collected in a transparent manner and with appropriate consent, and that it is protected against unauthorized access.

Human-machine interaction is a central concept in the Philosophy of Information, which analyzes how humans and AI systems can collaborate effectively and ethically. According to Floridi (2019), this interaction involves not only the use of technologies, but also the co-evolution of human and artificial capabilities. This collaboration should be designed to maximize benefits for humans and the environment, promoting an integration respectful of ethical and social values. The study of human-machine interaction is crucial to understanding how AI technologies can be developed and applied in ways that contribute to environmental protection and social justice.

The advancement of the dimension of AI in environmental protection requires international support and collaborative partnerships to improve access to technologies and the development of local human capabilities in human-machine interaction. Therefore, it is crucial to promote global initiatives for cooperation and technical support, in order to ensure a more equitable adoption of AI and to achieve the sustainable environmental goals on a global scale for the benefit of all.

Although philosophical discussions take place with reference to the practice of using AI in environmental protection, the development of such technologies has been taken up by the private sector. For example, the company Planet Labs uses a constellation of satellites to capture high-resolution images of the Earth and, in conjunction with AI algorithms, detects changes in vegetation cover with great precision. These systems allow for the early identification of illegal deforestation and the implementation of corrective measures before greater damage occurs (Planet Labs, 2024).

Additionally, Google Earth Engine has been a powerful tool in environmental analysis, using AI to process large volumes of satellite data and provide insights into climate change, air quality, and land use patterns. Studies have shown that integrating AI with satellite data can significantly improve the ability to predict and mitigate natural disasters (Google Earth Engine, 2024). Real-time data analysis has also played a

crucial role in environmental protection. NASA's Crops in Space system uses AI to monitor crop health and predict crop failures, providing valuable data for sustainable natural resource management (NASA, 2024). Another example is Microsoft's Air Quality Index, which uses AI to analyze air quality sensor data and predict pollution patterns, allowing cities to adjust their pollution control policies more effectively (Microsoft, 2024). As we can see, the implementation of AI technologies has the potential to significantly influence environmental policymaking at the international level. AI tools are increasingly being used to process large volumes of data and provide detailed analyses, enabling policymakers to develop more effective strategies based on empirical data. The problem is that these solutions are, in most cases, being developed by the private sector. Moreover, they require significant expenditures that most countries, including Brazil, cannot afford by themselves. Nonetheless, environmental protection should be part of a global effort, even though at the beginning of 2025, Donald Trump's inauguration as president of the United States has turned the country into an environmental denier.

Given this twofold difficulty, EU initiatives are becoming even more relevant to the world and Brazil in particular. This is because the EU has the economic resources and international political clout to face the challenges posed by the United States at this historic moment. It is even generating broader partnerships, including with China. In the next section, we will present some European experiences of good use of AI for environmental protection that can be internationalized in the logic of the Philosophy of Information.

4. The EU's use of AI for global environmental best practices

The EU's Copernicus program uses satellite data combined with AI algorithms to monitor emissions and air pollution patterns in real time (Copernicus, 2024). This information has been used to adjust environmental policies and respond quickly to local and regional crises,

demonstrating how AI can enable policy decisions with greater precision (UNFCCC, 2020).

The EU has adopted AI as a strategic tool to strengthen its sustainability policies and ensure compliance with environmental regulations. The integration of AI into its policies is evidenced by several projects and initiatives to effectively monitor and manage environmental issues. Examples include:

- **Emissions and Pollution Monitoring System:** The European Commission has developed advanced AI-based monitoring systems to track pollutant emissions and air quality in real time. AI is used to process large volumes of data and provide detailed information on pollution sources and their impacts (European Commission, 2024). This allows authorities to respond quickly to pollution events and adjust control policies according to local and regional needs.
- **Environmental Data Platform:** The EU has launched the European Union Environmental Data Platform, which uses AI to consolidate and analyze environmental data from different sources, including sensors, satellites and monitoring reports (European Environment Agency, 2024). This platform provides an integrated view of the environmental situation across Europe and makes it easier to identify areas that are not in compliance with environmental regulations. AI helps identify patterns and anomalies that may indicate compliance issues or areas that require urgent intervention.
- **Artificial Intelligence and Water Management:** The EU has implemented AI technologies to monitor water quality and manage the allocation of water resources. Projects like Horizon 2020 Water-IF use AI to analyze sensor data in real time and predict potential water-related crises such as droughts and pollution (Horizon 2020, 2024). This allows for more efficient resource management and rapid responses to emerging issues.

- **Data Analytics for Environmental Policy:** Researchers in Europe are using advanced technologies like artificial intelligence in conjunction with contributions from civilian scientists to monitor and protect threatened habitats and species. These tools help track changes in ecosystems and provide valuable data to support conservation policies (Horizon Magazine – European Commission, 2025).

As can be seen above, the EU's use of AI for monitoring and enforcing environmental regulations demonstrates the potential of technology to improve environmental governance and promote international cooperation. This is in line with public opinion on the topic measured in the quantitative data collection carried out using the Brand24 tool.

The EU's use of AI in environmental matters is supported by a network of its own satellites, as well as commercial and public satellite networks. As part of the Copernicus Program, since the launch of Sentinel-1a in 2014, the EU will place 20 satellites in orbit by 2030. This is a high-cost infrastructure that most countries cannot afford (Copernicus, 2024).

In other words, the adoption of AI in environmental policies, although promising, faces a number of significant challenges in developing countries, which are often linked to limitations in access, implementation and technical capacity. These challenges can create considerable disparities in the way different countries achieve global environmental goals.

Developing countries like Brazil often face difficulties in accessing advanced AI technologies due to economic constraints and lack of infrastructure. The high cost of the necessary equipment and software can be prohibitive, and many of the most advanced technologies are developed and maintained by private companies based in developed countries (ISRO, 2019).

Furthermore, even when technologies are available, the lack of an adequate infrastructure and human resources can limit their effective implementation. In Brazil, for instance, a shortage of technology experts

and a lack of adequate training have prevented a broader and more effective adoption of AI in environmental policies (Cesar et al., 2021).

These barriers to accessing and implementing AI may negatively impact the achievement of global environmental goals. Developing countries that struggle to adopt and implement AI technologies face difficulties in monitoring and reducing their greenhouse gas emissions and managing their natural resources sustainably. The lack of accurate data and limited capacity to respond to environmental crises can result in a slower progression towards global goals, exacerbate inequalities and compromе international efforts to address environmental challenges (UNFCCC, 2020).

As such, we can state that the implementation of AI in developing countries faces significant barriers related to costs, infrastructure and human resources, which can create disparities in the achievement of global environmental goals. This highlights the need for international support and collaborative initiatives to ensure a more equitable and effective adoption of AI technologies.

Against this backdrop, the EU's Copernicus program can be a model for the universalization of AI use in environmental protection, notably Brazil. Studies in the field of Philosophy of Information, specifically the ethical dimension of information, are of importance here. Copernicus may well serve as a guide to build a collaborative approach that transcends national borders, aiming to establish global standards and guidelines that promote the responsible use of AI for environmental protection.

Initiatives like the General Data Protection Regulation (GDPR) and the Regulation on Artificial Intelligence are important advances in creating a regulatory framework for the use of AI in various sectors, including environmental protection. Among other issues, both regulations require that AI systems be transparent and auditable, promote equity in access to and application of technology, and that they should not reproduce or amplify existing inequalities (European Commission, 2021).

Notwithstanding, the implementation of such laws in developing countries faces significant obstacles. It is therefore up to the EU to make

efforts from an ethical perspective of information, in a collaborative sense, with countries that have limited capacities in this area, including Brazil.

Conclusion

This study has revealed the transformative impact of AI on environmental protection, highlighting its innovative capabilities to monitor and manage critical issues like deforestation, pollution and climate change. Satellite technologies and real-time data analysis systems have enabled more accurate detection and faster responses to environmental crises. These advances demonstrate the potential of AI to provide detailed insights and proactive solutions, improving the global approach to environmental protection. The integration of AI into the European Union's environmental policies, as can be seen within the scope of the Copernicus Program, is testament to this.

The continued advancement of AI offers new opportunities and challenges for environmental protection, but also requires constant vigilance to ensure its ethical and responsible use. The integration of AI with emerging technologies (quantum computing and big data analysis) can further expand environmental monitoring and management capabilities.

However, the disparity in access to technology and capacity to implement it in developing countries raises questions about the equity of these advances. In this sense, to maximize the benefits of AI in environmental protection and ensure its ethical and responsible use, transparency and accountability must be emphasized. Clear guidelines for the collection, storage and use of data must be implemented, ensuring that AI systems respect privacy and avoid algorithmic bias. The creation of regulatory frameworks, such as the European Union's Regulation on Artificial Intelligence, can serve as a model, provided they are adapted to local needs and contexts to promote more inclusive and fair governance.

Additionally, international cooperation is essential to overcome the barriers faced by developing countries. Initiatives should be expanded to

include technical and financial support, enabling these countries to adopt and implement AI technologies effectively. Collaboration should focus on the transfer of knowledge and resources, promoting the construction of infrastructure and local human technical know-how. These actions will contribute to a more equitable adoption of AI, and a sustainable and inclusive environmental protection for all.

The collaborative and adaptive approach advocated by the Philosophy of Information literature will allow for a continuous integration of AI-based solutions into environmental protection. It is desirable that the EU becomes a hub for initiatives for the public dissemination and regulation of AI in overcoming inequalities in access and implementation of technologies to promote environmental protection. By establishing global standards and promoting international cooperation, it will be possible to ensure that AI is used in a fair and inclusive manner, thus contributing to the achievement of global environmental goals and sustainable development in all regions of the world.

Both the EU and Brazil have much to gain by cooperating in this type of initiative. Most of all, to establish a foothold in the geopolitical dispute with the United States to guarantee the use of AI for environmental protection.

References

AFRICAN DEVELOPMENT BANK. *Africa's AI Landscape*: Unlocking the Potential of Artificial Intelligence in Africa. Abidjan: African Development Bank, 2020.

BOSTROM, Nick. *Superintelligence:* Paths, Dangers, Strategies. Oxford: Oxford University Press, 2014.

BRAND24. *Brand Monitoring and Social Listening Tool*. Breslávia: Brand24, 2024. Disponível em: https://brand24.com/. Acesso em: 26 jul. 2024.

CESAR, E.; ALMEIDA, R.; SILVA, T. Desafios na implementação da Inteligência Artificial no Brasil: infraestrutura e capacitação técnica. *Revista Brasileira de Tecnologia e Sustentabilidade*, São Paulo, v. 5, n. 3, p. 45-67, 2021.

COPERNICUS. *European Union's Earth Observation Programme*. Bruxelas: Comissão Europeia, 2024. Disponível em: https://www.copernicus.eu/en. Acesso em: 26 jul. 2024.

EUROPEAN COMMISSION. *Proposal for a Regulation of the European Parliament and of the Council on Artificial Intelligence (COM(2021) 202 final).* Bruxelas: Comissão Europeia, 2021.

EUROPEAN COMMISSION. *Climate Report Shows the Largest Annual Drop in EU Greenhouse Gas Emissions for Decades*. Bruxelas: Comissão Europeia, 2024. Disponível em: https://commission.europa.eu/news/climate-report-shows-largest-annual-drop-eu-greenhouse-gas-emissions-decades-2024-11-05_pt. Acesso em: 24 jan. 2025.

EUROPEAN ENVIRONMENT AGENCY. *Environmental Data Platform DataHub*. Copenhague: Agência Europeia do Ambiente, 2024. Disponível em: https://www.eea.europa.eu/en/datahub?size=n_10_n&filters%5B0%5D%5Bfield%5D=issued.date&filters%5B0%5D%5Btype%5D=any&filters%5B0%5D%5Bvalues%5D%5B0%5D=All%20time. Acesso em: 24 jan. 2025.

FLORIDI, Luciano. *The Ethics of Information*. Oxford: Oxford University Press, 2019.

GANASCIA, Jean-Gabriel. *Epistemology of Artificial Intelligence*. Londres: Routledge, 2010.

GLOBAL PARTNERSHIP ON ARTIFICIAL INTELLIGENCE. *GPAI Principles*. Paris: GPAI, 2021.

GOOGLE EARTH ENGINE. *A Planetary-Scale Platform for Earth Science Data & Analysis*. Mountain View: Google, 2024. Disponível em: https://earthengine.google.com/. Acesso em: 26 jul. 2024.

HORIZON 2020. *Water-IF Project:* AI for Sustainable Water Management. Bruxelas: Comissão Europeia, 2024. Disponível em: https://www.h2020.net/. Acesso em: 24 jan. 2025.

HORIZON MAGAZINE – EUROPEAN COMMISSION. *Researchers combine citizens' help and cutting-edge tech to track biodiversity*. Bruxelas: Comissão Europeia, 2024. Disponível em: https://www.biodiversity.europa.eu/. Acesso em: 16 jan. 2025.

ISRO BHUVAN. *Indian Geo-Platform of ISRO*. Bengaluru: Organização Indiana de Pesquisa Espacial, 2024. Disponível em: https://bhuvan.nrsc.gov.in/. Acesso em: 26 jul. 2024.

MICROSOFT. *Air Quality Index*: AI-driven pollution forecasting. Redmond: Microsoft, 2024. Disponível em: https://www.microsoft.com/en-us/sustainability. Acesso em: 24 jan. 2025.

MITTELSTADT, Brent *et al*. The Ethics of Artificial Intelligence. *Nature*, Londres, v. 587, n. 7838, p. 38-45, Nov. 2019.

MUEHLENBACH, K. *et al*. Machine learning for forest fire risk prediction: a case study in Mediterranean Europe. *International Journal of Wildland Fire*, Collingwood, v. 30, n. 7, p. 644-655, jul. 2021.

NASA. *Crops in space:* AI for agricultural monitoring. Washington, D.C.: NASA, 2024. Disponível em: https://earthdata.nasa.gov/. Acesso em: 24 jan. 2025.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD). *AI and the Environment*: Supporting Sustainable Development. Paris: OECD Publishing, 2021.

PLANET LABS. *Daily satellite imagery and insights*. São Francisco: Planet Labs, 2024. Disponível em: https://www.planet.com/. Acesso em: 26 jul. 2024.

SAVIN, Adrian. The ethics of Artificial Intelligence. *The Journal of Artificial Intelligence Research*, Ann Arbor, v. 68, n. 1, p. 443-518, jan. 2020.

UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (UNESCO). *The UNESCO Framework for Ethical AI*. Paris: UNESCO, 2021.

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC). *The Paris Agreement*. Bonn: UNFCCC Secretariat, 2015.

Environmental regulation strategies as a basis for the agricultural trade agreement between the European Union and Mercosur

José Neto Cassiano de Camargo
Karla Emmanuela Ribeiro Hora

Abstract: The context of global climate change has led to changes in trade strategies between different economic blocs, as can be seen in the proposed trade agreement between the European Union (EU) and Mercosur, based on the inclusion of environmental provisions. Although structured differently, environmental clauses open new possibilities for regulatory changes between the countries involved. In view of this, this text, based on a bibliographic review and documentary research, aims to reflect on how environmental regulatory provisions adopted by the European Union, with the purpose of protecting ecosystems, fit into international trade negotiations. With emphasis on trade in agricultural products and their possible consequences for Brazil. The results indicate that, despite distinct economic and social structures, environmental provisions open the possibility for the inclusion of new actors in the negotiations, as well as for the enhancement of existing environmental monitoring devices for protected areas in Brazil.

Keywords: commodities; agriculture; protected areas; environment; climate change.

Introduction

The global climate change scenario has led to the development of different strategies to contain the increase in average global temperatures and its consequences. In addition to greenhouse gas emissions resulting from the use of fossil fuels, deforestation for the expansion of agricultural

https://doi.org/10.36311/2025.978-65-5954-580-3.p29-40

areas has proven to be a major contributor (Coelho *et al.,* 2024). Due to the environmental impacts resulting from agricultural production processes, new commercial demands have emerged on the global scene that seek to protect and conserve natural ecosystems (Lima; Matias, 2023).

Given that international trade is essential for the economic and social development of many countries, new trade agreements seek to include clauses that guarantee the traceability of agricultural production and, thus, prevent the commercialization of products originating from deforested areas. The essential purpose of trade agreements is to reduce customs barriers, although labor, the environment, energy, technology, human rights and climate change aspects are also considered (Thorstensen et al., 2014). In this context, the proposal for a free trade agreement between the European Union (EU) and Mercosur (ME) blocs is noteworthy. The negotiations for this agreement began in the 1990s and were only completed in 2024, but to date there is no forecast for its entry into force (Brasil, 2024).

The trade volume between the two blocs is already robust, given that in 2023, exports from Mercosur to Europe reached US$ 66.792 billion. Brazil alone accounts for around 81% of these transactions, with agricultural commodities being the main items, while the remainder of the trade is conducted by the bloc's other active members; Argentina, Uruguay and Paraguay (ECLAC, 2024). Among the various importers of Brazilian products, the EU was the destination of approximately 13% of all goods exported by the national agribusiness in 2023. Hence, the EU consolidated its position as the second biggest destination for Brazilian agricultural products, after China. Belgium alone accounted for 31% of Brazil's orange juice exports, Germany for 13% of its coffee and Spain 10% of national fruits (Cepea, 2024).

As noted, inter-bloc trade is considerable and will likely increase after ratification of the agreement. It is therefore important to anticipate its likely impacts, which may be ample and generate unwanted or unforeseen consequences. The adoption of specific environmental regulations with protective effects can be effective and in the interest of society, because

they prevent ecosystems from being degraded under the justification of serving the new open consumer market (Lima; Matias, 2023).

In this sense, the EU has been approving innovative environmental legislation in recent years, with the purpose of contributing to the preservation of nature and improving the population's quality of life. This can be seen in regulations aimed at generating extraterritorial effects and that can serve as a model and inspiration for other countries (Moura et al., 2023). Likewise, Brazil is also seeking to move to create regulations with the aim of promoting sustainable development and meeting external demands.

As such, the objective of this text is to reflect on the impacts of environmental regulatory devices adopted by the EU, which are part of international trade negotiations. The emphasis is on trade in agricultural products covered by the EU-Mercosur agreement and its possible implications for Brazil.

Methodology

The study's methodological design consists of a literature review and documentary research, based on a compilation of data on the characteristics of international trade. The focus is on the EU's environmental legislation aimed at agricultural trade and its implications on the protection of strategic areas in the global south. To this end, the authors have employed the exploratory method (Gil, 2022), looking to identify the mechanisms of environmental regulation, their implications and potential for the protection of sensitive ecosystems. First, the relevant legislation is identified, then compared with the design of the EU-Mercosur agreement, and realigned with the possibilities of environmental protection provided by the Brazilian Forest Code.

For Sousa *et al.* (2021), bibliographic research provides a possibility to study and learn from preexisting texts by other authors on a given topic. A critical analysis of these publications makes it possible to find new interpretations and impressions on the subject under study, considering

its most relevant and current aspects. As such, the literature review allows for a synthesis of different texts and ideas, with a clear focus on the particularities raised by the reviewers.

Results and Discussion

Inclusion of Brazilian agribusiness in the Mercosur-European Union Agreement

The Brazilian agricultural market stands out on the international scene due to its high level of productive efficiency and technological sophistication. The modernization of Brazil's agriculture occurred mainly in the second half of the 20th century. It not only significantly increased agricultural production each year, but has changed the national agrarian space, consolidating large properties as the standard production model, with access to credit, technology and technical assistance. This enabled the country to become an important global player in food production (Monteiro Neto *et al.,* 2017), albeit at a significant socio-environmental cost.

The importance of Brazilian agriculture is even more evident when we consider that Brazil is the world's third largest food producer, in addition to being the leader in exports of the following agricultural products: coffee, beef, orange juice, sugar, and ethanol (Embrapa, 2023). In 2023, Brazil's agribusiness accounted for 48.6% of all exports, an essential part of the national trade balance. At the same time, it represented 6.8% of all imports (Ferreira; Souza Júnior, 2024).

In the 1990s, against the background of changing global geopolitics and the possibility of expanding consumer markets and new trade agreements, the possibility of creating a preferential trade agreement between Mercosur and the European Union arose (Nonnenberg; Ribeiro, 2019). It is important to note that an agreement between the two blocs implies the integration of a market with around 700 million inhabitants

and almost 25% of global GDP, and with more than US$ 90 billion in bilateral trade in goods and services (Brazil, 2019).

Debates regarding this trade agreement are complex, as they involve two very different blocs. While Mercosur is made up of four active full members, the EU consists of 27 countries. The fact that each country has its own national interests makes it difficult to finalize the agreement, given that approval and ratification by all member states of both blocs is a precondition (Abreu; Florêncio, 2015; Costa, 2017).

According to Silva et al. (2019), during the more than 20 years of negotiations the agricultural sector occupied a central space. The talks were complex, and over time Mercosur made several concessions, notably a reduction of import tariffs on European industrialized products, with the intention of obtaining reciprocity for South American agricultural produce. However, resistance from EU representatives persists. Their opposition to the import of agricultural products from Mercosur reveals concerns about the competitiveness and survival of European producers, especially small and medium-sized producers in countries with strong economies like France.

In an effort to protect their respective agricultural markets, the two blocs foresee the implementation of import quotas within the agreement's framework, meaning that the flow will not be fully liberalized. This can be observed for items like pork, which is set to have a quota of 25 thousand tons, with a specific tariff of €83/ton for entry into the EU, whereas in 2023 the tariff was €536/ton. In the case of Mercosur, 30,000 tons of cheese will be allowed to enter with a progressive tariff reduction, with differentiated tarriffs above mentioned quota. It is worth noting that these quotas are to be divided between member states (Nonnenberg; Ribeiro, 2019).

Since Brazil is the member with the greatest economic and territorial expression within Mercosur, the effects of the agreement will be most noticeable in that country. Especially with the increase in its exports based on the primary sector, which could show a significant growth of 76%. Therefore, if it comes into force, the agreement will have the capacity to change the Brazilian economic structure, with the further strengthening of part of the agricultural sector (Megiato *et al.*, 2016).

European and Brazilian legislation aimed at environmental preservation.

To access new markets and consolidate those already accessible, Brazil must present the best sustainable production standards, in addition to providing products with good sanitary quality. Offering consumer markets grains, vegetables, fruits and proteins whose production process respects the health of the planet and of society as a whole is increasingly important. Consequently, complying with the regulatory framework of export destinations is essential, as these rules can affect the trade flows between different countries (Domene *et al.*, 2023; Moura, 2023).

According to Lima and Matias (2023), the application of laws that aim to protect ecosystems is a challenge. In this sense, the European Union is a pioneer, since it has adopted a legal framework capable of interfering not only in its own jurisdiction but, based on the extent of its foreign trade, is also able to foster environmental recovery and conservation in third countries. Therefore, the agreement with Mercosur involved several environmental dimensions (Brasil, 2024).

Thorstensen *et al.* (2022) consider that the EU's ability to establish and lead the international debate on trade and the environment is due to its leadership and its public commitments. The anti-deforestation law 2023/1115 is a good example of this, in which the EU established standards and requirements for the import of some products, such as soybeans, beef, timber and coffee, which, in order to enter the European market, must come from areas with zero deforestation. This legislation also prevents the entry of products from places where deforestation is authorized by the domestic legislation of the exporting countries. This measure stems from the perception that some countries have low production transparency and modest engagement with environmental protection, thus imposing the use of more restrictive rules (Nonnemberg *et al.*, 2024).

Being subject to the consequences of climate change itself, the EU's actions follow local and global interests to foster international cooperation in reducing and mitigating its effects. It is within this scope that the Anti-

Deforestation Regulation 2023/1115, which strengthens environmental protection and encourages sustainable production, came into being. That being said, such legislation is the target of several objections and could undergo amendments. Even more so in the context of international trade, which seeks to reconcile the various interests involved, and relies on means of retaliation and protectionism that can generate more instability and increases in international prices (Moura *et al.,* 2023).

Regulation 2024/1991, which deals with nature restoration, is another regulation that reinforces the European Union's environmental concern. It was approved in 2024 for the territories under its jurisdiction and aims to restore 20% of all land and sea areas by 2030. By 2050, the goal is for all degraded ecosystems to have undergone restoration processes. This will be done by planting trees, regenerating rivers, and increasing pollinating insects, among others. In a context in which 80% of European habitats are in a state of degradation, it is estimated that for every euro invested, 38 euros are returned in ecosystem benefits, such as improvements in soil, water and air quality (European Commission, 2024).

In the case of the Nature Restoration Act, its direct impact on non-EU countries is limited, but it can serve as an example and a path for several other nations. According to Thorstensen *et al.* (2022), this type of regulation may be able to reposition the entire bloc in international trade, given that it requires international partners to adopt similar conservation measures. Finally, environmental issues are raised across the board, being present in all projects undertaken by the European Union.

In the Brazilian case, a comparative reflection would be the active performance of the Rural Environmental Registry (CAR), derived from the Forest Code, Law No. 12,651 of May 25, 2012. Through the monitoring of areas and data registered in the CAR, various agricultural supply chains will be able to certify the origin of their goods and ensure that their production processes are in accordance with the demands of importing markets. Thus, with periodic updates, the CAR could become a strategic tool for effective commercial exchanges, acting as a guarantor of environmental conservation, the traceability of goods, in addition to adding value to national agricultural output (Weid; Amorim, 2023).

The Brazilian forestry code has other mechanisms for the conservation of national ecosystems. The legal reserve (RL), for example, consists of allocating a percentage of the area of rural properties, varying between 20% and 80% depending on the biome, to the conservation of native vegetation and sustainable economic use. In addition, another legal provision concerns permanent preservation areas (APPs), the purpose of which is to guarantee protection for specific regions, such as riverbanks, springs, mangroves, and others. It is clear that Brazil, like the EU, has sought to implement regulatory measures with a view to protecting its natural biomes (Brazil, 2012).

Additionally, the creation of consistent environmental recovery programs based on tactical actions, such as the promotion of conservation strategies in biomes like the Amazon and the Cerrado, with the reduction of agrarian conflicts in Protected Lands and the remediation of degraded pasture areas, may be interesting for strengthening environmental measures linked to trade exchanges (Coelho *et al.,* 2024). However, for such sustainability to materialize, non-hegemonic actors in trade negotiations like Traditional Peoples and Communities and Family Farming should be included. Although this would result in longer negotiation times, it has the potential to yield qualitative climate gains for nation states (Middeldorp, 2021). Even more so when considering that the territories under the management of such communities have larger areas of protected vegetation than more settled regions.

Conclusions

It is important to keep in mind that international trade agreements are strategies for reserving market share between the parties. They can, on the one hand, boost the local economy whilst, on the other, create barriers to development or exacerbate social exclusion. Furthermore, factors like food security and the protection of traditional means of production in each country also have to be taken into consideration, which is why the Brazilian agricultural sector is prominently present in these types of negotiations.

On the international stage, the EU has been consolidating its position as a leader in environmental issues by enacting innovative legislation, such as regulations 2023/1115 and 2024/1991. These regulatory frameworks are capable of inducing changes outside the EU jurisdiction proper. By including environmental requirements in the international trade sphere the EU exercises soft power, which helps other nations find their own alternatives and solutions to issues regarding environmental protection. Thus, with the entry into force of the Mercosur-EU agreement, environmental concerns are likely to come to the forefront, either due to the volume of the trade flows or their aggregate value.

The Mercosur-European Union agreement could open up several opportunities for trade. Despite this, preventing the increase in deforestation to meet new business opportunities is essential. Furthermore, the agreement could favor and cover strategic areas of activity beyond the production of agricultural commodities, such as speeding up the regularization of protected territories in compliance with ILO 169. Therefore, by looking at the EU's normative acts, following its regulatory and monitoring mechanisms, as well as its operational developments, it is possible to stimulate the adoption of environmental innovations in production systems, with a focus on energy efficiency, water resource management, genetic improvements, and environmental protection of strategic territories.

In a scenario of acute climate change, the coming years will be challenging for international trade between the two blocs. There is an urgency to adapt to new international requirements, search for sustainable production practices and to open a dialogue with other segments of society.

References

ABREU, S.; FLORÊNCIO, L. *Trajetória do Mercosul e mudança de paradigmas e de posições da política externa brasileira:* começo virtuoso e crise recente – possíveis interpretações. Brasília, DF: Instituto de Pesquisa Econômica Aplicada, 2015. (Texto para discussão).

BRASIL. *Lei nº 12.651, de 25 de maio de 2012*. Dispõe sobre a proteção da vegetação nativa. Brasília, DF, 2012. Disponível em: https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm. Acesso: 31 dez. 2024.

BRASIL. *Acordo de associação Mercosul-união europeia.* Resumo informativo elaborado pelo governo brasileiro. Brasília, DF, 2019. Disponível em: https://www.gov.br/mre/pt-br/media/2019-10-24-resumo-acordo-mercosul-ue-cgnce.pdf Acesso em: 2 jan. 2025.

BRASIL. Ministério da Agricultura e Pecuária. *Perguntas e respostas* - Acordo de Parceria MERCOSUL-União Europeia. Disponível: https://www.gov.br/agricultura/pt-br/assuntos/noticias/anuncio-da-conclusao-das-negociacoes-do-acordo-de-parceria-entre-o-mercosul-e-a-uniao-europeia/copy_of_PerguntaserespostasMERCOSULUE.pdf. Acesso em: 12 dez. 2024.

COMISIÓN ECONÓMICA PARA AMÉRICA LATINA Y EL CARIBE (CEPAL). Oportunidades y desafíos para la integración regional en un escenario de fragmentación mundial. *Boletín de Comercio Exterior del MERCOSUR*, Santiago, n. 7, p. p. 9-52, 2024.

CENTRO DE ESTUDOS AVANÇADOS EM ECONOMIA APLICADA (CEPEA). Índices exportação do agronegócio de janeiro a dezembro de 2023. Piracicaba: ESALQ/USP, 2024.

COELHO, C. A. W. *et al. Mudança do clima no Brasil:* síntese atualizada e perspectivas para decisões estratégicas. Brasília, DF: Ministério da Ciência, Tecnologia e Inovação, 2024.

COMISSÃO EUROPEIA. *Nature Restoration Law*. Bruxelas: Comissão Europeia, 2024. Disponível em: https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-law_en. Acesso em: 26 dez. 2024.

COSTA, O. *A União Europeia e sua política exterior*. Brasília, DF: FUNAG, 2017.

DOMENE, S. M. A. *et al. Segurança alimentar:* reflexões sobre um problema complexo. Estudos avançados,São Paulo, v. 37, n. 109, p. 181-206, set./dez. 2023. DOI: 10.1590/s0103-4014.2023.37109.012. Disponível em: https://www.scielo.br/j/ea/a/fWcBkcLhN577MztGLnddSDn/?format=pdf&lang=pt. Acesso em: 20 mar. 2024.

EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA *(*EMBRAPA). *Brasil em 50 alimentos*. Brasília, DF: Embrapa, 2023.

FERREIRA, D.; SOUZA JÚNIOR, J. R. C. *Comércio exterior do agronegócio em 2023*. Rio de Janeiro: Ipea, 2024. (Carta de Conjuntura nº 62, 1˚ trimestre).

GIL, A. C. Como *elaborar projetos de pesquis*a. São Paulo: Editora atlas, 2002.

LIMA, M. C G. V.; MATIAS, J. L. N. Os efeitos extraterritoriais do regulamento antidesmatamento da união europeia no brasil. *Revista CEJ*, Brasília, DF, Ano XXVII, n. 85, p. 47-54, jan./jul. 2023.

MEGIATO, E. I.; MASSUQUETTI, A.; AZEVEDO, A. F. Z. Impacts of integration of Brazil with the European Union through a general equilibrium model. *Economia,* Bingley, v. 17, n. 1, p.126–140, Jan./Apr. 2016. DOI: 10.1016/j.econ.2015.10.001. Disponível em: https://www.sciencedirect.com/science/article/pii/S1517758015000429. Acesso em: 12 dez. 2024.

MIDDELDORP, N. *O Acordo Comercial UE-Mercosul*: uma análise crítica e uma alternativa. Amsterdã: Ed. Handel Anders, 2021. p. 4-42.

MONTEIRO NETO, A.; CASTRO, C. N.; BRANDÃO, C. A. *Desenvolvimento regional no Brasil*: políticas, estratégias e perspectivas. Rio de Janeiro: Ipea, 2017.

MOURA, A. B.; LERIN, C.; SANTOS, B. M. Impactos extraterritoriais do regulamento (eu) 2023/1115: a proibição da comercialização de matérias primas e produtos associados ao desmatamento e à degradação florestal. *Revista de Ciências do Estado*, Belo Horizonte, v. 8, n. 2, p. 1-30, 2023. DOI:10.35699/2525-8036.2023.48034. Disponível em: https://periodicos.ufmg.br/index.php/revice/article/view/e48034/e48034. Acesso em: 12 dez. 2024.

MOURA, A. M. M. Integração entre as políticas ambiental e agrícola no brasil. *In:* VIEIRA FILHO, J. E. R.; GASQUES, J. G. *Agropecuária Brasileira:* evolução, resiliência e oportunidades. Rio de Janeiro: Instituto de Pesquisa Econômica Aplicada (Ipea), 2023. p. 219-243.

NONNENBERG, M. J. B.; RIBEIRO, F. J. *Análise preliminar do acordo Mercosul-União Europeia*. Rio de Janeiro: Ipea, 2019. (Carta de Conjuntura nº 44, 3˚ trimestre).

NONNENBERG, M. J. B.; MARTINS, M. M. V.; CECHIN, A.; VIANNA, R. S.; CRUZ, C. C. P.; SILVA, F. A.; BISPO, S. Q. A.; SANTOS, F. E. L. A. *Efeitos da lei europeia contra desmatamento sobre as exportações brasileiras*. Rio de Janeiro: Ipea, 2024. (Texto para discussão 3016).

SILVA, R. R. M.; SILVA, R. D.; FERREIRA, F. R. O agronegócio brasileiro e as negociações Mercosul-União Europeia. *Revista Carta Inter*., Belo Horizonte, v. 14, n. 3, p. 5-32, nov. 2019. DOI: 10.21530/ci.v14n3.2019.940. Disponível em: https://www.cartainternacional.abri.org.br/Carta/article/view/940/734. Acesso em: 12 dez. 2024.

SOUSA, A. S.; OLIVEIRA, G. S.; ALVES, L. H. A pesquisa bibliográfica: princípios e fundamentos. *Cadernos da Fucamp*, Monte Carmelo, v. 20, n. 43, p. 64-83, mar. 2021.

THORSTENSEN, V.; BANDIN, R. M. S.; MÜLLER, C.; ELEOTÉRIO, B. *Acordos preferenciais de comércio:* da multiplicação de novas regras aos mega-acordos comerciais. São Paulo: FGV-EESP, 2014.

THORSTENSEN, V.; MOTA, C. R.; ARIMA JÚNIOR, M. K.; THOMAZELLA, F. J. T.; ZUCHIERI, A. M. *Vanguardismo ambiental e protecionismo comercial na União Europeia e nos Estados Unidos*. Rio de Janeiro: Ipea, 2022. (Texto para discussão 2724).

WEID, C. V. D.; AMORIM, D. I. M. O cadastro ambiental rural [car] como ferramenta de política comercial e acesso a mercados. *Sinergia*, Rio Grande, v. 27, n. 1, p. 51-66, jan./jun. 2023. DOI:10.17648/2236-7608-v27n1-14073. Disponível em: https://periodicos.furg.br/sinergia/article/view/14073/10183. Acesso em: 12 dez. 2024.

Climate governance in perspective:
a comparison between brazilian and spanish climate adaptation and mitigation policies

Diego Tarley Ferreira Nascimento
Javier Martín-Vide

Abstract: This study features a comparative analysis between Brazilian and Spanish climate adaptation and mitigation policies, with the aim of identifying Spanish best practices that may strengthen Brazilian climate governance. To this end, a survey, review and a critical analysis of legislation, strategies and programs related to the topic was conducted, covering the national, regional and local levels in both countries. In the Spanish case, the documentary analysis at the regional scale was focused on the Autonomous Community of Catalonia and the Metropolitan Area of Barcelona, with the city of Barcelona itself as local scale. On the Brazilian side, the research was conducted in the state of Goiás regionally and the municipality of its capital Goiânia locally. Based on the analysis, the progress and challenges present in both countries are highlighted, offering reflections on how Brazil could incorporate lessons learned from the Spanish experience to adapt and improve its legal and institutional structures. Finally, possible strategies for climate governance in Brazil are outlined, such as integrating administrative levels, ensuring climate finance, strengthening local governance, promoting climate justice, and a sustainable and inclusive energy transition.

Keywords: climate change; public policies; climate resilience

Introduction

Evidence of climate change is widely observed on a global scale, manifesting itself through increased average temperatures, warming and rising sea levels, reduced polar ice sheets, the migration of tropical disease

https://doi.org/10.36311/2025.978-65-5954-580-3.p41-53

vectors and an increase in the frequency and intensity of extreme weather events in all regions of the planet (IPCC, 2021). These phenomena not only alter the climate system and cause environmental impacts, but also significantly affect key sectors like food and energy production, as well as water availability (Hoff, 2011; Mariani *et al.*, 2016). There is an increasing pressure on natural resources, exacerbating conflicts in various regions of the world and intensifying the migratory flows of so-called "climate refugees" (Hartmann, 2010; Biermann; Boas, 2010). The economic impacts of climate change are also notable, especially those associated with extreme events like floods, droughts, storms and heat waves, which result in significant material losses and increase reconstruction and recovery costs (Cassol; Bohner, 2012). In addition, the compromised climate affects the well-being and health of the population, in particular vulnerable groups, such as the elderly, children and the chronically ill, especially during heat and cold waves (Clayton, 2020; Masselot *et al.,* 2023; Romanello *et al.* 2024).

According to the Intergovernmental Panel on Climate Change (IPCC, 2021), climate change is widespread, accelerated and without historical precedent. Scientific literature points to the unquestionable anthropogenic influence on climate change on the planet (Cook *et al.,* 2013), including a possible point of no return (Lenton *et al.*, 2019; Armstrong Mckay *et al.*, 2022).

The IPCC (2022a, 2022b) highlights that there are viable options for reducing greenhouse gas emissions (mitigation) and minimizing climate impacts (adaptation), which involve energy efficiency, urban green infrastructure, waste management and sustainable management of forests, plantations and pastures. Other authors advocate degrowth, i.e. the reduction of resource consumption (Turiel, 2020). Thus, in view of the emergency of the climate crisis (Artaxo, 2020; Ripple, 2020, 2024), climate resilient development currently requires political governance. Political governance plays a fundamental role in establishing effective guidelines and actions to address the climate crisis (IPCC, 2022b). However, such governance must be adapted to national and local contexts, and promote the participation of civil society and the private sector. In addition, it needs international funding and cooperation (Taks, 2019). In this context,

this chapter presents a comparative analysis between climate governance policies and strategies in Brazil and Spain, considering that both countries are signatories to international treaties and are committed to reducing the effects of climate change. The objective is to identify common advances and challenges, as well as Spanish best practices that can strengthen Brazilian climate governance, with a focus on the national, regional and local levels.

The methodology includes a documentary review and content analysis, supported by a literature review for critical analysis. The laws, programs and plans related to climate change were compiled from official sources in both Spain and Brazil. In Spain, the regional analysis focused on Catalonia and the Barcelona Metropolitan Area, and locally on the city of Barcelona. In Brazil, the regional level consisted of the state of Goiás and, locally, the municipality of its capital Goiânia.

After this contextualization, the text is organized into three main topics. The first presents an overview of climate policies in Spain and Brazil, including their history, scope and strategies. The second provides a comparative analysis of the relevant legislation in both countries. Finally, the third provides insights to strengthen Brazilian climate governance, based on the Spanish experience.

Spanish and Brazilian policies to combat climate change

In Spain, the 2006 National Climate Adaptation Plan (PNACC) was milestone in the coordination between different levels of government. It assesses impacts, vulnerabilities and adaptation and mitigation strategies for climate change. The plan established clear goals to achieve carbon neutrality by 2050, prioritizing strategic sectors such as water resources, biodiversity, health, agriculture and urban planning. In addition, the PNACC promoted the integration of these actions into regional and local policies, offering a comprehensive climate governance model. In 2021, the plan was updated for the period of 2021 to 2030, expanding its initial scope by adding principles of social equity, evidence-based science, integration in sectoral plans, as well as the mobilization of public and private actors.

The PNACC is in line with international commitments, notably the Paris Agreement and European Union (EU) policies like the European Climate Adaptation Strategy, the European Green Deal and the Sustainable Finance Action Plan. Furthermore, the implementation of local actions was driven by EU funding, in particular the Next Generation EU program, which enabled infrastructure works, expansion of green areas and water resource management.

At the regional level, the Catalan Climate Change Law of 2017 stands out. It established guidelines to reduce greenhouse gas (GHG) emissions by 40% by 2030 and promote the transition to a net-zero economy. This law was drafted through a process of civil participation, testament to a commitment to social inclusion. A relevant mechanism of this legislation is the Climate Fund, which directs resources from environmental taxes to climate mitigation and adaptation projects. Complementing these initiatives, the Catalan Energy Institute developed the National Pact for the Energy Transition of Catalonia, which seeks to achieve a 100% renewable energy matrix by 2050, prioritizing energy efficiency, decentralized energy and civil empowerment.

At the local level, Barcelona stands out for its pioneering actions. The city has been implementing mitigation measures since the late 1990s, such as the Solar and Thermal Energy Regulation (1999), the Energy Efficiency Plan (2002), the Photovoltaic Energy Regulation (2011) and the Barcelona Energy, Climate Change and Air Quality Plan (2011-2020). Barcelona is also a signatory to the Pacto de Alcades (Covenant of Mayors), committed to exceeding European emission reduction targets.

At the COP21 (2015), where the Paris Agreement was signed, the Barcelona Climate Commitment (2015-2017) was presented, consolidating Barcelona as a pioneer in joining forces to mitigate and adapt to climate change in an equitable and participatory manner. As a result, the Barcelona Climate Plan (2018-2030) was established. It included ambitious targets of reducing emissions by 45% by 2030 and achieving climate neutrality by 2050, through integrated actions in mitigation, adaptation, climate justice and participatory governance. More recently, Barcelona has made even more ambitious climate commitments, stemming from the 2021 Climate

Emergency Action Plan and the 2024 Barcelona City Climate Agreement, all of which call for action in the face of the climate emergency.

By incorporating nature-based solutions, such as green roofs and greenways, ecological corridors and infiltration gardens, Barcelona is becoming a global benchmark in sustainability. An iconic urban adaptation strategy in Barcelona refers to climate shelters. Little known in Ibero-American cities, climate shelters comprise spaces (open or closed), properly signposted, where the population can take shelter from high temperatures during the summer and low temperatures during the winter, with access to water and a place to rest (Martín-Vide; Moreno Garcia, 2024). In Spain, the city of Barcelona was a pioneer in implementing a climate shelter network, with currently over 350 spaces. Another interesting adaptation measure in Barcelona is a network with more than 100 drinking water fountains for the population. In addition, it is worth mentioning the iconic urbanistic project of superblocks. This is recognized by the United Nations Environment Program (UNEP) as an innovative example of combating climate change, since it ensures the expansion of green areas and the improvement of air quality, noise pollution and urban mobility, further consolidating Barcelona as a global reference in urban sustainability (Frago; Morcuende, 2024).

In Brazil, climate governance is guided by the National Policy on Climate Change (NPCC) of 2008. The NPCC made a commitment to reduce GHG emissions between 36.1% and 38.9% by 2020, established guidelines for environmental preservation, reducing deforestation in the Amazon by 80% and in the Cerrado by 40%, and has encouraged the creation of sectoral plans. One of the main instruments of the NPCC is the 2008 National Plan on Climate Change (NPCC), which emphasized integration between different spheres of government and laid the foundations for federal climate governance, as pointed out by Santos (2021).

Another instrument of the NPCC is the National Plan for Adaptation to Climate Change (PNA) launched in 2016. This plan expanded climate actions in the country by addressing specific sectors, such as water resources, health, agriculture, and cities, integrating principles of sustainable development and climate justice. Currently, both the NPCC

and the PNA are being updated. The new Climate Plan (2024-2035) provides for national mitigation and adaptation strategies, with sectoral plans and a cross-cutting approach that includes financing, a fair transition and monitoring. Furthermore, also in 2024, the Ministry of Environment and Climate Change (MECC) published Ordinance 1.256, offering technical and financial support for the preparation of Municipal Plans for Adaptation to Climate Change (AdaptaCidades), aimed at strengthening action at the local level.

Nevertheless, a review of climate policies and the current Federal Government's commitment to the issue (Vilani; Ferrante; Fearnside, 2023) led to the presentation in 2024, during COP29, of a new Nationally Determined Contribution (NDC), with bolder commitments for Brazil. It includes targets to eliminate illegal deforestation by 2028, reduce GHG emissions between 59% and 67% by 2035 and achieve carbon neutrality by 2050. Despite criticism related to the concept of net zero emissions (Bayrak; Marafa, 2016; Pajares, 2024; Smil, 2024), these targets represent a significant advance in tackling climate change, especially in light of the previous federal government' legacy, which involved the dismantling of organizations and the repeal of several environmental policies (Ripple *et al.,* 2016, 2021;).

At the regional level, the state of Goiás has a robust policy guided by Law 16.497/2009, which established the State Policy on Climate Change (PEMC), with principles and guidelines for climate mitigation and adaptive action. However, it was only in 2021 that the State Plan for Mitigation/Adaptation to Climate Change and Sustainability in Agriculture was established as a legal instrument to reduce GHG emissions. The Goiás Carbon Neutral Strategy, launched in 2023, set targets of 25% emission reduction by 2025 and 50% by 2030, and of neutralizing carbon emissions by 2050. To this end, programs such as REDD+ Goiás and PSA Cerrado em Pé have contributed to the implementation of regulatory, administrative, and financial structures for forest conservation and low-carbon rural development. Another recent initiative is the Goiás Resilient Program, launched in 2024, which aims to improve the technical and operational capacity of municipal civil defense organs, to ensure the

integration of calamity risk reduction policies, and to foster community participation and the adherence of local governments to the Federal Government's AdaptaCidades.

At the local level, Goiânia stands out for its Municipal Master Plan (PDM), launched in 2007 and updated in 2022. This is a planning and territorial organization instrument that incorporates guidelines for tackling climate change, encouraging sustainable practices and clean technologies. In 2011, the city also developed the Goiânia Sustainable Plan, within the scope of the Emerging and Sustainable Cities Platform of the Inter-American Development Bank (IDB). Additionally, the city has policies focused on urban mobility, sanitation, solid waste, and civil defense. More recently, the Goiânia Resiliente Report (Novaes; Ramalho, 2024) presented a diagnosis of the municipality's vulnerability and exposure, proposing guidelines to increase the municipality's climate resilience, including green infrastructure, water management, air pollution control and climate financing mechanisms.

Comparative analysis of Spanish and Brazilian legislation

Climate legislation in Spain is integrated and clear, with specific guidelines, whereas in Brazil it is fragmented, making implementation and integration between different levels of government difficult (Neves; Chang; Pierri, 2015). The National Policy on Climate Change (NPCC) faces challenges, such as a lack of command and control instruments, as well as the non-implementation of the Brazilian Emissions Reduction Market, which was only regulated in 2024.

Spain also stands out for the implementation of well-funded adaptation and mitigation programs, with a focus on nature-based solutions and citizen participation. In Brazil, the implementation of climate programs is hampered by a lack of resources and technical support (Setzer; Macedo; Rei, 2015). Despite some progress in cities like São Paulo and Rio de Janeiro (Martins; Ferreira, 2011; Di Giulio *et al.*, 2018), local climate governance needs to be strengthened, as emphasized by Jacobi

(2023). Local governments play a crucial role in implementing climate policies (Ryan, 2015), although they face limitations due to a lack of adequate funding, human resources and the short duration of political mandates (Leme, 2010).

In terms of mitigation strategies, Spain has adopted integrated actions that combine mitigation and adaptation, such as climate monitoring networks and coastal management. In Brazil, policies focus on combating deforestation and renewable energy, with few adaptation initiatives (Rodrigues, 2014; Chiquetto; Nolasco, 2024). Nonetheless, both countries face financial barriers and political resistance, in addition to a need for better intersectoral coordination.

Insight for strengthening Brazilian climate governance

The Spanish experience suggests that climate governance in Brazil should be improved through unified and integrated legislation across different levels of government, as proposed in the National Plan. Furthermore, it is essential to implement climate adaptation strategies, especially nature-based solutions as seen in Barcelona. Effectively implementing funding mechanisms for climate actions is also crucial, given that the National Fund on Climate Change still demonstrates an institutional weakness in mobilizing resources (Lopes; Albunquerque, 2023).

Brazil needs to strengthen its administrative structures and the technical and financial capacity of local governments in order to formulate preventive and reactive action plans in the face of climate emergencies. Of particular significance here are the initiatives of Goiás Resiliente (state) and AdaptaClima (federal). It is also vital to guarantee climate justice, in the sense of ensuring the participation of civil society in the formulation of climate policies. Moreover, it is necessary to invest in climate education so as to raise awareness about the impacts of climate change and about the need to adopt different habits (Rosa, 2021). Actions that reduce social and economic inequalities, and democratize access to resources which increase

the capacities of individuals and infrastructures should also be prioritized to build more resilient cities and communities (Ioris; Irigaray, Girard, 2014).

Conclusion

Climate governance in Brazil and Spain reflects the commitment of these two countries to mitigate and adapt to the impacts of climate change. Although both Brazil and Spain have made significant progress in climate policies, they face distinct challenges. Spain stands out for its integration with European Union guidelines and multiscalar governance, whereas Brazil faces the challenge of balancing ambitious goals with environmental preservation and the promotion of socioeconomic development. Local initiatives, such as those in Barcelona and Goiânia, show that cities have a vital role to play in building resilience and implementing innovative solutions for the climate crisis.

The aforementioned laws and plans reflect multiscalar approaches, integrating national, regional and local policies to address climate challenges. A comparative analysis of these initiatives offers valuable insights for improving Brazilian climate governance, inspired by Spanish best practices. Areas of interest include cooperation between different government levels, securing climate funding, strengthening local governance, promoting climate justice, as well as a sustainable and inclusive energy transition. Adopting innovative solutions and promoting a greater integration between administrative spheres are crucial steps to ensure a fair and resilient transition. Dialogue between nations should be encouraged to share experiences and address global climate challenges in a cooperative manner.

References

ARMSTRONG MCKAY, D. I. *et al.* Exceeding 1.5°C global warming could trigger multiple climate tipping points. *Science,* Washington, v. 377, n. 6611, p. 1171-1179, Sept. 2022.

ARTAXO, P. As três emergências que nossa sociedade enfrenta: saúde, biodiversidade e mudanças climáticas. *Estudos Avançados,* São Paulo, v. 34, n. ?, p. 53-66, out. 2020. Disponível em: https://www.revistas.usp.br/eav/article/view/178752. Acesso em: 26 jun. 2024.

BAYRAK, M. M.; MARAFA, L. M. Ten Years of REDD+*:* A Critical Review of the Impact of REDD+ on Forest-Dependent Communities. *Sustainability*, Basel, v. 8, n. 620, p. 1-22, Jul. 2016.

BIERMANN, F.; BOAS, I. Preparing for a warmer world: towards a global governance system to protect climate refugees. *Global Environmental Politics*, [*S. l.*], v. 10, n. 1, p. 60-88, Feb. 2010.

CASSOL, P. B.; BOHNER, T. Os eventos climáticos e a sua indissociabilidade na saúde e na economia global. *Revista Eletrônica em Gestão, Educação e Tecnologia Ambiental*, Santa Maria, v. 5, n. 5, p. 653-657, out. 2012.

CHIQUETTO, J. B.; NOLASCO, M. A. Climate adaptation in Brazil: advancements and challenges. *Environmental science and policy*, Amsterdã, v. 161, n. 4, p. e103888, Nov. 2024.

CLAYTON, S. Climate anxiety: Psychological responses to climate change. *Journal of Anxiety Disorders*, Amsterdã, v. 74, n. 2, p. e102263, Aug. 2020.

COOK, J. *et al*. Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters*, Bristol, v. 8, n. 1, , p. 024024, May 2013.

DI GIULIO, G. M. *et al. Mainstreaming climate adaptation in the megacity of São Paul*o, Brazil. *Cities*, Amsterdã, v. 72, n. ?, p. 237–244, Jun. 2018.

FRAGO, L.; MORCUENDE, A. Urban planning paradoxes and sociospatial fragmentation*:* the superblock Barcelona case (2016-2023). *International journal of urban and regional research*, Oxford, v. 48, n. 6, p. 1055-1078, Nov. 2024.

JACOBI, P. R. Desafios da governança ambiental urbana face à emergência climática. *Cadernos de Pós-Graduação em Arquitetura e Urbanismo*, São Paulo, v. 23, n. 1, p. 9-20, jan./jun. 2023.

HARTMANN, B. Rethinking climate refugees and climate conflict: Rhetoric, reality and the politics of policy discourse. *Journal of International Development,* Chichester, v. 22, n. 2, p. 233-246, mar. 2010.

HOFF, H. Understanding the Nexus. *Background Paper for the Bonn 2011 Conference:* the water, energy and food security nexus. Stockholm: Stockholm Environment Institute, 2011.

IORIS, A.; IRIGARAY, C.; GIRARD, P. *Institutional responses to climate change:* opportunities and barriers for adaptation in the Pantanal and the Upper Paraguay River Basin. Climatic Change, Dordrecht, v. 127, n. 1, p.139-51, Mar. 2014.

IPCC. *Climate Change 2021:* The physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, NY, USA: Cambridge University Press, 2021,

IPCC. *Climate Change 2022:* Impacts, adaptation, and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, NY, USA: Cambridge University Press, 2022.

IPCC. *Climate Change 2022*: Mitigation of climate change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, NY, USA: Cambridge University Press, 2022.

LEME, T. N. Os municípios e a política nacional do meio ambiente. *Revista Planejamento e Políticas Públicas*, Brasília, DF, v. 35, n. 2, p. 25-52, jul./dez. 2010.

LOPES, A. C. C. G.; ALBUQUERQUE, A. A. de. Financiamento climático: eficácia institucional do Fundo Nacional sobre Mudança do Clima. *Revista de Administração Pública*, Rio de Janeiro, v. 57, n. 3, p. e2022-0318, maio/jun. 2023.

MARIANI, L.; GUARENGHI, M. M.; MITO, J. Y. L.; CAVALIERO, C. K. N.; GALVÃO, R. R. de A. Análise de oportunidades e desafios para o nexo água-energia. *Desenvolvimento e Meio ambiente*, Curitiba, v. 37, p. 9-30, 2016. Edição especial.

MARTINS, R. A.; FERREIRA, L. da C. *Climate change action at the city level:* tales from two megacities in Brazil. Management of Environmental Quality: An International Journal, Bingley, v. 22 n. 3, p. 344-357, Apr. 2011.

MARTIN-VIDE, J.; MORENO GARCIA, M. del C. Unas notas sobre la emergencia climática: ciudades y salud. *Geo UERJ*, Rio de Janeiro, v. ?, n. 46, p. e87631, nov. 2024.

MASSELOT, P. *et al. Excess mortality attributed to heat and cold:* a health impact assessment study in 854 cities in Europe. Lancet Planet Health, Amsterdã, v. 7, n. 4, p. 271-281, Apr. 2023.

NEVES, F. M.; CHANG, M.; PIERRI, N. As estratégias do enfrentamento das mudanças climáticas expressas nas políticas públicas federais do Brasil. *Desenvolvimento e meio ambiente*, Curitiba, v. 34, n. 1, p. 5-23, jan./jun. 2015.

NOVAES, P. da C.; RAMALHO, T. *Goiânia Resiliente:* mudanças climáticas, adaptação urbana e direitos humanos. Goiânia: Prefeitura Municipal de Goiânia; Secretaria Municipal de Direitos Humanos e Políticas Afirmativas, 2024. 58 p.

PAJARES, M. Bla-bla-bla. *El mito del capitalismo ecológico.* Valência*:* Rayo Verde, 2024.

RIPPLE, W. J. *et al. The 2024 state of the climate report:* Perilous times on planet Earth. BioScience, Special Report, p. p. 1-12, Jan. 2024.

RIPPLE, W. J. *et al*. World Scientists' Warning of a Climate Emergency. *BioScience*, Oxford, v. 70, n. 1, p. 8-12, Sept. 2020.

RIPPLE, W. J. *et al*. World Scientists' Warning of a Climate Emergency 2021. *BioScience*, Oxford, v. 71, n. 9, p. 894-898, Sept. 2021.

RODRIGUES, D. F. *A política brasileira de mudanças climáticas:* competição, cooperação e diversidade internacional. Fortaleza, Edições UFC, 2014.

ROMANELLO, M. *et al. The 2024 report of the Lancet Countdown on health and climate change:* facing record-breaking threats from delayed action. The Lancet, Londres, v. 404, n. 10465, p. 1847-1896, Nov. 2024.

ROSA, J. Comparing climate science misconceptions with worldview and cognitive reflection suggests poor understanding and motivated reasoning among undergraduates. *Journal of Geoscience Education*, Londres, v. 70, n. 4, p. 501-516, Oct. 2021.

RYAN, D. *From commitment to action:* a literature review on climate policy implementation at city level. Climatic Change, Londres, v. 131, n. 4, p. 519–529, Dez. 2015.

SANTOS, A. C. Política Nacional sobre Mudanças do Clima no Brasil: uma avaliação de instrumentos e de efetividade. Espaço Público: *Revista de políticas públicas da UFPE*, Recife, v. 6, n. 1, p. 1-25, jan./jun. 2021.

SETZER, J.; MACEDO, L. V.; REI, F. Combining local and transnational action in adaptation of climate policies in the city of São Paulo. *In*: JOHNSON, C.; TOLY, N.; SCHROEDER, H. (ed.). *The urban climate challenge*: Rethinking the role of cities in the global climate regime. New York: Routledge, 2015. Cap. 6, p. 101–118.

SMIL, V. *Halfway between Kyoto and 2050:* Zero Carbon Is a Highly Unlikely Outcome. Vancouver: Fraser Institute, 2024. 46 p.

TAKS, J. Transformaciones de la narrativa del cambio climático global en Uruguay. *Sociologias*, Porto Alegre, ano 21, n. 51, maio/ago. p. 102-123, 2019.

TURIEL, A. *Petrocalipsis*: crisis energética global y cómo (no) la solucionaremos. Barcelona*:* Alfabeto Editorial, 2020.

VILANI, R. M; FERRANTE, L.; FEARNSIDE, P. M. *The first acts of Brazil's new president:* Lula's new Amazon institutionality. Environmental Conservation, Cambridge, v. 50, n. 3, p. 148-151, Sept. 2023.

About the European Union's Deforestation Regulation:
Sustainability Policy or Economic Protectionism?

Filipe Prado Macedo da Silva

Abstract: This chapter reflects on the European Union's Deforestation Regulation (EUDR - 2023/1115). Scheduled to come into force at the end of 2024, but recently postponed to December 2025, its objective is to ensure that seven agricultural products and their derivatives – beef, cocoa, coffee, palm oil, rubber, soybeans and timber – imported, processed and consumed by the European Union (EU) shall not contribute to deforestation and forest degradation worldwide. In practice, the EUDR will monitor the "most critical" agricultural products, originating from third countries with a "high risk" of deforestation and forest degradation, such as Brazil. Thus, this regulation is part of the new green paradigm of the EU's sustainable strategies, institutionalized in the European Green Deal. The problem is that the EUDR raises ambiguities about its role in protecting the international environment versus its role in geopolitical disputes involving economic protectionism. Using official documents from the EU and environmental studies from multilateral organizations and Brazilian entities, in addition to speeches by European authorities, this chapter demonstrates that the EUDR is in fact more focused on environmental and sustainability concerns than on protectionism. Therefore, in the case of Brazil, it may help transform the international relations agenda and improve national tools to monitor and protect the country's forests.

Keywords: European green deal; deforestation; forest degradation; European Union; forests.

Introduction - an imminent climate emergency

A large part of environmental legislation drafted in the 21st century points to the same problem: greenhouse gas emissions are producing an

https://doi.org/10.36311/2025.978-65-5954-580-3.p55-66

unprecedented international climate emergency. According to a report by the World Meteorological Organization (WMO), greenhouse gas concentrations in the atmosphere reached a new record in 2023 (WMO, 2024b). The consequence of this persistent accumulation of greenhouse gases in the atmosphere is rising temperatures now and, inevitably, in the future. Forecasts presented at COP29 have indicated that 2024 is on track to be – the data have yet to be consolidated – the hottest year on record, temporarily exceeding the 1.5ºC limit of the Paris Climate Agreement (UNEP, 2024; WMO, 2024a, 2024b).

In this context of increasing average temperatures since 1980, a recent report by the Institute for Economics & Peace (IEP) revealed a tenfold increase in the frequency of natural disasters since the 1960s, rising from 39 global incidents in 1960 to 396 in 2019 (IEP, 2020; WMO, 2024a). Furthermore, the same IEP report (2020) noted an increase in the intensity of natural disasters between 1990 and 2019. During this period, 9,924 incidents were recorded worldwide, meaning that over the course of 29 years, an extreme weather event occurred every 25 hours. Around 71% of the climate emergencies between 1990 and 2019 were caused by floods and severe storms. According to the IEP (2020), such extreme climate threats expose around 80% of the world's population (in 141 countries) to economic and human losses.

In light of such a climate emergency, it is worth asking which economic sectors are responsible for global greenhouse gas emissions. Updated data from the United Nations Environment Programme (UNEP) show that four sectors are responsible for more than 60% of contamination, namely: the energy production sector (26%); transport (15%); industry (11%); and agriculture (11%) (UNEP, 2024). The first three sectors – energy, transport and industry – generate atmospheric contamination through the burning of fossil fuels. The agricultural sector, on the other hand, contributes to greenhouse gas emissions through deforestation and forest degradation, given that the burning of forest to submit areas to agricultural use intensifies the increase in atmospheric contamination.

This chapter will focus on deforestation and forest degradation. It is important to remember that forests are natural carbon reservoirs and

that, therefore, deforestation and degradation release the carbon stored in forest biomass into the atmosphere in the form of CO2. According to the Food and Agriculture Organization (FAO), the world loses around 10 million hectares of forest per year. Between 1990 and 2020, around 420 million hectares were deforested and degraded worldwide (FAO, 2021). This corresponds to 10% of the remaining forests in the world – an area equivalent to more than 100% of the EU's territorial extent and around 50% of Brazil's territory (FAO, 2021; Silva, 2024a).

Another serious problem resulting from deforestation and forest degradation is the loss of biodiversity, especially in so-called "primary" or "pristine" forests, that is, those that have never been deforested and have developed through natural processes, including natural regeneration. Therefore, primary forests are unique, heterogeneous and irreplaceable, housing around 80% of the Earth's biodiversity. In this case, Brazil is one of the three countries – along with Canada and Russia – that are home to the largest area of primary forests in the world (FAO, 2021). In the Brazilian case, the Amazon rainforest represents the largest primary forest area in the world (FAO, 2021; Silva, 2024b). Planted forests, on the other hand, have a different development in terms of biodiversity and have ecosystems different from primary forests. It is in this context of imminent climate emergency that the EU has stepped up its environmental concerns, implementing a new sustainability paradigm: the ambitious European Green Deal. Launched in December 2019, the European Green Deal aims to make Europe the first climate-neutral continent by 2050. As such, it acts as an institutional umbrella for the EU's various green public policy strategies and regulations. This includes the new EU Regulation 2023/1115 on "Products Not Associated with Deforestation" (EUDR). Thus, the EU does not hide its interest in being a protagonist in the preservation of forests worldwide and in being the "normative" leader in the international system for promoting the global ecological transition.

In the next section, we consider the purpose and functioning of the EUDR. We will assess whether it is likely to function as a new sustainability policy or as a tool for economic protectionism. Finally, we will suggest

some sustainable strategies that may improve Brazil's relations with the EU, while benefiting the economy and the environment on both sides.

The European Green Deal: EU Regulation 2023/1115

Several green policy strategies and regulations have already been approved, and others are in the legislative debate stage in the European Parliament, all of which can change the EU's environmental regulations in the coming years. These include EU Regulation 2023/1115 on "Products Not Associated" with Deforestation (EUDR), approved by the European Parliament in April 2023. It was initially expected to come into force at the end of 2024, but the European Parliament recently approved an extension to December 2025. This extension was due to requests from several global partners, including Brazil under the Lula government (Brazil, 2024). Additionally, some EU member states expressed concerns about their preparedness to comply with the new environmental legislation (European Union, 2024).

Although the EUDR is more recent, the first EU document with the intention of protecting forests worldwide dates back to 2019. A document titled "Stepping up EU action to protect forests worldwide" by the European Commission initiated the debate and formulation of the environmental regulation in all EU governance bodies, in addition to including European civil society in the discussions. In November 2021 the European Parliament published the first legislative proposal. The following year, in 2022, the proposal gained traction in the European legislature, being promptly approved by all legislative committees it passed through. It was at this point that environmentalists began to praise the European initiative, whereas international agribusinesses pointed to it as a protectionist attack.

In this scenario, how will the EUDR work? First, it is worth noting that its objective is to ensure that agricultural products imported and consumed by EU citizens do not contribute to deforestation and forest

degradation worldwide, thereby reducing greenhouse gas emissions and biodiversity loss (European Union, 2023). In practice, European operators and traders will have to carry out due diligence in traceability and geolocation, assessing the risk levels of their suppliers before placing fresh agricultural products on the EU market or exporting processed (agro-industrial) products. All 27 EU member states are to have authorities designated to monitor products entering (fresh) and leaving (processed) the EU.

However, will the EU monitor all products originating from agribusiness? According to the European Union (2023), in Annex I, only the "most critical" agricultural products shall be monitored, that is, those that are responsible for the largest share of deforestation and forest degradation driven by EU consumption. This decision was underpinned by a scientific study, which concluded that in particular seven products and their derivatives needed to be monitored in terms of production and consumption, being beef, cocoa, coffee, palm oil, rubber, soy and timber (see Table 1). It is important to highlight that the monitoring of these seven products and their derivatives includes those produced and processed within the EU, such as Irish cattle and Finnish timber.

Table 1 – Estimated Impact of EU Production and Consumption on Global Deforestation and Forest Degradation, for Selected Products, 2019-2030

Agricultural Products and their Derivatives	Participation of Annual Impact (%)	Estimative of Annual Impact (hectares)
Beef	5,0	12.400
Cocoa	7,5	18.600
Coffee	7,0	17.360
Palm oil	34,0	84.320
Rubber	3,4	8.432
Soy	32,8	81.344
Timber	8,6	21.328

Source: Pendrill, Persson, Godar and Kastner (2019); European Union (2023).

The EU's production and consumption of these seven agricultural products translates into an annual forest impact of 248,000 hectares between 2019 and 2030 (European Union, 2023). In the same sense, data from the World Wide Fund for Nature (WWF) indicate that EU imports are responsible for 16% of global deforestation (Deutsche Welle, 2024). Table 1 shows the high impact on deforestation and forest degradation of the production and consumption of, for example, palm oil (34%) and soy (33%). Meanwhile, the lowest environmental impact is that of rubber and its derivatives (3%). It is in fact based on these data that the EU will regulate the intensity of inspections per product and producing country. Most third countries will be classified as low risk or "no risk", meaning that they will be subject to little inspection.

Regardinge the intensity of inspections in high-risk cases, the level of inspections and audits will reach up to 9% of European operators/traders who purchase selected agricultural products from countries at high risk of deforestation and forest degradation. It is important to highlight that the attention of EU authorities will focus on five high-risk countries – Brazil, Argentina, Paraguay (in South America), Indonesia (in Asia) and Congo (in Africa) – i.e. the countries responsible for more than half of the deforestation attributed to agricultural and pastoral expansion worldwide. Moreover, in the Brazilian case there is an additional risk related to products produced or extracted from indigenous lands (Silva, 2024a, 2024b).

With reference to sanctions for European operators/traders in cases of violations, EU member states can apply different penalties, such as fines, confiscation of products and revenues obtained from irregular sales, and even the temporary prohibition of economic activities in EU territory. It is important to remember that the EUDR established a deadline for products not to be associated with deforestation: December 31, 2020. From that date onwards, forests cannot be cleared of degraded, especially for the production of the aforementioned seven critical agricultural products. This includes deforestation and natural degradation unrelated to human activities. Such areas should not be used for agricultural production, and steps are to be taken to restore and manage them sustainably.

Sustainability Policy or Economic Protectionism?

Faced with the imminent international climate emergency, we can rest assured that the EUDR has a strong environmental focus, representing a new sustainability policy aligned with the most diverse scientific studies and ecological data about the impact of agricultural production on the world's forests. In this context, the EU has been praised for its unprecedented initiative in combating deforestation and forest degradation by environmentalists and international non-governmental organizations, including in Brazil. However, the appraisal came with critical observations that the regulations should reach beyond the Amazon, covering Brazilian ecosystems like the Cerrado, the Caatinga, the Pantanal and the Pampa (Deutsche Welle, 2024; Silva, 2024a).

In general, the harshest criticism of the EUDR originated from the productive sectors and governments of the producing countries. In practice, what is at stake are the extra costs of traceability and geolocation of selected agricultural products, in addition to the limits indirectly imposed on agricultural expansion into new lands (for example, those previously covered by forests). Furthermore, they have claimed that the EUDR violates free trade agreements and create new non-tariff barriers to agricultural products from third countries, thus confirming its protectionist bias. In Brazil, rural associations, cooperatives and producers have said that the EU's environmental regulations will result in an average annual loss of US$ 15 billion in agricultural exports (Faverin, 2024).

However, the following four points affirm that the EUDR does not have a protectionist bias and will not block agricultural produce from third countries:

1. The argument that the EU will exceed its legal territorial limits and impose its new environmental legislation on other territories is mistaken (Silva, 2024a). In reality, the EU is legislating – with environmental improvements – what enters the borders of its 27 member countries (article 1) (European Union, 2023). This already occurs with products that are illegal or prohibited as

per European legislation. Furthermore, the EU's strictness in agricultural imports has been known since the 1990s mad cow disease. This means that the Brazilian cattle market, for instance, already has expertise in the traceability of exported herds and is able to adopt more sustainable practices;

2. The criticism that the EUDR violates the environmental laws of third countries – in the Brazilian case, the Forest Code – is incorrect, since Article 3 of the EUDR states that agricultural products inspected by the EU must have "been produced in accordance with the applicable legislation of the country of production" (European Union, 2023). In Brazil, the problem is that much of the deforestation in the Amazon, for example, is illegal (above the 20% threshold set by the Forest Code) and for the purpose of clearing pasture (90% for cattle). A similar example is soy farming, which has been systematically advancing towards the fringes of the Amazon rainforest in southern Pará. Hence, it is products that already violate the environmental law of the producing country which will be prevented from entering the EU consumer market;

3. It is incorrect to state that the new EU regulation will hinder or harm small agricultural producers. This is especially true because, in general, small farmers do not export directly to Europe, especially those of the seven mentioned products subject to scrutiny. For example, in the case of Brazilian coffee, small and medium-sized coffee growers are organized in cooperatives, such as Cooxupé (from Minas Gerais), to carry out international commercial operations. In this situation, the cooperatives have the technical and financial conditions to prepare the path for their members. Meanwhile, European micro-, small and medium-sized (SME) traders who sell the inspected products will have a longer preparation period (Article 38), as well as simplified due diligence and verifications (Article 19);

4. Finally, according to economic literature, protectionism occurs when a country, in order to protect its national production,

creates barriers for foreign imports or blocks them altogether (Krugman; Obstfeld; Melitz, 2015). This is not the case with the EU's environmental regulations, because with the exception of cattle and timber, all other agricultural products subject to inspection are not commercially produced by European agribusiness.

Conclusion: Sustainable Strategies

The EUDR appears to be an appropriate and necessary measure in current times. Third countries and producers like Brazil can take advantage of European legislation to push for changes in the international relations agenda (external strategy), and to improve internal command and control tools regarding forest management and sustainability (internal strategy). The fact is that forest destruction, at the current rate, is harmful to both exporting countries (e.g. Brazil, Indonesia and Ivory Coast) and importers (the 27 EU member states) of the seven agricultural products covered by the EUDR. Against this background, the short-term costs of a new sustainability policy are always lower than the long-term costs of an unprecedented climate emergency.

As for Brazilian foreign policy, a diplomatic strategy could be to negotiate with the EU a financial counterpart to compensate for any possible barriers to agricultural products associated with deforestation and forest degradation. For example, the EU could return the value of barred products by investing an equivalent sum in the protection of Brazilian forests. This may be done through donations to the Amazon Fund, for example. In addition, the Brazilian government and rural producers should invest more in international missions to raise awareness and ensure that goods produced legally are not confused with illegal produce. On the national scale, improvements in public agricultural funding should favor producers who 1) adopt more sustainable practices in accordance with the Forest Code; 2) recover degraded lands, reducing the pressure on new

agricultural frontiers; and 3) incorporate new agroecological technologies like tracking mechanisms.

References

BRASIL. Ministério do Desenvolvimento, Indústria, Comércio e Serviços. *Proposta de adiar lei antidesmatamento reconhece pleito do governo por maior clareza na lei*. Brasília, DF: MDIC, 2024. Disponível em: https://www.gov.br/mdic/pt-br/assuntos/noticias/ 2024/outubro/proposta-de-adiamento-da-eudr-reconhece-pleito-do-governo-por-maior-clareza-na-lei. Acesso em: 10 jan. 2025.

DEUTSCHE WELLE. *Comissão Europeia propõe adiamento de lei antidesmatamento*. Berlim: DW.COM, 2024. Disponível em: https://p.dw.com/p/4lLxI. Acesso em: 11 jan. 2025.

FAVERIN, V. Lei europeia pode impactar 60% das exportações do agro brasileiro ao bloco, diz FGV. *Canal Rural,* São Paulo, 25 set. 2024. Disponível em: https://www.canalrural.co m.br/agricultura/agronegocio/lei-europeia-pode-impactar-60-das-exportacoes-do-agro-brasileiro-ao-bloco-diz-fgv/. Acesso em: 11 jan. 2025.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO). *Evaluación de los recursos forestales mundiales 202*0 – Informe principal. Roma: FAO, 2021. Disponível em: https://openknowledge.fao.org/handle/20.500.14283/ca9825es. Acesso em: 6 jan. 2025.

INSTITUTE FOR ECONOMICS & PEACE (IEP). *Ecological Threat Register 2020:* Understanding Ecological Threats, Resilience and Peace. Sydney: IEP, 2020. Disponível em: http://visionofhumanity.org/reports. Acesso em: 6 jan. 2025.

KRUGMAN, P. R.; OBSTFELD, M.; MELITZ, M. *Economia internacional.* 10. ed. São Paulo: Pearson Education do Brasil, 2015.

MANNERS, I. Normative Power Europe: A Contradiction in Terms? *JCMS*: Journal of Common Market Studies, v. 40, n. 2, p. 235-258, Dec. 2002. Disponível em: https://doi.org/10.111 1/1468-5965.00353. Acesso em: 10 jan. 2025.

PENDRILL, F.; PERSSON, U. M.; GODAR, J.; KASTNER, T. Deforestation displaced: trade in forest-risk commodities and the prospects for a global forest transition. *Environmental Research Letters*, Bristol, v. 14, n. 5, May 2019. Disponível em: https://doi.org/10.108 8/1748-9326/ab0d41. Acesso em: 11 jan. 2025.

SILVA, F. P. M. da. *Sobre el Reglamento Europeo de Deforestación:* ¿protección del medioambiente o proteccionismo económico encubierto? Madrid: Plataforma Tierra Cajamar: Actualidad, 2024a. Disponível em: https://www.plataformatierra.es/actualidad/ reglamento-europeo-deforestacion-proteccion-medioambiente-proteccionismo-economi co-encubierto. Acesso em: 8 jan. 2025.

SILVA, F. P. M. da. *Como a lei de desmatamento europeia pode ajudar à Amazônia*. The Observatory on European Studies. Florianópolis: Latin American Center of European Studies, 2024b. Disponível em: https:// eurolatinstu dies.com/en/como-a-lei-de-desmatamento-europeia-pode-ajudar-a-amazonia/. Acesso em: 8 jan. 2025.

UNIÃO EUROPEIA. Comissão Europeia. A intensificação da ação da UE para proteger as florestas a nível mundial. COM/2019/352 final: Bruxelas: Jornal Oficial da União Europeia, 2019. Disponível em: https://eur-lex.europa.eu/legal-content/PT/TXT/PDF/?uri=CELEX:52019DC0352. Acesso em: 8 jan. 2025.

UNIÃO EUROPEIA. Comissão Europeia. Regulation of the European Parliament and of the Council, on making available on the Union market as well as export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) 995/2010. COM/2021/706 final: Brussels: The Official Journal of the European Union, 2021. Disponível em: https://www.europarl.europa.eu/RegData/docs_autres_institutions/com mission_europeenne/com/2021/0706/COM_COM(2021)0706_EN.pdf. Acesso em: 10 jan. 2025.

UNIÃO EUROPEIA. Regulamento (UE) 2023/1115 do Parlamento Europeu e Conselho da União Europeia, de 31 de maio de 2023. *Jornal Oficial da União Europeia,* Luxemburgo, JO L 150 de 9.6.2023, p. 206-247. Disponível em: https://eur-lex.europa.eu/legal-content/PT/ TXT/?uri=CELEX:32023R1115. Acesso em: 3 jan. 2025.

UNIÃO EUROPEIA. Comissão Europeia. *A Comissão reforça o seu apoio à aplicação do Regulamento Desflorestação da UE, em resposta aos apelos dos parceiros mundiais, propondo uma prorrogação, por mais 12 meses, do período de introdução progressiva*. Comunicado de Imprensa. Bruxelas, 2024. Disponível em: https:// ec.eu ropa.eu/commission/presscorner/detail/pt/ip_24_5009. Acesso em: 10 jan. 2025.

UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP). *Emissions Gap Report 2024*: No more hot air … please! With a massive gap between rhetoric and reality, countries draft new climate commitments. Nairobi: UNEP, 2024. Disponível em: https://doi. org/10.59117/20.500.11822/46404. Acesso em: 6 jan. 2025.

WORLD METEOROLOGICAL ORGANIZATION (WMO*). State of the Climate 2024*: Update for COP29, Geneva: WMO, 2024a. Disponível em: https://library.wmo.int/idurl/4/ 69075. Acesso em: 6 jan. 2025.

WORLD METEOROLOGICAL ORGANIZATION (WMO). *WMO Greenhouse Gas Bulletin:* The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 202. Geneva: WMO, 2024b. Disponível em: https://library.wmo.int/ idurl/4/69057. Acesso em: 3 jan. 2025.

Sustainable transformation:
The role of INYAGA/UFRJ in the Brazil-EU connection

Kelyane Silva
Fabiana dos Santos e Souza Frickmann
Thalissa Pádua Gilaberte
Eliane Ribeiro Pereira
Ana Paula Sperling Mendes
Antônio José Barbosa de Oliveira
Rosário Mauritti
Vicente Antônio de Castro Ferreira
Rodrigo Antunes Malvar Hermida

Abstract: In 2025 Brazil will host the 30th UN Climate Change Conference (COP30). The transition to more efficient economic models that take into account health, social justice, and environmental responsibility has become a global priority, both in Brazil and Mercosur, as in the European Union. Entrepreneurial initiatives are being articulated to promote new technologies and sustainable solutions with social impact. In this context, the Social and Environmental Impact Business Incubator (Inyaga) at the Federal University of Rio de Janeiro (UFRJ) has emerged as an integrative platform for technological and sustainable innovation to support startups and entrepreneurs. It promotes businesses with a social and environmental impact to solve complex local problems, such as inequality in access to resources, climate change, pollution, soil improvement, environmental monitoring, and social inclusion. With a multidisciplinary and collaborative approach, Inyaga connects academics, managers, researchers, students, and entrepreneurs to opportunities that promote innovation. It has also created links with international partners like the University Institute of Lisbon (ISCTE) to foster scientific and technological cooperation between the UFRJ and ISCTE. As such, the

https://doi.org/10.36311/2025.978-65-5954-580-3.p67-78

organ reflects a willingness to build ties that strengthen innovation, sustainability and an exchange of experiences and good practices between Brazil and Portugal, representing a bridge for international academic and scientific exchange. This encourages the creation of innovative solutions that can be replicated in different contexts, integrating local Brazilian knowledge with international technological and methodological developments. Inyaga values diversity in the inclusive and holistic way required to face global challenges. As such, its collaboration with ISCTE is an example of a partnership that strengthens public policies and creates sustainable solutions for the global challenges of the 21st century through international cooperation.

Keywords: Sustainable solutions; environmental responsibility; entrepreneurs innovation; UFRJ, Brazil-EU connection

Introduction

In the contemporary scenario, where Brazil will host the 30th UN Conference on Climate Change (COP30) in Belém (PA) in November 2025, innovation and sustainability policies play a key role in addressing the most urgent global challenges. The transition to development models that integrate economic efficiency, health, social justice, and environmental responsibility has become a priority on national and international agendas. This movement is driven by issues such as climate change, epidemics, increasing social inequalities, the pressure for greater economic competitiveness in globalized markets, and the need to conserve natural resources for future generations.

In Brazil and within the scope of Mercosur and the European Union, initiatives focused on innovative entrepreneurship have emerged in response to these demands. These initiatives not only promote the creation of new technologies and solutions, but also seek to integrate sustainability and the social impact of economic development.

According to the *Global Entrepreneurship Monitor* (GEM) (2021), entrepreneurship in Brazil has shown significant trends towards innovation and social impact, reflecting a transformation in the profile of emerging businesses in the country. The report highlighted that entrepreneurial initiatives are not only addressing economic demands, but are increasingly

aligned with sustainable development goals, promoting solutions that integrate technology, sustainability, and social benefits.

In this context, business incubators play a crucial role, acting as true laboratories for the development of entrepreneurial ideas that, besides being economically viable, are aligned with socio-environmental transformation goals. Incubators are more than spaces for logistical and technical support, and have traditionally been used to support startups (Bergaman; McMullen, 2022; Capatina *et al.,* 2023).

These spaces act as ecosystems that promote interaction between entrepreneurs, academic institutions, public and private organizations, as well as investors, creating an environment conducive to innovation and interdisciplinary collaboration. It is important to highlight that the primary goal of an incubator is to foster the growth of successful, financially sustainable, and competitive companies in their markets. As such, they ensure that these organizations continue to evolve even after completing their incubation period (Dornelas, 2008; Bergaman; McMullen, 2022). This initial support can be decisive for the consolidation of companies that contribute not only to economic development, but also to the construction of innovative social technological solutions aimed at global demands (Chavez, 2016).

In this panorama, the Social and Environmental Impact Business Incubator (Inyaga), linked to the Federal University of Rio de Janeiro (UFRJ), has emerged as a relevant example of how Brazilian institutions can integrate technological innovation and sustainability into their practices.

Inyaga supports startups and entrepreneurs by promoting social and environmental impact businesses. It focuses on solving complex, real, and local problems, such as inequality in resource access, climate change, pollution, soil improvement, environmental monitoring, and social inclusion. Its model is based on a multidisciplinary and collaborative approach, connecting academics, business managers, researchers, students, and entrepreneurs to opportunities that promote innovation. Furthermore, as argued by Sansone *et al.* (2020), public policies are essential to foster social incubators, because they have the potential to support entrepreneurship in

Brazil more effectively, thus contributing to the strengthening of the social and environmental innovation ecosystem.

The main objective of this chapter is to analyze the performance of Inyaga as a practical example of how innovation and sustainability policies can be implemented in a national and global context. The analysis covers its organizational structure, the support programs offered, and the impacts generated in terms of socioeconomic and environmental development. Additionally, it seeks to understand how Inyaga positions itself within the Brazilian innovation ecosystem, investigating its relationship with public policies that encourage innovation and international collaboration networks.

Development

Overview of Innovation and Sustainability Policies

In Brazil, the formation of incubators is relatively recent compared to the United States, beginning in the 1980s with the initiative of CNPq (National Council for Scientific and Technological Development) to create the first institutions to support innovative ventures in the country, located in Campina Grande (PB), Manaus (AM), São Carlos (SP), Porto Alegre (RS), and Florianópolis (SC). This decision led to the creation of ParqTec - São Carlos High Technology Park Foundation - in 1984, where Brazil's first incubator was established (Anprotec, 2016).

However, it was only in 2004 that the National Science, Technology, and Innovation Strategy (ENCTI) was created, with the publication of Innovation Law No. 10.973 (Brasil, 2004). This law was an important milestone for promoting innovation in the country, as it encouraged actions like the creation and development of technological parks.

Regarding socio-environmental sustainability, society in 2024 had a dual perception (except for indigenous peoples and traditional

communities): one of socio-historical origin and another of scientific origin. Since the 1960s, urban populations have become increasingly aware of the planet's growing deterioration, due to issues like pollution, environmental accidents, degradation of ecosystems and natural resources, the limitation of these resources, accelerated and chaotic urbanization, and anthropogenic disturbances. The scientific origin reflects actions to capture knowledge about nature and its elements from natural sciences (Chaves, 2015).

The European Union is recognized for its robust innovation and sustainability strategies, with programs like Horizon Europe, which integrates investments in green technology and social impact startups (European Commission, 2020). In Mercosur, although there are joint efforts such as the MERCOSUR Network of Business Incubators, challenges to regional integration have limited the advancement of transnational projects.

In this context, although it is evident that both Brazil and the EU promote policies aligned with the seventeen Sustainable Development Goals (SDGs) (UN, 2015), they employ different strategies. Whereas the EU prioritizes regulatory harmonization and long-term funding, Brazil faces structural challenges that require creative local solutions, such as those proposed by Inyaga.

The scientific and technological partnership between the School of Business and Accounting Sciences at the Federal University of Rio de Janeiro (UFRJ) and the Instituto Universitário de Lisboa (ISCTE) illustrates how the exchange of knowledge and experience between institutions from different countries can enhance local initiatives, thus strengthening the impact of business incubators and contributing to the consolidation of a global innovation environment.

Therefore, this chapter aims to reflect on the progress and challenges faced by initiatives like Inyaga, exploring its transformative potential in both the Brazilian and international contexts. The actions of Inyaga consider socio-economic aspects and Brazil's reality. Unlike European

countries, Brazil faces a discrepancy in environmental and social realities, which manifests in different understandings of territorial knowledge.

For instance, it is worth highlighting the interfaces between traditional knowledge (indigenous peoples, quilombolas, traditional farmers, etc.), scientific knowledge, and urban knowledge. In this regard, partnerships through scientific and technological cooperation with developed countries have proven to be a promising tool for reflecting on Brazil's alignment with the global sustainable development goals.

Socio-Environmental Impact & Results

The scientific and technological cooperation agreement between UFRJ and ISCTE reflects the parties' willingness to build ties that strengthen innovation and sustainability. It also allows for the exchange of experiences and best practices between Brazil and Portugal, in which capacity it serves as a bridge for academic and scientific exchange between Mercosur and the EU.

This partnership not only strengthens Brazil's innovation and entrepreneurship capacity, it also positions the country as a relevant player in the international sustainable development arena. The exchange of knowledge and experiences facilitated by the agreement fosters the creation of innovative solutions that can be replicated in other contexts, thus expanding the reach of best practices. Moreover, by integrating local Brazilian knowledge with international technological and methodological advances, the agreement contributes to the appreciation of the country's cultural and scientific diversity, in addition to promoting a more inclusive and holistic approach to global challenges.

Another relevant aspect is the creation of opportunities for young researchers and entrepreneurs who, through this cooperation, gain access to international cooperation networks and resources that enhance their initiatives. The connection between Inyaga, the UFRJ, and ISCTE exemplifies how cooperation between institutions from different countries

can result in mutual benefits, while consolidating an environment conducive to advancing science, technology, and innovation.

Inyaga operates as a business incubator focused on socio-environmental impact. It has an organizational structure that prioritizes interdisciplinarity and the integration of knowledge. Based on its mission, the incubator organizes its support programs into three main pillars: specialized mentoring; connections with national and international innovation networks; and the promotion of sustainability. These pillars enable entrepreneurs from various sectors to develop innovative and sustainable solutions that address local and global demands.

The governance of Inyaga reflects a collaborative approach, involving not only UFRJ experts, but also external partners. This support network is essential for creating a fertile environment for innovation, and it ensures a convergence of resources and knowledge.

Brazil-European Union Connection: Cooperation Agreement with ISCTE and Interdisciplinary Subjects

The Scientific and Technological Cooperation Agreement, signed in 2019 between FACC/UFRJ and the School of Sociology and Public Policy at ISCTE aims to strengthen the academic and scientific exchange between both institutions. The partnership facilitates joint participation in research projects, the organization of scientific events, participation in academic committees, publication development and, most importantly, the creation and implementation of interdisciplinary subjects focused on innovation and entrepreneurship.

The objective of the Agreement is to enhance the training of leaders and equip them to tackle the complexities of contemporary challenges, promoting sustainable practices and driving technological advancements essential for national development. As part of this strategy, since 2023, four subjetcs have already been implemented at UFRJ, as a direct result of the cooperation between ISCTE and UFRJ:

- Acquisition of Interpersonal Skills for Innovation and Entrepreneurship
- Innovation and Technology
- Design Thinking for Innovation and Social Impact
- Innovation Indicators

These subjects not only provide students with essential complementary training to face contemporary challenges, they have also contributed to the establishment of a Laboratory of Transversal Competencies at UFRJ, the latter being aimed at consolidating an institutional model focused on higher education innovation. It is worth noting that new interdisciplinary subjects are planned to further expand the initiative's impact.

The knowledge and experience gained by students in these subjects are further enhanced through their immersion in innovative environments like Inyaga. In this context, Inyaga serves as an experimentation platform, allowing students to engage with real-world challenges, apply classroom-acquired knowledge, and develop practical experiences through projects and internships.

With an organizational structure that prioritizes interdisciplinarity and knowledge integration, Inyaga supports entrepreneurs through three key pillars: specialized mentoring; connection with national and international innovation networks; and sustainability promotion. These pillars enable the development of innovative solutions aligned with both local and global demands, strengthening the entrepreneurial ecosystem within the university.

Inyaga's governance reflects this collaborative approach, involving not only UFRJ experts but also external partners, such as ISCTE. This cooperative network is essential for creating an academic and professional environment conducive to innovation, fostering the convergence of knowledge and resources, and driving the adoption of innovative practices in higher education.

Inyaga as a model for Socio-Environmental impact incubators

As defined in its statutes, Inyaga is an innovation unit at the UFRJ that promotes teaching, research and extension projects. Its main objectives include identifying and supporting emerging ventures, while fostering a culture of technological and social innovation, and creating a measurable socio-environmental impact. This model stands out for integrating academics, managers, entrepreneurs and investors into a collaborative ecosystem.

Among Inyaga's programs, the following stand out:

- Pre-Incubation Program: Structuring innovative ideas and enabling their transformation into sustainable businesses.
- Mentorships and Consultations: Continuous support in business modeling, socio-environmental impact assessment, Technology Readiness Level (TRL), intellectual and industrial property, as well as strategic development, all focused on enhancing innovative solutions.
- Workshops and Training: Practical and theoretical workshops on innovation, sustainability and entrepreneurship, contributing to strengthening the capacities of incubated businesses and the external community.
- Connection with Investors: Building networks between entrepreneurs and investors interested in social and environmental impact, in addition to expanding fundraising opportunities for impactful businesses.

Through this multifaceted approach, Inyaga has positioned itself as a reference among socio-environmental impact incubators in Brazil. In this capacity, it contributes to the consolidation of an innovation ecosystem that prioritizes sustainable and inclusive solutions.

Inyaga Structure and Governance

Inyaga operates with a participatory governance structure composed of three main bodies: the General Management; Advisory Board; and the Technical Committee. This organization allows for decentralized and inclusive management, promoting collaborative decisions able to meet the demands of the innovation ecosystem and Brazil's environmental needs, aimed at sustainable development.

The Advisory Board, for instance, is responsible for deliberating on strategic issues, including the selection of new members and performance assessment. The Technical Committee acts as an advisory body, and analyzes the technical quality of projects applying to the incubator's programs. This robust structure ensures that Inyaga maintains a standard of excellence in its operations.

Inyaga, whose name means "Our Land" in the Brazilian Ka'apor indigenous language, stands out in preparing UFRJ's scientific environment by furthering innovation research and commercial links with enterprises and new businesses.

- Mission: Contribute to building a more just and sustainable world through the catalysis of technology-based businesses and socio-environmental values.
- Vision: Become a reference as a catalyst for businesses capable of causing socio-environmental impacts and innovative solutions by 2030.
- Values: Sustainability, ethics & respect, innovation, partnership and entrepreneurship.

Conclusion

The academic integration between Brazil and the European Union, exemplified by the agreement between UFRJ and ISCTE, shows

how international partnerships can drive sustainable development and innovation. These collaborations are essential for strengthening public policies and creating shared sustainable solutions for the global challenges of the 21st century.

In conclusion, the cooperation between both institutions serves as an example of how academic partnerships may contribute to sustainable development and innovation. Moreover, Inyaga's performance has been able to stimulate interactions between researchers and the industrial sector at the national level. Thus, Inyaga contributes to the development of strategic innovations necessary for Brazil's industry to gain a competitive edge, and also promotes the sustainability of Brazilian cities as replicable models that can be adopted by other countries through international cooperation.

References

ANPROTEC. *Histórico do setor de incubação de empresas no Brasil e no mundo*. Brasília, DF: ANPROTEC, 2016.

BERGAMAN, B. J.; McMullen, J. S. Helping entrepreneurs help themselves: a review and relatioanal research agenda, on entre preneurial support organizations. *Entrepreneurchip Theory and practice,* Newbury Park, v. 46, n. 3, p. 688-728, Jul. 2022.

BRASIL. Presidência da República. *Lei n. 10.973 de 02 de dezembro de 2004*. Dispõe sobre incentivos à inovação e à pesquisa científica e tecnológica no ambiente produtivo e dá outras providências. Lei de Inovação Brasileira. Brasília, DF: Planalto, 2004.

CAPATINA, A.; CRISTEA, D. S.; MICU, A.; MICU, A. E.; EMPOLI, G.; CODIGNOLA, F. Exploring causal recipes of startup acceptance into business incubators: a cross-country study. *International Journal of Entrepreneurial Behavior & Research*, Bingley, v. 29, n. 7, p. 1584-1612, Jan. 2023. DOI 10.1108/IJEBR-06-2022-0527. Disponível em: https://www.emerald.com/insight/content/doi/10.1108/ijebr-06-2022-0527/full/pdf?title=exploring-causal-recipes-of-startup-acceptance-into-business-incubators-a-cross-country-study IJEBR-06-2022-0527_proof 1584..1612. Acesso em: 6 jan. 2025.

CHAVES, M. P. S. R. Desenvolvimento e Sustentabilidade na Amazônia. *In:* CASSIOLATO, M. G.; PODCAMENI, M. C. SOARES, J. *Sustentabilidade socioambiental em contexto de crise*. Rio de Janeiro: E papers, 2015. p. 193-210.

CHAVEZ, V. A.; STINNETT, R.; TIERNEY, R.; WALSH, S. The importance of the technologically able social innovators and entrepreneurs: A US national laboratory perspective. *Technological Forecasting & Social Change*, Amsterdã, v. 121, p. 205-215, Oct. 2017.

DORNELAS, J. C. A. *Empreendedorismo:* transformando ideias em negócios. 3. ed. Rio de Janeiro: Elsevier, 2008. 222 p.

FAVERO, M. B.; C. CHIRNEV; P. R. da SILVA; L. H. P. TOME; R. T. CEZARIN; M. PENHA. Empreendedorismo e ensino superior: análise do perfil empreendedor de alunos de um centro universitário. *Gestão, Inovação e Empreendedorismo,* Ribeirão Preto, v. 7, n. 1, p. 118-130*,* 2024. Disponivel em: https://doi.org/10.5281/zenodo.13852022. Acesso em: 6 jan. 2024.

GLOBAL ENTREPRENEURSHIP MONITOR (GEM). *Empreendedorismo no Brasil:* Relatório Nacional 2021. Londres: GEM, 2021. Disponível em: https://www.gemconsortium.org. Acesso em: 14 jan. 2025.

ONU. *Agenda 2030 para o Desenvolvimento Sustentável.* ODS. Objetivos para o Desenvolvimento Sustentável da Agenda 2030 das Organizações Unidas (ONU). East River, Nova York: ONU, 2015.

MACHADO H. O. *et. al*. Mapeamento de atores do ecossistema de inovação da cidade de Timon – Maranhão e suas potencialidades. *Revista de Gestão e Secretariado,* Lisboa, v. 15, n. 1, p. 995–1011, jan./mar. 2024.

SANTA ANA, M. F. O distanciamento que existe entre as pesquisas desenvolvidas nas universidades e a inovação que chega as indústrias brasileiras. *Revista Ibero-Americana de Humanidades*, *Ciências e Educação,* São Paulo, v. 7, n. 7, p. 324-334, jul. 2021. DOI: http://doi.org/10.51891/rease.v7i7.1691. Disponivel em: https://periodicorease.pro.br/rease/article/download/1691/680. Acesso em: 15 nov. 2024.

SANSONE, G.; ANDREOTTI, P.; COLOMBELLI, A.; LANDONI, P. Are social incubators different from other incubators? Evidence from Italy. *Technological Forecasting & Social Change*, Amsterdã, v. 1 Disponivel em: 61, n. 158, p. 1-13, Jun.. 2020. Acesso em: 13 jan. 2025.

Final Considerations

This book has highlighted the main themes of each chapter and their relevance in the context of Brazil-EU relations and the Jean Monnet Chair at UFG, from the perspective of Laís Forti Thomaz, Chair Coordinator. This conclusion addresses the main policy recommendations (policy prescription) addressed to the EU, Brazil and the state of Goiás. The present recommendations result from the particular interpretation of each chapter of this book.

First, the use of artificial intelligence in the service of environmental protection is recommended, as it allows for the monitoring of deforestation, pollution and climate change, among others (see chapter by Oliveira and Flauzino). Data collection and analysis using AI could provide more effective, faster and more accurate public policies in the face of environmental problems.

Guidelines and regulations are recommended to ethically guide the collection, storage and use of data. Additionally, the promotion of inclusive and fair governance based on a collaborative and adaptive approach in view of global standards and local needs is emphasized.

Secondly, a perspective that integrates economic, environmental and local community approaches is recommended in view of the provisions on

https://doi.org/10.36311/2025.978-65-5954-580-3.p79-81

trade and environmental protection contained in the agreements between Mercosur and the EU (see chapter by Camargo and Hora). In this context, at least at the diplomatic level, there was an understanding about the need to combat deforestation, restore degraded areas and regularize the protected territories of indigenous peoples.

In this case, Brazil adheres to the ILO Convention 169 and has adopted a robust forestry code. This recommendation highlights the possibility of benefiting agricultural exporters who respect the standards and actively promote sustainability. Therein lies a potential for innovation in cooperation with the EU in the areas of energy efficiency, water resource management and genetic improvements, among others. However, not all Brazilian exporters abide by these rules, and it is this group of producers that the EU is concerned about with reference to Brazil.

Thirdly, it is recommended that Brazil pay attention to the opportunities to achieve high standards of environmental preservation supported by European funding for projects to promote sustainable development (see chapter by Silva). In this sense, Brazil could, instead of accusing the EU of economic protectionism under an environmental pretext, highlight products and economic sectors that comply with both national legislation and EU requirements. This reinforces the argument that promoting environmental sustainability is also a way to foster economic development.

Fourthly, recommendations directly related to municipalities stand out: aligning local legislation and projects with national and global guidelines and standards; as well as promoting the exchange of experiences with a view to implementing these laws and projects (see chapter by Nascimento and Martín-Vide). For example, both Brazil and Spain have committed to mitigating and adapting to the impacts of climate change, but nationally and locally, there are several layers that differentiate these contexts. Sharing experiences has the potential to diagnose similar problems and apply adaptive solutions.

In the fifth place, the report on the partnership between the Social and Environmental Impact Business Incubator (Inyaga) of the Federal

University of Rio de Janeiro (UFRJ) and the University Institute of Lisbon (ISCTE) reinforces the aforementioned recommendation (see chapter by Silva *et al.*). In addition, it inspires an additional recommendation, which concerns the interdisciplinary approach of projects in unison with the private sector. It is worth noting, in this context, that actions to promote innovation and sustainable development do not depend solely on the State, and that it is crucial to stimulate businesses, especially those with a high socio-environmental impact.

Finally, two recommendations present in all chapters of this book stand out. The first is the centrality of local actors. The perspectives presented in this work have emphasized the leading role of these actors, the need to adapt to them, or both. The second relates to the centrality of the EU as a global actor, which is indicated by its prominence in the environmental agenda or by the capillarity of initiatives (programs or projects) that involve cooperation at the national, regional or local level, as well as between state and non-state actors.

Diego Trindade d'Ávila Magalhães
Vice-Coordinator of the Jean Monnet Chair at UFG

Authors' Mini Biographies

Ana Paula Sperling Mendes
Plastics Engineer (ULBRA) with a specialization in Environment (UFRJ) and Business Processes (FGV). Socioenvironmental Innovation Agent at the UFRJ Social and Environmental Impact Business Incubator (Inyaga). Email: ana@inyaga.ufrj.br

Antônio José Barbosa de Oliveira
PhD in Social Memory (UERJ). Associate Professor and Director at the School of Administration and Accounting Sciences (FACC) of the Federal University of Rio de Janeiro (UFRJ). Email: antoniojose@facc.ufrj.br

Diego Tarley Ferreira Nascimento
Geographer and PhD in Geography, Associate Professor at the Federal University of Goiás (UFG) and accredited to the Graduate Programs in Geography (PPGEO/UFG), Environmental Sciences (CIAMB/UFG) and Geography (PPGEO/UEG). Contact: diego_nascimento@ufg.br

Diego Trindade d'Ávila Magalhães
Vice-Coordinator of the Jean Monnet Chair at UFG. Associate Professor of International Relations at the Federal University of Goiás (UFG). PhD in International Strategic Studies (UFRGS). Contact: diegotdm@ufg.br

Eliane Ribeiro Pereira
PhD in Production Engineering (UFF). Full Professor at the School of Administration and Accounting Sciences (FACC) of the Federal University of Rio de Janeiro (UFRJ). Coordinator of the UFRJ Incubator for Social and Environmental Impact Businesses (Inyaga). Email: Eliane@facc.ufrj.br

Fabiana dos Santos e Souza Frickmann
PhD in Plant Biotectology (UFRJ). Master in Tropical Forest Ecology (INPA). Specialist in phytomedicines (NGBS/FIOCRUZ). Biologist (UFRJ). Socio-environmental Innovation Agent at the UFRJ Social and Environmental Impact Business Incubator (Inyaga). Email: phasect@yahoo.com.br

Filipe Prado Macedo da Silva
Professor and Researcher at the Institute of Economics and International Relations of the Federal University of Uberlândia (IERI/UFU). Leader of the "Conexão Bruxelas | Study Group on Europe and the European Union". Institutional email: filipe.prado@ufu.br.

Javier Martín-Vide
Mathematician and PhD in Geography and History, Full Professor at the University of Barcelona (UB), member of the Royal Academy of Sciences and Arts of Barcelona and coordinator of the Expert Group on Climate Change of Catalonia. Contact: jmartinvide@ub.edu

José Neto Cassiano de Camargo
Graduated in Agronomy, Master in Sustainable Rural Development and PhD candidate in Environmental Sciences (Ciamb) at UFG. Contact: jose.camargo@discente.ufg.br

Karla Emmanuela Ribeiro Hora
Graduated in Architecture and Urbanism, Master in Geography, PhD in Environment and Development from UFPR. Professor at the PPG Ciamb/UFG. Contact: karla_hora@ufg.br

Kelyane Silva
PhD in Intellectual Property and Innovation (INPI). Associate Professor at the School of Administration and Accounting Sciences (FACC) of the Federal University of Rio de Janeiro (UFRJ). Vice-Coordinator of the UFRJ Incubator for Social and Environmental Impact Businesses (Inyaga). Email: kelyane@facc.ufrj.br

Laís Forti Thomaz
Coordinator of the Jean Monnet Chair at UFG. Associate Professor of International Relations. Chief of Staff at the Ministry of Mines and Energy (MME). laisthomaz@ufg.br / lais.thomaz@mme.gov.br

Marcelo Fernandes de Oliveira
Full Professor at UNESP – Marília Campus and CEO of IGEPRI (Institute of Public Management and International Relations). Contact: marcelo.fernandes@unesp.br.

Rodrigo Antunes Malvar Hermida
Master's student in Production Engineering (UFRJ). Business Administration with specialization in Marketing (PUC RIO) and Project Management (FGV RJ). Socioenvironmental Innovation Agent at the UFRJ Incubator for Social and Environmental Impact Businesses (Inyaga). Email: rodrigoantunes@inyaga.ufrj.br

Rosário Mauritti
Sociologist. Associate Professor at Iscte-University Institute of Lisbon. Director of the Laboratory of Transversal Skills (LCT-Iscte). Email: rosario.mauritti@iscte-iul.pt

Thalissa Pádua Gilaberte
PhD in Intellectual Property and Innovation (INPI). Lawyer and Socio-Environmental Innovation Agent at the UFRJ Social and Environmental Impact Business Incubator (Inyaga). Email: thalissa@inyaga.ufrj.br

Vicente Antônio de Castro Ferreira
PhD in Industrial and Technological Economics (UFRJ). Professor at the Institute of Economics of the Federal University of Rio de Janeiro (UFRJ). Email: vicente@coppead.ufrj.br

Victória Eduarda Flauzino
Bachelor in Social Sciences from UNESP -/Campus de Marília and Researcher at IGEPRI (Institute of Public Management and International Relations). Contact: victoria.e.flauzino@unesp.br

About the book

Cataloguing in Publication (CIP)
Telma Jaqueline Dias Silveira
CRB 8/7867

Normalization
Elizabete Cristina de Souza de Aguiar Monteiro
CRB - 8/7963

Cover and
Cairo José Alves Guimarães
Gláucio Rogério de Morais

Layout
Gláucio Rogério de Morais

Graphic production
Giancarlo Malheiro Silva
Gláucio Rogério de Morais

Technical Consultancy
Renato Geraldi

University Workshop
Laboratório Editorial
labeditorial.marilia@unesp.br

Format
16 x 23cm

Typology
Adobe Garamond Pro

2025

ISBN 978-65-5954-581-0