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Article

Are Regulatory Standards Enough to Leverage Forest Restoration? A Brazilian Case Study

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ABSTRACT

Environmental offsetting is a compensation for a deforested or degraded area usually in the form of forest recovery. We provide an update on the ongoing regulatory standards (RS) regarding ecological restoration in Brazil, analyzing the existence of monitoring protocols. The introduction of Environmental Rural Registry (CAR) created by law in 2012 has become the main driver of local RS. The aim of CAR is to guarantee forest cover on rural properties by the force of RS, but it lacks to consider the vegetation structure, functionality, and quality of the vegetation. Currently only four states in Brazil uses a protocol that includes ecological criteria as a measurement of success. The existence of a specific legislation for forest restoration may enhance restoration effectiveness by clarifying the restoration process and regulations to those stakeholders involved in implementing restoration projects. It is necessary for RS to include diverse technical approaches, providing the opportunity for solutions contemplating local possibilities and conditions.

Keywords: ecological restoration policy; environmental adequacy; regulatory standards.

RESUMO

A compensação ambiental de áreas desmatadas ou degradadas, geralmente acontece na forma de restauração florestal. Este trabalho traz a atualização sobre as normas regulatórias (NR) em vigor sobre restauração ecológica no Brasil, analisando a existência de protocolos de monitoramento. A implantação do Cadastro Ambiental Rural (CAR), criado por lei em 2012, passou a ser o principal impulsionador do surgimento de NR no nível local. O objetivo do CAR é garantir a cobertura florestal nas propriedades rurais pela força do RS, mas falta considerar a estrutura da vegetação, a funcionalidade e a qualidade da vegetação.Atualmente, apenas quatro estados do Brasil utilizam protocolos que incluem critérios ecológicos como medida de sucesso. A existência de uma legislação específica para restauração florestal pode aumentar a eficácia da restauração, esclarecendo o processo de restauração e os regulamentos para as partes interessadas envolvidas na implementação de projetos de restauração. É necessário que as NR considerem abordagens técnicas diversas, oportunizando soluções que contemplem as possibilidades e condições locais.

Palavras-chave: política de restauração ecológica; adequação ambiental; padrões regulatórios.

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Introduction

Ecological restoration is used as a strategy to compensate for biodiversity loss caused by human activities (Maron et al., 2012). Furthermore, ecological restoration plays a key role in addressing sustainability challenges and climate change (Scheidel and Gingrich, 2020). This strategy involves the balancing of biodiversity loss in one place by an equivalent biodiversity gain elsewhere, but this simplistic compensation has profound implications. Worldwide biodiversity offsetting has become a regulatory requirement and can be achieved via commercial transactions of biodiversity "credits" though its environmental efficiency and societal desirability remain unclear (Bonneuil, 2015).

The essential problem lies there in, as the biodiversity loss due to development may be underestimated and legislation could be improved to avoid unintended consequences (Apostolopoulou and Adams, 2017). In this sense, an analytic framework for calculating offset ratios that guarantee conservation gains in restored areas is required to avoid biodiversity loss in the long run (Moilanen et al., 2009).

In Brazil the Federal Law Nº°12.651 of May 25th, 2012, entitled Native Vegetation Protection Law (LPVN), provides programs of control and encourages forest preservation and conservation, establishing various mechanisms of control such as the Environmental Rural Registry (CAR), the Environmental Compliance Program (PRA), the Project for Recovery of Degraded and Altered Land (PRADA), and the Environmental Reserve Quotas program (CRA), allowing for an integrated management approach, advancing beyond monitoring and enforcing compliance (Brancalion and Chazdon, 2017).

The environmental heterogeneity of Brazil, is already a challenge, and, the state governments could establish legal instruments to determine and reference restoration successes for each ecosystem type, that contemplates the entire restoration process, i.e. between the planting and the establishment of a new forest (Maron et al., 2012). Currently in Brazil, environmental regulations result basically from centralization and planning policies conducted by each of the countries' State. Results show that most recent regulations were demanded by a an increasingly environmentally aware and more organized civil society, through more participatory and democratic political frameworks and improved scientific knowledge and requirements (Drummond and Barros-Platiau, 2006).

In this paper, we describe and analyze laws, decrees, regulations, resolutions, and institutional mandates linked to ongoing legislation and the most recent regulations regarding ecological restoration in Brazil, with the introduction of the existence of monitoring protocols in Brazil's 27 States.

Material and methods

Legal framework

The Brazilian Federal Law nº12.651 of May 25th, 2012, formally entitled Native Vegetation Protection Law (LPVN), provides programs of control and incentive to facilitate and promote forest preservation and conservation, establishing various mechanisms of control such as the Environmental Rural Registry (CAR), the Environmental Compliance Program (PRA), the Project for Recovery of Degraded and Altered Land (PRADA), and the Environmental Reserve Quotas program (CRA), contemplating an integrated management approach, advancing beyond simple monitoring and enforcing compliance (Brancalion et al., 2016).

The LPVN determines that every rural private property has to set aside a percentage of its total area for forest conservation and management in a legal instrument called the "Legal Reserve" (RL). This varies per Biome; 80% in the Amazon, 35% in the Brazilian savanna (cerrados) and 20% in all other biomes, as Atlantic Rainforest and Pantanal. The RL aim is to offer some economic and sustainable use of the rural property's natural resources whilst promoting biodiversity conservation (Chaves et al., 2015).

There is still a provision in the law which includes areas for restoration called Permanent Preservation Areas ("APP" in Portuguese), which are areas in riparian buffer zones along streams and around springs, on slopes greater than 45 ° and hilltops where restoration is mandatory (Calmon et al., 2011).

The LPNV also created an integrated online protocol for regulating environmental legal compliance and planning the productive use of rural properties. All landowners have to register their properties in the system known as "The Environmental Rural Register" (CAR in Portuguese), in which all APPs and RLs whether covered or not by native vegetation have to be declared, as well as productive areas in a geodatabase. Owners of landholdings with less native vegetation cover than the minimum required by law are obliged to implement restoration, and invited to adhere to the "Environmental Regularization Program" (PRA).

Legislation survey

The data used in this study was obtained in cooperation with the Brazilian Network for Ecological Restoration, also called REBRE (Isernhagen et al., 2017), consulted on the legal database of each of the 27 Brazilian states for CAR validation, or was provided or indicated by specialists spread across Brazil

For this study, we surveyed the regulatory standards of forest restoration in Brazil consulting the government's databases that guide two main drivers of forest restoration in Brazil; the Brazilian Federal Law 12.651/2012 (LPNV), and local regulations of environmental offsetting. In addition, we referred to the forecasts of monitoring as an indication of protocols to follow up restoration projects. We consider a regulatory standard as a benchmark promulgated by a regulatory agency, created to enforce the provisions of legislation.

Geodatabse survey

The geodata was collected on the National Database of Environmental Rural Registry (SICAR) of the State of Rio de Janeiro. It includes the spatial information of all rural properties and their environmental liabilities pointed automatically by the SICAR system. This is available at: http://www.car.gov.br/

The decision to restrict analysis of restoration projects occurring in the state of Rio de Janeiro is due to access to the environmental offsetting legislation database in a website: https://www.restauracaoflorestalrj.org/

Data analysis

We verified the existence or absence of legislation and its driver that can be the LPVN or offsetting policies (OP) as the following list: Federation State; Existence of legislation; LPVN legislation; OP legislation; Synergy of LPVN x OP; Restoration Method Prediction (RMP); RMP | Natural regeneration; RMP | Enrichment; RMP | Nucleation; RMP | Seedling;

RMP | Planting; RMP | Agroforestry; RMP | Mixed plantations; RMP | Topsoil transposition; Monitoring forecast; Deadline forecast; Monitoring protocol; Remote sensing monitoring; Self-monitoring; Self-monitoring methodology.

The collected information was organized into a spreadsheet where each parameter was verified for each of the 27 Brazilian states. The information was verified by reviewing the ongoing legislation and norms founded for each state.

The analysis of the geo database obtained on SICAR, and the maps were made on the software QGIS 3.12.1.

The data collection includes diverse ecosystem types as the Brazilian Atlantic Forest (Mata Atlântica) and Brazilian Savanna (Cerrado) biomes, recognized as global biodiversity hotspots (Myers et al., 2000).

Results and discussion

Since the launch of the Federal Decree nº 7.830 in 2012 which regulates the Environmental Rural Registry (CAR), this study found a positive correlation (R^2=0,968) in the number of local legislations linked to the Environmental Regularization Program (PRA). We found that 19 states have legislation in compliance with the PRA and the LPVN. In 2011, before the introduction of the CAR, only 2 states had forest restoration legislation in place that specifically applied for the environmental offsetting regulation.

This increment of regulatory standards since 2012 consolidated as an innovative tool for land-governance and environmental policies in Brazil creating conditions for developing an efficient monitoring system to determine critical deforestation areas, integrated government and NGO's efforts, and heavy investments from national and international funding agencies (Roitman et al., 2018).

The rising of new RS of forest restoration creates an unprecedented opportunity for implementing large-scale strategies that should be designed considering ecological aspects, but also socioeconomic matrix interests and uses of landscape to expand project strategies and methodologies while also supporting a more effective, long-lasting and inclusive restoration (Siqueira et al., 2021).

Our results indicate the increase of regulatory standards in Brazil, with a new scenario that comes with the emergence of PRA, and, 70,37 % of the Brazilian States have it as the sole policy with regulation regarding ecological restoration. With PRA and Offsetting considered, 92,5% of the States have regulatory standards as just two states have no standards established as shown on Fig. 1 and Fig. 2.

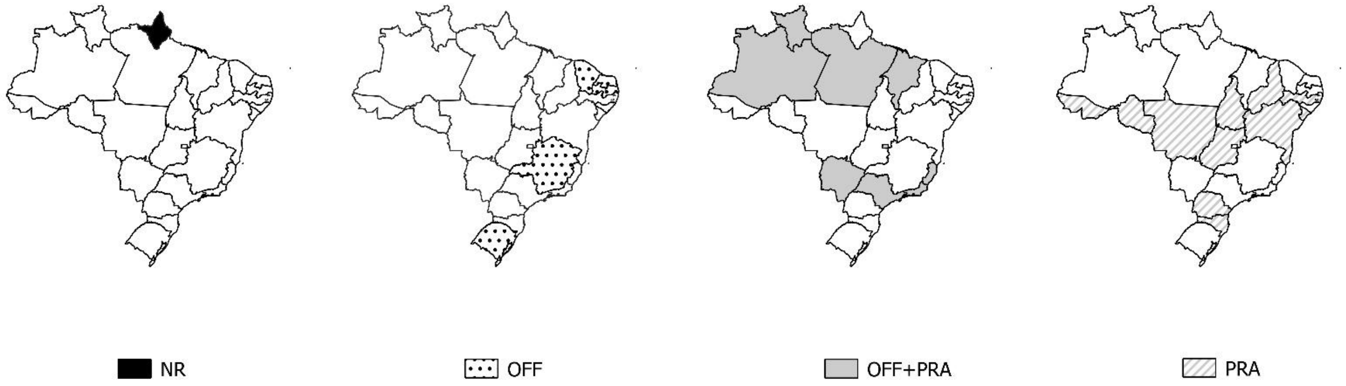

Fig.1. Brazilian states with associated regulatory standard drivers of forest restoration. Where: NR: no regulation; OFF: offsetting policy; PRA: Environmental Compliance Program.

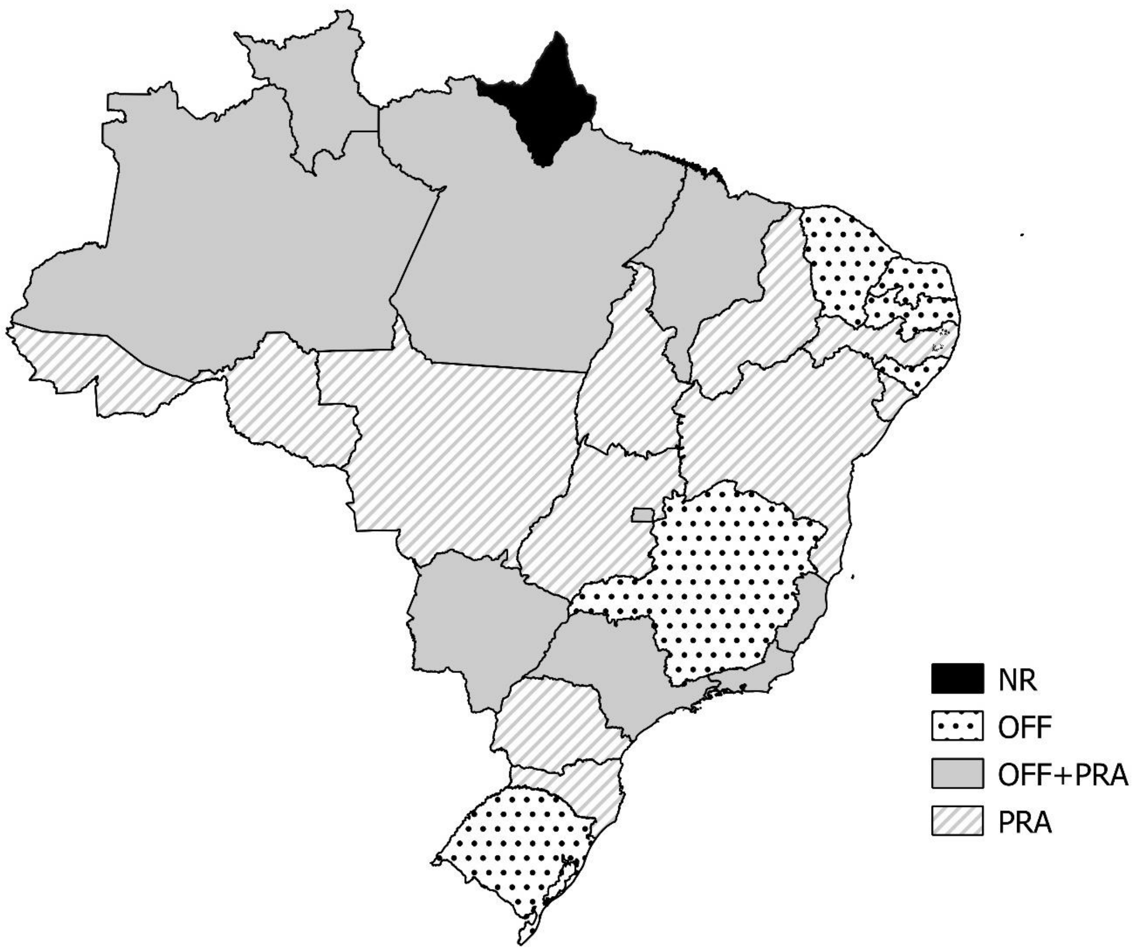

Fig.2. Brazilian states with regulation associated with forest restoration. Where: NR: no regulation; OFF: offsetting policy; PRA: Environmental Compliance Program.

Just four states have an established protocol of monitoring, although this activity is expected by 48,1% of the actual regulation. As, the current aim is to increase forest cover, with virtually no references on the regulatory standards to indicators of vegetation structure and functionality. Pacheco et al. (2021) indicate that the improvement of regulatory standards about forest restoration can contribute to the availability and quality of natural resources such as ecosystem services and biodiversity depend on the conservation and restoration of native vegetation.

Considering that ecosystem restoration is a long-term process, the evaluation of each stage of its trajectory may allow us to predict the success of the restoration goals. Given that there are plenty of indicators in the scientific literature for measuring restoration success, and there are stakeholders who are the key actors of restoration, is desirable to determine a common and simple set of indicators ranked by stakeholders for evaluating the restoration trajectory (Oliveira et al. 2021).

Despite the monitoring forecast on ongoing legislation, there is a clear gap in the absence of monitoring protocols, existing in only 4 states or 18% of the total of existing regulations.

Monitoring forest restoration projects are very useful when applied, especially in the context of offset policies intended to achieve serious compensation for environmental degradation or loss of biodiversity (Chaves et al. 2015). Besides that local governments, research institutions and NGOs, should promote efforts and of working in synergy to produce relevant information with the aim of ensuring the implementation of public environmental policies and thereby improving land use (Arvor et al. 2021).

1.1. Rio de Janeiro State overview

Rio de Janeiro is among the states that has specific monitoring protocol and regulatory standards applied to offsetting and the PRA program. By comparing characteristics of the restoration areas in Rio de Janeiro, our results indicated varied results as presented on Table 1.

Table 1. Comparison of forest restorable areas in hectares on CAR and environmental offsetting programs in Rio de Janeiro State

Parameter	**CAR**	**Offsetting**
Avg size (ha)	5.51	4.03
Total area (ha)	340.106,48	6.636
SD (ha)	15.47	12.71

The average size of the forest restoration areas used in environmental offsetting is 4.03 ha (SD= 12.71), and on the average size in CAR is 2.46 ha (SD= 15.42).

The average size of forest restoration areas has direct implications for farmers' land use. In the light of the fiscal modules (FMs) which roughly mean the area enough for a family to have income, survive, and thrive is a concept brought by the Native Vegetation Protection Law (Law 12.651/2012) and gives equal treatment to all people who own up to four FMs through the Environmental Regularization Program (PRA) for small properties and family agriculture. Oliveira et al. (2020) used a case study in the state of Rio de Janeiro to analyze how updating the FM affects the PRA proposed by the Native Vegetation Protection Law and found that the existing FM groups in the state, which range from 5 to 35 ha.

The total area in the process of implementation or with a legal commitment to offset is 6.636 ha o and the total area that the CAR stipulates needs to be restored is 340.106.48 ha, divided between 286.275.24 ha for RL and 53.831.24 ha for APP.

This difference in the average size of the polygons can be explained because of the recovery of the APP varies depending on the size of the rural property, according to article 61-A of Federal Law nº 12.651/2012. The LPVN determines that the restoration projects can be done in a strip starting from 5 meters wide up to 100 meters along streams, springs, and rivers.

It is relevant to consider that that 53% of Brazil's native vegetation occurs on private properties which represent around 105 ± 21 GtCO2e (billion tons of CO2 equivalents) and play a vital role in maintaining a broad range of ecosystem services, so management of these private landscapes is critical if global efforts to mitigate climate change are to succeed (Soares-Filho et al. 2014).

It is also important to state that the size of the restoration projects can compromise the long-term biodiversity goals. There appears a negative correlation on the project size and the success of restoration in terms of biodiversity (Crouzeilles et al., 2016).

This difference has implications on financing and on the forest landscape restoration approach (Schultz et al., 2012) and should be part of a longer-term policy shift emphasizing large-scale, collaborative, and adaptive planning. It should be considered when planning environmental policies because it can suggest an improvement of 7,7 % of the Rio de Janeiro State area with forest cover. Currently Rio de Janeiro has 30% covered by native forests (SOS Mata Atlântica, 2017). In this case, planting is one of the steps and guaranteeing the results through monitoring is essential.

Monitoring systems

The evaluation of the methods and indication of forest restoration techniques in 14 states showed an average of prediction of techniques of 4,85 (±2,75). The state of São Paulo is considered a trendsetter, with its normative instrument mentioning 8 different restoration methods prediction (RMP) followed by the Federal District (7) and Rio de Janeiro (7). It is important to mention that no restriction was found on any RS the use of any forest restoration technique.

In Rio de Janeiro, the State Environment Agency (INEA) is pioneering the application of protocols providing a new legal framework in restoration, focused on the ecological "results" of restoration, rather than simply assessing the extent of implementation (Albuquerque et al., 2021).

At this point, it is important to avoid complex measures such as ecosystem services, carbon sequestration or biodiversity and ecosystem functionality (Tilman et al., 2014) due to the lack of qualified staff for monitoring forest restoration initiatives or even the costs involved on the data survey. Moreover part of the success of large-scale restoration is related to the development of restoration governance, communication, and articulation, promotion of strategies to influence public policies, and establishment of restoration monitoring systems (Crouzeilles et al., 2019).

The results indicate that only four states have established monitoring protocols in place though the use of remote sensing for monitoring is being analyzed in seven states (26% of total).

Two states, Acre (AC) and Federal District (DF), are developing auto-monitoring systems for the PRA, and its implementation is to be conducted by the respective landowners, that will simplify and turn more accessible the monitoring practice.

Communication is essentialand a good example is the Rio de Janeiro Forest Service (GESEF), which regularly promotes meetings and workshops to keep stakeholders informed and trained on the monitoring protocols and legal instruments of the local legislation, creating a channel to receive feedback from the system's users.

The GESEF experience reveals that the acceptance and compliance with the regulations on forest restoration is higher when the stakeholders are involved (Moura et al., 2019). The sustainability and adherence to the legislation should be based on the three pillars: feasibility, desirability and liability of application of the established laws.

Conclusions

The practice and management of forest restoration and its monitoring, still a novelty for governments and environmental agencies. The uprising of specific regulatory standards for forest restoration indicates that and may enhance restoration effectiveness by clarifying the restoration process and rules to all stakeholders involved in implementing projects. The Federal Decree nº 7.830 in 2012 which regulates the Environmental Rural Registry (CAR) led to the emergence of state regulations, aimed at organizing environmental regularization initiatives on rural properties. In addition to regulatory standards and policy instruments, monitoring still incipient, and few regulatory standards predicted the activity. However, states must conduct their restoration asset surveys in order to develop environmental policies and strategic planning that can generate multiple environmental and socio-economic thereby meeting international restoration commitments.

The state of Rio de Janeiro can be considered a reference model since it gone beyond the regulatory standards, but created a forest restoration management system, ensuring access to information, transparency, and effectiveness in communicating and monitoring environmental commitments.

Finally, it is necessary that the public authorities organize, prepare and create mechanisms that facilitate the new reality that arises from environmental adequacy in rural properties throughout Brazil. When implemented, forest restoration can guarantee and maximize the social and environmental benefits resulting from this activity.

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