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Review Article / Artigo de Revisão
Production and international trade: challenges for achieving targets 6 and 11 of the Global Strategy for Plant Conservation in Brazil

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Abstract
Target 6 of the Global Strategy for Plant Conservation of the United Nations Convention on Biological Diversity states that by 2020 at least 75% of production lands in each sector will be managed sustainably, consistent with the conservation of plant diversity. Target 11 stipulates that by 2020 no species of the wild flora will be threatened by international trade. Both targets, therefore, are related to production, consumption and trade, which must be sustainable if the targets are to be achieved. Here we examine Brazil's progress in achieving these two targets. We focus on the three economic sectors of agriculture, cattle raising and forestry, which are historically responsible for most of the native-ecosystem conversion in the country and in South America. Brazil has set a number of innovative policies for moving these sectors towards a sustainable path. However, the country needs to put these policies into action to generate tangible results. The results of all efforts so far are mixed. Whereas ecosystem conversion due to the expansion of rural production and the volume of illegal international logging trade have been reduced significantly, the absolute number of hectares of native ecosystems converted into cropland, pastureland or planted forests remains high, especially in Amazonia and the Cerrado. In addition, the number of species threatened by illegal timber exploration remains high mainly in Amazonia and the Atlantic forest.
Key words: Convention on Biological Diversity, illegal logging, plant conservation, sustainable agri-food systems, sustainable forestry.

Resumo
A meta 6 da Estratégia Global para a Conservação de Plantas (GSPC) da Convenção de Diversidade Biológica das Nações Unidas (CDB) propõe que, em 2020, pelo menos 75% das terras destinadas à produção em cada setor serão manejadas de forma sustentável, em alinhamento com a conservação da diversidade vegetal. A meta 11 determina que em 2020 nenhuma espécie da flora silvestre será ameaçada pelo comércio internacional. Ambas as metas, portanto, são relacionadas à produção, consumo e comércio internacional, que se espera que tenham uma base sustentável, para que as metas sejam alcançadas. Esse artigo examina os avanços do Brasil em direção ao alcance dessas metas, focalizando em três setores econômicos (agricultura, pecuária e silvicultura), que são historicamente responsáveis pela maior parte da conversão de ecossistemas nativos no país e na América do Sul. O Brasil criou várias políticas inovadoras para promover a sustentabilidade desses setores. Contudo, várias dessas políticas precisam ser de fato implementadas para gerar resultados tangíveis. O sucesso dessas políticas ainda é variável até aqui. Enquanto a conversão de habitats devida à expansão da produção rural, bem como o volume do comércio ilegal de madeira, tenham reduzido significativamente, os números absolutos de hectares de ecossistemas nativos convertidos em agricultura, pastagem ou silvicultura ainda é elevado, especialmente no Cerrado e na Amazônia. Além disso, o número de espécies ameaçadas por exploração ilegal de madeira ou para outros fins também é alto, particularmente na Amazônia e na Mata Atlântica.
Palavras-chave: Convenção da Diversidade Biológica, madeira ilegal, conservação de plantas, sistemas sustentáveis de agricultura e produção de alimentos, sustentabilidade florestal.

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Introduction

Target 6 of the Global Strategy for Plant Conservation (GSPC) of the United Nations Convention on Biological Diversity (CBD) states that by 2020 at least 75% of production lands in each sector will be managed sustainably, consistent with the conservation of plant diversity. Target 11 stipulates that by 2020 no species of the wild flora will be threatened by international trade. Both targets, therefore, are related to production, consumption and trade, which must be sustainable if the targets are to be achieved.

These two targets, like all targets of the GSPC, are closely related to the Aichi targets of the CBD, especially targets 5 (prevention of habitat loss), 6 (sustainable management), 7 (sustainability in agriculture and forestry) and 12 (prevention of species extinction), and to the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC), which includes commitments of all countries related to sustainable land use (Schleussner *et al.* 2016). As a consequence, their eventual accomplishment would have positive impacts on goals 2 (elimination of hunger), 12 (sustainable production and consumption), 13 (climate action) and 15 (terrestrial species conservation) of the 2030 Agenda of Sustainable Development, the most inclusive global agreement that seeks to find a balance between environmental conservation, economic prosperity and social equality (UN 2015).

At the national level, global agreements and conventions are considered 'outside-in' policies, in which major commitments are negotiated and determined internationally, but concrete implementation depends on the capacity of the national and local governments to deliver on their promises by designing and putting into action effective policies (Silva & Chennault 2018). In this paper, we present a qualitative evaluation of the degree to which Brazil has advanced on targets 6 and 11 of the GSPC.

Methods

This analysis complements the recent paper by Martins *et al.* (2017) and the various publications in this special issue of Rodriguésia. Our focus is on the agriculture, cattle-raising and forestry sectors, because they are the primary causes of land-use change and natural-vegetation conversion in Brazil and South America (Aide *et al.* 2013), which are in turn the main drivers of plant-biodiversity loss (Magrin *et al.* 2014; Cashore *et al.* 2016). For this three sectors, we made a literature search on Google Scholar for the period 2009–2018, focusing mainly on land use and trade. Land use data is particularly relevant to GSPC's target 6, and information related to trade can refer both to GSPC's target 6 and 11. Whenever necessary, we have also assessed governmental reports and also studies and reports of federations of the productive sector. For the land use component of any given activity, we searched specifically for numbers related to total land cover, productivity, jobs creation, water footprint, pollution, deforestation. For aspects related to trade, we searched specifically for both legal (*e.g.*, crop, pulp and beef exportation - GSPC target 6) and illegal practices (*e.g.*, illegal animal trade - GSPC target 11). Finally, we looked into national policies and international commitments of Brazil and how they related to GSPC's targets 6 and 11.

Results and Discussion

Land Use

Of Brazil's 852 million hectares (Mha), nearly 40% (330 Mha) are dedicated to agriculture, cattle raising and forestry (Fernandes *et al.* 2012). Of this percentage, approximately 170 Mha are pasturelands, 152 Mha are croplands and 8 Mha are planted forests (Fernandes *et al.* 2012; Strassburg *et al.* 2014; IBÁ 2016; Graeub *et al.* 2016). Therefore, pasturelands represent the most common form of land use across the country.

Brazilian pasturelands are far from being productive. Macedo (2009) estimated that at least 60 Mha of the pasturelands in Brazil have low productivity (less than one animal per hectare) and/or are in an advanced state of degradation. Moreover, Strassburg *et al.* (2014) estimated that the productivity of Brazilian cultivated pasturelands (excluding, of course, the 55–60 Mha of natural pasturelands, mostly in the Pantanal and the Pampas) is 32%–34% of its potential and that increasing productivity by intensification to 49%–52% of the potential would suffice to meet demands for meat, crops, wood products and biofuels until at least 2040, without further conversion of natural ecosystems.

Agriculture is essential to the Brazilian economy. For instance, in 2012 it accounted for nearly 4.5% of the gross domestic product and reached USD 100 billion (Oliveira *et al.* 2014). Agricultural commodities have been the main focus of Brazilian production and exports, and the country is now a leading manufacturer and exporter of food, fibres, meat and energy as well as one of the largest producers of coffee, corn, soybeans, sugarcane (sugar and ethanol), oil plants, oranges (fresh fruit and juice), grapes and meat (Oliveira *et al.* 2014) in the world. However, large-scale agriculture (including cattle raising and forestry), mainly for commodity exportation, holds 76% of the area of rural properties, whereas the remaining 24% are family farms, which are responsible for 70% of the food produced in Brazil and employ 74% of the country's agricultural labour (Fernandes *et al.* 2012; Graeub *et al.* 2016). In some regions, croplands are water intensive and use unsustainable irrigation systems that withdraw freshwater from small rivers and streams well beyond their current carrying capacities. Brazil ranks fourth among countries in freshwater footprint (Hoekstra & Mekkonen 2012), and most of this footprint derives from beef and agricultural products (Da Silva *et al.* 2016). Brazilian croplands are also a permanent source of freshwater pollution, because the country is one of the world's largest users of agrochemicals (Gerage *et al.* 2017). Between 2001 and 2013, cropland expansion in Brazil took over some 17 Mha in states such as Goiás (GO), Mato Grosso do Sul (MS) and Mato Grosso (MT), but particularly in the new agricultural frontier, the so-called 'MATOPIBA' (Graesser *et al.* 2015), an acronym for the Cerrado cover of the states of Maranhão, Tocantins, Piauí and Bahia. On the positive side, much of the cropland expansion in GO, MS and MT took place over what was previously pastureland. However, as Strassburg *et al.* (2017) demonstrated, the suppression of the Cerrado has occurred to such an extent that in a business-as-usual scenario of further agricultural expansion with limited protection, 31%–34% of the remaining Cerrado may be removed by 2050. These authors also showed that the projected deforestation will drive to extinction some 480 plant species endemic to the Cerrado, which is more than three times all documented plant extinctions since the year 1500. In the Amazon, the main driver of land-use change from 2001 to 2013 has been pastureland, especially in the arc of deforestation in the state of Pará (Graesser *et al.* 2015). Therefore, from a socioecological perspective, recent trends in the Brazilian croplands and pasturelands are far removed from patterns that could be considered 'sustainable'.

Just as in the case of agriculture and cattle raising, forestry in Brazil is dominated by monocultures of exotic species, in this case *Eucalyptus* and *Pinus* (Seroa da Motta 2015). The cultivation of these species are mostly located in the biodiversity-rich ecosystems of the Atlantic forest and Cerrado but have an expanding area towards especially the Pampas (Reichert *et al.* 2017). Many studies have investigated the impacts of such plantations on biodiversity, and results vary. A thorough review by Valduga *et al.* (2015), covering over 150 publications on Brazilian case studies, found that papers reporting negative impacts (55.9%) of non-native tree plantations on biodiversity were more common than positive reports (27%) or mixed reports with pros and cons (17.1%). Negative impacts were often related to declines in species richness and abundance and positive impacts on natural regeneration. Valduga *et al.* (2015) concluded that adequate management is essential to promoting sustainability and reducing negative impacts on biodiversity.

In general, Brazil is well below the GSPC target 6, the goal of which is sustainable management in 75% of the production lands in each sector (in this case, agriculture, cattle raising and forestry) by 2020. This is particularly due to unproductive cattle raising but also due to unsustainable large-scale commercial agriculture. Legal forestry, which covers much less area and has a number of best practices on course (which we will discuss next), is less of an issue in this respect. A positive side to this pattern is that annual forest loss in Brazil decreased on average 1,318 km^2/year (Hansen *et al.* 2013) as a consequence of the creation of protected areas, recognition of indigenous lands, increased enforcement of the existing environmental legislation, creation of incentives for native forest production and the reduction of illegal subsidies that sustained illegal deforestation (Hecht 2011; Assunção *et al.* 2015; Rajão & Georgiadou 2014; Bebber & Butt 2017). However, the overall number of hectares of native habitats converted due to agriculture and cattle raising remains high in absolute terms (Hansen *et al.* 2013). In parallel, other innovative initiatives, such as the soybean moratorium – an agreement between non-governmental organisations and soybean retailers whereby major traders agreed not to purchase soy grown on Amazon lands deforested after July 2006 – were either successful in their early stages (deforestation due to soy expansion in the Amazon dropped to less than 1%), did not last or had collateral effects (Rudorff *et al.* 2011; Gibbs *et al.* 2015). It was detected that soy expansion leaked into neighbouring biomes, particularly the Brazilian Cerrado (Morton *et al.* 2016), and it was shown more recently that deforestation due to soybean farming in Amazonia has increased again (ABIOVE *et al.* 2017).

In addition to impacts on biodiversity, the patterns described here have social impacts. First, Brazil has one of the world's most concentrated and unequal land-tenure structures, with 1.5% of the landowners holding 52.6% of the agricultural land (Fernandes *et al.* 2012). Second, the expansion of these sectors often followed the traditional frontier mindset, in which natural ecosystems are replaced by other types of land use suited to quick economic gains with little concern for the local populations' traditions and culture (Becker 2001; Silva *et al.* 2017). Third, there is evidence that the expansion of these sectors in the new Brazilian frontiers exacerbated social conflicts (Prates & Bacha 2011; Souza *et al.* 2015) and did not always significantly contribute to the improvement of local human development (Silva *et al.* 2017).

Trade

As Moran & Kanemoto (2017) demonstrated, global agri-food systems of international trade create 'biodiversity footprint hotspots', which represent the additional pressure imposed by consumer demands from large markets (*e.g.*, the United States, the European Union and China) on biodiversity hotspots. These authors showed also that this pressure is a hurdle for Brazil's achievement of GSPC target 6, because the Cerrado, due to agricultural exports, and to a lesser extent the Amazon, have become footprint hotspots. On the other hand, considering that 30% or more of the food produced globally is lost or wasted (FAO 2011), international trade is very important in connecting areas with food surpluses with areas that have a food deficit, as long as adequate governance systems are in place (Huang *et al.* 2011). This is, however, threatened by conflicts that may emerge due to increasing food prices, food-sovereignty movements and land grabbing (Allouche 2011).

Illegal trade of goods derived from biodiversity is another significant threat to plant species and a hurdle to the achievement of GSPC target 11 (see Sharrock *et al.* 2018, in this issue). At the global level, countries have created the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) in an attempt to regulate and minimise the international trade of species under extinction risk. In Brazil, 2,620 plant species have been listed by CITES. This list consists mostly of orchid (85%) and cacti species (10%). Forty-five species (2%) are woody species, 39 of which belong to the genus *Dalbergia*; the other six are important tree species (*Swietenia macrophylla* King, *Paubrasilia echinata* (Lam.) Gagnon, H.C.Lima & G.P.Lewis, *Aniba rosaeodora* Ducke and three species of *Cedrela*). Seventeen cacti species, eight orchid species and *Dalbergia nigra* (Vell.) Allem. *ex* Benth. belong to Appendix I of CITES, which categorises the most endangered species (see <https://www.speciesplus.net/>).

The scale of the illegal commerce of timber can be estimated from the fact that between 2000 and 2012, 68%–90% of forest clearing in Brazil was illegal (Lawson *et al.* 2014). Cashore *et al.* (2016) showed that although forest products in Brazil are destined mostly to domestic markets, international influences cannot be discarded. These authors attributed illegal logging to fraudulent land titles, counterfeit permits, tax evasion and corruption and argued that illegal timber exploitation and deforestation are closely interconnected (see also Adeodato *et al.* 2011). Authenticity issues related to species identification are also a problem commonly reported regarding *Dalbergia nigra* (Ugochukwu *et al.* 2018) and *Paubrasilia echinata* (Abensperg-Traun 2009).

Advances

Perhaps one of the most important recent advances in relation to sustainability in land-use systems in Brazil, and one that directly relates to GSPC targets 6 and 11, is the Brazilian Nationally Determined Contribution (NDC) of the Paris Agreement of the UNFCCC. In 2015, Brazil committed to restoring 12 Mha of degraded lands, restoring 15 Mha of degraded and unproductive pasturelands, enhancing 5 Mha of integrated cropland-livestock-forestry systems and achieving zero illegal deforestation in the Amazon by 2030 (BRAZIL 2015). Unlike the NDC of most other countries that signed the Paris agreement (Hoehne *et al.* 2016), Brazil's adherence to the aforementioned global goals is anchored by a set of national policies, such as the Native Vegetation Protection Law, also known as the New Forest Code, which establishes the proportion of land to be protected or restored within private properties (Scarano 2017). Nearly 53% (200 Mha) of the native vegetation in Brazil lies within private properties, with requirements to restore some additional 20 Mha (Sparovek *et al.* 2011; Soares-

Filho *et al.* 2014). Although recent literature has shown mixed attitudes regarding the potential for accomplishment of this law (*e.g.*, optimism in Santiago *et al.* 2018 *vs.* predominantly criticism in Brancalion *et al.* 2016) and regarding positive repercussions of compliance on biodiversity and ecosystem services (*e.g.*, optimism in Scarano 2017 *vs.* scepticism in Vieira *et al.* 2017), the scale is not in dispute (see also Sharrock *et al.* 2018, in this issue). And precisely because of the scale, for this regulatory policy to be put into effect, given the costs that both conservation and restoration entail, incentive mechanisms (such as subnational payment for ecosystem-service schemes) and other market policies (such as eco-certification) will most likely be necessary (Scarano 2017). One interesting sectoral example of commitment comes from the forestry sector. From the 13 Mha that these companies own, 5 Mha are set aside as private protected areas following the Native Vegetation Protection Law, which are reported to provide important large-scale corridors, especially in the Atlantic forest biodiversity hotspot (IBA 2016).

Similarly, the zero illegal deforestation target in Amazonia will be more efficiently accomplished if regulatory policies are coupled with incentive mechanisms (Vieira *et al.* 2005). Although Brazil remains the second-largest gross annual forest loss in area, its loss proportional to its area is lower than that of many other developing forested countries (Hansen *et al.* 2013). Monitoring and enforcement have been essential to this reduction (Monteiro *et al.* 2014; Romijn *et al.* 2015), along with creation of protected areas (Jenkins & Joppa 2009; Silva & Prasad 2017). Incentive mechanisms have also played a key role, such as in the case of Bolsa Verde, which consisted of conditional cash transfers to poor rural families in selected municipalities who were already recipients of the Bolsa Família poverty alleviation program (Kasecker *et al.* 2018). This incentive was given to families that had not deforested their properties since 2011, but the program was suspended in 2017 due to the country's political and economic crises.

The replacement of tropical timber with PVC, aluminum, metal, MDF and timber from planted forests helped to reduce the extraction of roundwood from 28.3 million m^3 in 1998 to 14.2 million m^3 in 2009 (Lima & Munk 2015), nearly matching the global decline in extraction since

Table 1 – Global and national challenges related to GSPC targets 6 and 11, and Brazil's progress in achieving these targets.

	Current challenges		Advances in Brazil	
	Global	**Brazil**	**Up to now**	**Needed**
Sustainable rural production (target 6)	Main driver of habitat conversion and biodiversity decline	Main driver of habitat conversion and biodiversity decline	New global commitments backed up by national legislation to enhance rural productivity while protecting and restoring natural habitats and reducing greenhouse gas emission; land clearing and deforestation reduced drastically over the past decade	Compliance of farmers with legislation, government enforcement of legislation and further incentive mechanisms to promote compliance and offset
	Air pollution: 30%–35% emission of greenhouse gases	> 60% emission of greenhouse gases		
	Soil and freshwater pollution: 2.3 billion kg of pesticides used annually worldwide	Largest use of agrochemicals in the world: 0.5 billion kg		
	70% of global water footprint	Irrigation: 70% of the national water footprint		
Illegal logging and international trade (target 11)	Significant threat to biodiversity	2,620 species in CITES list, 2% of which are timber species	Advances in monitoring, certification and techniques to determine species authenticity	Enforce legislation and incentivise sustainable community management of native forests
	Global wood supply from natural forests: peaked around 1989 and in decline since	Extraction of roundwood: declining (from 28.3 million m^3 in 1998 to 14.2 million m^3 in 2009) but still high	Monitoring, identification techniques and certification as well as an increasing consumer substitution of tropical timber for PVC, aluminum, metal, MDF and planted timber	Change of international consumption patterns to replace tropical timber; monitoring and enforcement to curb illegal logging

1989 (Warman 2014). Scientific and technological advances in tree-species identification have also helped to reduce illegal logging. Several studies on the Brazilian timbers *Dalbergia nigra*, *Swietenia macrophylla* and *Paubrasilia echinata* have shown how emerging technologies such as the International Barcode of Life, as well as new wood-anatomy techniques, have the potential to address authenticity issues in international markets, reduce quality uncertainty and complement regulatory enforcement under CITES (Chimeli & Soares 2011; Gasson 2011; Ugochukwu *et al.* 2018). Finally, although it is not the primary goal of certifications (such as the ones provided by the Forest Stewardship Council) to solve the issue of illegal logging, such logging has declined in areas where rates of certification are high (Voigtlaender 2015). Community-based forest-management certification also seems to be a positive addition to efforts to curb illegal logging in the Amazon, despite some challenges (Humphries *et al.* 2012).

Conclusions

Table 1 summarises the main trends described in this paper. In short, Brazil has made positive advances in regard to GSPC targets 6 and 11, especially when we look at the regulatory policies that can help to move three important economic sectors of the national economy (agriculture, forestry and cattle raising) towards a more sustainable development path. However, to generate tangible results, the country needs to put these policies into action and their results monitored. Without a systematic monitoring, it is difficult to say at this stage whether 75% of the productive land in the country is managed sustainably. Probably, Brazil is still far from this target. Similarly, Brazil has still plant species threatened by international trade. In fact, whereas habitat conversion due to the expansion of rural production and the volume of illegal international logging trade have been reduced significantly, the absolute number of hectares of native ecosystems converted into cropland and pastureland - and to a lesser extent planted forests - remains high, especially in Amazonia and the Cerrado. Moreover, the number of species threatened by illegal timber exploration is still reason for concern, particularly in Amazonia (*e.g.*, *Swietenia macrophylla*) and also in the Atlantic forest (*e.g.*, *Dalbergia nigra*, *Paubrasilia echinata*). However, there is some hope that Brazil can achieve GSPC targets 6 and 11 if some of the new and innovative policies are fully implemented, such as (1) promote protection of native-ecosystem within farmlands, (2) create incentive mechanisms for conservation and restoration, (3) foster nongovernmental agreements to curb commodity-based deforestation, and (4) enable certification and identification protocols for native timber and certification for crops and beef.

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