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Sacred groves, sacrifice zones and soy production: globalization, intensification and neo-nature in South America

Gustavo Oliveira and Susanna Hecht

Soy has become one of the world's most important agroindustrial commodities – serving as the nexus for the production of food, animal feed, fuel and hundreds of industrial products – and South America has become its leading production region. The soy boom on this continent entangles transnational capital and commodity flows with social relations deeply embedded in contested ecologies. In this introduction to the collection, we first describe the 'neo-nature' of the soy complex and the political economy of the sector in South America, including the new corporate actors and financial mechanisms that produced some of the world's largest agricultural production companies. We then discuss key environmental debates surrounding soy agribusiness in South America, challenging especially the common arguments that agroindustrial intensification 'spares land' for conservation while increasing production to 'feed the world'. We demonstrate that these arguments hinge on limited data from a peculiar portion of the southern Amazon fringe, and obfuscate through neo-Malthusian concerns multiple other political and ecological problems associated with the sector. Thus, discussions of soy production become intertwined with broader debates about agrarian development, industrialization and modernization. Finally, we briefly outline the contributions in this volume, and identify limitations and fruitful directions for further research.

Keywords: soy; South America; land sparing; intensification; globalization; flex crops; *pool de siembra*; political ecology

1. Introduction

Soy. Whether praised as the most efficient means to 'feed the world' or condemned for the manner in which it erases entire ecosystems beneath its seemingly endless green rows, soy has indubitably become one of the most important agroindustrial commodities in the world - serving as the nexus for the production of food, animal feed and hundreds of industrial products - and driving one of the most rapid landscape alterations (and enclosures) of the last 30 years. Soy production in South America now covers over 57 million ha, more than on any other continent (USDA 2015). Farmers and companies there are responsible for 54 percent of global production and 58 percent of total exports. This has taken place through the direct extension of highly capital and chemical intensive agroindustrial practices into areas that had been considered marginal for this kind of production system, such as the fringes of the Amazon, the Cerrado and Caatinga in Brazil, across Bolivia's and Argentinian Chaco forests, and parts of the Atlantic forests. The system also builds on the 'post-frontier' areas where tenure regimes have been stabilized and consolidated, intensifying production over pastures and replacing less profitable crops (as in the Brazilian Cerrado and the Pampas of Argentina and Uruguay). It has also involved the transformation of many complex woodland systems whose inhabitants lived from forest products, livestock and small-scale agriculture (Porro 2005; Sawyer 2008; Gordillo 2014). This process has converted huge tracts of some the world's most complex ecosystems, some with as many as 600 species per ha, into a monoculture with its symbionts with fragmented forest remnants along waterways, mountain-tops and some protected forests. The social life of agriculture and livelihoods in many places has been equally depleted. Yet less than six percent of all soy produced in the world is consumed directly as human food, and virtually all of it in South America is crushed to produce livestock feed and edible oil, as well as biodiesel and other industrial products (Highquest Partners and Soyatech 2011). Soy is no simple staple crop – it is an agro-industrial feedstock, a complex assemblage of technologies and techniques for the flexible implementation of its production across highly variable landscapes, a global network of machinery, warehouses, trucks and ships channeling commodity flows to multiple markets around the world, structured by an even broader diversity of institutions, social relations and practices. This is the 'material' soy that we can study and engage as land use, commodity, industrial input and oilseed.

But soy also embraces another set of meanings and symbols generated by the narratives of its development and the massive transformation of societies and landscapes that this has entailed in South America, presaging perhaps also transformations sought elsewhere in the tropics, particularly sub-Saharan Africa. As Norman Borlaug, a Nobel Laureate and one of the fathers of the first 'Green Revolution', claimed,

> Eventually the Cerrado technology or one similar to it will move to the llanos of Colombia and Venezuela, and hopefully into Central and Southern Africa where the soils are similar. This will bring tens of millions of hectares previously marginal for agriculture into high yield agriculture. (Borlaug 2006)

The symbolic work of soy as emblem of agrarian progress extends beyond its reality as an agricultural system into a signifier or icon of twenty-first-century rural development, from its genomics to its globalization. It carries the visual imprint of order and efficiency, the reality of a highly technified, 'fordist' style of production rather than the scruffy, atavistic and externally unintelligible features of locally complex agriculture that include substantial areas with woody species and differentiated landscape management. Even though the boom of soy production across South America has been implicated in multiple social and ecological problems that we discuss further on, its extension rests on several powerful narratives. One is simply the economic power of the crop that kept many of the new 'pink tide' governments in good financial standing and floated many of their redistributive policies, such as 'Bolsa Familia' and the expansion of the agricultural processing and service sector in new urban centers like Lukas do Rio Verde in Mato Grosso, Brazil (See Garrett and Rausch 2016, this volume; Weinhold et al. 2013; Richards, Pellegrina, and Spera 2015). With faltering industrial production and the global shifts associated with the rise of China's manufacturing industries, commodity development valorized a largely disarticulated export-led development model. Next, the simple Malthusian narrative is often advanced about expanding food production for a world of eight billion (Brown 2012; Smil 2001), and thus soy was positioned as an international food security question. Since most soy production is used as animal feed, the Malthusian framing increasingly has given way to a more truthful stance: soy attends to rising incomes in Asia and its demand for meat. The expansion is thus framed as an international market rather than a humanitarian concern. These powerful narratives about soy itself are complemented with symbolic content about what it means to be modern in rural areas.

The expansion of soy expresses most profoundly the image of the new developed and developing third-world state, even as, we show later, many of the previous structural vices of 'unmodern' agriculture were reproduced under the modernist mantle of soy. Its role in triggering urban and agrarian transitions was seen as salutary, again a mark of post-millennial modernism. These narratives and their allied environmental discussions provide tremendous strength to soy agribusiness in South America and beyond, which has increasingly drawn on depoliticized Malthusian, modernist and technocratic discourses to depict the sector as the solution for – rather than the driving force behind – the problems of equity, environment and the viability of future rural development in the tropics. Yet soy has also been central to the volatility of southern cone economies that structured their strategies around production and export of this commodity, and which are all at this moment in various degrees of recession.

We begin with a description of soy as material commodity, land-use practice, and nexus of structural relations between agroindustry, the state and new forms of finance. We then shift to the 'discursive' soy and its symbolism, contestations and implications. This then leads into our discussion of the contributions selected for this collection, our collective contribution to the literature, as well as its limitations and directions for further research.

2. Neo-nature and the soy complex in South America

2.1. *The shock of the new*

Soybeans were first brought to South America for agronomic experiments in the late nineteenth century, and small-scale production was established during the first half of the twentieth century by Japanese, Mennonite, Ukrainian and other immigrant farmers in southern Brazil, parts of Paraguay and the Argentinian pampas who rotated it with wheat as a nitrogen-fixing cover crop. In the second half of the twentieth century, soy became established as a major input for the vegetable oil and confined chicken industry in Brazil and Argentina, and later even in Colombia (Shurtleff and Aoyagi 2009; Goodman, Sorj, and Wilkinson 1987; Sorj et al. 2008). Since the 1970s, soy, and especially tropical soy, has evolved as the most dynamic legal agricultural segment in Latin America's rural economies and the fastest growing agroindustrial commodity in the world. Its continental magnitude is depicted on the map below (Figure 1) and the fast pace of its expansion is visible in Figure 2.

'Tropical soy' is a relatively new genomic agroindustry – a kind of 'neo-nature' – an assemblage of an exotic leguminous oilseed, selected to be amenable to mechanized planting and harvesting, adapted to longer photoperiods and higher temperatures, and able to grow in more acidic, low-phosphorus soil conditions than the temperate areas of China, the USA and Ukraine. A precondition for this 'tropicalization' of soy was the agronomic research and adaptation of soybean varieties to South American landscapes and (sub-)tropical climates undertaken by Brazilian and Argentinean state-owned agricultural research companies during the 1970s. They and domestic seed companies played leading roles until the late 1980s, when Brazil and Argentina served as 'incubators' for sub-tropical and tropical soybean production technologies that were then transferred to Paraguay, Uruguay and Bolivia. But the development of transgenic technologies by chemical companies in the United States and Europe has since displaced these public and domestic enterprises, even though they continue to play key roles in the development of soybean varieties

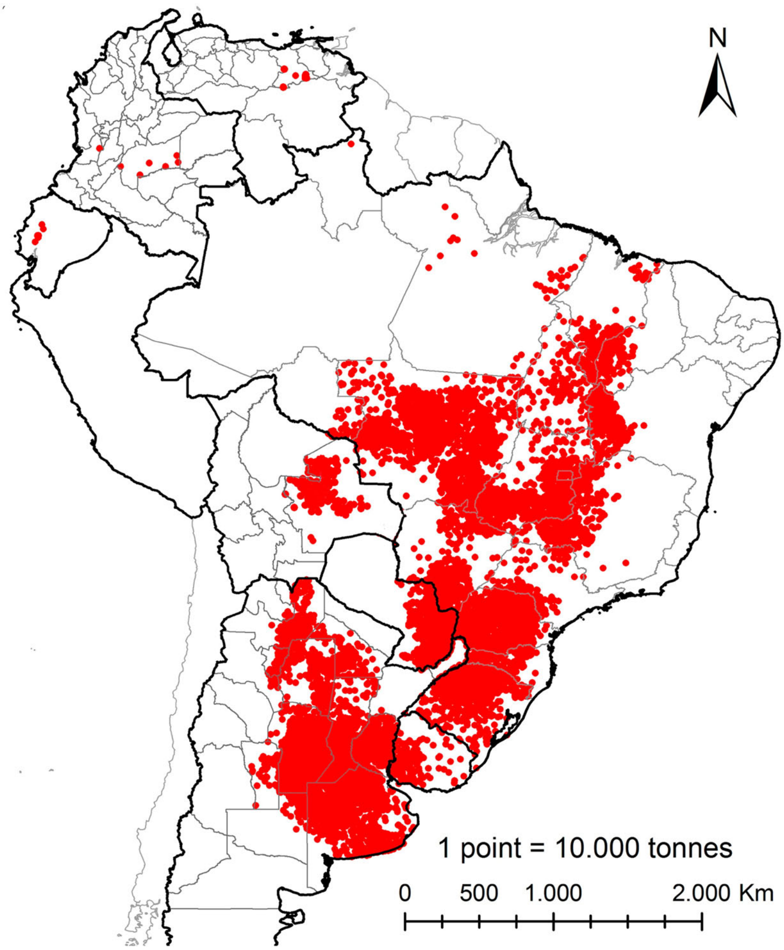

Figure 1. Map of soy production in South America by volume, 2013.
Source: Elaborated by Valdemar Wesz Jr., Ben McKay, Gonzalo Colque, Efrain Tinta, and the authors from multiple sources.

into which patented transgenic material from transnational companies is inserted, as well as multiplying and commercializing seeds with traits from transnational companies (Craviotti 2016, this volume). The soy boom that began in South America during the 1970s accelerated further in the 1990s into tropical areas, with policy shifts to export-oriented production, elimination of export tariffs and deregulation of banking sectors that facilitated foreign investments in processing and trade infrastructure (e.g. warehouses, crushing facilities and ports).

Transgenic or genetically modified (GM) varieties were approved in Argentina in 1995 and smuggled into Brazil, Paraguay and Bolivia until those governments also approved them between 2003 and 2005. During this period, a handful of transnational agrochemical companies began to dominate soybean seed and associated agrochemicals markets. Currently, the top three companies – Monsanto, Syngenta and DuPont/Pioneer – control over 55 percent of global soybean seed markets, and this concentration is even greater in

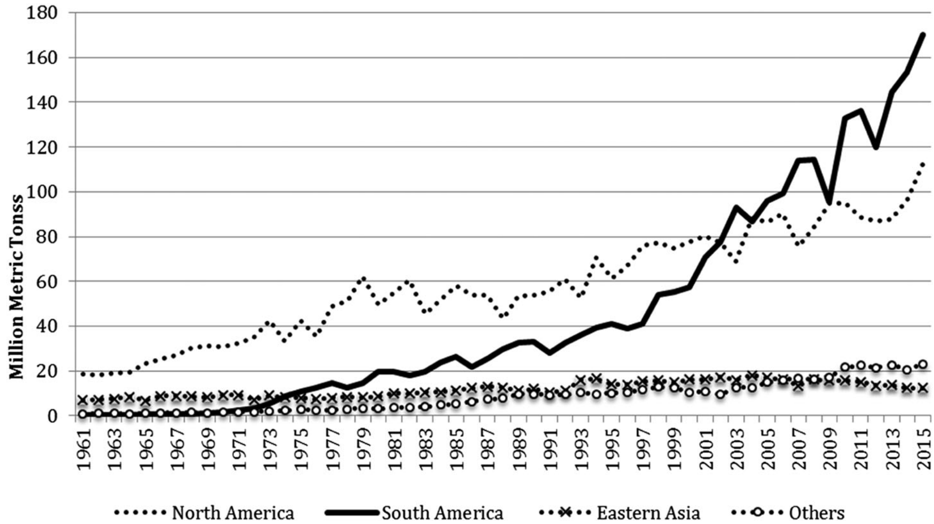

Figure 2. Soybean production volume by continent, 1961–2015.
Source: Elaborated by the authors from United States Department of Agriculture data.

South America where GM varieties predominate. The top five companies – Syngenta, Bayer, Basf, Dow and Monsanto – control 69.5 percent of global agrochemical markets, and the first three alone control over 49.1 percent of the agrochemical market in Brazil (EcoNexus and Berne Declaration 2013; Silva and Costa 2012). The ongoing merger of Dupont and Dow, worth USD 130 billion and ChemChina's acquisition of Syngenta would consolidate an already highly oligopolistic sector even more.

This key transformation in technologies and techniques began with GM soybean varieties modified to resist glyphosate-based herbicides (originally patented by Monsanto as RoundUp and RoundUp-Ready or RR soybean seeds). Agrochemical and soy agribusinesses asserted the RR technological packet would simplify production practices by reducing applications of agrochemicals and increasing productivity, thereby lowering production costs and increasing farmer profits. One of the central allurements of the tropical soy system is that it enabled no-till farming techniques that enable double cropping, placing it at a clear productivity advantage over temperate zone soy cultivation systems. Currently, GM seed use ranges from 88 percent in Brazil to 93 percent in Bolivia, 95 percent in Paraguay and over 99 percent in Uruguay and Argentina (WWF 2014). In its complete destruction of pre-existing natures, agrarian and otherwise, and its use of land essentially as a substrate, soy represents almost more completely than any other biotic production system the construction of a 'neo-nature'.

Yet the idea that GM use would be more productive and reduce applications of agrotoxics compared to conventional varieties has not been borne out everywhere and over the long term (Cotacora-Vargas et al. 2012; Altieri and Pengue 2006). Although soy systems are novel, 'neo' ecosystems in many ways, they are not exempt from evolutionary processes, and problems of resistance have emerged as pests have adapted to the selection pressure attending these monocultures. Indeed, many of these, such as Johnson grass in Argentina (Binimelis, Pengue, and Monterroso 2009), have become widespread and almost ineradicable pests, and a single field may have to be drenched with multiple treatments as much as 15 or 16 times per planting cycle.[1] This has exacerbated a technology treadmill that constantly requires new public and private research and development, and forces farmers to purchase newer varieties and inputs in order to maintain competitive levels of productivity. It has also been attended by panicky searches for short-term, highly toxic alternatives when existing solutions fail.

The leading agrochemical associated with GM soy is glyphosate. It is consumed more than any other agrochemical in Brazil, Argentina and other soy-producing countries in South America even though resistance to it is now widely reported (Nicholls and Altieri 1997; Binimelis, Pengue, and Monterroso 2009; Cerdeira, Gazziero, and Matallo 2011), and it has been identified by the World Health Organization (WHO) and multiple South American scholars as 'probably carcinogenic to humans' (Guyton et al. 2015; Silva et al. 2015), and associated with multiple other serious health problems (Marc et al. 2004; Richard et al. 2005; Benachour and Séralini 2009; Berger and Ortega 2010; Paganelli et al. 2010; Moreira et al. 2010; Oliveira et al. 2014). Even breast milk in soy production regions has been contaminated by agrochemicals (Palma et al. 2014). Aerial spraying of glyphosate and other agrochemicals is widely associated with collateral damage to rural residents and livestock, and destruction of non-target crops and other vegetation (Rulli 2007; Moreira et al. 2010; Cerdeira, Gazziero, and Matallo 2011; Arancibia 2013; Gordillo 2014). The emergence of glyphosate-resistant weeds has produced a frenzied search for more toxic herbicides such as atrazine and Dow's 2,4–D, a component of 'Agent Orange', the chemical weapon used by the US military in Vietnam, which has not yet been authorized in the US. Another dire example during the 2013–2014 season occurred when there was a major outbreak of *Helicoverpa hermigera* in Brazil, supposedly controlled by the pest-resistant *Intacta* GM varieties. Despite the widespread adoption of *Intacta* seeds, soy farmers across Brazil used a record amount of pesticides, even importing benzoate-based agrochemicals from Paraguay that are illegal in Brazil (cf. Cotacora-Vargas 2014). Although the Brazilian Soybean Producers Association (APRSOJA) and the national landowners association (Confederação Nacional da Agricultura – CNA) publicly defend the use of GM varieties and push the government to hasten approval of new and stronger agrochemicals, many soy farmers – including those in leadership positions in these associations – complain that 'we are being held *hostage* by the chemical companies', who 'do not have our interests at heart'.[2] Indeed, inputs (agrochemicals and seeds) already account for 37–47 percent of production costs for soybean in Brazil (Silva and Costa 2012), and they have certainly been increasing with the latest round of technological upgrades necessary to cope with resistant pests and weeds.

The highly standardized technological packet that characterizes GM soy cultivation assures product uniformity essential to intermediate processing and international markets (Goodman, Sorj, and Wilkinson 1987; Jepson et al. 2005; Sousa and Busch 2006), benefitting those companies downstream from farming that tightly integrate soy and other agroindustrial commodity processing, logistics and global markets. With the ability to shift sourcing and attend multiple markets, these companies made soy into one of the world's leading 'flex crops' sitting at the nexus between food, animal feed, fuel and myriad industrial inputs. This idea of 'flexing' is not necessarily new. Henry Ford, for example, who was

[1]Michael Coe, personal communication, 2015; Gustavo Oliveira, interviews with soy producers in Mato Grosso do Sul, Goiás, Tocantins, and Bahia states in Brazil, 2014 and 2015.

[2]Gustavo Oliveira, field notes from meetings of the Grain and Oilseed Chambers of APROSOJA/State Federation of Agriculture in Goiás, Bahia, and Rio Grande do Sul, Brazil, 2014 and 2015.

an eccentric booster of this crop as a diet supplement and industrial input, already imagined his car's non-metallic structures composed mostly of soy derivatives. But with the advent of soy-based biodiesel and the actual integration of soy as input for hundreds of processed foods and non-food products, soy 'flexing' is now becoming a real and powerful force shaping the sector (Borras et al. 2015; Hecht and Mann 2008; Oliveira and Schneider 2015; Grandin 2009). It is recasting continental production systems, agrarian regimes, agronomic infrastructures, finance systems, urban forms and networks, and migration and economic patterns according to what we can classify as a tropical high modernist 'neo-nature' (Scott 1998; Hecht 2005).

2.2. *The 'United Soybean Republic', or 'Soylandia'*

South America has surpassed North America as the world's leading soybean-producing region since 2003 (Figure 2), and Brazil now disputes the position of largest producer with the United States. Five countries in the 'southern cone' of South America (Brazil, Argentina, Paraguay, Uruguay and Bolivia) occupy half the spots on the list of the top 10 soybean producing countries, which concentrate the lion's share of total soy production around the world. Brazil and Argentina alone are currently responsible for 30 and 19 percent of world production. Although China and India are among the world's top 10 soybean producers, India never was a major exporter and China became a net importer decades ago. Now, virtually all their harvests are consumed domestically. Outside North and South America, the Ukraine is the only meaningful exporter, and even then it is only responsible for less than two percent of the total share of the international market. Presently, the five South American soybean-producing countries account for 58.3 percent of global exports (Table 1). But note that the following figures and table only indicate imports and exports of unprocessed soybeans, without considering soy oil and meal, and thus disguising somewhat the more significant participation of countries that supply international markets with greater ratio of soy oil and/or meal to whole beans, particularly Argentina.

The agroindustrial model of the 'green revolution' into which soy production became integrated in South America over the course of the twentieth century has its ideological and technical foundation in the US, but it wasn't until the neoliberal reforms of the 1990s in South America that domestic companies across the soybean complex, from seed production to soybean processing and international trade, were overtaken by the transnational trading corporations that had an oligopoly over US production technology and dominated market share and exports. Argentina, Brazil and the rest of South America set multiple policies to encourage export-oriented production and attract foreign investments to the sector, including tariff reduction, free trade policies and banking reform, practices that converged in the aggressive push by the leading US and European trading companies (ADM, Bunge, Cargill and Louis Dreyfus – collectively known as the ABCDs) to acquire local companies and make greenfield investments in soybean storage, processing, logistics and trade that have since made them dominant exporters from South America (Goldsmith et al. 2004; HighQuest Partners and Soyatech 2011). Until 1995, these companies only owned about 10 percent of soybean-crushing capacity in South America, but by 2002 they controlled about 50 percent of crushing capacity and 85 percent of whole-bean exports from South America, and this volume has since increased even further (Wesz Jr. 2016, this volume). These reforms also orchestrated private and foreign acquisitions of agricultural research and development, which shifted from state agencies and domestic seed

Table 1. Soybean area, volume and share of global production and exports in 2015.

	Country	Area (million ha)	Production (million metric tons)	Share of global production (%)	Share of global exports (%)*
1st	USA	33.4	106.88	33.54	35.96
2nd	**Brazil**	**32.1**	**96.20**	**30.19**	**44.53**
3rd	**Argentina**	**19.3**	**60.80**	**19.08**	**7.69**
4th	China	6.80	12.35	3.87	−63.75
5th	India	10.9	9.00	2.82	0.20
6th	**Paraguay**	**3.24**	**8.10**	**2.54**	**3.63**
7th	Canada	2.23	6.05	1.90	2.77
8th	Ukraine	1.80	3.90	1.22	1.91
9th	**Uruguay**	**1.33**	**3.11**	**0.96**	**2.24**
10th	**Bolivia**	**1.08**	**2.65**	**0.82**	**0.21**
11th	Russia	1.90	2.59	0.81	−1.35
12th	South Africa	0.69	1.06	0.33	−0.06
13th	Italy	0.32	0.90	0.28	n/a
14th	Nigeria	0.65	0.65	0.20	−0.08
15th	Indonesia	0.43	0.60	0.18	−1.67
16th	Serbia	0.18	0.44	0.14	−0.00
17th	Mexico	0.19	0.36	0.09	−3.25
18th	Japan	0.13	0.23	0.07	−2.38
20th	Iran	0.08	0.20	0.06	−0.76
20th	Burma	0.17	0.20	0.06	0.00
	Others	2.58	2.00	0.63	0.86

Source: USDA-FAS data, elaborated by the authors.
*Negative numbers are provided for net importers, indicating share of global imports.

companies in South America to a handful of leading seed-and-agrochemical companies from the United States and Europe.

The rapid rise and concentration of this technologically homogenous agro-ecosystem across state borders in the 'southern cone' of South America led transnational agribusinesses to imagine – and project the image of – a 'United Soybean Republic' over which they could preside (Figure 3; Grain 2013; Turzi 2011). This reflects a strategic response by North Atlantic-based agrochemical and commodity trading companies to capture the emerging shifts of production to South America from the United States, as well as consumption markets created by increased poultry and pig production in Europe and East Asia, particularly China, triggering a race for control over these new production sites and flows of this key agroindustrial sector (Figures 4 and 5; Oliveira and Schneider 2015).

While the technological homogeneity and corporate concentration of the sector has been characterized as an iconic mark of a global 'corporate food regime' distanced and disarticulated from local political, social and environmental realities (Turzi 2011; McMichael 2012; Clapp 2014), it is important to understand that there has been continued state engagement in this sector since its early implementation, including institutional development throughout the region in terms of government-subsidized credit, modernization of cadastral data and land titling, state-supported infrastructure development and machinery imports, and significant research and development funding (Hecht 2005; Fearnside 2007; Wolford 2008; Richards 2010; Urcola et al. 2015; Oliveira 2016, this volume). Although transnational seed and export companies dominate the sector, their business logic and operations

Figure 3. *Locus classicus* of the so-called ‘United Soybean Republic’.
Source: Reproduced with permission from Grain 2013.

remain firmly rooted in concrete social and ecological relations, embedded rather than abstracted from their place.

There has already been considerable scholarship on how the ABCDs established a global monopsony (Goldsmith et al. 2004; HighQuest Partners and Soyatech 2011; Morgan 2000; Murphy, Burch, and Clapp 2012; Oliveira and Schneider 2015), but countering these tendencies was the earlier development of cooperatives in southern Brazil that pooled capital to purchase inputs, build storage and processing facilities, and increase their bargaining power vis-à-vis trading companies (Chase 2003; Fajardo 2005). Some of the largest scale farmers, such as Blairo Maggi in Brazil and Gustavo Grobocopatel in

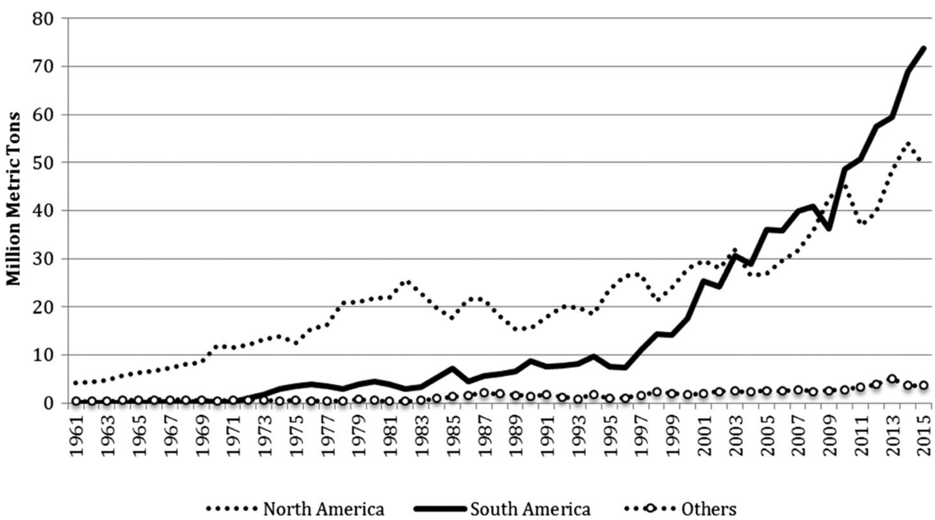

Figure 4. Soybean exports by continent, 1961–2015.
Source: Elaborated by the authors from United States Department of Agriculture data.

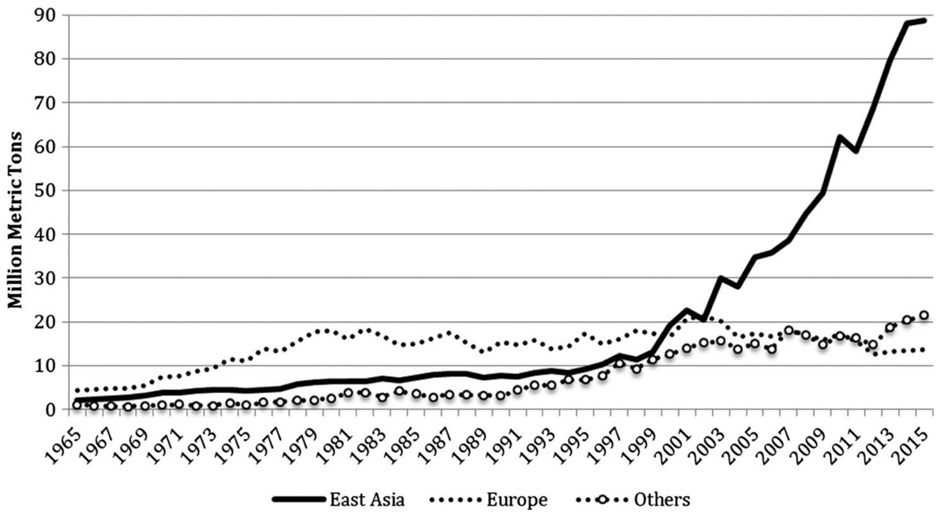

Figure 5. Soybean imports by continent, 1965–2015.
Source: Elaborated by the authors from United States Department of Agriculture data.

Argentina, have even been able to expand vertically into the construction and operation of their own trading operations (Table 2). But farmers are largely price takers in domestic and international soybean markets, because of the bottleneck associated with the concentration of a very few economic actors in the processing, logistics and marketing realms. A small minority of farmers have contracted for non-GM or even organic soy production in order to gain price premiums from niche markets (Vennet et al. 2016, this volume; Garrett, Lambin, and Naylor 2013; VanWey and Richards 2014), and policy incentives for biodiesel companies to source from small-scale farmers have also established a segmented market for some soy producers in southern Brazil (Oliveira and Schneider 2015). The predominant strategy for soy farmers to cope with their weak position relative to soybean crushers and trading companies has been to increase production and control the quality of their harvests. Since the intensive use of glyphosate and other herbicides drastically reduces the contamination of harvests with weeds and leaves, farmers now consider glyphosate-resistant GM varieties necessary in order not to incur price deductions at the point of delivery, deepening the technological treadmill and the farmers' need for finance.

2.3. *Financing 'Soylandia' and fragmenting farms*

Historically, soy and other cash crop production was financed largely by state-owned and subsidized national banks, but this role has largely shifted to agrochemical/seed providers and commodity trading companies. Partnerships between major seed and agrochemical input manufactures with major soybean trading companies (e.g. Monsanto with Cargill, Syngenta with Bunge) enable these agribusinesses up- and downstream from soy farms to effectively control the inputs and farming practices of most soy farmers across South America, and lock in prices and delivery of portions of their harvests through prearranged provision of fertilizer, pesticides, herbicides and seeds – a practice typical of contract farming more generally. Smaller and less capitalized farmers might commit as much as two thirds of their harvest to input/trading companies before the planting season, and even large and well-capitalized farmers frequently contract around a quarter of their

Table 2. Major *pools de siembra* and farm management companies in South America.

Name	Country/year established	Investors	Total ha controlled	Notes
Cresud/ Brasilagro	Argentina, 1936 (restructured in 1959 when listed on the Buenos Aires Exchange)	Originally established by Credit Foncier (Belgium), purchased by the Dolphin Fund in 1994 (operated by Eduardo Elsztain), who remain its major shareholders and primary managers. In 2006, it created Brasilagro with JP Morgan Whitefriars (USA) and Credit Suisse (Switzerland).	Owns 866,215 ha in Argentina, Brazil, Paraguay and Bolivia; 204,706 ha cultivated in 2015, including 77,179 ha on lease or concession.	Its main focus since 1994 has been the development of farmland for resale, and at its peak it owned over 1 million ha across four countries. Soybeans account for 56% of its crop production, while sugarcane and ranching cover 27% and 14%, respectively, of its land under production. In 2006, Cresud created Brasilagro as a public company listed on BM&F Bovespa to expand into Brazil.
Amaggi/Bom Futuro	Brazil, 1977, Bom Futuro becomes independent in 1993	Privately controlled by the Maggi family. The Amaggi Group is led by past governor and senator of Mato Grosso state, Blairo Maggi. Bom Futuro Group is owned by the Maggi Scheffer branch of the family, led by Blairo's cousin Eraí.	> 511,300 ha in Brazil; Amaggi: 252,300 ha (51,900 ha on lease); Bom Futuro: over 259,000 ha.	Largest private soybean producers in the world. The companies have also expanded to seed and fertilizer production, agricultural commodity storage and trading, fluvial navigation and hydroelectric energy production. Amaggi in particular participates in key joint ventures with Bunge and Louis Dreyfus for Amazon basin exports, and operates its own trading offices in Argentina, Paraguay, Norway, Switzerland and the Netherlands.

(*Continued*)

Table 2. Continued.

Name	Country/year established	Investors	Total ha controlled	Notes
Adecoagro	Argentina, 2002 (with the purchase of Pecom Agropecuária)	Soros Fund Management, Ospraie Management, Jennison Associates, Brandes Investment (USA), Stichting Pensioenfonds Zorg en Welzijn (Netherlands) and Qatar Holdings.	437,245 ha in Argentina, Brazil and Uruguay; (124,412 ha leased for sugarcane, and 55,797 ha for soy).	In 2004, it began expanding to Uruguay and Brazil and diversifying from soy to sugarcane, rice, and dairy production and processing. In 2011, it was listed on the New York Stock Exchange.
SLC Agrícola	Brazil, 1945 (as Schneider Logemann & Co., producing agricultural machinery)	Black Rock, Neuberger Berman, Fidelity SelectCo, DFA Emerging Markets, Global Thematic Partners, Dimensional Fund (USA), Verde Asset Mgt. (Brazil), Deutsche Bank (Germany/China), Credit Suisse (Switzerland).	384,070 ha in Brazil; (75,871 ha leased).	SLC began producing soy in 1977 when it still focused on agricultural machinery production and a joint venture with John Deere, then divested from machinery production in 1989, and became listed on BM&F Bovespa in 2007. In addition to agricultural production, SLC also aims to profit from bringing ‘new’ land into production for resale.
El Tejar/O Telhar	Argentina, 1987, moved headquarters to Brazil in 2013	Private company held by the Alvarado family, Altima Partners (UK) since 2006, the Capital Group (USA) since 2009, and other minor investors.	~300,000 ha primarily in Brazil; ~1,100,000 ha at its peak in 2010 across Argentina, Brazil, Paraguay and Uruguay (about 70% on leased land).	One of the creators of the *pool de siembra* model, the Alvarado family controlled the company until 2009, when majority shifted to its financial investors. It expanded into Brazil in 2003, buying its own farmland, but maintained leases for its expansion into Paraguay and Uruguay. However, the company abandoned this model, withdrawing from Paraguay in 2011, and from both Uruguay and Argentina in 2013, when it hired a Brazilian chief executive officer and shifted its headquarters to Brazil.

(*Continued*)

Table 2. Continued.

Name	Country/year established	Investors	Total ha controlled	Notes
TIAA-CREF Global Agriculture	Brazil, 2008, via Radar and Tellus: 2012, as TCGA	TIAA Global Ag (US), Cosan (Brazil), AP2 (Sweden), Caisse de Depot et Placement du Quebec, British Columbia Investment Management (Canada), Cummins UK Pension Plan Trustee, Greater Manchester Pension Fund (UK), New Mexico State Investment Council, Environment Protection Agency Pension Fund (USA).	> 230,000 ha in Brazil; Also owns land in the US and Australia, seeking investments in Chile, New Zealand, Central and Eastern Europe.	Led by one of the earliest and most aggressive pension funds to launch transnational farmland investments, the Teachers Insurance and Annuity Association – College Retirement Equities Fund (USA), it joined the Brazilian sugar conglomerate Cosan in 2008 to purchase and lease farmland for sugarcane and soy production. By 2012, it already owned 151,468 ha, when it began expanding towards the northern Cerrado states, where it has been accused of involvement in illegal land grabs and violent dispossession of peasants.
V-Agro	Brazil, 2003, as Brazil EcoDiesel (BED); changed its name in 2011 merging with Vanguarda and Maeda Agronegócios	BED was composed by BT Global, Zartman, Boardlock, and Carleton Towers (USA), Deutsche Bank (Germany), BMG (Saudi Arabia), Nelson Silveira, Bradesco, Fibra, Bonsucex, and Banco Fator (Brazil). Current main shareholders: Fim CP Veritas, Gávea Investmentos, Bonsucex, EWZ Holding, and Pollus Capital (Brazil).	224,317 ha in Brazil; (135,220 ha leased).	BED was the leading biodiesel producer in Brazil at the time of its merger with Vanguarda and Maeda (with the capacity for producing 700,000 m^3 of biodiesel per year); since then V-Agro has become listed on BM&F Bovespa, divested from biodiesel processing, and focused on soy production, and also began operations to develop farmland for resale.

(*Continued*)

Table 2. Continued.

Name	Country/year established	Investors	Total ha controlled	Notes
MSU	Argentina, 1985, 1997, as *pool de siembra*	Private company held and managed by the Uribelarrea family, with Stitchtings Pensioenfonds ABP (Netherlands) and other foreign minority investors since 2007.	210,000 ha in Argentina, Brazil, Paraguay and Uruguay.	Originally as Juamarita SA operating on 15,000 ha of private land, MSU began leasing farmland in 1997. In 2007, it created Santa Juana Ltd. as a land acquisition company to expand from Argentina to neighboring countries. In 2012 its main creditors were Banco Galicia and Hypotecario (Argentina), and Itaú (Brazil), accounting for about 42% of its loans. It has also established subsidiaries for agricultural aviation, poultry and egg production, farm management and bioenergy.
Los Grobo	Argentina, 1984	The Grobocopatel family are the major shareholders and primary managers, but multiple minority partners and joint ventures have been incorporated for specific operations, such as UPJ in Argentina, Tierra Roja in Paraguay, ADP in Uruguay, and Pactual Capital/Vinci Partners in Brazil.	Currently leases ~100,000 ha in Argentina; At its peak it leased ~320,000 ha in Argentina, Brazil, Paraguay and Uruguay in 2010/2011.	One of the creators of the *pool de siembra* model, it began leasing farmland in 1987. In 2004 it expanded to Uruguay, in 2005 to Paraguay, and in 2008 to Brazil. In 2013, it sold its Brazilian subsidiary to Mitsubishi (from Japan) and withdrew from Paraguay, and in 2015, it sold its participation in ADP to its Uruguayan partners. It has shifted its focus from agricultural production (only accounting for 15% of revenues by 2014) to focus on agroindustrial processing, financing and trading.

Source: Elaborated by the authors from company websites, stock exchange reports and other sources.

harvest in exchange for fertilizer and other inputs (Wesz Jr. 2016, this volume). The leading agrochemical, seed and trading companies now derive a very substantial portion of their income from such operations, and such financing also permits much closer monitoring of production, providing extremely valuable data for transnational trading companies. This is part of a broader process of global financial deregulation and financialization of farmland markets and agricultural production that has become the subject of an important new field of research (Murphy, Burch, and Clapp 2012; Fairbairn et al. 2014; Fairbairn 2014; Isakson 2014).

A still under-studied aspect of this process has been the creation of new vehicles for channeling multiple forms of capital into soy production. These emerged from the practices of land-leasing and outsourcing specific operational tasks (such as harvesting or spraying agrochemicals) that were beginning to take shape on the Argentinian Pampas during the 1980s (Gudynas 2008; Urcola et al. 2015; Leguizamon 2016, this volume). Where this process has taken root, the figure of the independent soy farmer has been splintered into multiple characters, as smaller scale landowners lease their farms to companies that hire agronomists, farm managers, planter/harvester operators and other specialized laborers to run the soy production system. These companies, known as *pools de siembra* or 'sowing pools', collect their capital from a large number and variety of investors, ranging from rural and urban individuals to institutional investors and financial corporations. Drawing on increasingly larger and more cross-regional and transnational financial flows, these companies merge agroindustrial and management expertise with rented farmland and hired labor to expand vertiginously across the continent. Now, literally hundreds of thousands of farm units are operated by a handful of companies that manage millions of hectares across South America. Table 2 provides illustrative samples.

The land-lease basis of Argentinian *pools de siembra* expanded to a certain extent into neighboring countries, but multiple institutional and economic challenges also led them to shift and transform strategies to accomplish similar goals of cross-regional expansion to reduce risks associated with climate variation, pest outbreaks and multiple institutional challenges/benefits in different places. Some *pools de siembra* shifted towards production on their own land (especially in Brazil), and others shifted into processing, logistics and trade, while still others acquire farmland only to develop it for re-sale, capturing a speculative boost in many cases. This is especially true when soy development 'leapfrogs' into more frontier areas (Gibbs et al. 2010; Meyfroidt et al. 2014; Richards, Walker, and Arima 2014; Graesser, Aide, and Ramankutty 2015). As management shifts to farm-service companies, even non-corporate contract farming relations are transforming, so the nature and 'autonomy of farming' are increasingly disciplined and structured by external forms of management based on the application of technological packages and farm-service logistics. Indeed, soy farm operations in South America have become so extensive and tightly interwoven with service provision that 'family farmers' from the Midwest of the United States who come to Brazil struggle more to deal with these new social relations of production than with new climates or agroecosystems (Ofstehage 2016, this volume). In Bolivia and Paraguay as well, where Argentinian *pools de siembra* did not take strong root, the technological treadmill and managerial logic of multi-unit operators has left many farmers who previously gained small (c. 50 ha) plots under colonization schemes with no option but to lease their land to neighboring soy farmers who gradually increased their land to a few hundred hectares. This trend towards farmland and wealth concentration has accelerated with the introduction of GM technologies, and aggravated the already unequal distribution of farmland, credit and capital in the eastern lowlands of Paraguay and Bolivia that results from their frontier form of colonization (McKay and Colque 2016, this volume; Elgert 2016, this volume).

In some areas of southern Brazil, relatively small soy farms (< 300 ha) continue to exist, yet they are only economically viable insofar as they are able to capture price premiums from niche markets or integrate soybeans as part of a more diversified farming system (Vennet et al. 2016, this volume). In the Cerrado region of central Brazil, most soy farms are medium (300–1000 ha), but large farms (1000–30,000 ha) account for the overwhelming majority of production. In some areas, for example, farms larger than 1000 ha account for over 90 percent of the planted area (Cacho 2016, this volume). Moreover, large-scale farm management firms – modeled upon Argentinian *pools de siembra* bur frequently owning more land than they lease – are quickly increasing their operations over the Cerrado region, with multiple farms that range from 10,000 to 30,000 ha. Consequently, they have become the preferred instrument for new financial actors – such as private equity and pension funds like TIAA-CREF – to make arm's-length investments in both farming and land speculation. These new financiers have no history in direct agricultural production, but found in *pools de siembra* and farm management companies a useful tool for diversifying their portfolios, capturing gains from these expanding commodity and land markets.

3. Monoculture, modernization and Malthus

Serious environmental questions and intense debates attend the expansion of soy production throughout South America. Several concerns have to do with the environmental impacts of the soy fields on their own sites, particularly as direct and indirect exposure to agrochemicals generates problematic levels of human and environmental poisoning (Altieri and Pengue 2006; Rulli 2007; GRR 2009; Berger and Ortega 2010; Moreira et al. 2010; Arancibia 2013; Palma et al. 2014; Silva et al. 2015). Further longitudinal and epidemiological studies remain to be carried out, but enough evidence has emerged for the WHO to list glyphosate as 'probably carcinogenic to humans' (Guyton et al. 2015).

A considerable literature has also explored more regional and indirect environmental effects of soy expansion, including the dynamics of run-off, deforestation and impacts on the critical Pantanal wetland and other ecosystems adjacent to major soy production areas (Silva and Sousa 2015b; Schulz, Ioris, and Glenk. 2015); the complex effect on regional hydrology, including stream flow dynamics and water warming (Coe et al. 2009; Deegan et al. 2011; Macedo et al. 2013; Neill et al. 2013); impacts on biodiversity through habitat loss, deforestation and ecosystem fragmentation (Steininger et al. 2001; Fearnside 2007; Carrero and Fearnside 2011; Redo, Millington, and Hindery 2011; Redo 2012; Soares-Filho et al. 2012; Oliveira, Costa, and Coe 2013; VanBeek, Brawn, and Ward 2014; Alencar et al. 2015); and the larger scale interactions between soy production zones, continental air moisture flows, deforestation and climate change (Sawyer 2008; Nobre et al. 2009; Malhi et al. 2009; Asner, Loarie, and Heyder 2010; Coe et al. 2013; Brando et al. 2014; Swann et al. 2015; Zhang and Castanho 2015). These regional impacts affect far more land than even the millions of hectares of direct conversions, and sit at the heart of the long-term problem of historical and current carbon emissions.

At this macro level, serious concerns are raised about what one might call 'disappearing biomes' underneath the expansion of soy. Most widely discussed is the southern Amazon transition zone infamous as the 'arc of deforestation' (Barlow and Peres 2008; Nepstad et al. 2014; Anadon, Sala, and Maestre 2014), but far more significant is the Cerrado itself, which has declined by 53–66.3 percent over the last few decades (Jepson 2005; Bianchi and Haig

2013; Beuchle et al. 2015), and its transition into the Caatinga – the dry forests of northeastern Brazil that declined by about 53 percent in a similar period (Santos and Leal 2011). The Paraguayan Atlantic forests have also been almost completely cleared with the expansion of industrial agriculture (Richards 2011), while more than 15.8 million and 9.67 million ha of dry forests have been cleared in the Paraguayan and Argentinian Chaco respectively (Macchi, Grau, and Marinaro. 2013; Gasparri, Grau, and Sacchi 2015; Vallejos et al. 2015; Volante and Paruelo 2015). Even highly remote forests like the Chiquitania in eastern Bolivia have declined by some 18 percent (Pinto-Ledezma and Mamani 2014; Baldi et al. 2015).

There are multiple processes of soy expansion, from direct clearing to intensification of existing land uses – 'writing over' with the enhanced 'ecological efficiency' of soy systems – and the indirect displacement of previous land uses, such as extensive ranching, into woodland landscapes (Marsik et al. 2011; Meyfroidt et al. 2014; Graesser, Aide, and Ramankutty 2015). These dynamics are driven by global and regional commodity markets (Fearnside et al. 2013; VanWey and Spera 2013), regulated by international commodity prices and currency exchange rates (Richards, Myers, and Walker 2012; Oliveira 2016, this volume), institutional configurations (Garrett, Lambin, and Naylor 2013), supply chain dynamics (Nepstad et al. 2013; Newton, Agrawal, and Wollenberg 2013), differentials in land prices (Mann and Kaufmann 2010; Richards 2015; Sauer and Leite 2012), tenure and access regimes (Barbier and Burgess 2001; Hecht 2005; Walker and DeFries 2009; Jepson et al. 2010; Larson 2011; Aldrich et al. 2012; Borner et al. 2014; Meyfroidt et al. 2014; Richards, Walker, and Arima 2014; Marinaro, Grau, and Zelaya 2015), and the restructuring of 'flex crop' processing companies (Oliveira and Schneider 2015). These also include enhanced infrastructure for export like roads, warehouses and ports, as well as continued agronomic extension, research and credit lines. Common to all analyses is the evidence that intensification of profitable land uses tends to enhance its spread rather than to confine it spatially, regardless of the mix of drivers (Hecht 2005; Morton et al. 2008; Rudel et al. 2009; DeFries, Rudel, and Hansen 2010). Yet in spite of its notable and extensive direct and indirect impacts, soy agribusiness is viewed very positively in policy circles and mainstream media, certainly in its contribution to national coffers, but also in symbolic terms. This dynamic has two central dimensions: first, the meaning of this expansion for the state, as we suggested earlier in this paper, through its economic and developmental symbolism pertaining to a modern state and its lands; and, second, an emergent environmental and moral discourse rather at odds with earlier vehement critiques of agribusiness.

Beginning with regional integration and state making over ideologically 'empty lands' that are in fact inhabited working landscapes,[3] soy has become the central means for contemporary state 'territorialization', expanding and integrating state presence into remote areas of national hinterlands. In a way, this is a continuation of the five-century-long process of colonization that rested primarily on extensive cattle ranching across South America. Yet this process began to change during the twentieth century through what Brazilians called the 'March to the West' and Bolivians dubbed the 'Conquest of the Orient', among other kindred slogans about territorial integration. These forays accelerated during the second half of the century with state-funded infrastructure, credit and land titling and colonization programs, and although 'green revolution' technologies began to be

[3]These landscapes often turned out to have been occupied by traditional peoples for many decades, and by some people for millennia.

implemented, most labor relations and production practices expressed rather atavistic arts and land use. While in many ways livestock achieved territorialization goals by transforming earlier frontiers (Hecht 1985; Gardner 2009; Rodrigues et al. 2009; Walker et al. 2009; Hoelle 2014), it lacked significant backward linkages (since both the grass and the animals were able to reproduce themselves) and limited forward linkages, remaining largely linked to regional administrative capitals and abattoir cities, while creating a great deal of displacement of peasants into urban slums (Gonçalves, Siqueira, and Hacon 2014). Given the low productivity of extensive ranching, land degradation and abandonment, low employment, and deep association with speculation and violence generated over decades, such land use came under sustained critique as a development strategy (Hecht and Cockburn 1989; Schmink and Wood 1992; Laurance et al. 2004), enabling the search for a substitute that could better accomplish state goals.

Soy, with its production complexity, global imprimatur, demand for specialized goods, and (few but some) skilled labor and services, produced a new kind of agroindustrial landscape as well as a new agroindustrial urbanism: unlike the earlier administrative centers or labor-depot urbanism of earlier South America frontiers (Browder and Godfrey 1997), soy cities are structured more around service provisioning, industrial processing and finance (VanWey and Spera 2013; Richards, Pellegrina, and Spera 2015). Places like Lucas do Rio Verde stand as iconic cases of this sort of urbanism (Hecht and Mann 2008; VanWey and Spera 2013; Richards and VanWey 2015), as they emerged ‘from nothing’ through complex migration flows and services in increasingly depopulated surrounding landscapes (Desconsi 2011; Rumstain 2012; Miranda 2012). From unruly forest and grasslands emerge ordered, fast-growing cities and fields as the incarnations of progress, a positive denouement for states that always saw their hinterlands as backward. In this sense, the agrarian modernism that soy agribusiness encapsulates is more than just a production system; it becomes a larger national symbol, and a feature of modern state making (cf. Scott 1998; Oliveira 2016, this volume).

This dynamic has also been attended by a new and powerful class of agribusiness managers and technocrats operating across regional, national and international politics (Gudynas 2008), who have become increasingly assertive over national political debates on agricultural and land-use policy. In Brazil, for example, the agroindustrial lobby encouraged politicians to roll back environmental restrictions in the Forest Code and provide amnesty and legitimation of previous illegal clearing (Soares-Filho et al. 2014). In lowland Bolivia, agribusinessmen – particularly in the soy sector – tried to secede from the rest of Bolivia in reaction to the electoral victories of the indigenous and leftist coalition for Evo Morales, and Paraguay’s agricultural elite successfully organized to overthrow the country’s first leftist president, Fernando Lugo, when he sought to redistribute farmland dedicated to soy agribusiness. These examples illustrate how soy agribusiness has inflected and influenced state policy not only through the territorialization of the state in agroindustrial frontiers, but through its capacity for putting political pressure on the state in favor of agribusiness interests.

One of the most important manners in which these agribusiness interests have become articulated has been in the discursive transformation of soy from a key driver of deforestation in the Amazon into the modern embodiment of the solution to the eternal problem in tropical development: combining environmental stewardship with development. The extraordinary attention to this dynamic had a dramatic effect, which we call the ‘Amazon swerve’.

3.1. *The Amazon swerve: Mato Grosso exceptionalism and the 'land sparing' debate*

Soy production was heavily critiqued by conservationists due to the social and ecological impacts arising from monocultures that drench landscapes in glyphosate and pesticides, and the history of violent displacement and extensive deforestation that produced these landscapes in the first place (Hecht 2005; Pacheco 2006; Morton et al. 2008; Rudel et al. 2009; Zhouri 2010). The largest soy-producing state in Brazil, Mato Grosso, was reviled for its continuing clearings along the 'arc of deforestation' across the southern Amazon. But around 2004, deforestation began to decline in Mato Grosso and neighboring Pará states, falling about 80 percent below its 2004 high point (Nepstad, Stickler, and Almeida 2006; Hecht 2012; Nepstad et al. 2009; Nepstad et al. 2014;). We call this event 'the Amazon swerve', a process that radically changed the perception of soy within environmental circles (powerfully structured by international non-governmental organizations (NGOs) like World Wildlife Fund and Conservation International) from a leading landscape destroyer to a key tool for conservation, melding the modernist state and agroindustrial project with conservation, meaning 'conservation of the Amazon' and *not* the sacrifice zones to its south and east.

Resting theoretically on the idea of 'land sparing' through intensification, the idea originally advanced by Borlaug (even described as the 'Borlaug hypothesis') proposes that increased productivity will satisfy crop demands without extending production area, allowing other areas to be set aside for 'strong' conservation, largely protected from all human use, as opposed to the difficult and messy process of agro-ecological harmonization through diversified working landscapes, the so called 'land sharing' approach to biodiversity conservation (Peres and Zimmerman 2001; Laurance et al. 2012; Grau et al. 2013; Macchi, Grau, and Marinaro. 2013; Edwards et al. 2015). The discourse emerged with local and international mobilizations against deforestation, particularly of the Amazon, leading to consumer boycotts and NGO efforts at monitoring and enforcement of environmental regulations. Leading NGOs, state officials and major soy agribusinesses coalesced around a Roundtable on Sustainable Soy, later renamed the Roundtable on Responsible Soy, to set voluntary guidelines for production practices. Ultimately, concerns over deforestation and the advance of indigenous and other traditional community demands for protecting their territories (in the Amazon) produced a voluntary 'moratorium' on soy from newly deforested Amazonian landscapes. Direct forest conversion to soy production declined significantly in Mato Grosso state. As a major deforestation hot spot, the slowdown dramatically reduced Brazil's global forest destruction profile.

Against the backdrop of intense Amazonian deforestation that galvanized scholars and activists since the 1970s, this notable decline in clearing in that particular stretch of Amazon-Cerrado transition zone appeared to show that increases in production could truly become a conduit for conservation. This projected the 'land sparing' discourse as a general principle rather than a peculiarity of the Mato Grosso political dynamics, shaped by an atypical combination of public and private actors at many different scales (Arvor et al. 2012; Macedo et al. 2012; Brando et al. 2013; Stickler, Nepstad, and McGrath 2013; Nepstad et al. 2013; VanWey and Richards 2014; Alkimim, Sparovek, and Clarke 2015). In principle, soy intensification would solve food production and the environmental crises in one swoop, especially if strong set-asides (such as indigenous reserves and completely protected parks) could be established once 'good governance' was in place (Nepstad et al. 2006; Ceddia, Bardsley, and Sedlacek 2014). Thus, despite all its unusual attributes, Mato Grosso became the 'poster child' for the land-sparing model, suggesting its local dynamics are emblematic rather than exceptional.

There are several issues one can raise about the Mato Grosso case. First, as mentioned, it represents an extraordinarily dense assemblage of forces at multiple scales that limit the replicability of models based upon it. While the soy technology itself may be an immutable mobile, *sensu* Latour, institutions and governance are a mutable immobile (Latour 1987) and this Amazon soy lineup is exceedingly difficult to reproduce, particularly the conditions for regulation without repression that do not exist everywhere in South America. Next, the Amazonian focus has diverted attention away from the clearing footprint of soy across the continent, and even within Brazil, where conversion of other ecosystems (particularly the Cerrado) is far higher than in the Amazon. As mentioned earlier, estimates of Cerrado loss run as high as 66 percent, and Paraguay's Atlantic forest biome has been almost completely destroyed. Researchers of other woodland systems that have been ravaged by soy production point to the lack of conservation infrastructure and general inattention to these dry and open forest ecosystems where the intensification/expansion of production coalesces (Hecht 2005; Klink and Machado 2005; Santos and Leal 2011; Bianchi and Haig 2013; Volante and Paruelo 2015; Grau et al. 2015). These 'orphan' forest systems fall outside most conservation interest, marked by weaker national and international networks of concern, monitoring and institutional or practical mechanisms for regulation, so the central drivers of deforestation reflect the dynamics and volatilities of agricultural commodity prices, land rents and state concerns about regional integration. These regions – where soy production has in fact been expanding while the Amazon has become protected – are thus much more vulnerable to boom-and-bust dynamics than the hyper-institutionalized and monitored Amazonian landscapes where soy production was curtailed. As Pfaff and others have also pointed out, one person's forest transition is another's deforestation, and there is evidence that the tight environmental regulations, cadastral requirements, better monitoring and enforcement in the Amazonian fringe have triggered 'leakage' into other woodland systems elsewhere in Brazil, Bolivia, Paraguay and Argentina, operational dynamics that are obvious to cross-continent farm management companies and migration choices of small- and medium-scale soy farmers (Hecht 2005; Pfaff and Walker 2010; Richards 2011). Indirect land-use change (ILUC) dynamics that can only be surmised in remote-sensing models become explicit through field-site inspections and interviews with agribusiness managers and soy farmers, who say that their expansion plans are not curtailed by intensification of production, but rather conditioned by favorable institutional settings for the 'development' of 'new' lands in less regulated areas like the northeastern edge of the Cerrado in Brazil (e.g. southern Maranhão and Piauí states), where profits from intensified production are often reinvested.[4] After all, as a general rule, intensification of profitable land uses results in territorial expansion rather than its reduction in area (Hecht 2005; Rudel et al. 2009; DeFries et al. 2013). This is the Jevons Paradox of tropical soy.

The narrow focus on Amazonian clearing, and the unusual conjuncture that produced the decline in deforestation in a section of the southern Amazon, has had the effect of obscuring a more general recognition of the much more widespread clearing consequences of this land use. There is a rich debate on this topic which we cannot engage fully in this essay, but the unique emphasis on agricultural productivity has been taken to task for its lack of attention to evolutionary processes (resistance of weeds, pests, etc.) externalities associated with non-target victims of toxics, land development, carbon emissions, and

[4]Gustavo Oliveira, interviews with farmers and soybean producer associations in Brazil, 2014 and 2015.

other questions of equity and sustainability (Haslberger 2006; Altieri and Pengue 2006; Porto and Milanez 2009; Schiesari and Waichman 2013). Moreover, the emphasis on soy as a solution to rising food demand elides the differences between agroindustrial commodities and 'food', ignoring the fact that most 'flex crop' production has expanded in recent years to attend non-food demands for fuel and industry (Borras et al. 2015; HLPE 2011). This is very clear in the case of soy, which finds in concentrated animal feed operations (CAFOs) its most important demand, and in biodiesel, its most important new market. Detailed life-cycle analyses and calculations of total-factor productivity unequivocally demonstrate that grain- and soy-based CAFOs are extremely *inefficient* forms of producing protein for human food, and soy-based biodiesel is only carbon efficient when produced in small-scale diversified farming systems (Cavalett and Ortega 2010; Oliveira and Schneider 2015; Schneider 2014; Steinfeld et al. 2006; Weis 2010, 2013a, 2013b). These considerations, among a broader political ecology literature, challenge the 'land sparing' discourse that sustains favorable academic, policy and business attitudes towards soybean agribusiness. How can intensified production limit expansion given the difficulty of 'good governance' across the entire soy frontier of South America, and given that increased production does not aim to satisfy relatively inelastic human food needs, but rather boundless demands for fuels and extremely inefficient but profitable concentrated livestock production?

4. Contributions to the literature

The papers in this collection do not necessarily resolve these debates and controversies, but they certainly provide a more nuanced and detailed discussion of the social, political, economic and ecological settings of the contemporary boom of soybean production in South America. We sought cutting-edge research with a solid foundation in recent fieldwork and innovative analysis that may shed light on the production processes and outcomes of this controversial crop. The contributions in this volume expose continuities in the political and economic processes of the export-oriented insertion across South America but also highlight truly novel patterns of production and social relations that emerge from soy's neo-nature. We hope thereby to contribute to and perhaps even reframe some key debates on soy production in South America upon the material realities confronted by upcoming and leading scholars in the field.

This collection is divided into four thematic sections. The first explores the 'friction' (Tsing 2005) of globalization in new agroindustrial landscapes of soy production. The papers in this section tackle the common notion that the homogenization of production technologies/techniques, domination of input markets and commodity trading by transnational corporations, increasing involvement of international finance, privatization of research and infrastructure, and deregulation across South America has produced a 'Soylandia' or 'United Soybean Republic' that is abstracted away from local social and ecological particularities. In his contribution, Valdemar Wesz, Jr., draws on aggregate political economic data across the southern cone of South America and ethnographic fieldwork in Brazil to reveal how the leading trading companies adopt strategies to become 'hybrid' actors that incorporate transnational dynamics while simultaneously relying on local employees who are deeply embedded in the social fabric of soybean farmer communities to operate successfully. Similarly, in her contribution, Clara Craviotti claims that while operations of seed companies and *pools de siembra* have expanded from Argentina throughout the continent with little apparent regard for borders, they remain profoundly embedded in territorial dynamics and social relations, and, like the trading companies analyzed in the previous contribution, it is precisely this territorial embeddedness that generates their power over soy farmers. Finally, Amalia Leguizamon argues that attempts by financial actors and technological innovators in the soybean sector towards 'distancing' and 'abstracting' this production system from social and ecological specifics are never fully accomplished, and remain very much rooted in physical bodies, resources and practices. This on-the-ground reality of globalization finds very interesting correlations with Andrew Ofstehage's ethnography of US soy farmers operating in Brazil. Together, these contributions demonstrate that despite the technical homogenization and omnipresence of transnational actors at every link of soybean production chains, place-specific material relations – particularly social relations of trust and familiarity for trade and labor management – remain crucially important for their successful operations. Rather than treating the soybean complex as an abstract global force increasingly disarticulated from specific ecologies and social relations, therefore, we ought to investigate instead how both transnational and local actors actively maneuver to reconfigure their relations to each other and to the concrete landscapes where they operate.

Concluding this opening section, a pair of papers explores the political dynamics and stakes of the current trajectory of soybean agribusiness globalization, focusing on Brazil as its main export platform and China as its predominant destination. Gustavo Oliveira delivers a fine-grained historical account of the development of the sector in Brazil that reveals its role in the consolidation of agrarian capitalism during the so-called Cold War. Oliveira then argues the Brazilian soy sector has continued to be fundamentally shaped by state interests even while transnational companies have taken over production technologies and trade, particularly given its geopolitical significance in times of climate change, high and volatile commodity prices, and new intersections between agro-industrial markets and currencies that challenge the hegemony of the US state and dollar. Yan Hairong, Chen Yiyuan and Ku Hok Bun in turn provide a detailed account of how and why China's soybean production collapsed with the inflow of imports from the United States and South America, and how this soybean crisis in China has created ecological, economic and geopolitical concerns about dependence on transgenic seeds and imports. All contributions in this section reveal how domestic actors and histories in China and South America have profoundly conditioned the current restructuring of the soybean complex at a global scale, and how the highly uneven concentration of benefits to a few corporate actors and distribution of costs and harms among multiple peoples and landscapes have placed transnational soybean agribusiness central to debates over agrarian development, industrialization and modernization.

The second section of this collection focuses on ethnographic and interview-based case studies of soy producers across various landscapes in South America. The contribution by Bert van der Vennet, Sergio Schneider and Joost Dessein, and that of Mateo Mier y Teran, attempt to undermine the simplistic caricature that all soy production in Brazil takes place on large-scale corporate farms. The former research two areas in southern Brazil where relatively small-scale farms (< 300 ha) still exist in substantial numbers, while the latter researches an area of central Brazil where mid-scale properties (300–1000 ha) make up the majority of farms, but *not* the bulk of soybeans produced. Their contributions reveal that multiple and distinct social relations of production (what these authors call 'farming styles', following Jan Dowe van der Ploeg) enable these relatively small and medium soy farms to remain in production for the time being, in part because of the historical stability of land tenure regimes, and in part because of their ability to attend niche markets. However, in spite of the diversity of farm sizes and their associated relations of production, both contributions reaffirm that these soy production systems themselves are indistinguishable from the largest corporate farms, and they become entangled in the economic and technological treadmill that adds constant downward pressure on soy prices and upward pressure on production costs, consolidating the long-term trend towards farmland concentration and corporate control. Andrew Ofstehage's ethnography tackles these questions of scale obliquely through his discussion of the challenges faced by US soy farmers who left their relatively small-scale farms (< 300 ha) in the US to purchase and manage large-scale farms (> 1000 ha) in the Brazilian Cerrado. Even though the techniques and technologies of production are exactly the same as in the United States, these farmers must suddenly address questions of labor management and cultural adaptation unlike anything they had dealt with before. Revealing in intimate detail the manner in which US agribusinessmen enter Brazilian territory at the point of production, Ofstehage's contribution also speaks to broader questions of globalization and the formation of transnational actors.

The third section of our collection presents papers that engage the environmental politics and debates regarding soy production in South America that often stand for discussions of contemporary biotechnology and agroindustrialization in general. Here in our introduction, we have shown how agribusinesses, NGOs and state actors have projected a model of forest transition through 'land sparing' and 'low carbon' intensification of soy production. Yet the 'Amazon swerve' upon which this argument relies has restricted debates over soy production to models and patterns of deforestation alone, drawn from case studies that cannot account for continent-wide 'leakage', and glossed over an array of other social and ecological concerns within soy landscapes themselves. A more general balance of the social and environmental contributions and shortfalls of the soybean sector to 'sustainable development' is the goal of the contribution by Rachel Garrett and Lisa Rausch. They compare soy production with sugarcane and extensive ranching in Brazil, and argue that the agroindustrial intensification of the soybean sector has provided greater macroeconomic benefits to the Brazilian economy, particularly in the mid-size cities that serve as hubs of the sector in the Cerrado region. Yet they do not analyze several other significant social and ecological harms associated with soy production and agribusiness expansion, and their comparison presumes that agroindustrial soy, sugarcane or extensive ranching are the only viable production practices for these landscapes. Smaller scale, diversified production systems are rendered invisible (for contrast, see Perfecto, Vandermeer, and Wright 2009).

This problem of 'visibility' is central to the contribution by Ludivine Eloy et al. to this volume, as they bring an innovative political ecology of environmental policies in the Cerrados of Brazil to demonstrate how environmental managers identify and blame fire-dependent traditional production systems and undermine participative management of protected areas, while legitimating the expansion of soybeans around them and contributing to rural exodus. In other words, the frameworks of environmental 'virtue' and the production of knowledge about social and ecological harms and benefits must also be carefully researched, analyzed and critiqued. Similarly, Pablo Lapegna's ethnography of social movement and government relations on the regulation of soy production in Argentina reveals how environmental problems caused by the expansion of GM soybeans are experienced primarily through the exposure of rural populations to toxic agrochemicals. Lapegna argues that the institutional recognition of rural social movements and the performative actions of the authorities from national to local levels of government respond to cases of agrochemical exposure in manners that create barriers to collective action that could more effectively curtail the negative socio-ecological impacts of soy production. The ethnographic nuance of these contributions demonstrates how various actors who seek to transform soybean production practices navigate tremendously disparate and complex social and political realities. In concluding this section, Laureen Elgert's contribution draws from her research on soy production in Paraguay to reveal how discourses of 'sustainable development' exemplified by the Roundtable on Responsible Soy are better understood as means of protecting large-scale investments, rather than as means of achieving sustainability in agricultural commodity production (cf. Baletti 2014). Elgert proposes more inclusive alternatives than soybean production, marked as it is by the exclusion of small-scale producers through the concentration, and often foreignization, of farmland in Paraguay.

The fourth and final section of this collection gathers two contributions that investigate the expansion of soybean production into new agricultural frontiers of South America. Lucia Goldfarb and Gemma van der Haar's contribution draws on interview data and participant observation in Argentina's Chaco to review the multiple paths of migration and the relations of conflict and cooptation that enable well-capitalized soy farmers to gain territory from its previous occupants and displace competing farmers and land uses. How land becomes incorporated into the soy economy remains one of the most dynamic research arenas, especially as the debates over displacement become more acute. Similarly, in their contribution, Ben McKay and Gonzalo Colque trace the expansion of soy production in Bolivia's eastern lowlands through the lens of 'productive exclusion', whereby the development of the soy economy in Bolivia is itself responsible for the social and economic exclusion of the majority of the population living in these areas that were previously considered marginal to the economy and politics of the country.

5. Limitations and directions for further research

We recognize that many lacunae still remain. Given the complex migration patterns that produce soy frontiers in South America, the intersection between class and race/ethnicity has been investigated in the literature about access to land and labor relations on soy-producing regions (Desconsi 2011; Rumstain 2012). In this collection, several contributions touch on the racial/ethnic tensions and connections to the production of these agroindustrial landscapes (Ofstehage 2016, this volume; Cacho 2016, this volume; van der Vennet, Schneider, and Dessein 2016, this volume; Goldfarb and van der Haar 2016, this volume). Yet, at the household level, what does this massive change mean for those who migrate and those who stay, and for those integrated and those excluded from production, and what are its gender dynamics? Much of the literature remains relatively blind to the intersections with and particular problems of gender that imbue daily life in South America's hinterlands, government halls and corporate offices. These gender dynamics of labor, migration and urbanization remain the terrain of limited studies (Ferro 2013; Miranda 2012; VanWey and Spera 2013; Richards and VanWey 2015).

Another important limitation is reflected in the heavy focus on Brazil and Argentina among the contributions to this volume. Certainly these two countries account for the vast majority of soy produced in South America, and the extensive nature of Brazil suggests that growth of the sector in South America will take place primarily there. Yet the historical geography of soy production in Paraguay and Bolivia, and their idiosyncratic connections with soy farmers and agribusinesses across the region, certainly deserves more attention than we were able to give it in this collection. And, of course, as Uruguay has even surpassed Bolivia in 2011 to become the fourth largest producer on the continent, it is especially regrettable that it is not the focus of any paper in this collection. The trajectory of soy production in Uruguay raises important questions about the dynamics of soy agribusinesses across the continent. For example, why didn't soy production expand significantly in Uruguay until the 2000s, when the crop already boomed a few hundred kilometers north

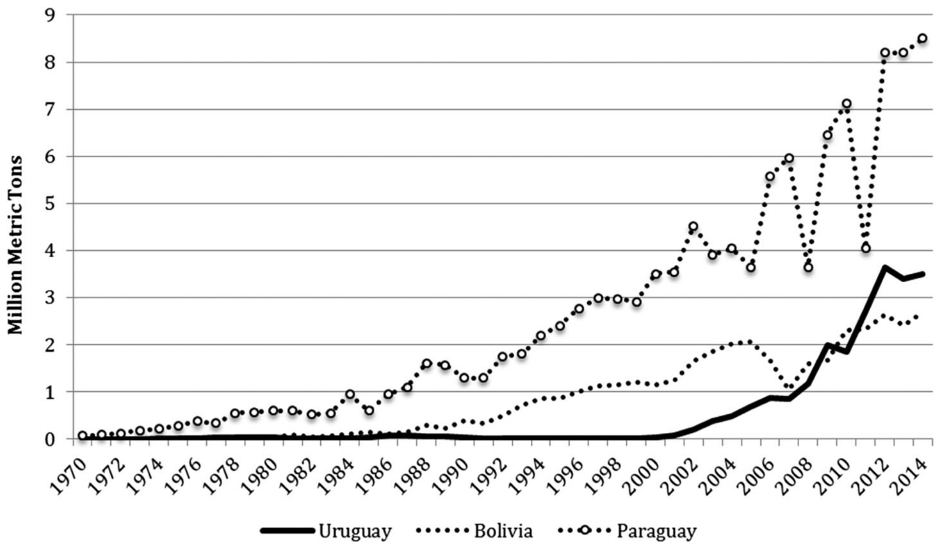

Figure 6. Soy production in Paraguay, Uruguay and Bolivia, 1970–2014.
Source: Elaborated by the authors from United States Department of Agriculture data.

and south of its borders in Brazil and Argentina? And why did this tendency change so sharply in the first decade of this millennium? (Figure 6).

There is of course excellent Uruguayan literature in Spanish discussing how Argentinian *pools de siembra* and other firms and farmers from the continent and beyond are participating in this dramatic expansion, and demonstrating how Uruguayans themselves transform these soybean operations and their own relations to the land. Oyhantçabal and Narbondo (2011) provide an extensive description and critique of the soybean agribusiness in Uruguay, identifying its main actors and showing how some collaborate with Argentinian and Brazilian investors to expand soy production not only in Uruguay, but also into in Venezuela and Colombia as well. We call for greater attention to and integration of the work of Paraguayan, Bolivian and Uruguayan scholars in Anglophone publications, as they not only complement but also transform our understanding of the operations of this major agroindustrial sector across the continent and around the world.

This need for greater attention to the distinct dynamics of the sector across the continent also applies to less traditional areas of soy cultivation in South America where expansion is nevertheless taking place (particularly Venezuela), where soy production has stagnated at low levels despite renewed interest in investments in the sector (namely Ecuador and Colombia), and where soy hasn't become incorporated into local agricultural production at all even though it is imported in increasingly larger amounts, such as Peru (Figure 7). Even a very limited account of the multiple trajectories of the soy sector in these countries suffices to demystify any illusion of uniform continent-wide expansion, and underscores the social and ecological 'friction' of each place. Take Ecuador, for example. Soy production began expanding there during the 1970s much like in the southern cone of the continent, but what caused this boom to turn into a sharp bust in the mid-1990s? And why has the recovery of the sector since stagnated when the country is the most advantageously located in South America to supply China, the world's largest (and growing) market for this commodity? The situation is similar in Colombia, but the sector never took root in Peru in the first

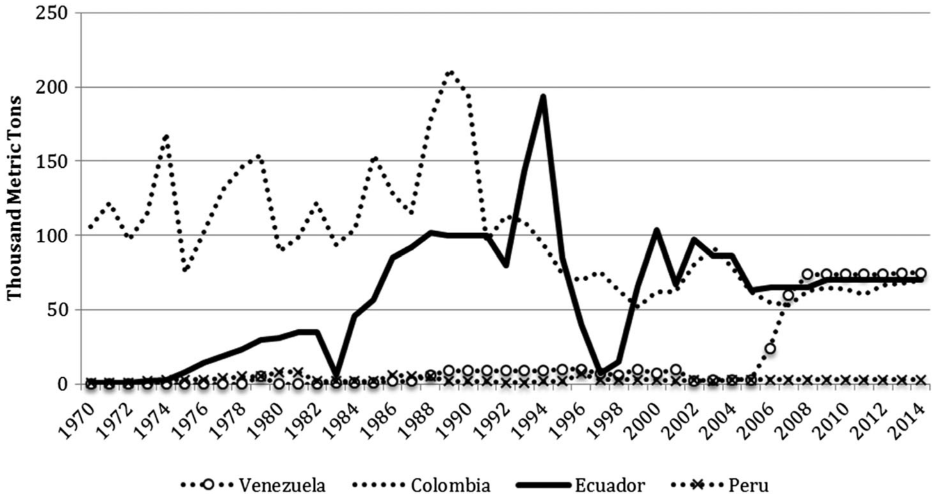

Figure 7. Soy production in Venezuela, Colombia, Ecuador and Peru, 1970–2014.
Source: Elaborated by the authors from United States Department of Agriculture data.

place. What are the alternatives or frictions that limited soy production from expanding further and faster in these Andean countries? A very different trajectory is witnessed in Venezuela, marked by its government import-substitution efforts to draw technologies and practices from Brazil in order to establish soy production over its eastern flatlands. The role of the state is particularly notable here, as government-led projects in the state of Anzoátegui account for the vast majority of all soy produced in the country, and where the Ministry of Agriculture and Land plans to bring an additional 32,000 ha under irrigation to produce over 250,000 tons of soy per year by 2019 (Ministry of Agriculture 2015). Still, private Venezuelan soybean agribusinesses, alongside those from Colombia and Peru, prioritize investments across borders in Bolivia rather than focusing on domestic production (cf. McKay and Colque 2016, this volume). What explains these different strategies and dynamics among Andean countries and agribusinesses? How are different actors negotiating different social networks and ecological landscapes as they assemble multiple investment practices and production technologies for expanding their soybean agribusinesses across the continent? This collection is only able to gesture towards these as important questions for further research and international collaboration.

A very prominent set of themes that could have been the subject of far more in-depth discussion are the transformations in the political economy and discursive practices of research and development in biotechnology. Ultimately, the continued expansion of the soybean agribusiness in South America depends on the narrative that the technological progress of the ‘green revolution’ rescued millions across the region from hunger and poverty, and that a new technological revolution based upon GM seeds and their associated agrochemicals is necessary to resolve our future need to increase food production. But if large-scale and long-term data on the adoption of GM technologies in the soy sector across the continent do not demonstrate rising yields and falling agrochemical use (Cotacora-Vargas et al. 2012; Cotacora-Vargas 2014), and we witness the aggravation of ecological harms and social exclusions already evident in previous ‘green revolution’ production systems, then agroecological alternatives to soy monocultures and GM technology must be sought (Foster 2000; Altieri and Pengue 2006; Mazoyer and Roudart 2006; Oliveira 2010;

Perfecto and Vandermeer 2010; Richards 2010; Patel 2013; Altieri, Nicholls, and Lana 2015).

This would require, of course, a fundamental reconstruction of the soy-livestock nexus that currently generates the greatest demand for this commodity as animal feed (Steinfield et al. 2006; Schneider and McMichael 2010; Weis 2010, 2013a, 2013b), and also a critical reconceptualization of the role of soybeans in the production of bioenergy and other industrial inputs, particularly biodiesel (Cavalett and Ortega 2010). The latter in particular may hold special importance, as the ability for agroindustrial processing firms to shift flexibly between various feedstocks and attend a growing number of multiple markets is becoming a key driver of global agroindustrial restructuring, a process that is being framed in agribusiness and development as a solution to the convergence of climate, energy and food crises, but which may in fact aggravate social-environmental harms already associated with the agroindustrial production of these flex crops (Borras et al. 2015). Ultimately, as Yan, Chen and Ku demonstrate in their contribution to this volume, these political-ecological questions and debates triggered by the contemporary dynamics of the soy sector lead us to re-examine the nature of globalization, the logic of modernization, the role of the state, the politics of science and knowledge production and the reach of corporate power in everyday life, and, most importantly, they encourage us to search and struggle for agroecological alternatives.

Disclosure statement

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References

Aldrich, S., R. Walker, M. Caldas, and S. Perz. 2012. Contentious land change in the Amazon's Arc of deforestation. *Annals of the Association of American Geographers* 102, no. 1: 103–128.

Alencar, A., P. Brando, and F. E. Putz. 2015. Landscape fragmentation, severe drought, and the new Amazon forest fire regime. *Ecological Applications* 25, no. 6: 1493–1505.

Alkimim, A., G. Sparovek, and K. C. Clarke. 2015. Converting Brazil's pastures to cropland: An alternative way to meet sugarcane demand and to spare forestlands. *Applied Geography* 62: 75–84.

Altieri, M., C. Nicholls, and M. A. Lana. 2015. Agroecology and the design of climate change-resilient farming systems. *Agronomy for Sustainable Development* 35, no. 3: 869–890.

Altieri, M., and W. Pengue. 2006. GM soybean: Latin America's new colonizer. *Seedling*, 17, no.1: 13–17.

Anadon, J., O. Sala, and F. T. Maestre. 2014. Climate change will increase savannas at the expense of forests and treeless vegetation in tropical and subtropical Americas. *Journal of Ecology* 102, no. 6: 1363–1373.

Arancibia, F. 2013. Challenging the bioeconomy: The dynamics of collective action in Argentina. *Technology in Society* 35, no. 2: 79–92.

Arvor, D., M. Meirelles, Agnès Bégué, and Y. E. Shimabukuro 2012. Analyzing the agricultural transition in Mato Grosso, Brazil, using satellite-derived indices. *Applied Geography* 32, no. 2: 702–713.

Asner, G., S. Loarie, and U. Heyder. 2010. Combined effects of climate and land-use change on the future of humid tropical forests. *Conservation Letters* 3, no. 6: 395–403.

Baldi, G., J. Houspanossian, Adriel A. Rosales, Carla V. Rueda , and E. G. Jobbágy 2015. Cultivating the dry forests of South America: Diversity of land users and imprints on ecosystem functioning. *Journal of Arid Environments* 123: 47–59.

Baletti, Brenda. 2014. Saving the Amazon? Sustainable soy and the new extractivism. *Environment and Planning A,* 46, no. 1: 5–25.

Barbier, E., and J. Burgess. 2001. Tropical deforestation, tenure insecurity, and unsustainability. *Forest Science* 47, no. 4: 497–509.
Barlow, J., and C. Peres. 2008. Fire-mediated dieback and compositional cascade in an Amazonian forest. *Philosophical Transactions of the Royal Society B-Biological Sciences* 363, no. 1498: 1787–1794.
Benachour, N., and G.-E. Séralini. 2009. Glyphosate formulations induce apoptosis and necrosis in human umbilical, embryonic, and placental cells. *Chemical Research in Toxicology* 22: 97–105.
Beuchle, R., R. Grecchi, et al. 2015. Land cover changes in the Brazilian Cerrado and Caatinga biomes from 1990 to 2010 based on a systematic remote sensing sampling approach. *Applied Geography* 58: 116–127.
Berger, M., and F. Ortega. 2010. Poblaciones expuestas a agrotóxicos: autoorganización ciudadana en la defensa de la vida y la salud, Ciudad de Córdoba, Argentina. (Populations exposed to agrotoxins: citizen self-organization in defense of life and health, City of Cordoba, Argentina). *Physis: Revista de Saúde Coletiva* 20, no. 1: 119–143.
Bianchi, C., and S.M. Haig. 2013. Deforestation Trends of Tropical Dry Forests in Central Brazil. *Biotropica* 45, no. 3: 395–400.
Binimelis, R., W. Pengue, and I. Monterroso. 2009. 'Transgenic treadmill': Responses to the emergence and spread of glyphosate-resistant johnsongrass in Argentina. *Geoforum* 40, no. 4: 623–633.
Borlaug, N. 2006. In: *Cerrado*. Available at: www.worldfoodprize.org/en/laureates/20002009_laureates/2006_lobato_mcclung_paolinelli/cerrado/ [Accessed January 4, 2016].
Borner, J., S. Wunder, S. Wertz-Kanounnikoff, G. Hyman, and N. Nascimento 2014. Forest law enforcement in the Brazilian Amazon: Costs and income effects. *Global Environmental Change-Human and Policy Dimensions* 29: 294–305.
Borras, S., J. Franco, et al. 2015. The rise of flex crops and commodities: implications for research. *Journal of Peasant Studies* 43, no. 1: 9–115.
Brando, P., J. Balch, et al. 2014. Abrupt increases in Amazonian tree mortality due to drought-fire interactions. *Proceedings of the National Academy of Sciences of the United States of America* 111, no. 17: 6347–6352.
Brando, P., M. Coe, et al. 2013. Ecology, economy and management of an agroindustrial frontier landscape in the southeast Amazon. *Philosophical Transactions of the Royal Society B-Biological Sciences* 368, no. 1619: 20120152.
Browder, J., and B. Godfrey. 1997. *Rainforest cities: urbanization, development, and globalization of the Brazilian Amazon*. New York: Columbia University Press.
Brown, L. 2012. *Full planet, empty plates: The new geopolitics of food scarcity*. New York: WW Norton & Company.
Carrero, G., and P. Fearnside. 2011. Forest clearing dynamics and the expansion of landholdings in Apui, a deforestation hotspot on Brazil's Transamazon Highway. *Ecology and Society* 16, no. 2: 26–0.
Cavalett, O., and E. Ortega. 2010. Integrated environmental assessment of biodiesel production from soybean in Brazil. *Journal of Cleaner Production* 18, no. 1: 55–70.
Ceddia, M., N. Bardsley, and S. Sedlacek 2014. Governance, agricultural intensification, and land sparing in tropical South America. *Proceedings of the National Academy of Sciences of the United States of America* 111, no. 20: 7242–7247.
Cerdeira, A., D. Gazziero, and M. B. Matallo. 2011. Agricultural impacts of glyphosate-resistant soybean cultivation in South America. *Journal of Agricultural and Food Chemistry* 59, no. 11: 5799–5807.
Chase, J. 2003. Regional prestige: Cooperatives and agroindustrial identity in southwest Goiás, Brazil. *Agriculture and Human Values* 20, no. 1: 37–51.
Clapp, J. 2014. Financialization, distance and global food politics. *Journal of Peasant Studies* 41, no. 5: 797–814.
Coe, M., M. Costa, et al. 2009. The influence of historical and potential future deforestation on the stream flow of the Amazon River: Land surface processes and atmospheric feedbacks. *Journal of Hydrology* 369, no. 1–2: 165–174.
Coe, M., T. Marthews, et al. 2013. Deforestation and climate feedbacks threaten the ecological integrity of south-southeastern Amazonia. *Philosophical Transactions of the Royal Society B-Biological Sciences* 368, no. 1619: 20120155.

Cotacora-Vargas, G., P. Galeano, S. Agapito-Tenfen, D. Aranda, T. Palau, and R. Nodari. 2012. *Soybean production in the Southern Cone of the Americas: Update on land and pesticide use*. Tromso, Norway: Center for Biosafety–GenOk.

Cotacora-Vargas, G. 2014. *Sustainability assessment of genetically modified herbicide tolerant crops: the case of Intacta Roundup Ready 2 Pro soybean farming in Brazil in light of the Norwegian Gene Technology Act*. Biosafety Report 2014/02. Tromso, Norway: Center for Biosafety–GenOk.

Deegan, L., C. Neill, M. Victoria R. Ballester, Alex V. Krusche, Reynaldo L. Victoria, Suzanne M. Thomas , and E. de Moor . 2011. Amazon deforestation alters small stream structure, nitrogen biogeochemistry and connectivity to larger rivers. *Biogeochemistry* 105, no. 1–3: 53–74.

DeFries, R., M. Herold, M. N. Macedo, and Y. Shimabukuro. 2013. Export-oriented deforestation in Mato Grosso: harbinger or exception for other tropical forests? *Philosophical Transactions of the Royal Society B-Biological Sciences* 368, no. 1619: 20120173.

DeFries, R., T. Rudel, and M. Hansen. 2010. Deforestation driven by urban population growth and agricultural trade in the twenty-first century. *Nature Geoscience* 3, no. 3: 178–181.

Desconsi, C. 2011. *A Marcha dos 'Pequenos Proprietários Rurais': trajetórias de migrantes do Sul do Brasil para o Mato Grosso*. (The march of the 'small rural landowners': Trajectories of southern Brazilian migrants to Mato Grosso.) Rio de Janeiro: E-papers.

EcoNexus and Berne Declaration. 2013. *Agropoly: A handful of corporations control world food production.* Oxford: Berne Declaration & EcoNexus. Available at: http://econexus.info/publication/agropoly-handful-corporations-control-world-food-production [Accessed August 29, 2014].

Edwards, D., J. Gilroy, et al. 2015. Land-sparing agriculture best protects avial phylogenetic diversity. *Current Biology* 25, no. 18: 2384–2391.

Fairbairn, M. 2014. 'Like gold with yield': evolving intersections between farmland and finance. *Journal of Peasant Studies* 41, no. 5: 777–795.

Fairbairn, M., J. Fox, et al. 2014. Introductions: New directions in agrarian political economy. *Journal of Peasant Studies* 41, no. 5: 653–666.

Fajardo, S. 2005. As cooperativas paranaenses e o novo padrão de desenvolvimento agroindustrial. (The cooperatives from Paraná and the new standard of agroindustrial development). *Formação* 12, no. 1: 165–192.

Fearnside, P. 2007. Brazil's Cuiabá-Santarém (BR-163) Highway: The environmental cost of paving a soybean corridor through the Amazon. *Environmental Management* 39, no. 5: 601–614.

Fearnside, P., A. Figueiredo, and S. C. M. Bonjour. 2013. Amazonian forest loss and the long reach of China's influence. *Environment Development and Sustainability* 15, no. 2: 325–338.

Ferro, S. 2013. *Gènero y Propiedad Rural en la Repùblica Argentina*. (Gender and rural property in the Republic of Argentina.) 2. ed. Buenos Aires: UCAR-MAGyP.

Foster, J. B. 2000. *Marx's ecology: Materialism and nature.* New York: Monthly Review Press.

Gardner, B. 2009. Are livestock a troublesome commodity? *Geoforum* 40, no. 5: 781–783.

Garrett, R., E. Lambin, and R. L. Naylor. 2013. Land institutions and supply chain configurations as determinants of soybean planted area and yields in Brazil. *Land Use Policy* 31: 385–396.

Gasparri, N., H. Grau, and L. Valeria Sacchi. 2015. Determinants of the spatial distribution of cultivated land in the North Argentine Dry Chaco in a multi-decadal study. *Journal of Arid Environments* 123: 31–39.

Gibbs, H., A. Ruesch, M. K. Clayton, P. Holmgren, N. Ramankutty , and J. A. Foley 2010. Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s. *Proceedings of the National Academy of Sciences of the United States of America* 107, no. 38: 16732–16737.

Goldsmith, P., B. Li, J. Fruin, and R. Hirsch. 2004. Global shifts in agro-industrial capital and the case of soybean crushing: implications for managers and policy makers. *International Food and Agribusiness Management Review* 7, no. 2: 87–115.

Gonçalves, K., A. Siqueira, and S. de Souza Hacon. 2014. Indicator of socio-environmental vulnerability in the Western Amazon. The case of the city of Porto Velho, State of Rondonia, Brazil. *Ciência & Saúde Coletiva* 19, no. 9: 3809–3818.

Goodman, D., B. Sorj, and J. Wilkinson. 1987. *From farming to biotechnology: A theory of agro-industrial development*. New York: Basil Blackwell.

Gordillo, G. 2014. *Rubble*. Durham, NC: Duke University Press.

Graesser, J., T. Aide, and N. Ramankutty. 2015. Cropland/pastureland dynamics and the slowdown of deforestation in Latin America. *Environmental Research Letters* 10, no. 3: 034017.

Grain. 2013. The United Republic of Soybeans: Take two. *Against the Grain*, June. Barcelona: Grain.

Grandin, G. 2009. *Fordlandia*. New York: Metropolitan.

Grau, H., R. Torres, Pedro G. Blendinger, Sofía Marinaro, and L. Macchi. 2015. Natural grasslands in the Chaco: A neglected ecosystem under threat by agriculture expansion and forest-oriented conservation policies. *Journal of Arid Environments* 123: 40–46.

Grau, R., T. Kuemmerle, and L. Macchi. 2013. Beyond 'land sparing versus land sharing': environmental heterogeneity, globalization and the balance between agricultural production and nature conservation. *Current Opinion in Environmental Sustainability* 5, no. 5: 477–483.

Grupo de Reflexión Rural (GRR). 2009. *Pueblos Fumigados: Informe sobre la problemática del uso de plaguicidas en las principales provincias sojeras de la Argentina*. Fumigated Peoples: Report on the problem of pesticide use in the main soy-producing provinces of Argentina. Available at: www.grr.org.ar/trabajos/Pueblos_Fumigados__GRR_.pdf

Gudynas, E. 2008. The new bonfire of vanities: soybean cultivation and globalization in South America. *Development* 51, no. 4: 512–518.

Guyton, K., D. Loomis, et al. 2015. Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate. *Lancet Oncology* 16, no. 5: 490–491.

Haslberger, A. 2006. Need for an 'integrated safety assessment' of GMOs, linking food safety and environmental considerations. *Journal of Agricultural and Food Chemistry* 54, no. 9: 3173–3180.

Hecht, S.B. 1985. Environment, Development and Politics - Capital Accumulation and the Livestock Sector in Eastern Amazonia. *World Development* 13, no. 6: 663–684.

Hecht, S.B. 2005. Soybeans, development and conservation on the Amazon frontier. *Development and Change* 36, no. 2: 375–404.

Hecht, S.B. 2012. From eco-catastrophe to zero deforestation? Interdisciplinarities, politics, environmentalisms and reduced clearing in Amazonia. *Environmental Conservation* 39, no. 1: 4–19.

Hecht, S.B., and A. Cockburn. 1989. *The fate of the forest: Developers, destroyers, and defenders of the Amazon*. New York: Verso.

Hecht, S.B., and C. Mann. 2008. How Brazil outfarmed the Americans. *Fortune* 157, no. 1: 92–106.

High Level Panel of Experts on Food Security and Nutrition (HLPE). 2011. *Price volatility and food security*. Report to the Committee on World Food Security of the Food and Agriculture Organization of the United Nations. Rome: CFS/FAO.

HighQuest Partners and Soyatech. 2011. *How the global oilseed and grain trade works*. St. Louis, MO: United Soybean Board/US Soybean Export Council.

Hoelle, J. 2014. Cattle culture in the Brazilian Amazon. *Human Organization* 73, no. 4: 363–374.

Isakson, S. R. 2014. Food and finance: The financial transformation of agro-food supply chains. *Journal of Peasant Studies*, 41(5): 749–775.

Jepson, W. 2005. A disappearing biome? Reconsidering land-cover change in the Brazilian savanna. *Geographical Journal* 171: 99–111.

Jepson, W., C. Brannstrom and R. Stancato. 2005. A Case of Contested Ecological Modernization: Governance of Genetically Modified Crops in Brazil. *Environment and Planning C: Government and Policy*, 23: 295–310.

Jepson, W., C. Brannstrom, et al. 2010. Access regimes and regional land change in the Brazilian Cerrado, 1972–2002. *Annals of the Association of American Geographers* 100, no. 1: 87–111.

Klink, C., and R. Machado. 2005. Conservation of the Brazilian Cerrado. *Conservation Biology* 19, no. 3: 707–713.

Larson, A. 2011. Forest tenure reform in the age of climate change: Lessons for REDD+. *Global Environmental Change-Human and Policy Dimensions* 21, no. 2: 540–549.

Latour, B. 1987. *Science in Action*. Cambridge, MA: Harvard University Press.

Laurance, W., A. Albernaz, et al. 2004. Deforestation in Amazonia. *Science* 304, no. 5674: 1109–1109.

Laurance, W., D. Useche, et al. 2012. Averting biodiversity collapse in tropical forest protected areas. *Nature* 489, no. 7415: 290–294.

Macchi, L., H. Grau, and S. Marinaro. 2013. Trade-offs between land use intensity and avian biodiversity in the dry Chaco of Argentina: A tale of two gradients. *Agriculture, Ecosystems & Environment* 174, no. 0: 11–20.

Macedo, M., M. Coe, et al. 2013. Land-use-driven stream warming in southeastern Amazonia. *Philosophical Transactions of the Royal Society B-Biological Sciences* 368, no. 1619: 20120153–20120153.

Macedo, M., R. DeFries, C. M. Stickler, G. L. Galford, and Y. E. Shimabukuro 2012. Decoupling of deforestation and soy production in the southern Amazon during the late 2000s. *Proceedings of the National Academy of Sciences of the United States of America* 109, no. 4: 1341–1346.

Malhi, Y., L. Aragão, et al. 2009. Exploring the likelihood and mechanism of a climate-change-induced dieback of the Amazon rainforest. *Proceedings of the National Academy of Sciences of the United States of America* 106, no. 49: 20610–20615.

Mann, M., R. Kaufmann, et al. 2010. The economics of cropland conversion in Amazonia: The importance of agricultural rent. *Ecological Economics* 69, no. 7: 1503–1509.

Marinaro, S., H. Grau, and P.V. Zelaya. 2015. Land tenure and biological communities in dry Chaco forests of northern Argentina. *Journal of Arid Environments* 123: 60–67.

Marc, J., R. Belle, et al. 2004. Formulated glyphosate activates the DNA-response checkpoint of the cell cycle leading to the prevention of G2/M transition. *Toxicological Sciences* 82, no. 2: 436–442.

Marsik, M., F. Stevens, et al. 2011. Amazon deforestation: Rates and patterns of land cover change and fragmentation in Pando, northern Bolivia, 1986 to 2005. *Progress in Physical Geography* 35, no. 3: 353–374.

Mazoyer, M., and L. Roudart. 2006. *A history of world agriculture: from the neolithic age to the current crisis*. New York: Monthly Review.

McMichael, P. 2012. The land grab and corporate food regime restructuring. *Journal of Peasant Studies* 39, no. 3–4: 681–701.

Meyfroidt, P., K. Carlson, et al. 2014. Multiple pathways of commodity crop expansion in tropical forest landscapes. *Environmental Research Letters* 9, no. 7: 1–13.

Ministry of Agriculture and Land of the Bolivarian Government of Venezuela. 2015. *Plan nacional de agricultura de riego y saneamiento de tierras*. (National Plan for Irrigated Agriculture and Land Reclamation.) Caracas: MPPAT/National Institute for Rural Development.

Miranda, H. 2012. The expansion of agriculture and its relationship with the urbanization process in the Northeast Region of Brazil (1990–2010). *Eure-Revista Latinoamericana De Estudios Urbano Regionales* 38, no. 114: 173–201.

Moreira, P., W. Pignati, et al. 2010. *Avaliação do risco à saúde humana decorrente do uso de agrotóxicos na agricultura e pecuária na região Centro-Oeste do Brasil.* (Evaluation of risk to human health due to agrotoxic use in agriculture and ranching in the Center-West region of Brazil.) Report 555193/2006–3, National Council for Scientific and Technological Development. Brasília: CNPq.

Morgan, D. 2000 [1979]. *Merchants of Grain: the power and profits of the five giant companies at the center of the world's food supply*. Lincoln, NE: iUniverse.

Morton, D., R. Defries, L. Giglio, W. Schroeder, and G. R. Van Der Werf. 2008. Agricultural intensification increases deforestation fire activity in Amazonia. *Global Change Biology* 14, no. 10: 2262–2275.

Murphy, S., D. Burch, and J. Clapp. 2012. *Cereal secrets: the world's largest grain traders and global agriculture*. Oxfam Research Report. Oxford: Oxfam.

Neill, C., M. Coe, et al. 2013. Watershed responses to Amazon soya bean cropland expansion and intensification. *Philosophical Transactions of the Royal Society B: Biological Sciences* 368, no. 1619: 20120425–20120425.

Nepstad, D., S. Irawan, et al. 2013. More food, more forests, fewer emissions, better livelihoods: linking REDD plus, sustainable supply chains and domestic policy in Brazil, Indonesia and Colombia. *Carbon Management* 4, no. 6: 639–658.

Nepstad, D., D. McGrath, et al. 2014. Slowing Amazon deforestation through public policy and interventions in beef and soy supply chains. *Science* 344, no. 6188: 1118–1123.

Nepstad, D., S. Schwartzman, et al. 2006a. Inhibition of Amazon deforestation and fire by parks and indigenous lands. *Conservation Biology* 20, no. 1: 65–73.

Nepstad, D., B. Soares, et al. 2009. The End of Deforestation in the Brazilian Amazon. *Science* 326, no. 5958: 1350–1351.

Nepstad, D., C. Stickler, and O. T. Almeida. 2006b. Globalization of the Amazon soy and beef industries: Opportunities for conservation. *Conservation Biology* 20, no. 6: 1595–1603.

Newton, P., A. Agrawal, and L. Wollenberg. 2013. Enhancing the sustainability of commodity supply chains in tropical forest and agricultural landscapes. *Global Environmental Change-Human and Policy Dimensions* 23, no. 6: 1761–1772.

Nicholls, C., and M. Altieri. 1997. Conventional agricultural development models and the persistence of the pesticide treadmill in Latin America. *International Journal of Sustainable Development and World Ecology* 4, no. 2: 93–111.

Nobre, P., M. Malagutti, D. Urbano, R. de Almeida, and E. Giarolla. 2009. Amazon deforestation and climate change in a coupled model simulation. *Journal of Climate*, 22, no. 21: 5686–5697.

Oliveira, G. de L. T. 2010. Prescrições agroecológicas para a crise atual (Agroecological prescriptions for the current crisis). *Revista NERA* 13, no. 16: 33–47.

Oliveira, G. de L. T., and M. Schneider. 2015. The politics of flexing soybeans: China, Brazil, and global agroindustrial restructuring. *The Journal of Peasant Studies* 43, no. 1: 167–194.

Oliveira, N., G. Moi, Ageo Mário Candido Silva, and Wanderlei Antônio Pignati. 2014. Malformações congênitas em municípios de grande utilização de agrotóxicos em Mato Grosso, Brasil. (Birth defects in municipalities with intensive use of agrotoxins in Mato Grosso, Brazil). *Ciência & Saúde Coletiva* 19, no. 10: 4123–4130.

Oliveira, L., M. Costa, and M. T. Coe. 2013. Large-scale expansion of agriculture in Amazonia may be a no-win scenario. *Environmental Research Letters* 8, no. 2: 024021.

Oyhantçabal, G., and I. Narbondo. 2011. Radiografía del agronegocio sojero: Descripción de los principals actors y los impactos socio-econónicos en Uruguay. (Radiography of the soybean agribusiness: Description of the main actors and socio-economic impacts in Uruguay.) Montevideo: REDES-AT.

Pacheco, P. 2006. Agricultural expansion and deforestation in lowland Bolivia: The import substitution versus the structural adjustment model. *Land Use Policy* 23, no. 3: 205–225.

Paganelli, A., V. Gnazzo, Silvia L. López, and A. E. Carrasco. 2010. Glyphosate-based herbicides produce teratogenic effects on vertebrates by impairing retinoic acid signaling. *Chemical Research in Toxicology* 23, no. 10: 1586–1595.

Palma, D., C. Lourencetti, et al. 2014. Simultaneous determination of different classes of pesticides in breast milk by solid-phase dispersion and GC/EDC. *Journal of the Brazilian Chemical Society* 25, no. 8: 1419–1430.

Patel, R. 2013. The long green revolution. *Journal of Peasant Studies* 40, no. 1: 1–63.

Peres, C., and B. Zimmerman. 2001. Perils in parks or parks in peril? Reconciling conservation in Amazonian reserves with and without use. *Conservation Biology* 15, no. 3: 793–797.

Perfecto, I., J. Vandermeer, and A. Wright. 2009. *Nature's matrix: Linking agriculture, conservation and food sovereignty*. London: Earthscan.

Perfecto, I., and J. Vandermeer. 2010. The agroecological matrix as alternative to the land-sparing/agriculture intensification model. *Proceedings of the National Academy of Sciences* 107, no. 13: 5786–5791.

Pfaff, A., and R. Walker. 2010. Regional interdependence and forest "transitions": Substitute deforestation limits the relevance of local reversals. *Land Use Policy* 27, no. 2: 119–129.

Pinto-Ledezma, J., and M. Mamani. 2014. Temporal patterns of deforestation and fragmentation in lowland Bolivia: implications for climate change. *Climatic Change* 127, no. 1: 43–54.

Porro, R. 2005. Palms, Pastures, and Swidden Fields: The Grounded Political Ecology of ?Agro-Extractive/Shifting-cultivator Peasants? in Maranhão, Brazil. *Human Ecology* 33, no. 1: 17–56.

Porto, M. and B. Milanez. 2009. Economic development axis and socio-environmental conflict generation in Brazil: Challenges to sustainability and environmental justice. *Ciência & Saúde Coletiva* 14, no. 6: 1983–1994.

Redo, D. 2012. Mapping land-use and land-cover change along Bolivia's Corredor Bioceanico with CBERS and the Landsat series: 1975–2008. *International Journal of Remote Sensing* 33, no. 6: 1881–1904.

Redo, D., A. Millington, and D. Hindery. 2011. Deforestation dynamics and policy changes in Bolivia's post-neoliberal era. *Land Use Policy* 28, no. 1: 227–241.

Richard, S., S. Moslemi, Nora Benachour, and Gilles-Eric Seralini. 2005. Differential effects of glyphosate and roundup on human placental cells and aromatase. *Environmental Health Perspectives* 113: 716–720.

Richards, D. 2010. Contradictions of the 'New Green Revolution': A view from South America's Southern Cone. *Globalizations* 7, no. 4: 563–576.

Richards, P. 2015. What drives indirect land use change? How Brazil's agriculture sector influences frontier deforestation. *Annals of the Association of American Geographers* 105, no. 5: 1026–1040.

Richards, P., H. Pellegrina, and S. Spera. 2015. Soybean development: The impact of a decade of agricultural change on urban and economic growth in Mato Grosso, Brazil. *Plos One* 10, no. 4: 0122510.

Richards, P., and L. VanWey. 2015. Where Deforestation Leads to Urbanization: How Resource Extraction Is Leading to Urban Growth in the Brazilian Amazon. *Annals of the Association of American Geographers* 105, no. 4: 806–823.

Richards, P. 2011. Soy, cotton, and the final Atlantic forest frontier. *Professional Geographer* 63, no. 3: 343–363.
Richards, P., R. Myers, R. T. Walker. 2012. Exchange rates, soybean supply response, and deforestation in South America. *Global Environmental Change-Human and Policy Dimensions* 22, no. 2: 454–462.
Richards, P., R. Walker, and E. Y. Arima. 2014. Spatially complex land change: The Indirect effect of Brazil's agricultural sector on land use in Amazonia. *Global Environmental Change-Human and Policy Dimensions* 29: 1–9.
Rodrigues, A., R. Ewers, C. Souza, A. Verissimo, and A. Balmford. 2009. Boom-and-bust development patterns across the Amazon deforestation frontier. *Science* 324, no. 5933: 1435–1437.
Rudel, T., L. Schneider, et al. 2009. Agricultural intensification and changes in cultivated areas, 1970–2005. *Proceedings of the National Academy of Sciences of the United States of America* 106, no. 49: 20675–20680.
Rulli, J. 2007. The refugees of the agroexport model. In *United Soya Republics: The truth about soya production in South America*, ed. J. Rulli. Buenos Aires: Grupo de Reflexión Rural, pp. 193–216.
Rumstain, A. 2012. *Peões no trecho: trajetórias e estratégias de mobilidade no Mato Grosso*. (Farmhands on the road: Trajectories and mobility strategies in Mato Grosso.) Rio de Janeiro: E-papers.
Santos, J., I. Leal, et al. 2011. Caatinga: the scientific negligence experienced by a dry tropical forest. *Tropical Conservation Science* 4, no. 3: 276–286.
Sauer, S., and S. Leite. 2012. Agrarian structure, foreign investment in land, and land prices in Brazil. *Journal of Peasant Studies* 39, no. 3–4: 873–898.
Sawyer, D. 2008. Climate change, biofuels and eco-social impacts in the Brazilian Amazon and Cerrado. *Philosophical Transactions of the Royal Society B: Biological Sciences* 363, no. 1498: 1747–1752.
Schiesari, L. A. Waichman, et al. 2013. Pesticide use and biodiversity conservation in the amazonian agricultural frontier. *Philosophical Transactions of the Royal Society B: Biological Sciences* 368, no. 20120378: 1–9.
Scott, J. 1998. *Seeing like a state: How certain schemes to improve the human condition have failed*. New Haven, CT: Yale University Press.
Schmink, M., and C. Wood. 1992. *Contested frontiers in Amazonia*. New York: Columbia University Press.
Schneider, M. 2014. Developing the meat grab. *Journal of Peasant Studies* 41, no. 4: 613–633.
Schneider, M., and P. McMichael. 2010. Deepening, and repairing, the metabolic rift. *Journal of Peasant Studies* 37, no. 3: 461–484.
Schulz, C., A. Ioris, and K. Glenk. 2015. Prospects for payments for ecosystem services in the Brazilian pantanal: A scenario analysis. *Journal of Environment & Development* 24, no. 1: 26–53.
Shurtleff, W., and A. Aoyagi. 2009. *History of soybeans and soyfoods in South America (1882–2009): Extensively annotated bibliography and sourcebook*. Lafayette, CA: Soyinfo Center.
Silva, M., and L. Costa. 2012. A indústria de defensivos agrícolas (The pesticide and herbicide industry). *BNDES Setorial* 35: 233–276.
Silva, J., A. Silva, Ricardo Dutra Aydos, and Inês Echenique Mattos 2015a. Correlação entre produção agrícola, variáveis clínicas-demográfcas e câncer de próstata: um estudo ecológico. (Correlation between agricultural production, clinical-demography variables, and prostate cancer: an ecological study). *Ciência & Saúde Coletiva* 20, no. 9: 2805–2812.
Silva, C., K. Sousa, et al. 2015b. Biodiversity and its drivers and pressures of change in the wetlands of the Upper Paraguay-Guapore Ecotone, Mato Grosso (Brazil). *Land Use Policy* 47: 163–178.
Smil, V. 2001. *Feeding the world: A challenge for the 21st century*. Cambridge, MA: MIT Press.
Soares-Filho, B., R. Silvestrini, Paulo Brando, Hermann Rodrigues, Ane Alencar, Michael Coe, Charton Locks, Letícia Lima, Letícia Hissa, and C. Stickler. 2012. Forest fragmentation, climate change and understory fire regimes on the Amazonian landscapes of the Xingu headwaters. *Landscape Ecology* 27, no. 4: 585–598.
Soares-Filho, B., R. Rajão, M. Macedo, A. Carneiro, W. Costa, M. Coe, H. Rodrigues, and A. Alencar. 2014. Cracking Brazil's Forest Code. *Science* 344, no. 6182: 363–364.
Sousa, I., and L. Busch. 2006. Standards and state-building: The construction of soybean standards in Brazil. In *Agricultural standards: The shape of the global food and fiber system*, ed. J. Bingen and L. Busch, Dordrecht, Netherlands: pp. 125–135.
Sorj, B., M. Pompermayer, et al. 2008. Camponeses e agroindústria: Transformação social e representação política na avicultura brasileira. (Peasants and agroindustry: Social transformation

and political representation in Brazilian poultry production). Rio de Janeiro: Scielo/Centro Edelstein de Pesquisas Sociais.

Steinfeld, H., P. Gerber, et al. 2006. *Livestock's long shadow: Environmental issues and options*. Rome: FAO.

Steininger, M., C. Tucker, Timothy J. Killeen, Arthur Desch, Vivre Bell, and Peter Ersts. 2001. Tropical deforestation in the Bolivian Amazon. *Environmental Conservation* 28, no. 2: 127–134.

Stickler, C., D. Nepstad, and D. G. McGrath. 2013. Defending public interests in private lands: compliance, costs and potential environmental consequences of the Brazilian Forest Code in Mato Grosso. *Philosophical Transactions of the Royal Society B-Biological Sciences* 368, no. 1619: 20120160.

Swann, A., M. Longo, Lee, Eunjee, and Moorcroft, Paul R. 2015. Future deforestation in the Amazon and consequences for South American climate. *Agricultural and Forest Meteorology* 214-215: 12–24.

Tsing, A. 2005. *Friciton: An ethnography of global connection*. Princeton: Princeton University Press.

Turzi, M. 2011. The soybean republic. *Yale Journal of International Affaris,* 6, no. 2: 59–68.

United States Department of Agriculture (USDA). 2015. World Agricultural Production. Circular Series WAP 12-15. Washington, DC: USDA/FAS.

Urcola, H., X. de Sartre, Elverdin, Julio, and A. Christophe. 2015. Land tenancy, soybean, actors and transformations in the pampas: A district balance. *Journal of Rural Studies* 39: 32–40.

Vallejos, M., J. Volante, Laura M. Vale, M. Laura Bustamante, and J. Paruelo. 2015. Transformation dynamics of the natural cover in the Dry Chaco ecoregion: A plot level geo-database from 1976 to 2012. *Journal of Arid Environments* 123: 3–11.

VanBeek, K., J. Brawn, and M. P. Ward. 2014. Does no-till soybean farming provide any benefits for birds? *Agriculture Ecosystems & Environment* 185: 59–64.

VanWey, L., and P. Richards. 2014. Eco-certification and greening the Brazilian soy and corn supply chains. *Environmental Research Letters* 9, no. 3.

VanWey, L., S. Spera, et al. 2013. Socioeconomic development and agricultural intensification in Mato Grosso. *Philosophical Transactions of the Royal Society B-Biological Sciences* 368, no. 1619: 20120168.

Volante, J., and J. Paruelo. 2015. Is forest or Ecological Transition taking place? Evidence for the Semiarid Chaco in Argentina. *Journal of Arid Environments* 123: 21–30.

Walker, R., J. Browder, Cynthia Simmons, Ritaumaria Pereira, Marcellus Caldas, Ricardo Shirota, Sergio de Zen. 2009a. Ranching and the new global range: Amazonia in the 21st century. *Geoforum* 40, no. 5: 732–745.

Walker, R., R. DeFries, et al. 2009b. The expansion of intensive agriculture and ranching in Brazilian Amazonia. In *Amazonia and Global Change*, ed. M. Keller, M. Bustamante, et al., Washington, DC: American Geophysical Union, pp. 61–81.

Weinhold, D., E. Killick, and E. J. Reis. 2013. Soybeans, poverty and inequality in the Brazilian Amazon. *World Development* 52: 132–143.

Weis, T. 2010. The accelerating biophysical contradictions of industrial capitalist agriculture. *Journal of Agrarian Change* 10, no. 3: 315–341.

Weis, T. 2013a. *The ecological hoofprint: The global burden of industrial livestock.* London: Zed Books.

Weis, T. 2013b. The meat of the global food crisis. *Journal of Peasant Studies* 40, no. 1: 65–85.

Wolford, W. 2008. Environmental Justice and the construction of scale in Brazilian agriculture. *Society & Natural Resources* 21, no. 7: 641–655.

World Wide Fund for Nature (WWF). 2014. *The growth of soy: Impacts and solutions*. Gland, Switzerland: WWF International.

Zhang, K., A. Castanho, et al. 2015. The fate of Amazonian ecosystems over the coming century arising from changes in climate, atmospheric CO2, and land use. *Global Change Biology* 21, no. 7: 2569–2587.

Zhouri, A. 2010. Adverse forces in the Brazilian Amazon: Developmentalism versus environmentalism and indigenous rights. *Journal of Environment and Development* 19, no. 3: 252–273.

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