



White Paper

A critical analysis of the Native Vegetation Protection Law of Brazil (2012): updates and ongoing initiatives



Pedro H.S. Brancalion^{a,*}, Letícia C. Garcia^b, Rafael Loyola^c, Ricardo R. Rodrigues^d, Valério D. Pillar^e, Thomas M. Lewinsohn^f

^a Forest Sciences Department, Escola Superior de Agricultura Luiz de Queiroz, Universidade de São Paulo (USP), Piracicaba, SP, Brazil

^b Center of Biological and Health Sciences, Universidade Federal de Mato Grosso do Sul (UFMS), Campo Grande, MS, Brazil

^c Conservation Biogeography Laboratory, Ecology Department, Universidade Federal de Goiás (UFG), Goiânia, GO, Brazil

^d Biological Sciences Department, Escola Superior de Agricultura Luiz de Queiroz, Universidade de São Paulo (USP), Piracicaba, SP, Brazil

^e Ecology Department, Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, RS, Brazil

^f Animal Biology Department, Biology Institute, Universidade Estadual de Campinas (UNICAMP), Campinas, SP, Brazil

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ABSTRACT

The Native Vegetation Protection Law of Brazil, which replaced the Forest Code from 1965, is still undergoing regulation at federal and state levels, and the constitutionality of some clauses are still in question. In order to support legal rulings, decisions by public officers, and to inform other stakeholders, we present a balanced assessment of the positive and negative consequences of Native Vegetation Protection Law in light of current scientific knowledge. Key advances were noted in the systems of controls and incentives, which promoted new mechanisms and policies to support the implementation of this law. The main environmental setbacks were (i) the removal of protection of certain environmentally fragile areas, (ii) the concession of amnesty of fines incurred for violating the preceding legislation, (iii) allowing continuous farming or maintenance of infrastructure in areas protected by law, without full recovery of native vegetation. The weakening of Native Vegetation Protection Law may hamper soil and watershed protection, biodiversity conservation, and even agricultural productivity, without manifest benefits for the country. On that account, we recommend that: (i) judiciary rulings and state and county regulations to correct pending issues with the Native Vegetation Protection Law based on scientific knowledge and with wider citizen participation; (ii) the strengthening of agencies for rural technical assistance; (iii) the development of incentives to develop the supply chain for native vegetation recovery; (iv) the regulation of compensation for Legal Reserves based on clear and robust environmental criteria; and (v) the assessment of legal compliance has also to be based on the environmental quality of recovered areas.

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* Corresponding author.

E-mail addresses: pedrob@usp.br, pedrobrancalion@gmail.com (P.H.S. Brancalion).

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Introduction

Almost four years ago the new norms that regulate the exploration, conservation and recovery of native vegetation in Brazil came into force, after a 13-year debate in the National Congress. These norms are defined in Law n° 12,651, sanctioned, with some vetoes, on May 25, 2012, by the President of the Republic, Dilma Rouseff, and altered by Law n° 12,727 from October 17, 2012. The current law, formally entitled *Native Vegetation Protection Law (NVPL – Lei de Proteção da Vegetação Nativa*, in Portuguese), is popularly known as the *New Forest Code*. However, the latter denomination is inadequate since it is not a code (i.e. a set of legal instruments referring to a specific juridical field, such as the Penal Code) and it does not comprise only forests. This law encompasses any and all native terrestrial ecosystems, including grasslands, shrublands, and savannas.

The NVPL defines the proportion of a given rural property that can be used for agriculture, silviculture or cattle ranching, as well as the area of native vegetation that must be maintained under protection or restricted use. It also defines situations in which landowners and landholders are required to recover natural vegetation on their land. Compliance with the NVPL is key for the preservation of what is left of the Brazilian flora, fauna and water resources: 53% of all remaining native vegetation in the country is located in private rural properties, rather than Protected Areas (Soares-Filho et al., 2014); in the Atlantic Forest, the most degraded biome in the country, where more than 60% of the Brazilian population live, this proportion reaches 90% (Ribeiro et al., 2009). The implementation of the NVPL is also essential to recover native vegetation remnants that have been eliminated from environmentally important areas in rural properties and, thus, ensure the provision of environmental services in each ecosystem, such as water for agriculture and human consumption, and the buffering of climatic variation. Such services are indispensable for the development of agriculture as well as for the well-being and safety of human populations who live in urban or rural areas.

Although the NVPL is in force since 2012, the regulation of some of its provisions will be effected at the state level. The pending ruling on the constitutionality of some provisions of this law by the Supreme Federal Court may also lead to significant changes that can both increase the rigor of the law for those that suppressed more native vegetation than was allowed in the past, and increase the demands regarding the recovery of preservation set-asides in rural properties. In the final section of this text, we evaluate some of the current actions that may modify the NVPL and show guidelines that could – in the authors' views – redirect the environmental legislation to attain its most important objectives with greater effectiveness and less ambiguity.

After the enactment of the NVPL in 2012, further discussion on the controversial aspects of this law were considered to be irrelevant and futile in the public eye, and even by many professionals and researches. Our understanding is the exact reverse. It is necessary to resume the technical and scientific debate of the NVPL, especially on its more polemic and ambivalent aspects, in order to provide guidelines for future

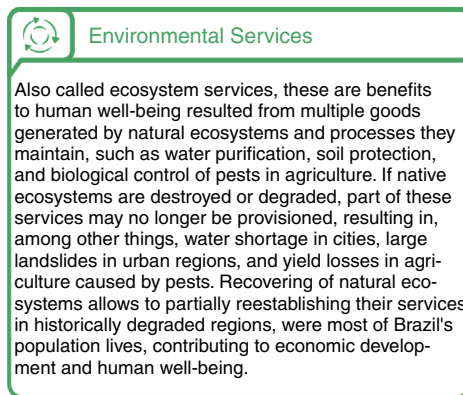


Fig. 1 – Environmental services – definition and implications for the Native Vegetation Protection Law.

decisions on regulations at the state level, and for possible rulings and adjustments by the Supreme Court. Regulation by states has already started without such guidelines, as well as enforcement of the NVPL by the Federal Government (Lima et al., 2014). The Brazilian scientific community must contribute to this discussion with a critical evaluation (Loyola and Bini, 2015), based on the positive and negative consequences that the enforcement of this new law could entail for agricultural production, biodiversity conservation, and the provisioning of environmental services (Fig. 1).

The present text is a White Paper produced by authors invited by the Brazilian Association of Ecological Science and Conservation (ABECO). A “White Paper” is an official document, usually published by a government, institution or international organization with the purpose of informing society about an important topic of discussion and providing guidelines on how to approach its associated problems, thus helping readers to form their own opinion or to make decisions. The present White Paper aims at offering a balanced analysis, in light of the current scientific knowledge and the practical experience of scientists who have been working on relevant aspects extensively for years, of the positive and negative consequences that may ensue from the implementation of the new environmental legislation.

Previous versions of the NVPL

The regulation of the exploration, conservation and recovery of native vegetation was initiated in 1934 with the first Brazilian FC (Federal Decree #23793 of 1934). This decree had the objective to mitigate the unruly expansion of agriculture over native vegetation in areas of great environmental importance, such as riverbanks and fountainheads (Fig. 2). Thirty years later, Federal Law # 4471 of 1965 created a more effective and objective version of the original FC, with clearer criteria for the conservation and rational use of native vegetation in rural landholdings. For example, the location and dimensions of Areas of Permanent Protection (APPs) were first determined and, in the case of water courses, varied according to their width. Besides the 1965 FC, three other Federal laws, still in force, complemented the Brazilian environmental legislation:

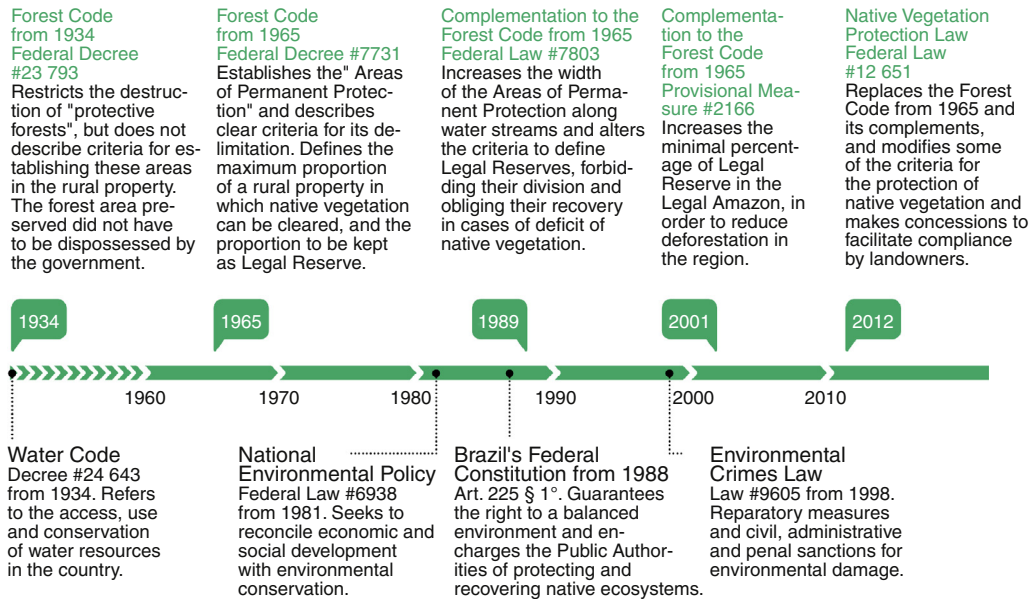


Fig. 2 – History of environmental legislation in Brazil, which consolidated the Forest Code as the chief legal instrument to protect and recover native vegetation on private properties in Brazil.

law #6001 of 1973, known as the “Indigenous Statute”, which set rules for the conservation of natural ecosystems in indigenous lands; Law #9605 from 1998, commonly known as the “Environmental Crimes Law”, which refers to the civil, penal, and administrative sanctions for conducts and activities that harm the environment; and Law #9985 of 2000, which created the National System of Conservation Units (SNUC in Portuguese) and defined the rules for the preservation of native fauna and flora in these areas (Fig. 2). Despite the importance of these three laws, the improvement of the legislation that rules the use, conservation and recovery of native ecosystems in rural properties is fundamental, since these properties occupy ~80% of the national territory (Sparovek et al., 2010), and, as mentioned above, they hold more than half of the remaining native vegetation cover in the country.

Even before the enactment of the NVPL, the Federal Constitution of 1988, which prevails over federal and state laws, in Article 225 had already provided for the protection of the Brazilian fauna and flora and the preservation of their ecological functions (Fig. 2). A year after the promulgation of the Federal Constitution, Law # 7803 of 1989 strengthened the 1965 FC by increasing the width of APPs riparian corridors to be maintained along water courses. Much of the original vegetation that needs to be recovered today has been lost due to both legalized suppression, before the establishment of environmental laws or their strengthening, and illegal suppression, in violation of the environmental legislation, such as the lack of environmental and production criteria for the rational expansion of the agricultural frontier, increase of cultivated areas to maximize profits, inadequate knowledge of the law, and the feeling of impunity created by poor enforcement.

Since the enactment of the Environmental Crimes Law (Law # 9605 of 1998), governmental agencies responsible for environmental compliance increased law enforcement, and the lack of compliance with the FC from 1965 led to civil,

administrative, and penal sanctions, as well as the imposition of corrective measures. There were several initiatives to reorganize land use in rural properties to meet legal requirements, but landowners were upset by the possibility of criminal prosecution in consequence of not conforming to the 1965 FC. Major entities that represent rural proprietors, such as the Confederation of Agriculture and Livestock of Brazil (CNA), increased pressure on the National Congress and started a political movement to draw up a new law to replace the FC of 1965 (Fig. 3).

Due to the Environmental Crimes Law, initiatives for the environmental regulation of rural properties originated from the international market for agriculture export commodities, in order to avoid legal sanctions and enable environmental certification to attend to foreign market requirements. Additionally, initiatives of corporate social responsibility of agricultural companies, mainly large-scale soy and beef producers, led farmers to engage in programs of land use planning to comply with legal and environmental criteria (Rodrigues et al., 2011; Nepstad et al., 2014). Consequently, there was a significant increase in the inspection of rural properties and punishment for law infringements in the years that preceded approval of the NVPL, which added to the pressure on non-compliant landowners and farmers.

Since the end of the 1990s, Brazilian congressmen debated the need to reformulate the 1965 FC based on a series of arguments. First, it was necessary to resolve the legal insecurity and additional demands of environmental recovery created by the amendments to the original law. Additionally, the regularization of properties that did not conform to the previous legislation should be facilitated, and social justice of the environmental legislation should be improved by reducing conservation requirements in small rural properties. Congressmen also suggested a complete reform of the 1965 FC to sanction farming activities and infrastructure facilities

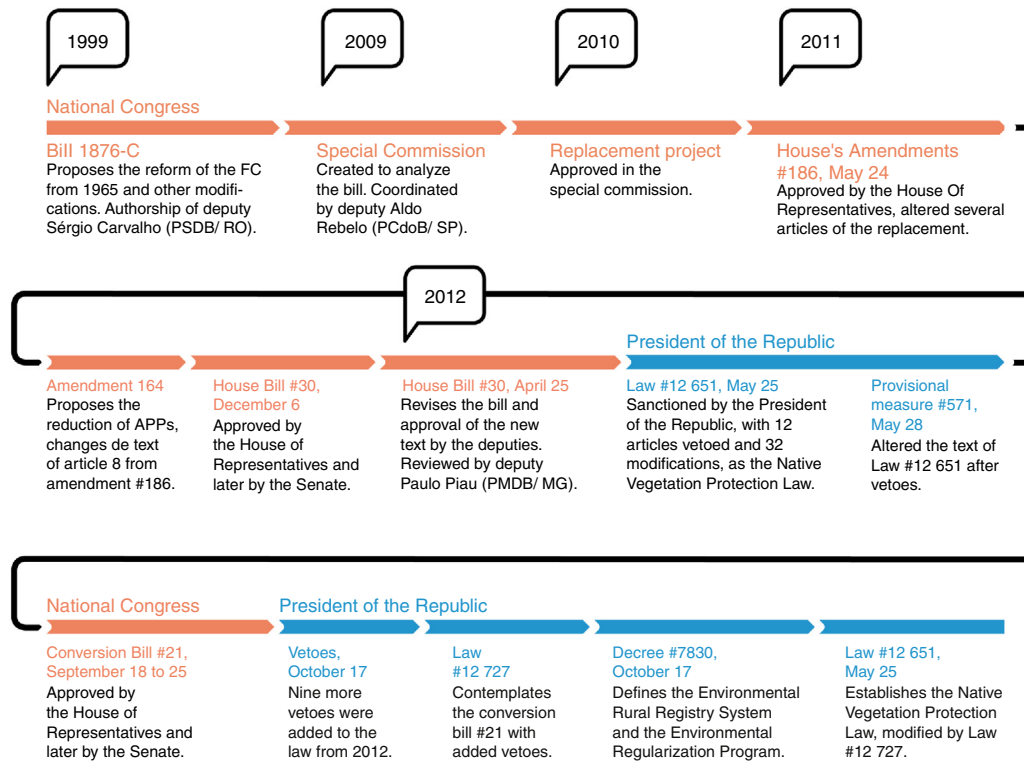


Fig. 3 – Legislative processes that led to the creation of the Native Vegetation Protection Law.

in legally protected areas that had been historically occupied by certain crops, such as coffee and banana plantations or vineyards on steep slopes and hilltops, and rice plantations in floodplains. Hence, the aim was to establish a new legal baseline, with rules that were expected to be clearer and more appropriate for contemporaneous Brazilian social and rural circumstances.

This initiative for legal reform, set in motion mainly by the agribusiness sector, gained strength from 2009 on in the National Congress (Fig. 3). Despite some scheduled public hearings and nominal consultations, there was little participation from the civil society and scientists whose research was relevant to the subject (Loyola and Bini, 2015). Researchers, through representative associations such as the Brazilian Academy of Sciences (ABC), the Brazilian Society for the Advance of Science (SBPC), and the ABECO, formulated proposals and suggestions that were submitted to Congress representatives and aides and to officers in the concerned Ministries (Lewinsohn, 2010; Metzger, 2010; Silva et al., 2012). However, these proposals were disregarded in the final version of the NVPL, enacted in 2012.

Advancements and setbacks of the NVPL

The changes brought about by the NVPL, which revoked and replaced the FC from 1965 can be summarized in three headings: (a) *general provisions*, which contain the mandatory rules to be observed by all rural properties since the enactment of the law; (b) *transitory provisions* containing concessions to favor the regularization of properties that were non-compliant with

the 1965 FC and pardoning all offenses previous to July 22, 2008 (the enactment date of Federal Decree #6514, which regulates the Environmental Crimes Law and specifies environmental infractions and sanctions); and (c) *control and incentive systems*, which led up to the creation of new mechanisms and public policies to subsidize the implementation of the NVPL. The main advances of this law are in the new *control and incentive systems*, whereas the environmental setbacks noted by the scientific community derive from the *transitory provisions* and certain *general provisions*. Some critical issues are discussed below.

Advances

The greatest merit of NVPL lies in the establishment of innovative programs of control and incentive to facilitate and promote compliance with the law. In the past, enforcement of the 1965 FC had to rely on localized denunciations or environmental enforcement officers. To address this gray area, the NVPL established the Environmental Rural Registry (CAR, in Portuguese), the Environmental Compliance Program (PRA), the Project for Recovery of Degraded and Altered Land (PRADA), and the Environmental Reserve Quotas program (CRA), which were set by Federal Decree #7830, on October 17, 2012. These four institutional tools allow for comprehensive and integrated management, advancing beyond monitoring and enforcing compliance.

The CAR is a free self-declaratory system for online registry of rural properties and rural holdings and their status as to the environmental NVPL demands. The registry tool produces a diagnosis of environmental compliances and

non-compliances of the landholding, and the information compiled in CAR will provide public authorities with a broad profile of the environmental status of rural properties in Brazil according to legal requirements, which will underpin programs of incentives for compliance as well as control, monitoring and enforcement actions. Properties not registered in CAR will suffer restrictions to obtain environmental licenses or rural bank financing; conversely, registered properties will be entitled to financial support (Central Bank Resolution # 4226/2013). This did stimulate massive engagement of landowners and landholders. Up to February 29, 2016, approximately 2.4 million rural properties, which encompass an area of 269 million hectares (67.6% of the total land required to be registered), had already been incorporated in the CAR, according to the Brazilian Forest Service (<http://www.florestal.gov.br/cadastro-ambiental-rural/numeros-do-cadastro-ambiental-rural>).

After being notified of their environmental liability by CAR, non-compliant rural properties or holdings either for not having the minimal required native vegetation cover in APPs or for a deficit of Legal Reserve set-asides (LR, Fig. 4), may enlist in the PRA to comply with the law, committing themselves to recover on-farm or compensate off-farm their vegetation deficit at the extent established by law. PRA was regulated by Federal Decree # 8235/2014 as part of the Program “Mais Ambiente Brasil”. Joining such program brings advantages, such as the suspension of fines and the possibility to “consolidate” (i.e. legalize) agricultural activities and infrastructure in APPs. After signing their commitment to PRA, the environmental liability of rural properties or holdings can be settled through devices such as the PRADA, where the person or company responsible for the property pledges to maintain and recover native vegetation in APPs and/or LR, or to compensate their LR deficit through instruments such as environmental leaseholds, purchasing either areas with native vegetation or Environmental Reserve Quotas (CRA), which must be within the same biome as the penalized property (Zakia and Pinto, 2013). Whatever the alternative, the landowner or landholder is formally committed to public authorities to be fully compliant with the law within 20 years, recovering farmlands gradually (10% of the area to be recovered every two years). This commitment can be monitored periodically by overlapping satellite images of native vegetation cover and the areas declared in CAR. Rural properties and holdings that do not join PRA or do not comply with PRADA will be submitted to more rigid rules, which include greater areas to be recovered and proscription of farming in areas whose use was prohibited according to the 1965 FC.

The NVPL further increased the enforcement power of public authorities by establishing, in Article #26, that the landowner or landholder must request authorization of the environmental agency to suppress native vegetation outside APPs and LRs. This requirement, non-existent in the 1965 FC, enables public authorities to implement effective actions of land-use planning over 97.9 million hectares of forest and non-forest ecosystems in the Brazilian territory. However, this demands adequate criteria with a sound scientific basis to concede or deny authorizations for suppression (Overbeck et al., 2015). Biased interpretations of the NVPL may hinder this advance. For example, in the State of Rio Grande do Sul,

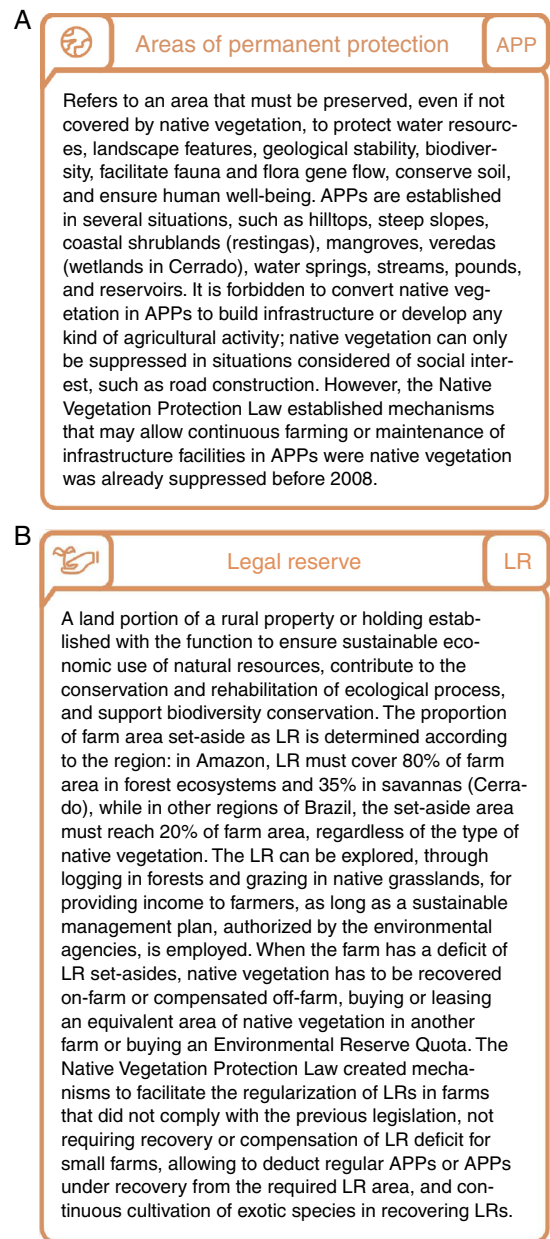


Fig. 4 – Definition of Areas of Permanent Protection (APP) and Legal Reserve (LR).

State Decree #52431/2015, passed under pressure from rural associations, allows grazed native grasslands to be considered as “rural areas consolidated by suppression of native vegetation used as pasture”. This classification hinders the effective protection of remaining native grasslands in the Pampa biome in Southern Brazil, by providing an opening to convert them into pastures of exotic grasses without any major legal impediment. Such distortion of the intent of environmental law highlights the importance of science-based regulation.

It is worth noting that the NVPL also establishes the possibility of using economic mechanisms, such as Payment for Ecosystem Services (PES) to stimulate the conservation and recovery of native vegetation in Brazil. Nevertheless, here again we note the lack of comprehensive and explicit

regulation protocols to guide application of PES, although this mechanism is already being employed in several parts of Brazil (Richards et al., 2015). For example, there are no federal public policies or regulations so far to define conditions of eligibility for financial compensation, modes of payment, the agencies responsible for payments, amounts or sources of resources to be allocated for compensation payments, or the parameters for evaluation whether environmental goals, such as services provisioned, are in fact being achieved.

Setbacks

The *general provisions* of the NVPL retained most of the requirements in the 1965 FC for the conservation of APPs and LRs. But some of these new provisions drastically reduced, or even completely removed the obligation to protect certain areas of key environmental importance that were protected under the preceding FC. This reduction can be clearly perceived in four cases. First, the exclusion of intermittent springs from the APP category. Such springs are more vulnerable to degradation because they do not produce water at certain times; however, they are no more considered APPs in the NVPL. Similarly, natural or artificial lentic water bodies with less than one hectare in surface area no longer require an APP buffer around their borders, even if these areas were created through damming, and consequent degradation, of a spring; this also disregards the importance of such water bodies for regional water services. The third case refers to hilltops: due to revised criteria for the preservation of such sites the total protected area on hills and mountaintops in Brazil was reduced by 87% compared to the preceding FC (Soares-Filho et al., 2014). The fourth example of a retreat imposed by the NVPL is the potential reduction of the native vegetation buffer to be maintained along streams. Previously, the width of preservation and restoration along riverbanks was scaled according to the maximum water level during the rainy season, whereas now it is set according to the regular river channel outside the rainy season. This modification has little impact on water bodies within steeper valleys, due to relieve restriction to streams overflowing. However, for rivers in plains, the area of native vegetation effectively conserved can be reduced by

half or more, since the APP buffer can be submerged when rivers are overflowing and their borders remain unprotected by native vegetation in this period (Garcia et al., 2013).

On the other hand, the NVPL *transitory provisions* softened the requirements to restore native vegetation, reducing the potential restoration area to 58% compared to the precedent legislation (Soares-Filho et al., 2014). This reduction comes from exceptions provided by the NVPL for landowners and landholders to regularize native vegetation deficits under the new law. Among these concessions, we highlight: (i) no required restoration of LRs in properties whose area is smaller than four fiscal modules (the fiscal module is the minimum size of an economically viable rural property, based on the main farming activities and socioeconomic indicators of each county in Brazil; this varies from 5 to 110 ha among regions). Previously, restoration was mandatory for all properties with a LR deficit, regardless of size; (ii) the possibility of reducing the area to be restored along streams, through exclusion (“consolidation”) of areas of APPs used for continuous cultivation (Fig. 4); (iii) no requirement to restore native vegetation in other types of APPs, such as hilltops and steep slopes; and (iv) the possibility to deduct regular APPs or APPs under recovery from the required LR area, so that the minimum percentage of native vegetation to be maintained as LR may be partly attained with APPs (the 1965 FC only allowed this in specific cases).

The obligation to restore native vegetation in APPs along water streams, one of the novel demands in the *transitory provisions* of the NVPL may, in some cases, have a paradoxical effect. Although the 1965 FC did not clearly require APP restoration, no farming activity was allowed in these areas, allowing the spontaneous recovery of native vegetation through natural regeneration wherever possible. By not requiring the restoration of APPs on hilltops and hillsides, and by establishing very narrow strips to be restored along water streams, with widths varying from 5 to 100m (Fig. 5), the total area to be restored will be reduced, despite the current obligation to restore APPs along water streams. This measure will significantly benefit native vegetation in severely deforested regions with a long history of intensive land use, such as the Atlantic Forest, where natural regeneration by now tends to be slow

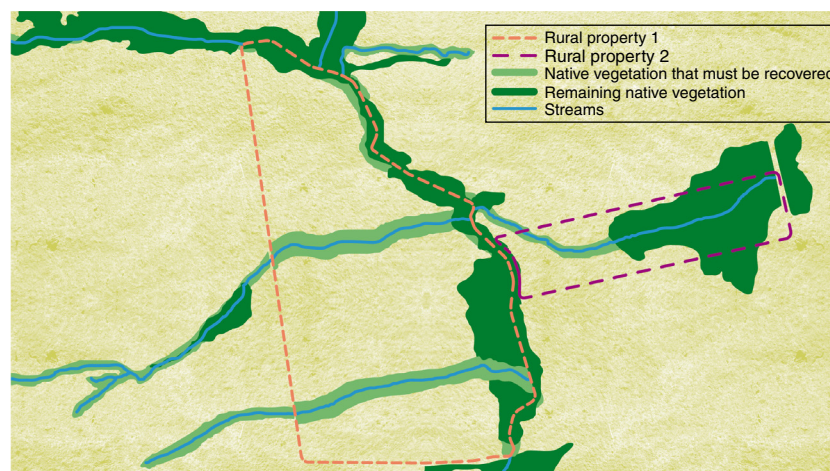


Fig. 5 – The reduction of native vegetation recovery strips in Permanent Preservation Areas (APP) associated to streams. (FC, Forest Code; FM, fiscal module).

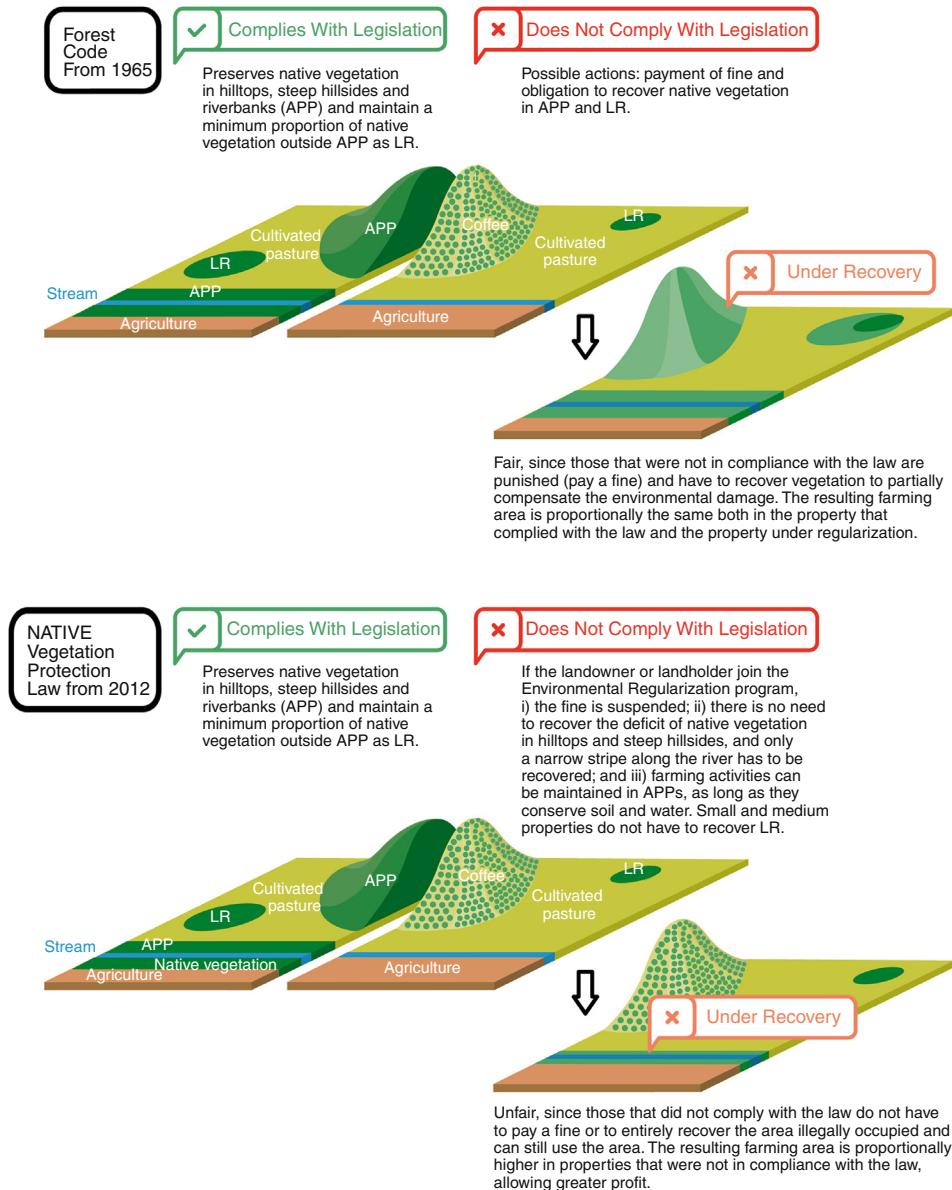


Fig. 6 – Since the Native Vegetation Protection Law defined that the width of riparian vegetation to be restored varies according to the size of the rural property, there may be large discrepancies in the size of riparian buffers between neighboring properties, which would equally affect ecological functions, such as soil and water protection and their use as an ecological corridor for fauna.

and ineffective. However, in regions such as large tracts of the Amazon, degradation is more recent and the landscape contains many natural remnants to support further regeneration in agricultural areas, so that natural regeneration is feasible. In such cases, legalization of farming activities in APPs may slightly reduce the potential area of native vegetation along water streams, restricting it to narrow corridors whose width is set according to the property size and river width (Fig. 6). Moreover, these extremely narrow strips of vegetation will have little effect on both biodiversity conservation and maintenance of environmental services. Several studies show that vegetation corridors along water streams have to be at least 50 m wide to be utilized by many animal species (Tubelis et al., 2004; Lees and Peres, 2008; Metzger, 2010; Ramos and

Anjos, 2014). One of the key factors for the effective restoration of native vegetation along water streams is the containment of local sources of degradation, such as extensive cattle grazing or continuous cultivation.

Another significant setback of the NVPL was the partial disregard of the environmental functions of APPs and LRs that were defined in the previous FC. The NVPL allows the legalization of both farming and infrastructure facilities that were already present in areas along river streams, on hilltops or on hillsides. Therefore, the law ratifies illegal actions of the past, considered now as accomplished facts. This possibility allows for the perpetuation of degradation in these areas by keeping them devoid of native vegetation. According to the NVPL, farming activities in APPs must incorporate suitable practices

for the conservation of soil and water bodies; however, the enforcement of such practices is not practicable. In this sense, very narrow strips of native vegetation associated to lands of continuous farming in APPs may be useless as environmental offsets.

In the case of LRs, the possibility to compensate past native vegetation suppression in a rural property by buying or leasing land in another property covered by native vegetation within the same biome, regardless if this property is in another watershed or even in another state, restricts biodiversity conservation and the maintenance of environmental services in widely degraded regions, such as Southeast Brazil. The high price of land in some regions of Brazil is likely to dislodge compensation areas to other regions in order to reduce costs. In this way, the transference of compensation areas ignores environmental criteria related to the fundamental function of LRs. This cost reduction is obtained at the expense of restoration of watersheds of importance for water supply to population and priority landscapes to assist gene flow and the movement of plants and animals, with direct impacts in crop pollination and biological control of pests.

The authorization to permanently cultivate exotic woody species in up to 50% of the LRs that will be restored is also highly questionable. This again disregards the main environmental functions of the LRs, especially its role for conserving the native flora. It is important to note that this provision does not restrict the use of invasive species, which may reduce populations of native species and negatively affect environmental services not only in the target area, but also in neighboring remnants of native vegetation, which can be colonized by invasive species introduced in LR areas.

In addition to reducing recovery requirements and allowing continuous farming in areas that should be covered by native vegetation, the NVPL allowed, conditioned to adherence to the PRA, the amnesty of fines for all rural landowners and landholders that were not in compliance with the 1965 FC and annulled obligations to recover their property from environmental degradation. This wide-ranging amnesty may apply to up to 90% of the rural properties in Brazil, indirectly punishing those that were historically in accordance with the law (Soares-Filho et al., 2014). Furthermore, these amnesties establish a dangerous precedent for two reasons. First, they create an expectation that future reviews of the law may again benefit those that did not comply with it. Second, by releasing landowners from legally responding for the damage they caused, and allowing them to continue to profit from these areas through farming while farmers that complied with the previous law do not have access to this benefit (Fig. 7), they ensure higher economic returns for those that committed environmental crimes.

Uncertainties

Almost four years after the NVPL was enacted, there is still substantial uncertainty regarding how the new law will be implemented. Some aspects require regulation, and the control programs and incentives for the full implementation of the NVPL remain to be created and implemented. Furthermore, the Supreme Court has yet to adjudicate on appeals

that question the constitutionality of certain parts of the law. Given the current state of affairs, we can offer only a partial assessment of the consequences of the NVPL that are of most concern for various sectors of our society. Most of the scientific community and environmental movements and entities fear that the new law will entail increased losses of native vegetation and reduced recovery in regions with advanced stage of environmental degradation due to the setbacks identified above. On the other hand, landowners fear that attending to the NVPL requirements will render their properties unprofitable, since they may be obliged to use part of their productive land to restore native vegetation using their own funds. Some of the potential impacts of the NVPL on biodiversity conservation, provision and maintenance of environmental services and for agricultural production deserve further discussion.

Biodiversity conservation

Several articles of the NVPL forbid the conversion of native vegetation to new agricultural areas. But exceptions provided for in some clauses, as well as ambivalent wording generate contradictions that may, in several cases, invalidate this principle. Contradictions arise mainly from transitory provisions which reduce the proportion of native vegetation that must be preserved in rural properties. Uncertainties regarding the content and validity of the new law beset its implementation and put the native vegetation in Brazil under added threat. This is especially noted in the Cerrado and Caatinga, which are, respectively, the most diverse savannah and semi-arid biomes of the planet and are under increasingly severe pressure from the expanding agricultural frontier (Soares-Filho et al., 2014). In the year following the publication of the NVPL, the rate of suppression of native vegetation in the formal Brazilian Amazon region ("Amazônia Legal") increased by almost 30%, reversing a trend of reductions in the previous 10 years (PRODES, 2014). The Atlantic Forest biome suffered an average increase of 9% in the rate of suppression of native vegetation, which in the State of Piauí reached 150% (SOS Mata Atlântica and INPE, 2014). These data maintain Brazil in the shocking position of the country with the highest rate of native vegetation destruction in the world (FAO, 2015).

The loss of habitat area is the main driver of species extinctions in Brazil (Ribeiro and Freitas, 2014). Consequences of these extinctions are globally important, since Brazil is the country with the highest biodiversity in the world (Lewinsohn and Prado, 2005). Even if suppression of native vegetation were to be fully stopped, many plant and animal species found in highly fragmented and altered ecosystems, such as the Atlantic Forest, may still be driven to extinction due to their reproductive isolation and reduced populations. Many of these species survive in precarious conditions in small and degraded fragments of native vegetation, isolated by vast areas of plantations and urban areas (Fig. 8). Recent studies indicate that there is an abrupt decline in the ecological integrity of natural communities of several animal groups when the proportion of native vegetation in a region drops below the threshold of 30% and 43%, respectively, in the Atlantic and Amazon forests (Pardini et al., 2010; Banks-Leite et al., 2014; Ochoa-Quintero et al., 2015). Given that only 11–16% the original Atlantic Forest cover is left (Ribeiro et al., 2009) and that many regions of other

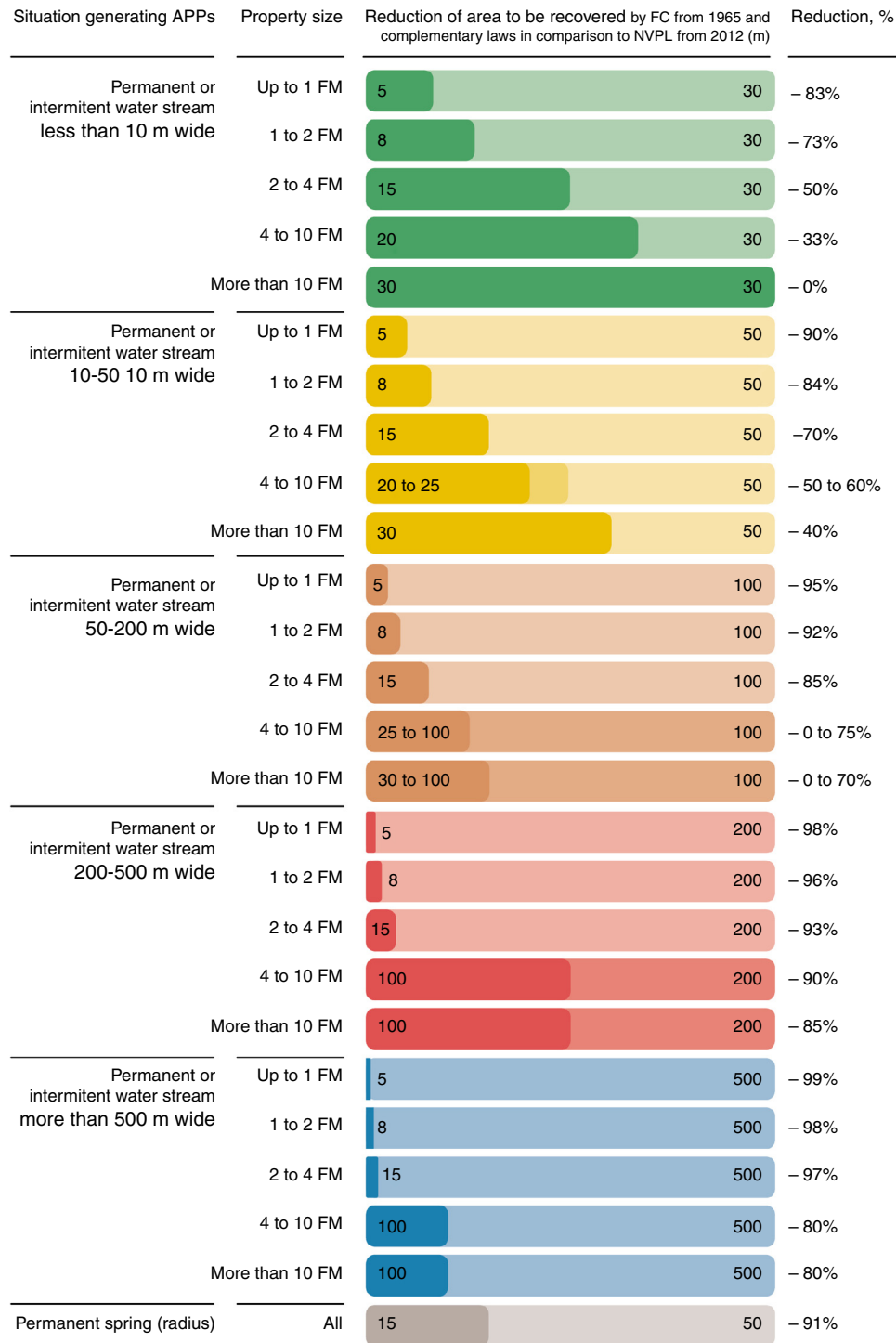


Fig. 7 – A comparison of rural properties that did and did not comply with the 1965 Forest Code as to soil use and the required recovery of native vegetation, according to the 2012 Native Vegetation Protection Law, in APPs and LRs.

Brazilian biomes are already below the thresholds detected in these studies, many extinctions seem to be imminent, it is just a matter of time.

The implementation of the NVPL may aggravate this scenario by allowing the reduction of up to 58% of the area required to be restored, and allowing compensation of LR deficits far from regions in urgent need of an increase in native

vegetation (Soares-Filho et al., 2014). These extinctions can be partially prevented through large-scale restoration of native vegetation, especially in areas that increase the connection of isolated fragments in the landscape (Brançalion et al., 2013). Hence, the dimensions of APPs and LRs defined in the 1965 FC should be retained, or even increased in critically endangered and fragmented ecosystems (Metzger, 2010).

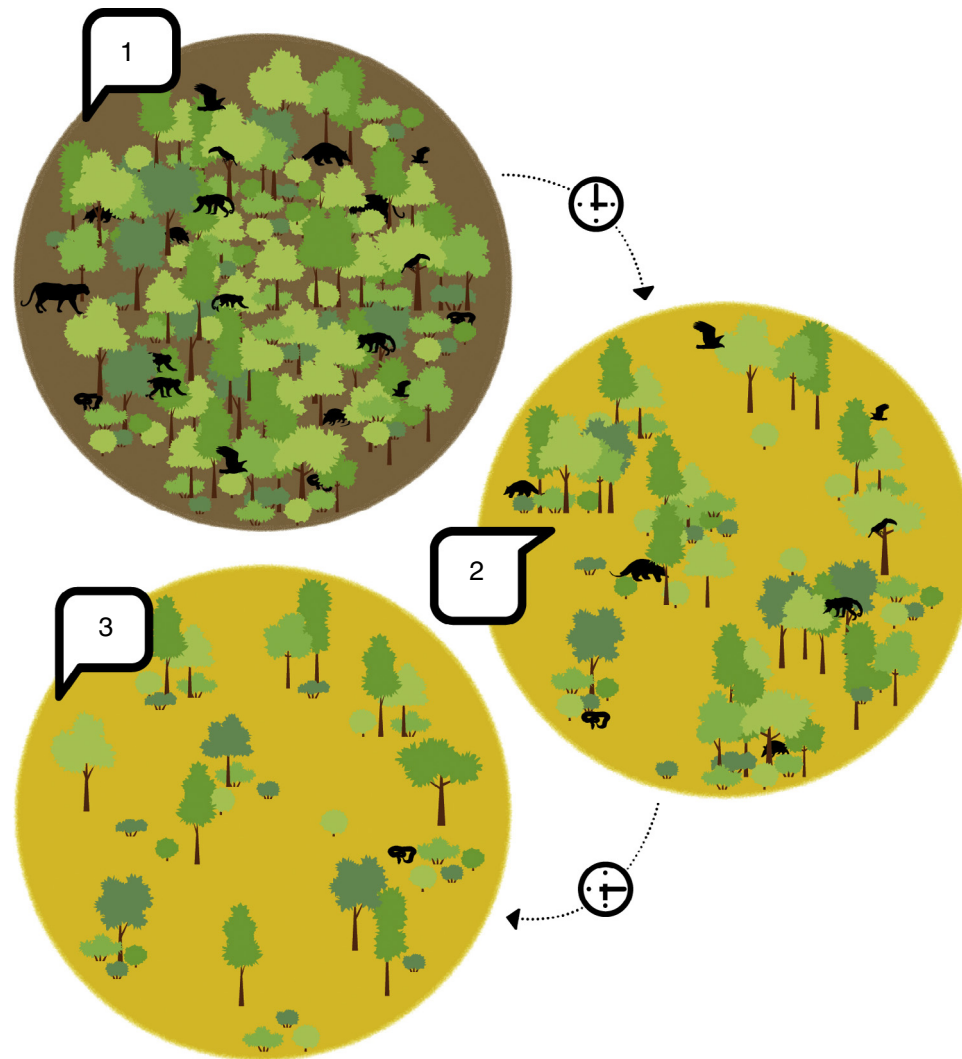


Fig. 8 – An example of how fragmentation of native vegetation after conversion to agriculture may lead to species extinction. Before habitat loss (1) fauna can move freely in a large area of native vegetation, finding food, shelter and breeding partners. This allows the maintenance of large and healthy (i.e. viable) populations. Directly after habitat loss (2) some animal species disappear immediately from small and isolated native vegetation patches, but may still subsist in somewhat larger or more connected areas. However, over time reproductive isolation may cause genetic problems and small areas may not offer enough resources to maintain viable populations, gradually losing some species.

Provisioning and maintenance of environmental services

Additional losses of native vegetation cover may compromise even more the maintenance of environmental services such as water purification, soil protection, crop pollination and climate regulation. Weakened protection of remaining native vegetation, reduced restoration requirements, and the distortion of environmental functions of APPs and LRs, may in turn expand and aggravate environmental problems already observed in several Brazilian regions, such as water shortage, landslides, severe floods and droughts.

These consequences may affect both economic activities and the well-being of human populations in urban areas and in regions extensively converted to agriculture. Strikingly, water sources within the Atlantic Forest region supply more than 8 out of 10 Brazilians, contribute to 70% of the national

GDP and produce 62% of the electricity in the country (Joly et al., 2014). Besides putting water supplies at risk, the suppression and lack of restoration of native vegetation may also compromise their quality. The so-called consolidation of farming activities in APPs and narrowing of restoration strips in APPs along water streams may limit the filtering function carried out by native vegetation, which can retain part of the soil, pesticides and fertilizers leached from adjacent agricultural land (Bicalho et al., 2010). The reduction of APPs also favors the deposition of sediments in other water bodies, which may damage turbines in hydroelectric power plants and reduce the lifespan and energy production of their dams.

The main beneficiary of the preservation and recovery of native vegetation around water reservoirs will be agriculture, a sector that demands up to 70% of the water consumed in Brazil, and that can also benefit from other environmental



Fig. 9 – Pollinator dependence of some Brazilian crops and economic impacts of this environmental service (adapted from Silva et al., 2012; 1 US\$ = R\$ 3.7, March 17, 2016; bi = billion, mi = million).

services. Studies show that crops near native vegetation are more productive, given that several species of animals, plants and microorganisms function as biological regulators of pests and diseases that reduce crop yield (Silva et al., 2012). Therefore, the reduction of native habitat of these organisms may reduce yields and increase the costs of agricultural production (Fig. 9).

APPs and LRs also provide a regional- and even global-scale environmental service by storing carbon and avoiding emissions of greenhouse gases. The federal Protected Areas in Brazil alone, spanning 17% of the country's territory, have already prevented 2.8 gigatons of carbon emissions into the atmosphere (Ferreira and Valdujo, 2014). In the carbon market, this service is valued at 24 billion dollars (Medeiros et al., 2011). However, the capacity to store carbon may be reduced in 53% if areas of APPs and LRs are not fully restored. In the Amazon and the Cerrado, the reduction of native vegetation cover will allow additional expansion of the agricultural frontier, but will also further complicate the fulfillment of international commitments of greenhouse gas emissions signed by Brazil (Rajão and Soares-Filho, 2015). A parallel loss is the reduction of monetary and social gains derived from ecosystem goods that can be sustainably harvested from managed native ecosystems, such as fruits, seeds, fibers, medicines, and cattle fodder.

Another service that is clearly threatened is the geological stabilization of areas vulnerable to disturbances, such as hilltops, hillsides and valleys. Every year in Brazil, hundreds of people die and thousands more are dislodged due to disasters caused by illegal land occupation, which forces the government to commit huge sums to mitigate these losses (MIN, 2014). In 2011, in the mountainous regions of the State of Rio de Janeiro, an estimated 70% of all deaths caused by floods and landslides occurred in areas that, according to the 1965 FC, should be under full protection (Fig. 10). Conserving

and recovering native vegetation in these areas at high risk, many of which lost their protected status under the new NVPL, would be a more effective way to avoid material losses, use public resources, and save lives.

Agricultural production

Detailed analyses and studies do not corroborate the concern that compliance with either the 1965 FC or with the current NVPL will restrict agricultural, livestock or silvicultural production in the country. Brazil has 275 million hectares of land for these activities, of which 70% are presently occupied by extensive livestock production systems, mostly in pastures composed of exotic grasses in areas previously occupied by forests and Cerrado woodland. The remaining 30% are used for agriculture and forestry (Sparovek et al., 2010). Current average productivity in pastures is much below the level that can be attained with good management practices. The increase in pasture productivity, mainly in areas previously occupied by forests, would be enough for Brazil to achieve the world's largest agricultural expansion over the next three decades, without occupying new areas of native vegetation: a 50% increase in the productivity of these pastures, without requiring large efforts or investments, would be enough to release 80 million hectares for agriculture (Strassburg et al., 2014).

The State of Mato Grosso represents a case in point. In recent years its agricultural production experienced significant increases without further suppression of native vegetation, proving the efficacy of this strategy (Macedo et al., 2012). The same trend has been observed for soybean production in Amazon (Nepstad et al., 2014). In the State of Espírito Santo, sustainable intensification of grazing is becoming a more viable strategy to expand both cultivation and areas of



Fig. 10 – In 2011, heavy rainfall in the mountain ranges of Rio de Janeiro killed hundreds of people and dislodged thousands, mainly in areas such as hilltops, steep slopes and riverbanks, which should have been protected under the 1965 Forest Code but whose protection was reduced by the Native Vegetation Protection Law. The image on the top shows an area before the landslide and on the bottom, the same area after heavy rainfall in 2011. Note also the impacts caused on the lower regions, where houses were built within APP.
Source: Images produced by Google Earth 2006/2010 and reproduced in MMA (2011).

native vegetation in order to reach goals established by public policies of land use (Latawiec et al., 2015).

The recovery of native vegetation in APPs and LRs if the NVPL determinations are obeyed in full, will induce only moderate losses by agribusiness. Only 600 thousand hectares of APPs that must be restored next to water streams are occupied by crops, which represent circa 0.2% of the land used for agriculture or livestock production in Brazil (Soares-Filho et al., 2014). In the case of LRs, if the recovery of native vegetation were located in pastures on steep slopes, which have low productivity and generate little income, less than 550 thousand hectares would have to be recovered on flat ground that is

suitable for mechanized agriculture (Soares-Filho et al., 2014). If these alternatives are put into effect, less than 0.5% of effectively productive areas will have to be set aside for restoration. This loss does not compromise the economic sustainability of rural properties to any significant degree (Rodrigues et al., 2011) and most of it could be compensated by further increases in productivity, which have been attained in the last years in Brazilian agriculture (Strassburg et al., 2014).

Also worth considering is the fact that most of the land that does not comply with the NVPL is employed for production of agricultural commodities in large properties owned by farmers with large financial resources. Furthermore, most of

the food consumed by the Brazilian population is produced by family farming, which suffers more from the lack of adequate rural policies than from legal environmental requirements (Martinelli et al., 2010). An aggravating factor is that family farmers are much more vulnerable to environmental degradation because they were historically displaced to areas with limited agricultural potential or previously degraded by inadequate land use (Rodrigues et al., 2011). Receiving no adequate technical guidance, they are compelled to use areas protected by environmental legislation, even if these have limited productive potential, in order to increase their cultivated area and ensure a minimum profit. Such facts underline the understanding that agricultural and environmental issues are interdependent and must be analyzed together.

Another argument raised by landowners against the NVPL and the previous legislation is that recovery of native vegetation would be too expensive and would jeopardize the economic feasibility of farming activities, compromising the international competitiveness of Brazilian agribusiness. According to mass media, estimated costs to implement restoration in rural properties in accordance with the new law would reach billions of reais. However, these estimates overlook that in fact most areas to be restored according to the NVPL can deploy natural regeneration; in other words, recovery will mainly be effected through the germination of seeds and re-sprouting from remaining stumps and roots in agricultural fields and pastures, or through the dispersion of seeds from surrounding native vegetation (Brançalion et al., 2015). Where natural regeneration is feasible, planting of seedlings may be reduced or even forgone, greatly reducing recovery costs.

In general, restoration cost estimates do not take into account that the establishment of native vegetation in LRs may generate income from the exploitation of wood, fruits, fodder, and other products of recovering ecosystems (Rodrigues et al., 2009; Brançalion et al., 2012). In LRs there is still the possibility of creating highly profitable mixed plantations of native and exotic species. Thus, recovery costs will certainly be much lower than those announced by opponents of the NVPL. However, it is important to reduce these costs further by offering technical assistance to farmers, developing new technologies, and by exempting the restoration production chain from taxes.

Current initiatives

Since January 2013, the Supreme Court has been examining three Direct Actions of Unconstitutionality (DAU) submitted by the Attorney General's Office. DAUs 4901, 4902 and 4903 argue that sections of the NVPL text violate the Federal Constitution by allowing, under certain conditions, the amnesty of fines for suppressing native vegetation in discordance with the previous legislation, as well as by reducing the native vegetation area that must be conserved or recovered. If they are confirmed, these DAUs will alter key aspects of the NVPL. Scientific societies such as SBPC and the ABC have stated their support of the DAUs (Nader and Palis, 2015), reinforcing the position of Brazilian scientists against the environmental setbacks provoked by the NVPL. Additionally, in 2015, the Minas

Gerais State Court of Justice (TJMG in Portuguese) ruled article 67 of the NVPL to be unconstitutional. This article states that owners of properties with less than four fiscal modules are exempted from recovering LRs to supply native vegetation deficit. The TJMG considers – and we agree – that this exemption is inadequate. This decision from the TJMG sets a legal precedent for other state courts to establish rulings on the abovementioned DAUs, without expecting the Supreme Court ruling. Several other case-law decisions from other states may follow this trend.

Regulation of the NVPL is also under way in some states. These regulations encompass the elaboration of complementary laws, decrees and resolutions to establish rules and clarify how federal law is to be applied in each state. Some mechanisms contemplated by the NVPL, such as the use of exotic species in LRs or compensation LR in other states, in areas prioritized by public authorities, still need to be regulated at the state and federal level. In this process, states can set environmental protection measures that are more rigorous, but never more permissive, than federal law. This offers a valuable opportunity to correct some of the environmental setbacks brought about by the NVPL and to further improve the law, adjusting it to the socioeconomic singularities of each state.

In the State of São Paulo, for example, Resolution SMA/SAA-1/2016 passed by the Agriculture and Environmental Secretary, only allows LR compensation outside the state in watersheds that supply São Paulo. However, this restriction is being strongly questioned by a political group formed by large landowners in the state, who demand to be allowed to compensate LR deficits in any state comprised in the Cerrado and Atlantic Forest biomes, which are represented in São Paulo. This illustrates the challenge of defending the common interests of society (in this cases, preserving catchments to ensure water supply) when they clash with the interests of groups with high financial and political power. Given the vague text in some parts of the NVPL, state-scale regulations may assist either environmental advances or further setbacks, based on dubious interpretations of the federal law, such as the lack of obligation to recover LRs in Cerrado areas of the State São Paulo.

The implementation of the National Plan for Native Vegetation Recovery (PLANAVEG) by the Ministry of the Environment is also currently under way; the plan aims at extending and strengthening public policies, financial incentives, markets, good farming practices, and other measures for the recovery of 12.5 million hectares of native vegetation over the next 20 years. Given the current environmental context of Brazil, PLANAVEG is an innovative plan for an area that, unlike the agriculture sector, never received incentives, financial or otherwise, from official programs or policies. However, the success of PLANAVEG will depend on a multi-sector public engagement, including, for example, the Ministry of Agriculture, for political and financial support to implement the plan.

Conclusions

The NVPL brought relevant advances that may, at last, allow the effective implementation of measures to protect and

recover native vegetation in private rural properties in Brazil. However, the law also opened the way for critical setbacks both in the protection and recovery of native vegetation, with ultimate consequences for conserving biodiversity and maintaining environmental services. In order to minimize the potential environmental damage and to reduce the pressure on landowners and landholders, we propose that:

- (i) The Judiciary considers available scientific knowledge in its rulings and that states and counties correct eventual distortions of the NVPL through carefully elaborated regulations, based on scientific knowledge and developed with broad participation of the civil society, rural landowners, and the scientific community. Similarly, we recommend that the Federal Government complete the CAR registry, which has been extended until May 2016, and the implementation of PRA, which is already past due. A federal bill that again extends CAR enlistment until 2018 has been submitted to Congress. These postponements beset yet again the already fragile restoration productive chain, further delaying restoration initiatives that are urgently required to mitigate the water crisis and natural disasters in several regions of the country.
- (ii) The strengthening of agencies for rural technical assistance and, even better, the creation of an agency environmental technical assistance to help landowners to comply with the law, especially those that cannot pay for such assistance.
- (iii) The development of financial incentives, such as tax reduction for the restoration supply chain (seed and seedling producers, project planners, companies and cooperatives that undertake plantings, etc.) and the payment for environmental services. Without such recognition of conservation efforts and reduction of recovery and preservation costs, NVPL will accomplish far less than it can or needs to.
- (iv) Compensation of LRs must be sited as close as possible to degraded areas (within the same watershed) and, if located in other states, should be restricted to the same vegetation type, such as specific forest types within the wider Amazon biome, prioritizing areas where biodiversity conservation and the provision of environmental services are more severely threatened due to lack of native vegetation. Such measures should aim at compensating in actual fact the loss of biodiversity and environmental services in a given region, rather than simply providing easier and cheaper ways to comply with the law.
- (v) The establishment of reference criteria to ascertain if an area under recovery has reached a minimum level of environmental quality, which public authorities can use to verify if the legal recovery commitment agreed with the landowner was in fact accomplished. Without these criteria, the enforcement of NVPL will be ultimately compromised. The State of São Paulo has already advanced in this respect by creating a resolution that defines vegetation parameters required to comply with the law (Chaves et al., 2015). Similar initiatives must be adopted by all states. Law enforcement agencies will urgently need these reference values and integrated accountability systems to evaluate the effectiveness of restoration projects that, in

many cases, are carried out with public funding through supporting mechanisms such as PES.

Finally, the Brazilian government deserves recognition for undertaking for the first time a national plan to support the implementation of the environmental legislation. However, we emphasize that this plan will be of little importance unless it is fully integrated within agriculture policies, which have been historically concerned with supporting crop, livestock and silviculture production without proper regard for environmental sustainability.

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