On the Map

Biofpr Biofuels Bioproducts & Biorefining

Sustainable bioproducts in Brazil: disputes and agreements on a common ground agenda for agriculture and nature protection

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Abstract: A key question for food, biofuels, and bioproducts production is how agriculture affects the environment, and social and economic development. In Brazil, a large agricultural producer and among the biologically wealthiest of nations, this question is challenging and opinions often clash. The Brazilian parliament and several stakeholders have recently debated the revision of the Forest Act, the most important legal framework for conservation of natural vegetation on Brazilian private agricultural lands. Past decades have shown improvements in the agricultural sector with respect to productivity and efficiency, along with great reductions in deforestation and growth of environmentally certified production. However, the opposing sides in the debate have ignored this progress and instead continue to entrench their respective combative positions. A structured exchange involving nine experts associated with major producer interests (livestock, crops, planted forest, and charcoal) and environmental NGOs was moderated based on a framework that sorted viewpoints into four categories: (i) common ground – compatible interests considered to be high priority for Brazilian sustainable agricultural development; (ii) serving exclusive nature conservation interest; (iii) serving exclusive agricultural production interest; and (iv) mainly serving the purpose of sustaining dispute. We conclude that the majority

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of actions and expected future trends reflect achievements and ambitions to balance production and conservation, but much public opinion – and in turn decisions in the parliament and government for agriculture and conservation – is shaped by a perceived conflict between these objectives and a debate that has become, at least to some extent, an end in itself. © 2016 Society of Chemical Industry and John Wiley & Sons, Ltd

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Introduction

Brazil is a major producer and exporter of food, feed, and various biofuels and other bioproducts, contributing to greenhouse gas (GHG) savings as well as to a range of social and economic objectives.[1–6] Further growth in production is expected due to increasing domestic and international demands for food, feed, biomaterials, and bioenergy products.[7] Brazil is also among the biologically wealthiest nations in the world and holds large areas of high value for biodiversity conservation.[8] Large-scale transformation of forests and other natural vegetation (NV) has supported agricultural growth,[9] but has also resulted in negative impacts, including loss of biodiversity.[10] NV with high conservation value is still prevalent in large areas and the land-use change (LUC) associated with Brazilian agricultural development is subject to lively public debate, as well as substantial scientific activity.[11-15] The debate concerns environmental, social, and economic aspects and involves a wide set of topics with many contrasting viewpoints. At the core of the debate lies the perceived conflict between agriculture production growth and objectives such as nature conservation and GHG emissions reduction.

Two main legal frameworks – the Forest Act (FA)[16] and Conservation Areas (SNUC)[17,18] – influence Brazilian agriculture and its expansion pattern in several ways. The FA is the most important legal framework for conservation of NV on private agricultural lands in Brazil. It divides private rural land into productive land and land dedicated to preservation, which is further subdivided into legal reserves – a specified proportion of all farmland that is reserved for conservation – and areas of permanent preservation, including riparian systems along rivers and other water bodies, steep slopes, hill tops and high altitude land.[19] In 2012, the FA was revised, since it was found to be ineffective in protecting NV and because it was perceived to be a barrier to development in the agricultural sector.[20] For more than three years, the Brazilian parliament, academics, and several other stakeholders, including environmental NGOs and farmer representatives, have debated the revision of the FA, a debate widely covered by public communication channels. Stakeholder debates are commonplace in Brazil, but this debate was more intense than usual due to the emphasis in the media.

By the end of 2012, revision of the FA was drawing to a close, and trade-offs between agricultural production and nature conservation were highlighted in popular media, articles, and opinion letters in scientific journals.[21–27] Such trade-offs have been discussed in Brazil for many years[19,28–30] but received particular attention in association with the FA revision.

This paper summarizes the outcome of a structured discussion involving nine experts associated with major producer interests, environmental NGOs, and communication NGOs. The goal was to clarify how these agendas relate to each other and to derive an agenda for sustainable agricultural development providing food, biofuels, and other bioproducts.

Material and methods

Face-to-face expert meetings were arranged from March to November 2012. Academic discussion leaders facilitated the discussions at the meetings and also managed subsequent tele-interactions to structure and document the outcome. A framework (Fig. 1) was used to analyze the expressed agendas concerning nature conservation and agricultural development, and to clarify whether perspectives and actions associated with the two agendas were (i) compatible, i.e., addressed both agricultural development and nature conservation objectives in a satisfactory way; or (ii) mutually exclusive, i.e., promoted nature conservation at the expense of agricultural development, or (iii) vice versa. The framework also let discussants characterize actions as (iv) means for dispute, i.e., primarily associated with the debate in itself and not necessarily benefiting either of the two objectives. Some of the actions belonging to this category could to some degree coincide with

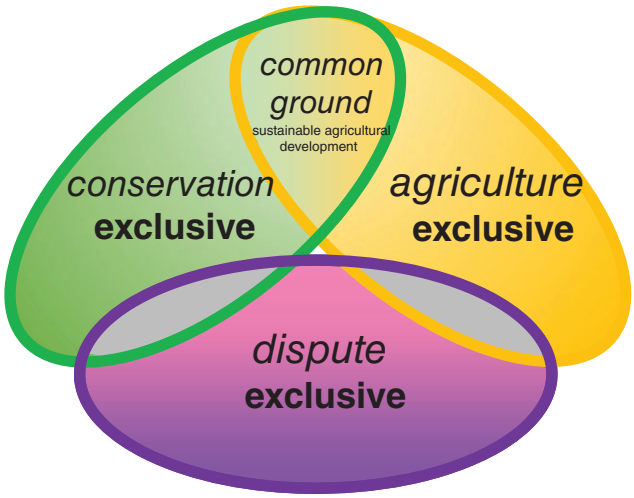

Figure 1.Framework used to analyze and clarify whether the expressed agendas concerning nature conservation and agricultural development were compatible or mutually exclusive.

actions belonging to (ii) or (iii), but not to the common ground category (i).

Those agriculture-focused actions that are associated with risks of negative environmental impacts were also excluded from the common ground category. For this case, discussants considered command and control measures in the near term, and Research and Development (R&D) to mitigate risks in the longer term. The common ground category also excludes actions solely focusing on Brazilian sustainable development, where discussants judged that support through economic and financial measures, exemptions or privileged access would be needed. Ideally, the recognition of actions in the common ground category would serve to keep those actions outside the scope of the most heated disputes, and major interventions by government concerning regulation and promotion.

The perspectives presented by the experts were also evaluated by the academic facilitators relative to the scientific peer-reviewed literature (described in the section Related scientific information). The facilitators also organized the actions based on the framework, linked them with a summary of the relevant scientific information, and labeled each combination to highlight relations between the sectors' reports (Table 1, Fig. 2). This process necessarily meant disregarding several discussion items and ignoring some complexity. The study follows the narrative theory modeling approach that is adequate for societal systems by providing a clear identification of the model components. Subsequently, this kind of narrative model can combine with other modeling approaches in complex systems, mathematical theory, or system analysis as described by Andersson *et al.*[31] More information, including quantitative data, about Brazilian agriculture and land governance can be found in Sparovek *et al.*[19,20,32]

Results

Beef

Sector perspective

Cattle production has always been the main agricultural activity in frontier areas. It can easily be adapted to scarce infrastructure, making use of low-productive lands and taking advantage of the initial forage growth boost promoted by the nutrients coming from deforestation. The relatively low initial investment required makes extensive cattle production more attractive than capital-intensive crop systems in the initial phases of land being converted to agriculture. Cow-calf production is the main start-up activity. Yearling-stocker or finishing producers are more dependent on location close to slaughterhouses and consumer markets and therefore prevalent in consolidated agricultural regions with better infrastructure. A long period of expanding agricultural area has continuously provided opportunity for extensive cow-calf production in frontier regions. The ample supply of new land in these regions has fostered a culture among producers and technology supply companies where management options to increase land-use efficiency of cow-calf operations are less important. Consequently, the development of improved systems for livestock production has not prioritized the cow-calf stage.

During the unstable economy from 1950 to the early 1980s, large-scale cow-calf operations in frontier regions maintained an oversupply of young animals and a price per livestock unit that was about 20% below the price of cattle. This situation benefited yearling-stocker producers that keep large areas for extensive grazing with young animals maintained for about two years before being moved to finishing and slaughter. These producers had a competitive advantage over a more integrated production system with internalized cow-calf operations in more consolidated regions. Because of the oversupply, specialized cow-calf producers in consolidated regions were slow to adopt new technologies during this period. Instead, the adoption of new technologies mainly occurred in later livestock production phases. Rising land prices in consolidated agricultural regions also increased demand for improving land productivity.

Table 1. Sector perspectives with labels, scientific information, dispute positioning.

	Sector perspectives			
	Common Ground	**Exclusive**	**Science information**	**Dispute exclusive**
Beef	Intensification is underway, needed and welcome by the majority of producers and slaughter companies. The end-consumer price of meat is increasing, promoting the shift toward more environmentally benign and efficient technologies. INTENSIFICATION SAVES LAND	The sector needs long time to promote needed changes. During this period, expansion and inefficient systems will coexist with intensified and environmentally benign production. WE NEED (A LOT OF) TIME	Intensification is underway and its role in making land available for crop production is recognized. Given the size of the pasture-based beef sector, the time issue is sensitive. Even with a favorable trend at the current pace, the transition period would involve major environmental impacts in several important regions. THERE ISN'T (SO) MUCH TIME LEFT	The share of low performing producers in frontier and consolidated regions is still high. Allowing low-performing producers to stay in the market reduces political pressure, but requires that these actors have alternative sources of economic gain, e.g. increases in asset values of land after deforestation and informal operations, none of which require direct public investments in subsidies. Dispute can lengthen the period of coexistence of low- and high performing producers, which can be considered attractive also when the majority of producers move toward intensification.
Crop	Reduction of environmental impacts is perceived equally important as other production-related decisions. Commitment and compliance with environmental practices do not need external enforcement since they are already part of the business. The last decades show large improvements for all major crops, and existing regulations are comprehensive. COMMITMENT & COMPLIANCE	Suitable Cerrado regions are claimed to be converted to crops to add important area to the mainstream expansion occurring on high quality pastures. Crop producers argue that the possible negative effects of converting pasture and Cerrado land, e.g. iLUC, should be addressed by investments in other sectors or by compensation. EXPANSION ON CERRADO & LARGE SCALE REPLACEMENT OF PASTURE WITH CROPS	Expansion in the Cerrado is not needed to meet the expected increase in demand. More efficient use of existing agricultural land suffices to meet the need. If use of such lands is not promoted and if systems to reward actors that seek to avoid NV conversion are ineffective, local views on economic opportunities may drive the conversion of Cerrado. This conversion needs to be avoided. NO NEED FOR EXPANSION BUT LACK OF INCENTIVES TO AVOID IT.	Pasture expansion on NV keeps pasture land prices low, which in turn reduces costs of converting pastures to croplands. The situation favors both beef and actors engaged with land grabbing. Dispute to prevent changes from status quo is considered desirable by crop producers since it lowers the costs of expanding over pastures, which avoids direct conflict with nature conservation.
Planted Forest	The sector is already above other agricultural sectors because of the adoption of voluntary certification schemes by almost all large producers. ALREADY AHEAD	The expansion to the North region, including the Amazonian borders, is strategic for expansion because of logistic advantages. The voluntary adoption of environmental certifications reduces impacts and avoids deforestation, but the sector claims that the indirect effects of such process should be addressed by other means. EXPANSION IN THE NORTH	The expansion of this sector is relatively small. If restricted to open areas and socially inclusive, expansion in the North will not cause substantial deforestation or other NV conversion. The indirect effects will be limited by the relatively small size of this expansion. Important local impacts may occur. LARGE SCALE IMPACTS LESS LIKELY	Since the sector does not benefit from dispute, it has expressed (relatively modest) support for zero deforestation policies and other positions that are more difficult to support for other sectors. However, a complete obstruction of the more general agricultural agenda may provoke retaliation measures in other sectors and in parliament, which can hit this relatively small sector hard.

Table 1. (Continued)

	Sector perspectives			
	Common Ground	**Exclusive**	**Science information**	**Dispute exclusive**
Charcoal	The current high share of non-renewable charcoal creates opportunities for increasing the production of renewable charcoal based on certified Eucalyptus plantations. UNATTENDED DEMAND	On the short term, supply of renewable charcoal cannot meet the industrial demand. A drastic and rapid limitation of non-renewable charcoal supply would impact the industrial production of steel. The non-renewable charcoal restricts the development of supply capacity of renewable sources due to unfair competition. PROTECT INDUSTRIES USING CHARCOAL	The indirect effects of steel production on deforestation are incompletely understood, and further research is needed for comprehensive understanding. The indirect relation of non-renewable charcoal as a facilitator (not a driver) of deforestation is mentioned in general terms, but not directly assessed in scientific literature. NEED TO IMPROVE OVERVIEW AND UNDERSTANDING	Illegal non-renewable charcoal production and trade benefits from weak governance and surveillance networks, which are mostly under public administration. Dispute can prevent or at least delay development of a common agenda and cooperation between relevant institutions and actors, which would enhance surveillance and legal enforcement.
Environmental NGOs	Most NGOs understand that environmental protection and agricultural development are both important objectives, and that a balancing approach is needed. Conservation shows important progress over the last decades. PROGRESS & BALANCE	Environmental protection has lower priority during the negotiation phase than production objectives. The environmental NGOs therefore claim that they have to aim very high to end up with at least something. OBSTRUCTION	Research points to solutions combining productivity improvements in the agricultural sector and the implementation of a wide range of initiatives promoting NV conservation. The research also supports the thesis that there is room for meeting both conservation and production objectives. PRODUCTION AND PROTECTION CAN COEXIST	NGOs depend on fundraising and public support. Fundraising and image building may in some situations benefit from media exposure, mostly covering disputes. Simple “good vs. bad” messages can be useful in communication and promotion. If NGO campaigns stress positive outcomes the public may understand this as a “mission-accomplished message” and conclude that NGOs no longer need support since they have reached their goal.

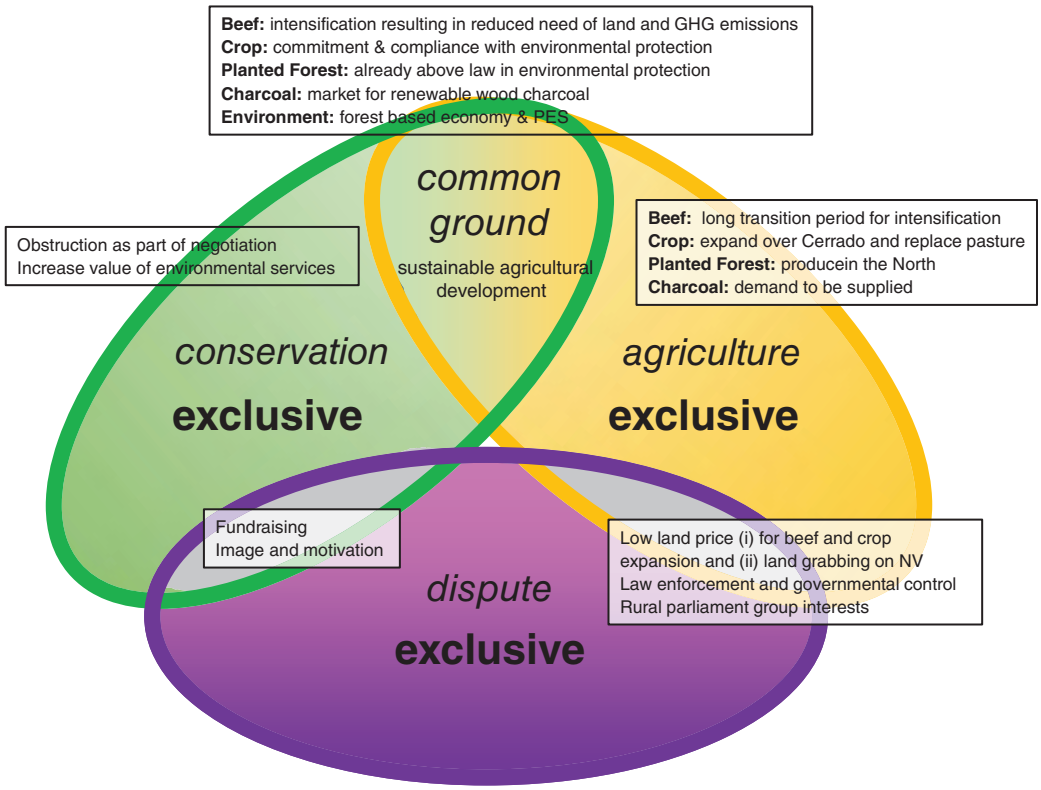

Figure 2. Core issues and viewpoints of the nine experts associated with major producer interests (livestock, crops, planted forest, and charcoal) and environmental NGOs.

In the early 1990s, when the Brazilian economy began to stabilize, the price of calves started to rise and during the 1990–2010 period has been about 20% higher than the cattle price. In recent years, deforestation and expansion of the agricultural frontier have slowed down. Therefore, the supply of calves from frontier regions has decreased and the relative price difference has increased further. Given that production costs per livestock unit are higher for calves, the present price difference is to be expected when cow-calf production in frontier areas is not boosted by agricultural expansion. When the later-stage producers are no longer subsidized by the oversupply of calves from expanding frontier regions, they need to adopt more efficient technology and management options to maintain the competitiveness with producers of pork and poultry. Technology adoption for pork and poultry production has progressed faster than for cattle. As cow-calf production in frontier areas is reduced, the price competition on food markets can be expected to stimulate faster adoption of new technology and management options in cattle production to reduce the disadvantages associated with lower area efficiency and longer production cycle compared to pork and poultry.

As evidenced by the continuous growth in cattle production and the changes in calf prices compared with cattle in recent years, further development of Brazilian cattle production does not require high deforestation rates supporting high cow-calf production in frontier regions. Rather, slower frontier expansion motivates adoption of technology and management options to improve land-use efficiency. However, while the adoption of more effective and environmentally benign cattle production systems progresses, a relatively long period of concurrent extensive and intensive cow-calf production can be foreseen. This is due to several factors, including: (i) the long production cycle of 4 to 5 years; (ii) the enormous size of the pasture-based beef sector; (iii) the domestic market's share of consumption, a market that currently seldom demands no-deforestation guarantees; and (iv) an expected slow change in production geography and cultural perceptions that have been shaped by agriculture expansion in frontier areas over a long time.

Related scientific information

Scientific studies confirm the sector's statement that extensive calf-cow production represents a major land use

in frontier areas[33] and further stresses the biodiversity impacts associated with conversion of forests and other natural ecosystems.[34,35] Studies point to interventions in the beef supply chain as one major aspect behind the decline in deforestation in Brazil[36] and observations [37,38] indicate that trends coincide with the events described by the cattle sector, stressing technology-based improvements in production efficiency as the way forward to address deforestation and GHG emissions from LUC and anaerobic digestion, which are frequently associated with the cattle industry,[39-41] although noting that biodiversity in grasslands might decrease as utilization for livestock production intensifies.[42,43]

Sustainable forest management (selective logging) is less profitable than logging followed by the establishment of extensive pasture-based beef production. Since sustainable forest management is the most often competing option with deforestation followed by establishment of pasture, under non-regulated market conditions, deforestation tends to be the natural choice.[44] However, studies indicate that beef production in the Amazon would not be economically attractive in a longer term scenario where there is a price on LUC emissions. [45]

The increasingly technology-intensive and integrated cattle production systems require higher initial investments and good infrastructure, both typical for consolidated agricultural regions rather than frontier areas. Spatial empirical data on deforestation rates and technology adoption in the Amazon region confirms this.[46] The land-use dynamics implicit in the cattle sector's account also conform to Forest Transition theory.[47]

The cattle sector has promoted specific sustainability actions. In 2009, the three main slaughter companies (JBS, Marfrig, and Minerva) engaged with Greenpeace in a voluntary moratorium for a progressive reduction and end of deforestation in the beef value chain.[48] In addition, a Sustainable Cattle Working Group (GTPS) has been created and a group of farms and beef slaughterhouses have been certified under the Sustainable Agriculture Network-Rainforest Alliance system, delivering certified beef to a mainstream supermarket chain.[49] The national government launched an ambitious agricultural low carbon production initiative (Plano ABC), offering subsidized credit to increase pastureland productivity.[50]

Spatial models that link deforestation with land use often fail to identify the underlying drivers and actions of specific agents.[51] Consequently, the clarification of cause-effect chains is difficult, i.e., whether the availability of frontier lands has hindered progress and conserved the extensive cattle management system typical in Brazil or if – conversely – the competitiveness of this management system has driven deforestation and frontier land expansion. Nevertheless, the recent period with increasing productivity shows that beef production can grow while partly decoupling from deforestation and frontier expansion. However, deforestation may need to be controlled at the present lower level to avoid rebound to the extensive livestock production system with cow-calf production in expanding frontier areas.

Crops

Sector perspective

Brazilian agricultural area (~30% crops + ~70% pasture) increased 1.2 Mha per year on average during the first decade of the twenty-first century, with deforestation peaking in 2004 and 2005. Further expansion is projected from 2012 to 2022, at about 0.4 Mha per year.[7] External and endogenous long-term factors explain the slower expansion, particularly for crops.

Until the mid-1990s, Amazonian deforestation was in part associated with logging and was a concern mainly for academics and environmentalists with little influence in government, society, or media. During the 2000s, Amazonian deforestation received plenty of attention outside academic and environmental circles. Pasture and later soybean production were claimed to be main causes of deforestation. The Cerrado Biome, the main agricultural frontier since the 1980s, could be noted on the conservation agenda. Buyers of agricultural products, especially from Europe, increasingly required guarantees that products were not associated with deforestation – especially in the Amazon. In 2008, the soybean industry, along with environmental NGOs and the national government, launched the Soy Moratorium, a commitment not to purchase soybeans from areas that had been deforested after 2006.

Sugarcane expansion for ethanol production was associated with food price increases and indirect LUC causing deforestation. Roundtables, certification systems, restriction of agriculture through zoning, for example high conservation value areas (HCVA), became routine in the sector.

In addition to market pressures, command and control policies (e.g. monitoring, fines, and credit restrictions) have resulted in increased compliance with legislation concerning farmland expansion. However, several farmers point out that the licensing system itself discourages compliance. Licensing costs vary from USD 10 to 50 per ha, with no

guarantees of whether or when licenses will be issued. The high costs, bureaucracy, and corruption mean that mainly larger producers with the required capital can afford to apply for licenses and operate legally in frontier areas.

In addition to these external drivers, land efficiency is steadily improved by several endogenous factors. Increasing land prices and costs of other production factors (e.g. labor, machinery, and fertilizers) incentivize intensification and efficiency improvements, and technologies for more intensive production are being developed on an ongoing basis. For example, grain varieties are increasingly adapted to allow two harvests per growing season, and crops are integrated with livestock production.

Researchers, producers in general, and agricultural markets are increasingly prepared to consider production under strict environmental regulations in the frontier regions, to meet the increasing demands for agricultural products while also complying with nature conservation requirements.

Related scientific information

The remarkable reduction of deforestation rates in Brazil[52] and the multiple underlying long-term reasons are described in detail by Nepstad *et al.*[36] and Boucher *et al.*[53] Explanatory factors include new protected areas,[54,55] rural credit restrictions implemented through the Critical Counties program,[56,57] effective surveillance and articulated networking of civil society and governmental agencies, as well as actions among important stakeholders in the agriculture sector (e.g. the soy moratoria) recognizing that businesses are negatively impacted by association with environmental degradation, especially in the Amazon.[36] The robustness of the recent low deforestation trends has been challenged.[58–60] Some studies point to indirect causes behind LUC[61,62] and studies further note that the lack of land governance and land tenure issues are critical factors behind deforestation in Amazon as well as in the Cerrado frontier.[63] Analyses indicate that the focus on command and control measures on larger properties in deforestation hotspots may be increasingly limited in their effectiveness, and that further reductions in deforestation are likely to require actor-tailored approaches, including better monitoring to detect small-scale deforestation and more incentives-based conservation policies.[64] In summary, the scientific literature reports uncertainties concerning important issues such as land governance and land tenure, the scope of deforestation monitoring, non-accounting for indirect drivers, and the stability of the conditions sustaining current trends.

With current options for increasing productivity,[65] total production can increase greatly by increasing the productivity of several crops that have had relatively slow yield growth in recent decades (e.g. beans, cassava, corn). Together with improvements in meat and dairy productivity, this can free up agriculture land for crop cultivation.[66] However, in a scenario where land productivity improvements outpace growth in demand, so that the increase in production volume is decoupled from area expansion, environmental impacts will, to a greater degree, arise because of the agricultural means to achieve the intensification, i.e., nutrient and pesticide leaching, soil erosion, etc.[67,68] Implementation of best management practices (BMPs), especially for cultivating low productivity pastures, will consequently be crucial for mitigation of environmental impacts.

Brazil has long been engaged in developing and implementing sustainability standards and certification systems for forest and agricultural commodities. It is among the top producers and exporters of certified coffee, soy, sugar, ethanol, and cotton, using, for instance, Bonsucro, Round Table for Responsible Soy, Proterra, Utz, Fair Trade, Organic, Sustainable Agriculture Network-Rainforest Alliance, and the Forest Stewardship Council.[69]

The scientific information confirms the sector's perspective on achievements and recently observed trends. Studies demonstrate the feasibility of technological options for balancing high productivity and environmental protection,[70] but the capacity for sustaining recent low deforestation trends through promotion of productivity improvements is uncertain in scenarios with very high demand growth in the agriculture sector.[71]

Planted fast-growing forest

Sector perspective

At the beginning of the last decade, Eucalyptus species began being planted in the Northeastern Cerrado areas (MAPITO). MAPITO is attractive due to land availability and favorable export logistics with railways and ports connecting to Europe and North America. The establishment of plantations in the region follows a cycle initiated in the 1960s and 1970s in the South and Southeast, continuing during the 1980s and 1990s north of Espírito Santo and south of Bahia, and around 2000 in southern Brazil and Mato Grosso do Sul. Development of improved plant varieties and production technology has raised productivity from typically ~12 $m^3 ha^{-1} year^{-1}$ at the beginning of the last century to the current national average of 42 $m^3 ha^{-1} year^{-1}$, with some commercial plantations reaching 80 m^3

ha^{-1} $year^{-1}$. It has also become possible to establish plantations in semi-arid regions.

MAPITO ranks lowest in Brazil in socioeconomic terms, specific R&D needs, and local logistics and infrastructure bottlenecks. The sector also faces the challenge of establishing operations in a region with little previous forestry activities and consequently lacking in workers with the relevant skills. Forest projects also need to ensure that local populations benefit from the development. The path toward inclusion starts with identifying social assets and the history of local communities that form the basis for the development of socio-environmental projects of mutual interest for companies and locals. An important asset of traditional communities is self-sufficiency agriculture producing staple food crops. Projects should aim to reflect the cultural values that underlie local history while improving agricultural practices, conserving natural resources, and promoting sound businesses. To ensure a high level of environmental integrity, projects generally target areas already largely used for agriculture, define protection of lands with high conservation value, and include ecological corridors connecting NV areas. Projects may also set aside larger areas than required by the FA to promote biodiversity and maintenance of natural cycles.

These are examples of practices in expansion areas intended to maximize the benefits that forest plantations can add to new regions. Clearly, conflicts cannot always be avoided. The arrival of a new economic actor can cause tension, and new types of activities tend to increase the risk of stress. Efficient and open communication channels, enrollment of local stakeholders, and various governmental agents can mitigate such risks. Building trust among stakeholders to reach agreements requires dedication and time. Strategies to achieve this should therefore be built into medium-and long-term regional development plans.

Related scientific information

Primary data is less readily available for planted forests than for crops and pastures. Even comprehensive and recent detailed scientific reports on silvicultural development, corporate strategies, and current practices[72] are mostly based on producer reports.[73] Independent scientific publications and reports from civil society confirm the high degree of commitment to good practices and voluntary certification schemes[74] and point to positive impacts[75] and multistakeholder initiatives (companies, civil society, governments) linking forest plantations with local smallfarmers benefits.[76] Brazil has the 6th largest area of certified fast-growing planted forests under Forest Stewardship Council certification, accounting for nearly 6 Mha out of 6.9 Mha total forest area for industrial wood production and ranks as the top Tropical and Southern Hemisphere country with respect to certified area. It is also one of the main countries engaged with the world PEFC forestry standard system.[69]

Despite this general perception in the scientific literature of high environmental commitment in the Brazilian planted forest sector, conflicts based in ethics involving large-scale pulp investment models have been reported in the State of Bahia.[77] Geber[78] reviewed 58 conflict cases of industrial tree plantations, including several Brazilian pulp-related issues, and concluded that policy and governance related to these plantations should be reappraised.

Wood charcoal

Sector perspective

Wood charcoal is produced from wood associated with deforestation (non-renewable wood charcoal) as well as from forest plantations or sustainably managed native forests (renewable wood charcoal). Although generic, these definitions help identify risks and opportunities. On the one hand, there is the risk of deforestation, on the other, the opportunity for the conservation of NV stocks and the creation of new stocks of planted forests connected to the green economy.

The risk of deforestation attributable to the expansion of planted forests for the production of renewable charcoal is quite low, due to several risk management factors, such as environmental regulation in general, including the new FA and certification schemes. However, the use of non-renewable charcoal may be a direct deforestation driver and may facilitate deforestation elsewhere. For instance, it can provide an informal source of working capital to clear lands and subsidize deforestation associated with other land-use activities. An exception is the use of non-renewable charcoal from licensed deforestation, since it involves a legitimate economic use of forest stocks that would be cleared anyway.

Comprehensive understanding of these pathways requires further research, but regardless of whether or not it causes direct deforestation, the use of illegal non-renewable charcoal results in a competitive disadvantage for those producers who operate on a legal and sustainable basis, since they bear the costs of establishing and managing planted forests. In addition, Brazil still faces a substantial deficit of planted wood due to economic, regulatory, and cultural barriers, as well as high transaction costs.[79]

The largest demand for charcoal comes from producers of pig iron, iron alloys, and steel. The insufficient supply of renewable wood added to the growing restrictions on non-renewable charcoal may result in the gradual loss of the market share to the use of coal coke. The planted area needed just to supply the charcoal-based iron and steel industries with renewable charcoal is estimated at double the current area. Therefore, a sustainable charcoal economy depends fiercely on the expansion of planted forests, as indicated by national policy directives.[80]

The final consumer does not easily perceive the effects of the industrial use of charcoal. It may seem utopian for consumers to attribute greater value to a car because it was made with renewable charcoal-based iron instead of non-renewable charcoal or fossil sources. The engagement of intermediate business-to-business production chains is therefore one of the crucial steps to allow for such a link with the final consumer. Producers and buyers of charcoal, iron and steel products, such as auto parts, casting products, among others are key decision-makers. There is no value differentiation between renewable and non-renewable charcoal, except for the cost difference. The cost of non-renewable charcoal is substantially lower due to not having to make long-term investments in plantations. In the absence of an immediate market solution, policies and incentives with the participation of civil society and final consumers could play a major role in curbing the effects of non-renewable illegal charcoal.

Although under different terms, an agreement between the private sector, civil society organizations and the government in the State of Minas Gerais has established a legal framework (State Law 14,309/2002, revised by Law 20,922/2013), gradually banning the use of non-renewable charcoal until a minimum share allowance is reached in 2019. Incentives for increasing planted forest stocks have also been addressed, with the objective of bridging the additional demand gap, such as the use of the multilateral carbon market.

The environmental degradation caused by non-renewable charcoal is associated with unhealthy labor practices, loss of biodiversity, depletion of water resources, emissions of GHG, in addition to unfair pricing practices and the damage to the sector's corporate image. The use of renewable charcoal in the production of one ton of pig iron avoids the emissions of approximately 1.8 tCO_2e (tons of CO_2 equivalents), when compared to the use of coal coke, and it generates net GHG removals of approximately 1.1 tCO_2e, because of new carbon stocks in the plantations.[81] Additional benefits include the recovery of tar and energy in the wood carbonization process, the maintenance of carbon stocks in conservation areas, the creation of jobs and rural and industrial development. Command and control mechanisms are important to prevent the use of non-renewable charcoal, but they do not suffice. The expansion of planted forests on a responsible basis, driven by proper policies and incentives is crucial to supply the current and future demand for charcoal and to allow for a virtuous cycle of sustainable and low carbon development throughout the supply chain.

Related scientific information

The direct links between charcoal demand in steel production and LUC, including deforestation, have been established for the Brazilian iron quadrangle region.[82] The supply chains for non-renewable charcoal production, along with the associated legal issues and corruption, are documented in magazines and in the news.[83] and in NGO reports.[84] but are not well-documented in the scientific literature.

Environmental protection

Sector perspective

The basis for identifying common ground between environmental NGOs and the agricultural sector is the observation that Brazil (i) has a strong international position as an agricultural producer, which is essential for societal welfare and for supplying the global market; (ii) holds substantial areas important for biodiversity, nature conservation and climate change mitigation – essential globally as well as locally; and (iii) has sufficiently large resources for meeting both production and conservation objectives, i.e., there need not be major disputes over territory.

Outlook modelling[7] indicates that the cropland area will expand by about 12 Mha until 2022, of which 5.5 Mha is presently covered by NV. The National Policy on Planted Forests projects a greater agricultural expansion of 15–20 Mha.[80] Additional expansion should be more carefully managed. In the Amazon biome, one-third of the area deforested before 2008 is no longer under agricultural use.[85] The 2006 IBGE agricultural census shows 90 Mha of pastures with less than one animal unit per hectare.[19,86] The environmental and agricultural stakeholders have a common interest in promoting sustainable land-use practices and minimizing the conversion of NV to establish agriculture with low productivity uses or even land abandonment after some years. NV at the agricultural frontier that has low suitability for production or has high environmental value should be prioritized for protection

without restricting expansion over already converted areas or NV where agricultural suitability is very high and environmental values are comparatively low.

Thus, the common ground consists of two parts. (i) Promote sustainable intensification of agricultural production especially in pasture areas highly suitable for crops. This requires convergence of policy, for example credit, technical assistance, research and extension, and zoning-based licenses, transparently implemented by the states and agreed by stakeholders. (ii) Implement efficient restriction strategies to prevent unnecessary expansion over NV. The assignment of 'no-go zones' and establishment of compensation markets (e.g. Legal Reserve areas and REDD+ projects) are examples of such strategies. As 'go zones', we define pasture areas with high and medium suitability for crop production where relevant infrastructure exists and there are no legal or environmental restrictions.

NGOs, businesses, and the government are key actors in developing fiscal and credit instruments that encourage intensification of production as well as mechanisms to protect NV. The assignment of go and no-go zones, compensation schemes, and crediting of ecosystem protection (e.g. Payment for Environmental Services - PES) are all crucial and urgently need to be implemented in the hot spots of conversion, currently located at the Cerrado in the Northeast region (MAPITO). The prompt regulation of a national carbon credit market that recognizes REDD+ and that remunerates for water protection are leading steps toward PES.

In already consolidated agricultural regions, where compliance with the FA requires that the amount of land in productive agriculture use is reduced, a forest-based economy is at the center of the common agenda. The restoration of forests, to provide timber and non-timber products and other environmental services, is of mutual benefit for agriculture and environment. Financial instruments already exist through the principle of paying for water, established by the National Water Agency (ANA). The states of Rio de Janeiro, São Paulo, Mina Gerais, and Espírito Santo have already introduced carbon markets to promote recovery of riparian areas and establishment of legal reserves for FA compliance.[87]

The Rural Environmental Registry (Cadastro Ambiental Rural - CAR) is a major and essential management tool for farms and rural landscapes. The new FA extended the already existing registry tools in several states. Pará and Mato Grosso already have almost half of their territories (60 Mha in total) registered. Bahia, Mato Grosso do Sul, Amazonas, Rondônia, Tocantins, and other states have also made progress with CAR registration. In the course of the last three years, the revision of the FA has been accompanied by debate and interactions indicating polarized positions among stakeholders and proposals that are not compatible with a cooperative and common agenda. However, the reality of the new FA, which establishes the registry, and the implementation of which has already redefined the agenda, may move stakeholders away from polarized positions and dispute. These stakeholders can and should now take on this new agenda and jointly show that it is possible to meet the demand for food production without compromising the integrity of natural capital and the associated ecosystem services needed by the present as well as future generations.

Related scientific information

Scientific information[26,66] supports the hypothesis that further conversion of NV into production use is not needed since the land already in use can accommodate the short- and medium-term expectations on agricultural production. Further, as shown generally,[88] and specifically for Brazil,[38] most of the land that is highly suitable for agriculture is already in use. Achieving production gains in a scenario with additional expansion requires investment in research, development and extension, and in rural infrastructure and institutions promoting productivity under marginal conditions.[71] The areas still covered by NV are mostly of marginal suitability for crops but can be essential for biodiversity and nature conservation, especially in regions where a large part of the land area is under intensive use.

Public–private partnership of Amazon Regional Protected Areas (ARPA) for collaborative financing, management, and implementation of conservation programs, requires a collaborative agenda among several agents (NGOs, governments, community leaders) to achieve outcomes in terms of institutional development and the advancement of environmental objectives.[89] In the absence of effective national and intergovernmental regulation addressing environmental and social problems, governance alternatives have proliferated, including self-regulation, corporate social responsibility, and public–private partnerships, many of them working as private market-driven governance systems.[90] Such initiatives go beyond legal regulations, encouraging responsibly produced goods and services through monitoring along entire supply chains. Agreements and common agendas are possible and may be effective in balancing environmental and production objectives, but they may involve complex and

comprehensive arrangements reflecting multiple dimensions, including religion.[91]

Discussion and conclusions

The scientific information demonstrates compatibility, i.e., common ground, between agricultural and conservation interests in four main ways: (i) there is sufficient area to meet both conservation and production objectives, so core objectives are compatible; (ii) there is large scope for productivity gains supporting increased agriculture production, so increasing production does not necessarily require additional land; (iii) environmental aspects are not the only reason that productivity gains are perceived to be important, i.e., the agriculture sectors share the interest in productivity gains; and (iv) environmental protection is a complex multistakeholder process also with multiple initiatives. From this perspective, the current trends and achievements are positive.

However, the common ground hypothesis – that further conversion of NV into production use is not needed since the land already in use is vast and productive enough to accommodate the short- and medium-term expectation on agricultural production – is valid from a geographic point of view, but is not when social and economic dynamic is considered. The hypothesis is also challenged by old and deeply rooted mutually exclusive conceptions and positions. Examples include: (i) objections to rapid management change, or even change at all, among conservative and traditional beef sector producers; (ii) the idea among producers that the Cerrado can be deforested to support effective soy and corn cultivation, reducing pressure to expand agriculture elsewhere where it would possibly cause greater impacts; (iii) the idea among politicians that agricultural development necessarily brings local socioeconomic benefits welcomed by communities; (iv) the perception among producers that agricultural development in the northern part of Brazil can bring new export income and reduce the logistic costs of exports; and (v) the perception among producers that environmental agendas mostly serve to enable a more comfortable negotiation process intending to promote expansion of agricultural markets, and at the same time leveling green washing and effective conservation initiatives.

Mutually exclusive agendas may be favored over compatible agendas if they are strategically and tactically advantageous in processes shaping the governance of land use in Brazil. The polarizing positions expressed during the FA discussions, and repeated on other occasions, indicate that stakeholders have indeed judged that debate and conflict will bring the most beneficial outcome. The fact that the structured discussion revealed several examples of means for dispute further supports this thesis.

The Brazilian agricultural sector is increasingly export-oriented, and there is a structural shift toward large-scale farming managed by corporations where the remaining individual farmers also associate more with corporations.[14] Political decisions in international forums, biofuel policies, regulations, legislation, and credits all influence corporate investments and decisions. The establishment of a rural parliament group favors decisions under this perspective. The Brazilian rural parliament group, formally named *frente parlamentar agropecuária* but sometimes also called *bancada ruralista,* counts 175 out of 513 representatives in the lower house and 11 out of 81 in the upper house[92] and is a very active and committed group. Several of the representatives are agricultural producers themselves, mainly in the beef sector.

The most recent agricultural census[86] indicates that in 2006, Brazil had 5.2 million agricultural producers that directly engage 17.5 million people (full or part-time), out of a total population of 184 million. Most producers have small areas and low income; and national poverty is concentrated in rural areas. Support for small-scale family-based agriculture is a high priority in parliament and in society as a whole, and for these producers efficiency is considered one among several other important issues, including social and economic security, food quality and nutritional security, and mitigation of migration from rural to urban areas. Since parliament groups have some independence from the wider party organizations, their support is crucial for the exclusive agendas. The existence of issues for dispute, which are not properly addressed by any party organization, motivates the establishment of separate parliament groups and ground for engagement by representatives supporting other no-party agendas.

Given its multi-party composition, the agricultural sector parliament group has to align with other major interests and some agendas can become challenging. A strong focus on productivity gains would exclude the majority of current small (efficient or not) and inefficient (small or large) producers and excessively promote corporate production. A zero deforestation agenda would not impose severe restrictions on the capacity to increase production, given the large extensions of already cleared land and the intensification potential. However, locally, where land conversion for agriculture expansion is still legally possible, such an agenda would be considered an obstruction requiring compensation (e.g. payments for nature conservation), and the required compensation schemes are

BOX: Dispute brings media attention

An independent media analysis[93] of 12 regional and 5 nationwide daily newspapers (>2000 texts), covering the political process in the Lower House of the Brazilian Congress to get the FA ready for vote, its approval, and the immediate repercussions from April to June 2011, revealed that about 60% of the texts had as their main theme the political dispute: divisions in the government's coalition alliance, efforts made by Deputy Aldo Rebelo – rapporteur of the White Paper – to articulate support for his project, and political bargains that prevented Dilma Rousseff's government from taking a clear position related to the relaxation of the FA. Thus, the political dispute overshadowed the environmental discussion and the debate also failed to recognize the core role of the FA as a tool to stimulate the goal of a sustainable agricultural sector in Brazil. Coverage was mainly led by journalists specializing in politics and not familiar with the science related to conservation. Their expertise shaped the relative terms with which newspapers dealt with the sustainability concept. Looking for balance, editors somehow accepted the hypothesis that the new FA should be the result of an agreement that met halfway between the interests of the agricultural sector and the environmental movement.

currently missing. Thus, supporting such an agenda would meet opposition from the parliament group representing agricultural producers as well as from other parties committed with local development, poverty alleviation and other political agendas.

Pastureland is the main alternative for expansion of certified soy, corn, sugarcane, and other crops. Pasture-based beef production uses almost three times as much land as all other agricultural production combined and this abundance in combination with high expansion capacity lowers the land price. Thus, frontier expansion, mostly pasture establishment, favors expansion of crop production systems since these can be established on existing pastures more profitably. In this way, promotion of more effective beef production indirectly reduces cropland expansion by reducing frontier expansion, which increases the land transaction cost of converting existing pastures to cropland – another effect to be added to other possible effects of increasing productivity in beef production.[66]

Land still covered by NV has a relatively lower price compared to where agricultural production is established. Actors engaged in land grabbing (designated *negócio de terras* in Brazil) facilitate land conversion by carrying transaction costs and risks that agriculture producers may not accept.[33] They are key in the process of making new land available by engaging with multiple and diverse landowners in order to purchase several small and adjacent areas to establish a large farm.[94] If policies and regulation prevent expansion, the conditions for land grabbing would drastically change and the acquisition price of existing agriculture land would be higher. Land grabbing is controversial and difficult to promote in political spheres. However, actors can promote this business by pushing mutually exclusive and disputed agendas since this maintains the role of land grabbing in the frontier areas. Additional actors favoring such agendas include segments of the beef sector, which still in part operate illegally and informally, and most of the non-renewable charcoal production, which benefits from weak governance and institutions with low capacity for surveillance and enforcement.

Participation in processes relating to sustainable development requires that NGOs engage in complex multi-stakeholder interactions, which require capacity to integrate economic, social, and environmental dimensions and assess evolving public and private policies ranging from local to global scales. Brazilian NGOs engaged with environmental issues commonly have close connections with academic institutions and young professionals with university background, and they commonly align with commitments toward nature conservation and social justice. During the last decade, funding of such NGOs from international cooperation has decreased dramatically and this has weakened the capacity of the NGOs who have lost human capacity to other sectors such as government and the private sector. Therefore, they have shifted focus from long-term and institutional strategies to projects and short-term agendas with more narrow focus on, for example species conservation and human rights in specific settings.

The capacity to intervene and negotiate has as a result been confined to a limited number of organizations (including international NGOs), which in turn has made collective, multi-institutional dialogue and collaboration toward a common sustainability objective more difficult. The asymmetry of power between a weakened and fragmented civil society and an organized, powerful and resourceful agricultural sector also reduces the possibility of dialogue and negotiation on a common agenda. Furthermore, in order to facilitate fundraising and image building, NGOs need media exposure. Dispute may there-

fore be favored since it attracts more attention from general or political media not specializing in environmental topics. The polarized debate about the Brazilian FA can to some extent be explained by this need for media attention. If dispute is considered desirable, it is naturally difficult to establish multi-stakeholder dialogue toward a common agenda balancing conservation and agricultural development objectives.

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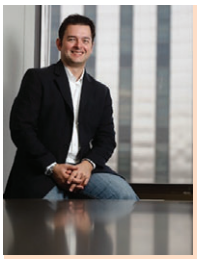

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