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THE POLITICS OF SUGARCANE FLEXING IN BRAZIL AND BEYOND

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INTRODUCTION

Global sugarcane production literally outweighs that of any other crop. In 2013 it reached 2.16 billion tonnes – more than double that of maize, which was the crop with the second largest weight (FAO 2014). While not necessarily an indication of the crop's market or 'exchange value', this measurement does reveal the sheer amount of biomass produced via sugarcane agriculture and hints at the potential gains that might develop from making and monetizing other 'use values' from the plant.

Of course, sugarcane's multiple uses are not new, as its liquid sucrose has provided the basis for sugar, molasses and rum for years, while steam energy has been creating through a process of burning cane stalks (bagasse) leftover after crushing. Recently however, attempts to realize this exchange value appear to have entered a new phase, as both the variety and volume of raw material produced by the sugarcane industry have increased markedly. These include more complex sucrose derivatives such as ethanol and other chemicals used for liquid fuel and plastics, more intensive use of bagasse as a solid fuel for electricity and gas generation, and the capture of 'waste' from the milling process that is then turned into fertilizer and animal feed. Even the cane straw – the tops and leaves that were previously burned away from the cane stalk before harvesting – are being targeted for use with the bagasse in electricity production or for transformation into so-called 'second generation' cellulosic ethanol. In short, and in the context of a rising demand for all forms of natural resources (food, fuel, feed, fertilizer, etc.), there has been a renewed effort to increasingly create and commercialize revenue streams, or as the milling group Illovo puts it, to "optimise the return on every stick of cane" (Illovo 2014b).

We are also witnessing a greater degree of flexibility over which of these revenue streams takes precedence in the production process. It is no longer the case that all other raw materials are mere by-products of sugar. Depending on anticipated returns, many sugarcane mills in Brazil engage in arbitrage and 'flex' from one harvest to another, moving between a product mix based on 60 per cent sugar and 40 per cent ethanol, to a 40-60 split. Indeed, such are the opportunities for capital accumulation in non-food markets that the owners of the biggest milling groups now openly declare their intent to "generate value through the vertical integration of the sugar and ethanol business chain" and build whole companies "focused on the infrastructure and energy sectors" (Copersucar 2014a, Cosan 2012).

Box 1 Brazil's blend ratio and the 'flexing' process

For 2013/14, the flex ratio was 48 per cent sugar and 52 per cent ethanol. In the production process, sugarcane is first crushed into a sugar-rich juice – this is the most expensive part of the operation. Next, sugar is produced first through crystallizing and centrifuging the juice, with the leftover molasses then being fermented and distilled to produce ethanol. Flexing is made possible by extracting less sucrose from the juice and thereby leaving more available in the molasses. One important consequence from co-producing sugar and ethanol is that it extends the milling season and thereby allows for greater use of their fixed capital. This is because the total sugar content of cane remains relatively high at the beginning and end of the season, despite a decline in sucrose content.

The growing multiplicity and flexibility of sugarcane and other fungible crops, such as soybean, oil palm and maize, which are used as industrial inputs has been highlighted by Borrás *et al.* (2014) as part of the ongoing re-organization of agriculture on a global scale. Not only are these 'flex crops' spread over greater expanses of land – displacing other rural activities and the people that rely on them – they are also increasingly interlinked through international exchange in food, feed, fuel and other markets. For example, Brazilian exports of sugarcane ethanol to the US are in part influenced by the domestic US production of maize ethanol, which in turn is shaped by the price of feed and the soybean supply.

The emergence of this dynamic is linked to the cycle of global capitalism and its crises and (putative) fixes. On the one hand, 'flexing' offers a way for agro-industrial capital to better manage the price volatility that is characteristic of export markets since the 'food crisis' of the mid-2000s, as well as for finance capital to find relatively low risk portfolio investments in the context of 'financial crisis' and uncertain yields on loans. On the other hand, 'flexing' also responds to expectations of future profits in biomass refining and the conversion of renewable feedstocks into various raw materials. This is considered one of the central elements of the 'green economy' required to provide climate stability, energy and food security, especially given growing resource demands from the so-called 'rising powers' and 'emerging economies' (Borrás *et al.* 2014). The politics of flexing, then, can partly be found in the way that certain flex-crop production complexes are cast as 'win-win' solutions to the problems of ongoing capital accumulation – including simply planetary limits on continual access to cheap natural resources (see also Franco *et al.* 2010).

In this paper we intend to stimulate debate on the following questions: How and to what extent do governments and agribusinesses influence the politics of 'flexing'? At what point, and by whom, does real flexing occur as opposed to anticipated or imaginary flexing? And how are processes of contemporary agrarian change shaping and being reshaped by the promotion of 'flex crops', discursively, institutionally, and materially? We offer our own, preliminary answers by using the case of sugarcane in order to provide greater detail on the (conflicted) role of the state in making markets for non-food products, whilst also managing the tensions that arise from this. We also look at how these dynamics differ in other, emerging centres of sugarcane flexing – Southern Africa and Southeast Asia – before offering some concluding thoughts on what this process means for academic research and social activism.

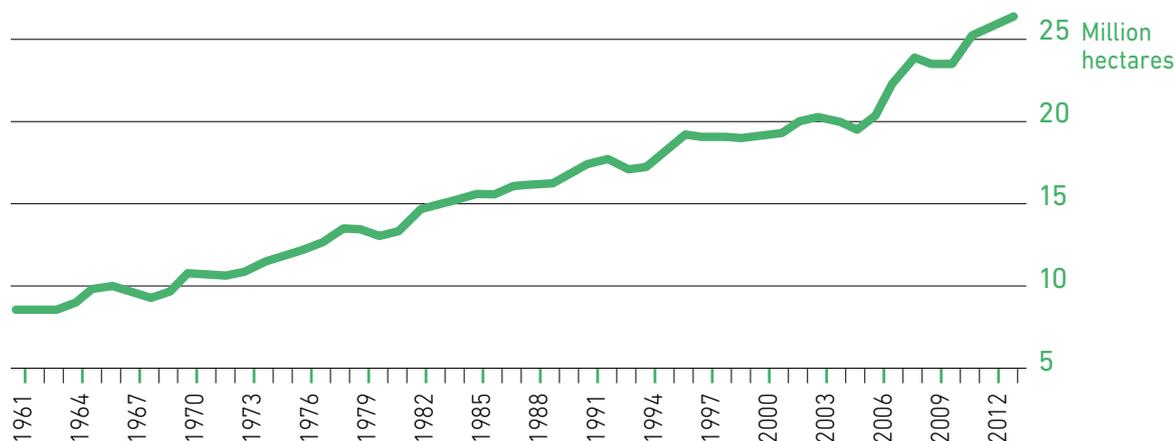
FLEXING AND THE NEW GEOGRAPHIES OF SUGARCANE

"Agro-energy is a new civilisation, a new geography for the agriculture of the world"

– former Brazilian Agriculture Minister, Roberto Rodrigues (Smith and Caminada 2007).

From 2005 to 2013, the total area of sugarcane harvested worldwide increased 26 per cent, surging from 19.7 million hectares to 26.5 million hectares (FAOSTAT 2014). During this period, the land mass dedicated to sugarcane was increasing at almost one million hectares

Figure 1 Worldwide sugarcane area harvested, 1961-2013



Source: Authors' own calculated from FAOSTAT database

Table 1 Countries with biggest expansion in sugarcane area harvested, 2005-2013

Rank by absolute increase	Country	Area in 2005 (hectares)	Area in 2013 (hectares)	Absolute increase (hectares)	Percentage increase (%)
1	Brazil	5,805,518	9,835,169	4,029,651	69
2	India	3,661,500	5,060,000	1,398,500	38
3	China	1,365,777	1,827,300	461,523	34
4	Thailand	1,035,227	1,321,600	286,373	28
5	Pakistan	966,400	1,128,800	162,400	17
20	Cambodia	5,992	28,500	22,508	376
23	Zambia	22,000	39,000	17,000	77
28	Tanzania	20,000	30,000	10,000	50
34	Swaziland	50,932	56,000	5,068	10
99	South Africa	328,000	325,000	-3,000	-1

Source: Authors' own calculated from FAOSTAT database.

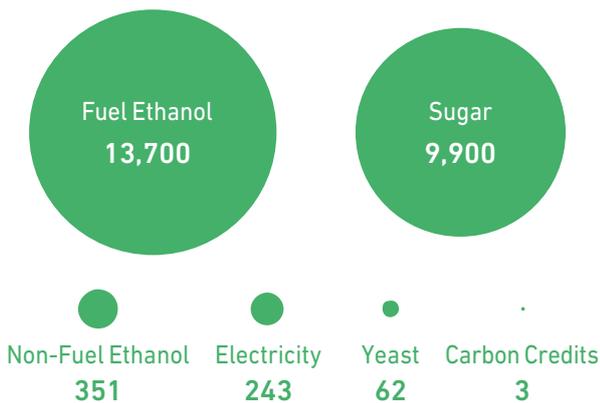
per year. This rate had been unprecedented since the beginning of FAO's records. Where was this additional cane being grown? The answer, by and large, was Brazil. As shown in the table below, an additional 3.9 million hectares were harvested in Brazil during this time period; *more than all the other countries of the world put together*. Certainly some countries experienced bigger expansions in relative terms – one of our case study countries, Cambodia, was actually the largest in this respect – and, of course, the sheer scale of expansion does not necessarily tell us anything about the nature of social displacement, environmental degradation or economic dislocation involved. But the changing Brazilian landscape is clearly an important place to look, and as we will demonstrate shortly, is closely linked to the phenomenon of flexing.

Brazil has truly become the world's 'sugar bowl'. In 2012 the country was the leader in world sugar production (22 per cent) and sugar exports (46 per cent) (FAO 2014, USDA 2013a). But as we stressed in the introduction, sugarcane production is about much more than just sugar. Brazil is the second biggest producer of ethanol in the world (27 per cent of world total, almost all of which is distilled from sugarcane) behind the US (57 per cent, mostly from corn), and collectively these two countries dominate the renewable fuel markets (RFA 2014). Although there is some trade and investment between them – prompting some scholars to articulate a potential 'ethanol assemblage of the Americas' (Hollander 2010) – it remains the case that most ethanol intended for transport fuel is sold domestically. Brazil has consumed, on average, 86 per cent of its ethanol production since 2006.

Box 2 Multiple-ness and carbon credits

Through the generation of bioelectricity, Brazilian mills have been able to acquire carbon credits and monetise yet another aspect of the production process. Led through the bureaucratic application procedure by carbon market consultants, there are 105 sugarcane bagasse projects worldwide that are registered under the United Nations' Clean Development Mechanism, with another 21 at the validation stage. A total of 8,640,000 carbon credits (known as Certified Emissions Reductions) have been issued to these projects, based mainly in Brazil and India, and have typically been sold to European-based private-sector trading firms (CDM Pipeline 2014). The argument is that by investing in new boilers and turbines to generate electricity – both for their own production sites and through export to the grid – mills can claim that they are displacing 'dirtier' electricity that would otherwise be made by burning fossil fuels. However, the use of the Clean Development Mechanism to exploit the multiple-ness of sugarcane has been controversial. Some critics question whether the bioelectricity projects deserve additional carbon market finance since they would likely have been built anyway, while others point to the non-carbon costs (e.g. loss of biodiversity, exclusion of other land-users) on which these projects are predicated (see Wittman 2012).

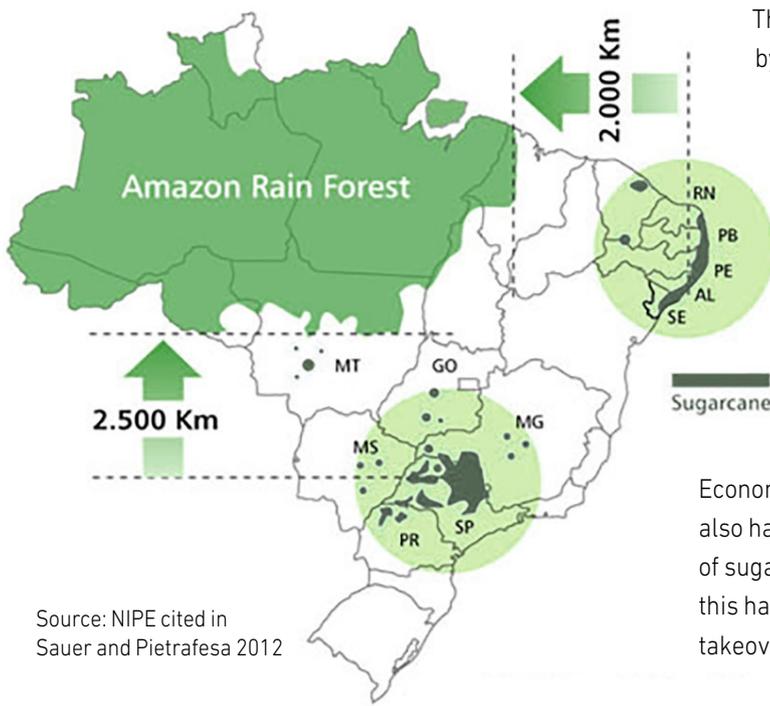
Figure 2 Market value of Brazilian sugarcane revenue streams, Millions of US \$, 2008



Source: Authors' presentation of data in Neves *et al.* 2010.

Moreover, other uses for ethanol are being found. In 2012 about 12.5 per cent of the country's ethanol was used for non-fuel products – including everything from cleaning products to perfumes – up from 6 per cent a decade previously (Financial Times 2012). That same year, around 3 per cent of Brazil's electricity requirements were met by sugar mills selling bagasse-generated energy, a ten-fold increase since 2005 (Souza 2014). Calculations on the relative value of these multiple sugarcane revenue streams are detailed in the graph below. Based on their sales price in consumer markets, and after deducting the amount paid in taxes to the state, it shows that in 2008, at the peak of the sugarcane boom in Brazil, US\$13.7 billion was made through fuel ethanol, US\$9.9 billion through sugar and just under US\$0.7 billion through other products.

Figure 3 Cane growing areas in Brazil



Source: NIPE cited in Sauer and Pietrafesa 2012

To speak of 'Brazil' as a single national entity, however, is somewhat misleading, since sugarcane cultivation is concentrated both spatially and economically. Geographically, planting and processing is largely located in the South-Central region of Brazil. According to data from the Brazilian Sugarcane Industry Association (UNICA in its Brazilian acronym), the state of São Paulo (SP) accounted for 53 per cent of the total area cultivated in Brazil, with Minas Gerais (MG), Goiás (GO), Paraná (PR) and Mato Grosso do Sul (MS) adding another 30 per cent between them (UNICA 2013a). One consequence of this has been an uneven experience of rural land price inflation, which rose the fastest in São Paulo state, increasing 57 per cent between 2005 and 2011 and leading to new dynamics of agrarian change (SugarOnline 2011).

Whilst serving as a boon to rural landowners selling or renting out land for sugarcane cultivation, such inflationary pressure has made it more expensive for the government to acquire land for the restoration of indigenous land or resettlement of landless peasants. It has also displaced existing livestock and agricultural production, thereby leading to the conversion of pastureland to arable land, and the creation of incentives for expansion or intensification of beef and dairy production as farmers and ranchers are squeezed out of their existing sites (see Sauer and Leite 2012, Wilkinson and Herrera 2010, Novo *et al.* 2010, Hermele 2012). Moreover, to the extent that a switch to ethanol production has reduced sugar exports – which happened in 2007-2008 – the upward pressure on the world sugar price has created incentives for producers in other countries to also convert land to sugarcane (HLPE 2013).

Thus, the map below – the type used extensively by the sugarcane industry to distance itself from allegations that it is contributing to deforestation of the Amazon – does not quite tell the full story. The decisions to plant new fields of sugarcane ('land-use change') or even to change the markets that sugarcane is sold into ('crop-use change') have complex secondary effects far beyond the borders of current cane growing areas, and indeed, Brazil itself (see Borrás *et al.* 2014).

Economically, ownership of the sugarcane industry also has a changing geography. In 2006, just 3 per cent of sugar mills were funded with foreign capital; in 2012 this had increased to 33 per cent – a virtual foreign takeover of the milling industry (Novacana 2013).

The milling sector itself is also becoming increasingly concentrated. Seven milling groups control 55 per cent of Brazil's sugarcane production with smaller, often family or cooperative-owned mills, disappearing due to indebtedness and takeovers (see Table 2 below). This process has enabled tighter policy coordination and greater 'class consciousness' on the part of capital, evident in UNICA's transnational lobbying efforts via its offices in Brussels and Washington D.C. and the 'More Ethanol' Movement that brought together corporate elites, politicians and civil servants in Brasilia to boost industry expansion.

The dynamics of ownership are in part a result of the economics of flexing. Firstly, investing in the factory technology to manufacture multiple products is an expensive business. To build a new mill that crushes 3-4 million tonnes of cane per year has been estimated at around US\$500 million, excluding the cost of designating extra land for cane growth (Reuters 2011a). Secondly, to ensure that markets can be found for non-food products, many milling companies have sought to extend their vertical integration downstream and guarantee access to fuel distribution infrastructure.

Table 2 The corporate control of Brazilian sugarcane

Company	Mills / Related Assets in Brazil	Production/year	Share of Brazilian market
Copersucar S.A (2014 – merger with Cargill, 50 per cent owned by each company)	Controls exclusive sale of sugar and ethanol volumes produced by 47 member mills and 50 non-member units	Sugar: 6.9 million tons Ethanol: 3.7 billion liters	Sugar-Ethanol complex (inc. transportation, storage, processing commercialization): 22 per cent Sugar sales: 19 per cent Ethanol sales: 16.3 per cent
Raizen (2011 merger - Royal Dutch Shell and Brazilian conglomerate Cosan)	24 mills 4,700 Shell service stations 54 airports 60 terminals	Sugar: 4 million tons Ethanol: 2 billion liters	Sugar-ethanol complex: 9.5 per cent Sugar: 11 per cent Ethanol: 8.8 per cent
Biosev (2009 merger – Louis Dreyfus Commodities sister company after merging with Brazilian sugarcane producer and processor Santelisa Vale)	12 mills	Sugar: 2.8 million tons Ethanol: 1.8 billion liters	Sugar-Ethanol complex: 7 per cent
Odebrecht Agroindustrial (Brazilian-based engineering, construction, and chemical conglomerate)	9 mills	Sugarcane: 40 million tons Ethanol: 3 billion liters	Sugarcane: 6.8 per cent Ethanol: 13.2 per cent
Guarani (Acquired by French sugar conglomerate Tereos in 2002; Petrobrás buys 46 per cent stake in 2011)	7 mills	Sugarcane: 20 million tons Sugar: 1.9 million tons Ethanol: 860,000 m3	Sugarcane: 3.4 per cent Sugar: 5.2 per cent Ethanol: 3.8 per cent
Bunge (US-based food processing corporation)	8 mills	Sugarcane: 21 million tons	Sugarcane: 3.6 per cent
Adecoagro (Argentina-based company heavily backed by US billionaire George Soros)	3 mills	Sugarcane: 17 million tons	Sugarcane: 2.9 per cent

Source: Authors' own from various data sources.

For these two reasons, milling groups have needed additional finance and expertise, and in order to acquire it, have turned to mergers and acquisitions.

For example, in 2011 and following its recent stock market floatation, the sugarcane conglomerate Cosan launched a joint venture with Royal Dutch Shell to produce Brazil's second largest sugar-ethanol corporation Raízen (Shell 2011). Also in 2011, British Petroleum bought out the mills Tropical BioEnergia and Companhia Nacional de Açúcar e Álcool, while the following year, the recently corporatized Copersucar acquired a controlling stake in Eco-Energy in order to access major fuel distributors in the US (Fick and Flynn 2011).¹ Nor has it only been Brazilian millers partnering with European/American traders and oil companies. In 2010, and following its own partial stock market floatation, the Brazilian energy company Petrobrás spun out an ethanol-arm and went into business with French sugar producer Tereos to form Guarani, whilst also agreeing with the São Martinho group to take a stake in what will become Brazil's biggest single biomass refinery, the Boa Vista mill in Goiás (Reuters 2010). Meanwhile, in order to develop second-generation biofuels from sugarcane cellulose rather than sucrose, Petrobrás formed a partnership with the US-based KL Energy Company, and plans to open a bagasse-processing ethanol plant in Brazil in 2015 (Petrobras 2014).

However, after this boom period there came a bust, which brought its own mechanisms of restructuring. Tight margins on sugar/ethanol prices, bad weather and limited credit in the wake of the global financial crisis all played their role in the sudden inability of many mills to pay down their debts as quickly as expected or roll them over by borrowing more. The collective debt of the industry thus ballooned, and was expected to reach R\$63 billion by the end of the 2013-2014 crushing season (Almeida and Kassai 2013). This led to dozens of mills being mothballed, which in turn has caused thousands of workers to be laid off, despite some still being owed wages. The most insolvent mills have even faced the threat of bankruptcy proceedings, allowing their competitors to buy them out cheaply, concentrating the industry even further. According to Dario Costa Gaeta, chief executive of the Paraiso Bioenergia mill which itself narrowly avoided bankruptcy, this dynamic is likely to wipe out the vast majority of the remaining 250 family-owned mills over the next decade or so, leaving the sugarcane sector – and flexing decisions – in the hands of the milling oligopoly (Ewing 2013).

THE ROLE OF THE STATE IN MAKING MARKETS

“We are and will continue to be world champions in clean energy, a country that will always know how to pursue healthy, balanced growth. Ethanol and hydro energy source will be greatly encouraged, as well as alternative sources: biomass, wind and solar energy”

– Brazilian President Dilma Rousseff in her inaugural speech to Congress (Huffington Post 2011).

The story presented so far, and one frequently repeated by the sugarcane industry itself, has been one of industrial innovation and private sector growth. Yet it is important to acknowledge the role of the state in making non-food markets into those in which (certain) industrial capitals have been able to circulate and expand – a feature that can be traced from the 2010s, as indicated in the quote above, all the way back to the 1930s. We focus here on industrial policy targeted at non-sugar markets specifically, though others have identified 'subsidies' that support the sugarcane industry as a whole. For example, Patrick Chatenay has argued that Brazilian agriculture, including sugarcane, benefits from a reduced mandatory contribution to the government pension fund scheme INSS. Farming pays a special tax, informally called 'Funrural', defined as 2.1-2.6 per cent of revenue instead of the standard 28.3 per cent on payroll that non-agricultural sectors contribute, with the remainder being paid by the Brazilian Treasury. Chatenay puts the benefit of this for sugarcane farming at US\$800 million for the 2012/2013 crop year alone (Chatenay 2013).

The role of the Brazilian state in the politics of sugarcane 'flexing' is usually dated to the 1975 Pró-Álcool programme, but in fact the first ethanol blend mandate of five per cent was put in place in 1931 (Costa *et al.* 2011). That said, it was not until the 1973-74 oil price crisis that Brazil's ethanol industry really started to develop. In 1975 Brazil's military government initiated the Pró-Álcool programme to support and promote ethanol production from sugarcane and cassava, although it was only the former that had the capacity to respond to state incentives. As an alternative transport fuel, ethanol production was intended to increase Brazil's energy independence and

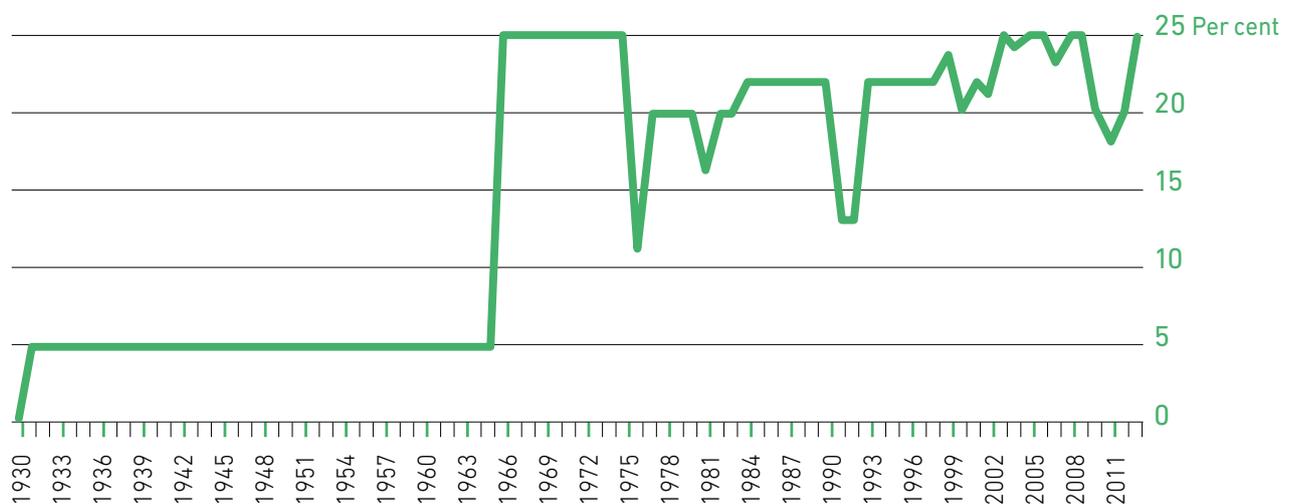
reduce oil imports. With *Pró-Álcool*, the state provided subsidies and credit guarantees for the expansion of sugarcane distilleries and processing plants, continued to slowly increase the ethanol-blend mandate for gas-powered vehicles, and applied import tariffs and export taxes on sugar in order to stimulate domestic sugarcane-ethanol production (Schmitz *et al.* 2003).

In the late-1970s, Brazilian subsidiaries of automobile corporations began to produce ethanol-fuelled cars. The state continued to intervene by providing subsidies and favorable credit terms for sugarcane producers, while applying an extra tax on gasoline, introducing bans on diesel-powered cars, and public procurement mandates for the new ethanol-powered cars (Pelkmans *et al.* 2008). By 1986, almost all new automobile purchases were of ethanol-fuelled cars and a distribution infrastructure had been put in place that allowed ethanol to be sold in almost all of the country's 30,000 filling stations (HLPE 2013). Incentives for research were given to institutes and universities, however, the steep drop in oil prices in 1985-86 – which remained below US\$30/barrel until 2000 – slowly crippled Brazil's *Pró-Álcool* programme. This was worsened (from drivers' point of view) by the fact that high sugar prices meant mills diverted sugarcane away from the fuel market. Under the neo-liberal policy leanings of the Cardoso government (1994-2002), the state's power to set prices and production quotas for sugarcane was renounced and by 1998 gasoline and ethanol prices fluctuated more freely with the market (Pelkmans *et al.* 2008).

The surge in oil prices in 2004-05, coupled with popular discourses of climate change, energy security, and rural development, reignited world ethanol production and Brazil's ethanol-based fuel economy was revived (see Franco *et al.* 2010). The ethanol industry further benefitted from the launch of flex-fuel vehicles in Brazil in 2003 – capable of running on gasoline, ethanol, or any combination of the two – which have since taken over Brazil's automobile industry, representing 95 per cent of current monthly sales and 62 per cent of the country's total vehicles (UNICA 2014a). Despite partial deregulation of fuel pricing, the Brazilian government has retained its use of ethanol mandates, instituting it as a means of supply-management to stabilize sugarcane prices, rather than to reduce oil consumption or offset high world oil prices (Schmitz *et al.* 2004). This is corroborated by the USDA, which attributed the Brazilian government's February 2013 decision to increase the blend ratio from 20 per cent to 25 per cent to an "expected higher sugarcane crop and higher availability of the product" (USDA 2013b). The graph below shows the ethanol-use mandate since its inception in 1931 and illustrates the underpinning of market demand.

Another important political tool has been taxation policy. In 2002, just before the launch of the first flex-fuel car in Brazil by Volkswagen, the Brazilian government extended the same tax exemption to flex-fuel vehicles that ethanol-fuelled vehicles had traditionally received over gasoline-powered cars (USDA 2013b). Differentiated tax rates have been applied to the fuel as well as the vehicle.

Figure 4 Brazilian ethanol blend mandate, 1930-2013



Source: Authors' adaptation from Puerto Rico 2007; USDA 2013a.
 Note: between 1966 and 1977 blending was mandatory up to the ranges shown.

Box 3 The post-petroleum sugar economy and the return of genetic modification

In 2014 the 'eco-friendly' cleaning products company Ecover announced it would replace some of the palm oil used in its laundry detergent with oil derived from the fermentation of Brazilian sugarcane by specially-designed algae. Opponents of genetic engineering, such as the ETC Group, accused Ecover and their supplier, US-based Solazyme, of using 'synthetic biology' to produce these algae as well as simply shifting from one unsustainable industrial crop (palm oil) to another (sugarcane). Ecover responded by denying that any 'unnatural' production processes were being used, that the algae were kept under strict control, lest they contaminate waterways, and that the sugarcane being used was sustainable because it had been certified by the multi-stakeholder organisation Bonsucro (see Thomas 2014 and Domen and Develter 2014). Since many of the multiple uses of sugarcane utilise fermentation techniques, we can expect debates over the use of genetically-modified organisms in industrial biotechnology to ignite some of the same debates that accompanied agricultural biotechnology.

The Contribution to the Social Integration Program/Contribution for Financing Social Security (PIS/COFINS in its Brazilian acronym) applies an extra tax on gasoline to the equivalent of R\$0.26/litre (around US\$0.2/litre), which currently does not apply to ethanol (USDA 2013b). Furthermore, in São Paulo, the heartland of sugarcane production, state sales taxes have been placed on gasoline and hydrous ethanol, but not on anhydrous ethanol (the type used in flex-fuel cars). Additionally, in 2011, Governor Geraldo Alckmin eliminated a tax on equipment that produces bioelectricity from sugar cane.

Perhaps the most important discretionary mechanism through which sugarcane ethanol and 'flexing' has been promoted is through state-credit. The Brazilian Social and Economic Development Bank (BNDES in its Brazilian acronym), a state-owned financing corporation, has historically played a major role in the development of the Brazilian sugar-ethanol industry. During the late-1970s, during the height of the Pró-Álcool programme, it was claimed that the amount of cheap credit provided by another state-owned bank, the Banco do Brasil, made it the largest agricultural lender in the capitalist world (Burbach and Flynn 1980). In the contemporary period, between 2006 and 2010, an annual subsidised credit allocation by the BNDES for investment in distilling machinery and equipment jumped from US\$143 million to US\$849 million, while credit for energy cogeneration grew from US\$84 million to US\$206 million. At the same time, credit extended to mills for increased sugarcane production – either as working capital or investment capital – jumped from US\$519 million to US\$1,121 million. By 2010, the total amount of subsidised credit available for the industry had reached an all-time high of US\$3.1 billion per annum (USDA 2011, Wilkinson *et al.* 2012, see also Sauer and Pietrafesa 2012).

Since 2010, various other credit lines have been created to service the growth of the sugarcane 'bio-economy'. In 2011, BNDES and the Funding Authority for Studies and Projects Agency (FINEP in its Brazilian acronym) of the Ministry of Science and Technology announced the Joint Plan to Support Industrial Technological Innovation in Sugarcane Sectors (PAISS Agrícola in its Brazilian acronym). This supported 35 business plans with R\$2.5 billion "aimed at providing support to industrial-technological innovation in the sugar-based ethanol and chemical sectors" (UNICA 2014b). In 2014 it was renewed and R\$1.5 billion made available for what it calls 'agricultural-technological innovation' in the sugar-ethanol sector. These included credit lines for transgenic crops, precision harvesting (so as to collect more biomass), integrating production processes and adapting industrial systems in other sectors to enable them to use ethanol as a raw material (Sauer and Pietrafesa 2012). Moreover, it is not just through the credit system that the industry's financial woes have been alleviated. Monies owed by mills to the state have been reduced through the Brazilian government's tax-resettlement programme for 'distressed companies' (REFIS in its Brazilian acronym). Among others, this has been taken up by Guarani to renegotiate and reduce its US\$42 million tax bill (Chatenay 2013: 18).

Finance has also been extended for distribution infrastructure, a key requirement of any 'flexing' project. In 2011, Logum Logística, a joint venture backed by Petrobrás, Copersucar, Raízen and Odebrecht among others, received a US\$924m loan from BNDES to begin building a giant ethanol pipeline

830 miles long, connecting the states of São Paulo, Minas Gerais and Goiás to consumption sites in the country's south-east (Nielson 2011). This pipeline is of particular importance, as these three states alone account for almost 70 per cent of sugarcane production in Brazil and will reduce dependence on costly road haulage to transport the ethanol (UNICA 2013a). Meanwhile, to ensure that enough raw materials were available to supply these intended product markets, and to provide some support to cane farmers and millers, BNDES also launched Prorenova in 2012. With a budget of R\$4 billion, this was designed "to encourage the production of sugarcane by financing the renovation of old sugarcane farms and the expansion of the cultivated area". To encourage uptake since its launch, interest rates have been reduced, increased funding per hectare has been made available, and applicability to foreign-owned companies has been extended (BNDES 2012; SeeNews 2014).

Yet, this activity by the BNDES has not been restricted solely to Brazil. As compiled by John Wilkinson (private communication, on file with authors), BNDES has recently financed sugar-ethanol projects in Angola (Oderbrecht in cooperation with Damer and the state-firm Sonangol), Ghana (Northern Sugar Resources), Mozambique (Petrobrás with Companhia de Sena and the state-firm Petromoc). It also financed Brazilian engineering firm Dedini for the construction of a plant in partnership with Kenana Sugar Company in Sudan, provided an US\$80m loan to Kenya in the form of agricultural machinery including 2,000 sugarcane tractors, and signed a cooperation agreement with the public Industrial Development Corporation in South Africa to prioritize lending to flex-fuel cars, co-generated renewable energy and agro-industry. The capital-intensive model of sugarcane farming and refining favoured in Brazil has aided firms supplying machinery, equipment, infrastructure and engineering services, as well as the industrial capital involved in milling.

International lending by the BNDES has formed part of a concerted state project – led most enthusiastically by the Lula government of 2003-2010 – to turn sugarcane ethanol into a global commodity. Thus, alongside credit with favourable conditions (but not concessionary rates), the Brazilian state has also promoted sugarcane flexing abroad. It has done this via diplomatic efforts to encourage adoption of biofuel policies in African

countries and through the technical advice of the African-branch of the Brazilian Agricultural Research Company (EMBRAPA in its Brazilian acronym) to cultivate sugarcane and construct bio-refineries (see Campanhola and Araújo 2012). Finally, the Brazilian government has been an ardent supporter of agricultural trade liberalization, with the 54-cents/gallon tariff placed by the US on biofuel imports among its particular bugbears. After applying pressure on the US to promote ethanol in a more liberal fashion – collaborating with Brazil to develop the fuel globally, rather than insulating itself and closing off the domestic market – the tariff was finally repealed at the end of 2011, publicly celebrated by UNICA among others.

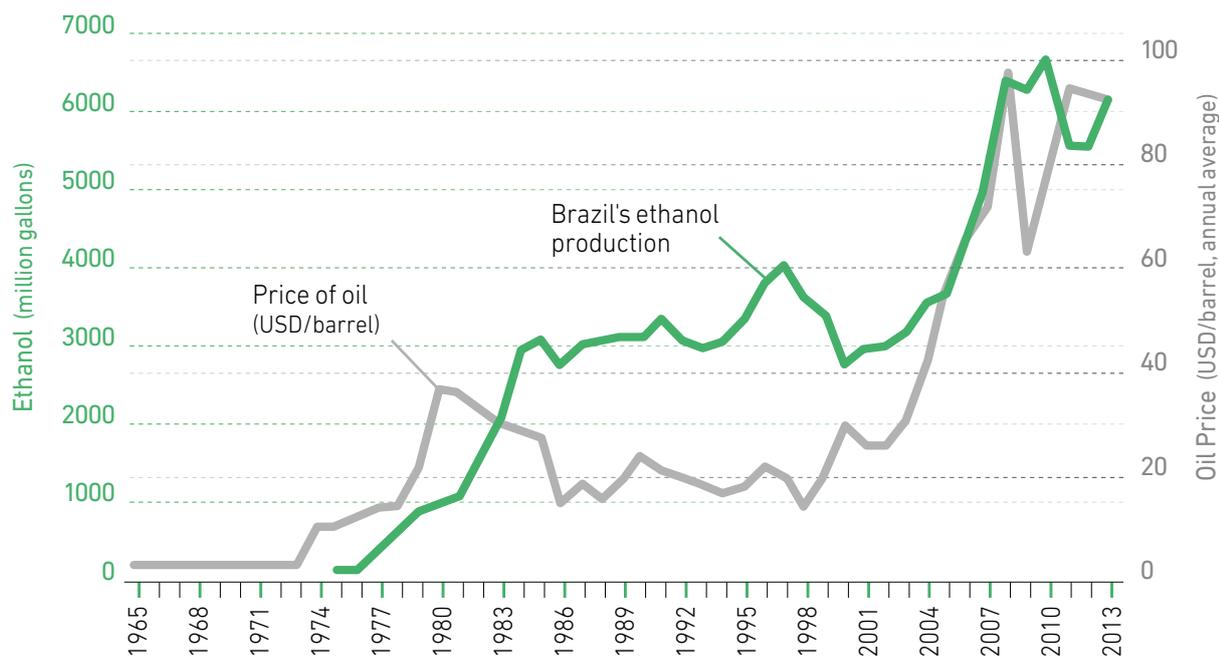
THE ROLE OF THE STATE IN MANAGING MARKETS

"Questions of a regulatory nature will be an important topic at the [2013 Ethanol] Summit, because these are what will ensure the competitiveness of renewables against fossil fuels" – Elizabeth Farina, CEO of the Brazilian Sugarcane Industry Association (UNICA 2013).

The previous section showed how the Brazilian state has been exclusively dedicated to the promotion of multiplying the uses and market value of sugarcane. Yet as the quote above from the CEO of UNICA suggests, there have in fact been many points of tension between those actors with a commercial interest in the sugarcane complex and those regulating the sector in government and other state agencies. In theoretical terms, this is an example of the dialectical relationship between accumulation and legitimacy that must be managed by the capitalist state. Perhaps nowhere in our case is this more evident than in fuel pricing and the political decisions that have been necessitated by sugarcane millers' capacity to flex.

To appreciate the impact of flexing on the consumer goods market for fuel, it is important to first outline the relationship between ethanol production and the price of oil (used to make gasoline). Figure 5 shows a positive correlation between these two variables. A strong claim can be made for causality too: the oil price crisis in 1973-74, for example, was clearly

Figure 5 Brazil's ethanol production and real world oil prices, 1965-2013



Source: adapted by authors from FRED 2013 and RFA 2013.

connected to the government's Pró-Álcool programme, while the eventual decrease in oil prices led to the programme's demise as fixed ethanol prices could no longer be publicly justified. During the last decade however, oil prices increased once again, moving rapidly upward from 2003 to 2008. This coincided with the launch of Brazil's flex cars in 2003 and undoubtedly contributed to the sugarcane boom of the mid-2000s (along with the food price crisis and 'rush to farmland', in which the oil price was also a driving factor).

Since its 2008 peak, however, the oil price has faltered, dampening further price rises for gasoline at the pump. Allied to this has been the anti-inflationary strategy of the Dilma government (first term 2011-2014). In the same inauguration speech in which she vowed to champion clean energy, Dilma also outlined her determination to prevent the 'poison' of inflation from eroding real wages (Huffington Post 2011). Her government has sought to do this primarily by keeping gasoline prices down, applying pressure on Petrobrás to import extra oil and sell it at below cost, whilst also cutting federal gasoline taxes (Almeida and Kassai 2013).

The consequence of this has been felt acutely by ethanol producers, which have lost their competitiveness against gasoline producers and are thus less able to convince flex-fuel drivers to switch from the gasoline-blend to 100 per cent pure ethanol. Table 3 shows the ratio of

ethanol to gasoline prices in Brazil's top three sugarcane producing states and suggests that the price incentives to switch to pure ethanol have been few and far between (because ethanol burns faster than gasoline, it is reckoned that ethanol must be below 60 per cent of the price of gasoline to encourage customers to switch). As a consequence, while 82 per cent of Brazil's flex-fuel cars were filling up with pure ethanol in 2009, by 2013 this had dropped to roughly 24 per cent (Almeida and Kassai 2013).

What is being argued here is that the Brazilian state has balanced support for ethanol production against consumer fuel prices. Sometimes it has shaped this relationship indirectly – as in the case above, or by promoting the exploitation of offshore oil deposits – but sometimes directly. In 1999 for example, one of the Brazilian anti-trust agencies, the Secretariat of Economic Law, disbanded a collective organisation of ethanol producers called Brasil-Álcool on the basis that they formed a cartel intent on raising consumer prices in the fuel market.² Meanwhile, at the beginning of the Dilma government, regulatory oversight of ethanol was moved from the Ministry of Agriculture to the Ministry of Energy, with the government immediately exploring the possibility of applying export taxes on sugar to divert Brazilian sugarcane into the domestic fuel market (Reuters 2011b).³

Table 3 Ratio of pure ethanol to gasoline-ethanol prices in Brazil, 2010-2013

		2010	2011	2012	2013
São Paulo	January	73 per cent	70 per cent	71 per cent	69 per cent
	February	73 per cent	71 per cent	68 per cent	68 per cent
	June	53 per cent	64 per cent	68 per cent	65 per cent
	August	57 per cent	68 per cent	66 per cent	n/a
Minas Gerais	January	79 per cent	75 per cent	78 per cent	74 per cent
	February	83 per cent	76 per cent	77 per cent	73 per cent
	June	70 per cent	74 per cent	76 per cent	73 per cent
	August	65 per cent	75 per cent	75 per cent	n/a
Goais	January	69 per cent	68 per cent	69 per cent	71 per cent
	February	71 per cent	70 per cent	68 per cent	69 per cent
	June	53 per cent	63 per cent	69 per cent	66 per cent
	August	57 per cent	65 per cent	67 per cent	n/a

Areas shaded in grey indicate that ethanol prices are low enough to encourage a consumer switch

Source: Adapted from data in USDA 2013b.

A second aspect of flexing necessitating state management relates to the control of infrastructure. As noted already, the production of energy (fuel, electricity) over a greater spatial area has required investment in distribution infrastructure. The activities of Cosan are instructive here. In 2011, it invested US\$695 million to construct the largest sugar terminal in the world, also partnering with Logum Logística, the ethanol pipeline project mentioned previously. In 2012, it also paid US\$1.8 billion for control of Brazil's largest gas distribution unit and in 2014 put in a US\$3 billion bid for the nation's largest railway operator, América Latina Logística (ALL).

One concern for state regulators here is whether this will lead to monopoly control. In the case of the Logum Logística pipeline, another of Brazil's anti-trust agencies, the Administrative Council for Economic Defense, did eventually approve the deal – although apparently deliberated over the possibility of installing a rival pipeline to provide some competition.⁴ At present, the ALL railway network deal remains subject to approval: again, there is concern about whether Cosan will prioritize sugar freight over other commodities such as soybeans and/or charge rival sugar producers higher fees. Consequently, state regulators have deliberated whether to block the deal or require the companies to sell assets or guarantee equal pricing (Bloomberg 2014). In other words, the vertical integration into distribution infrastructure being

precipitated by increasing production and industrial concentration has secondary consequences for other commodity complexes that require mediation by the state. Like inter-industry conflicts that have arisen out of the biofuels boom in other parts of the world – e.g. livestock and final food producers in the US complaining about the higher prices of maize – this is likely to remain another source of potent political conflict.

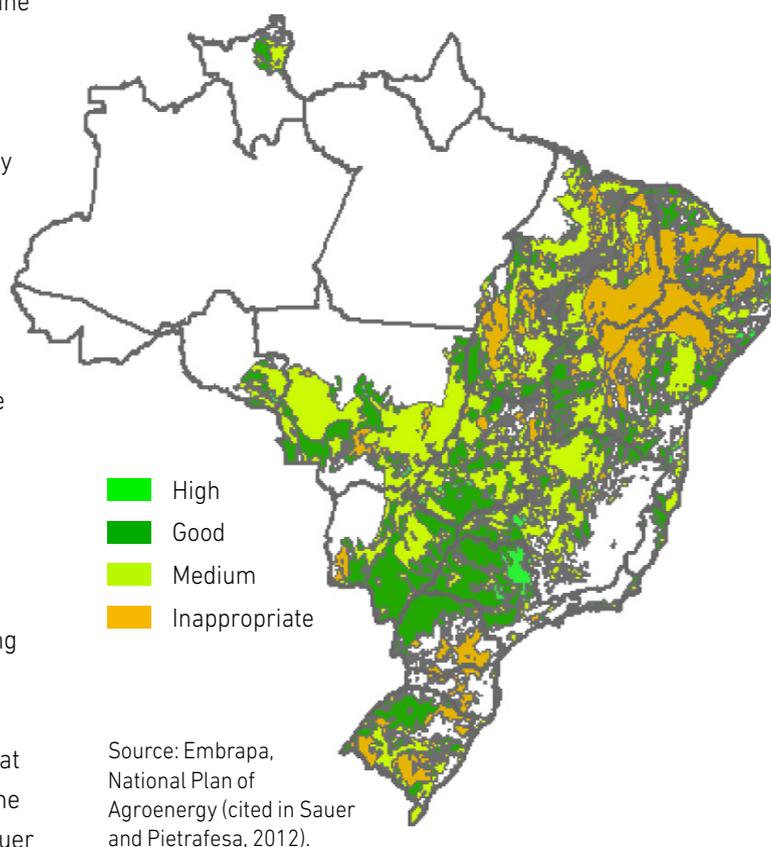
A third aspect of state management relates to land. We have already noted the way that sugarcane flexing has been yoked to discourse about clean energy, sustainability and green growth. For example, Vasco Dias, Chief Executive of Raizen, has said of cellulosic ethanol that: "This is the cleanest solution possible: taking rubbish – bagasse, biomass – and transforming it into fuel" (Financial Times 2012). Indeed, industry representatives now even talk about the use of cane leaves and tops allowing them to 'grow vertically', reducing the pressure to expand the planted area (Jank and Perina 2011). But a *quid pro quo* of this strategy is that it has caused the sugarcane industry to be viewed as one that is addressing its environmental impacts. For example, Braskem, which make plastic bags from ethanol, have admitted that: "Technically speaking, it doesn't make a difference whether we use cane or corn ethanol but it's very important for marketing... Our end customers want products that don't directly compete with the food chain" (Financial Times 2012).

The Brazilian state has actively participated in this project. Most notably in 2008, in order to assuage concerns that the expansion of the Brazilian sugarcane frontier was destroying the Amazon rainforest and other sensitive biomes, the government established the National Agro-Ecological Zoning of Sugarcane (ZAE Cana) programme. This was designed to identify available/suitable land for sugarcane, and took care to exclude land in the Amazon and Pantanal biomes, land that needed large-scale irrigation, and land that could not be harvested mechanically since these areas are otherwise burned (Manzatto *et al.* 2009).⁵ Cane burning had also been addressed at the state level: in 2002 the São Paulo leadership passed a law requiring its progressive phase-out over the coming years.⁶

At the same time, ZAE Cana has been criticized for not tackling indirect land-use change, not considering the areas for biodiversity conservation put forward by Ministry of Environment, and not establishing restrictions for existing plants or for new projects that have already obtained an environmental license in the excluded areas (Carvalho no date, Pietrafesa and Sauer 2012). Moreover, it has yet to be passed as a law and instead relies on conditions attached to loans and the withholding of milling licenses for compliance. At root, such classifications of 'available/appropriate' remain extremely problematic as they necessarily simplify complex land relations, ignoring the place of traditional farming practices in the plantation landscape (see Borrás and Franco 2012). The steady destruction of the indigenous Guarani-Kaiowá people and their way of life in Mato Grosso do Sul by the activities of the sugarcane industry bears grim testimony to this. However, what they do demonstrate is the need for legitimacy in such socio-ecological projects, and that this cannot be manufactured by capitalists solely on their own.

Finally, as politically important as those areas where the state *does* intervene are, so are those in which it *does not*. Chief here is the labour regime. One change hastened by sugarcane flexing relates to the redundancy of manual cane-cutters. Since the production of bagasse electricity requires more biomass to be brought to the mill, another incentive is created to move from cane burning to 'green cane' harvesting. Because this is more labour-intensive, meaning it requires more strikes of the machete to cut through the leafy and fibrous cane, it tends to be

Figure 6 ZAE Cana map of available and appropriate land for sugarcane



done mechanically, leading to tens of thousands of lay-offs in manual harvesting. In São Paulo state in 2006-07, 34 per cent of sugarcane area was harvested mechanically; by 2011-12 this had increased to 65 per cent (Raizen 2013). Across the same timescale, and despite the significant increase in output, the number of sugarcane workers declined from 178,000 to 94,000 (CONAB 2014). The fate of redundant workers has largely been left to industry, trade unions and charities, which try to manage the unemployed through a retraining programme called Projeto Renovação. Another change in the labour regime relates to inequities in the value chain. Sugarcane growers in the centre-South have complained that the revenue sharing formula which determines the amount they receive for their cane has not been adjusted to account for the increasing profits accruing from electricity co-generation, leaving them with a smaller share of the gains of bioenergy production (McGrath 2013). Following state withdrawal from price control in the 1990s, negotiations over the proportion of exchange value attributable to agricultural production as opposed to industrial processing are, at least in São Paulo, conducted through the institution CONSECANA.

Box 4 Bunge, Coca-Cola and the Guarani-Kaiowá in Brazil

In the Brazilian state of Mato Grosso do Sul, the indigenous Guarani-Kaiowá ('forest people') have been struggling to maintain their ancestral lands for centuries. Reduced to just 42,000 hectares of total surface area, each Guarani-Kaiowá has, on average, access to less than one hectare (FIAN 2012). The continual encroachment by large-scale agro-industrial corporations is driving them from their lands and leading to severe impoverishment, loss of livelihoods, and eroding traditional cultural practices. A recent study by the Conselho Indigenista Missionário (CIMI) revealed that there were 72 cases of suicide among the Guarani-Kaiowá in 2013 alone, and 684 cases since 2000 – the highest suicide rate in the world (CIMI, 2013). One of the key drivers forcing indigenous people from their land: sugarcane expansion.

Sugarcane plantations increased almost six-fold between 2000 and 2012 in Mato Grosso do Sul – from 98,958 ha to 558,664 ha (UNICA 2013b). The largest sugarcane processing company in the region is US-based Bunge and some of their sugarcane has been sourced from five properties located within Guarani-Kaiowá territory – now transformed into intensive monocrop sugarcane plantations. Despite acknowledging this, Bunge has refused to terminate supply contracts prematurely (Repórter Brasil 2012). Further down the supply chain, one of the principal buyers of sugar from Bunge is the Coca-Cola Company, which not only uses sugar for their soft drinks, but also for their new bio-plastic 'PlantBottle' technology. But Bunge is not the only multinational extracting resources from the region. Raizen, the joint venture between Shell Oil and Cosan, also sources sugarcane from indigenous lands of the Guarani-Kaiowá. This expansion of agro-industry has led to cases of harassment and attacks on indigenous people, as well as the contamination of water sources and the destruction of the territory's native vegetation from which peoples' livelihoods depend (Repórter Brasil 2012).

Dominant discourses supporting agro-fuels and 'flex' crops fail to bring these important issues to the fore. Instead, they rest their argument on the environmental sustainability of these renewable resources, yield productivity, and 'rural development' without taking into account the disastrous social, cultural, and ecological effects of the production process. Coca-Cola, for example, markets their 'PlantBottle' technology as a solution to fossil fuel dependence and part of a green economy strategy. As a major sponsor of the 2014 World Cup in Brazil, Coca-Cola went as far as using images of Brazil's indigenous in their advertisements with the slogan "Bem-vindos a copa a tudo mundo" (Welcome *everyone* to the World Cup). The Guarani-Kaiowá case is just one of many struggles around the world in which land, resources and livelihoods are threatened by powerful capitalist interests in advancing private property.

FLEXING BEYOND BRAZIL: THE CASES OF SOUTHERN AFRICA AND CAMBODIA

Southern Africa

"It's like harvesting nine tonnes of coal per hectare" – Simon Cleasby, Illovo Regional Director, Swaziland Sugar Association annual conference, Mbabane, 2011 (meeting attended by one of the authors)

Sugarcane production and flexing capabilities are most advanced in Brazil, but the dynamics of flexing are having broader implications around the world as state and corporate elites learn from one another – often through in-country visits sponsored by firms

which stand to gain from the international adoption of technology – and adapt bio-economy strategies suited to their own situations. In Southern Africa, the scale of flexing can be gauged with reference to declared revenue by Illovo (2014b), the region's biggest milling group and since 2006, part of the Associated British Foods conglomerate, one of the world's biggest multinational sugar producers.

The company's total revenue for 2013-14 was Rm13.2 billion of which 71 per cent was attributed to sugar production, 22 per cent to cane growing and just 7 per cent to downstream production and energy co-generation – a product mix much more reliant on sugar than in Brazil. Nevertheless, its Chairman Don MacLeod has

pledged that “strategic downstream investments will be pursued to enhance and diversify future revenue streams” and steps have been taken in regard to its recent investments in co-generation of electricity at its mill in Swaziland, in a distillery for potable ethanol in Tanzania, and in a Memorandum of Understanding with the Zambian government for an ethanol plant to serve the planned domestic fuel market (Illovo 2014b: 29). Similarly Tongaat Hulett – owner of seven mills in the region – has said that it is planning to purchase one power station and that its aspiration over the next decade “is to complete the construction and commissioning of a large scale electricity plant at each of its South African mills and to install at least one large scale bio-ethanol plant at one of its mills” (Tongaat Hulett 2014).

Mirroring our analysis of Brazil, we note again the ambitious (state-orchestrated) plans for sugarcane flexing. For example, in 2014 the South African government launched a ‘Bio-Economy Strategy’ which, among other things, articulated the need to source second-generation biofuels from woody biomass and sugarcane bagasse. It also highlighted bio-based materials and chemicals as an important growth area, and noted that “owing to the scale of investments needed to establish manufacturing facilities, large sugar and chemical companies are likely to dominate the future industrial biotechnology landscape” (South Africa Department of Science and Technology 2014: 36). Alongside this, other experts, such as academics, have also advanced the need for sugarcane agro-energy, although in Brazil the rhetoric has been dominated by the need for clean domestic energy, while in Africa it has been about economic development of the ‘biomass-poverty belt’ (Johnson and Seebaluck 2012). In terms of the investments already made, supportive regulation has again been key. An example here would be the Power Purchase Agreements signed by parastatal electricity providers in Mozambique and Swaziland to provide guaranteed prices/demand for bagasse electricity exported from the sugar mills. And similar tensions have also arisen with labour. In South Africa, cane cutters have complained about the move to green cane harvesting as it takes longer to cut and they are paid per tonne; in Swaziland, the Sugarcane Growers Association has threatened to take the millers to court for refusing to share the additional revenues earned on their ‘industrial’ activities.

Cambodia

“The 29% drop in our net profit this year compared to the previous year is due mainly to the significant decrease in price of sugar in the world market. However, the performance of our ethanol and biomass energy business is significantly better than that of the previous year. Our ethanol revenue rose from THB316 million to THB603 million while revenue from our biomass energy which we sell to the Electricity Generating Authority of Thailand rose from THB611 million to THB966 million” – Chamroon Chinthammit, CEO of KSL Sugar (KSL Annual Report 2013).

A look into Southeast Asia reveals another vector of expansion, primarily benefitting regional agro-industrial capitalists and their national political brokers. At its heart is Thailand, with its transnational sugar companies Mitr Phol, Thai Roong Ruang Sugar Group and Khon Kaen Sugar Industry (KSL). All are now also involved in ethanol and energy production, which as indicated in the quote above, has become a valued diversification strategy for export-dependent companies exposed to market volatility. Mitr Phol, the world’s fifth largest sugar producer also refers to itself as Asia’s biggest bioenergy producer. Its subsidiary Mitr Phol Bio-Fuel Co. has four ethanol plants in Thailand with a total capacity of 890,000 liters per day – benefitting from the Thai government’s National Biotechnology Policy Framework, in place since 2004.⁷ Through Panel Plus, another Mitr Phol subsidiary, the company has also become a leading manufacturer of ‘wood substitute materials’ from bagasse and rubberwood chips (Mitr Phol website). Mitr Phol is a member of the Thai Bioplastic Industries Association and sells carbon credits to Thai Airways.

Looking to expand within the Greater Mekong Subregion,⁸ Mitr Phol and KSL Sugar have become dominant players in the sudden and controversial creation of a Cambodian sugarcane complex. This complex has been based on three state-backed land concessions, all of which have been connected with severe human rights and labour rights abuses (see Equitable Cambodia and Inclusive Development International 2013, FIAN 2014). Concessions in Oddar Meanchey totaling almost 20,000 hectares are controlled by Mitr Phol while 70 per cent of the concessions in Koh Kong (19,000 hectares) are held by KSL Sugar.

The third set of concessions in Kampong Speu (24,000 hectares) are owned predominantly by the company of a Cambodian ruling party senator, Ly Yong Phat, although the sugar mill was built by the Thai company SU-ENCO, which also delivers factory technology to Mitr Phol.⁹

Mitr Phol also has strong ties to China operating seven sugar mills in Guangxi province, but at the same time, and illustrating the regional dynamics at work, Chinese-based capital is being invested in sugarcane plantations and factories in Cambodia. In Preah Vihar province, five side-by-side concessions have been granted to five Chinese-controlled companies, together totaling more than 40,000 hectares of land. The FAO data in Table 1 referring to 28,500 hectares under sugarcane cultivation in Cambodia does not fully capture the dislocation already underway in Cambodia due to sugarcane concessions. It is, in fact, estimated that the government has already granted Economic Land Concessions for sugarcane totaling more than 100,000 hectares.

Since 2009 Least Developed Countries like Cambodia have been able to export sugar tariff and quota free to the EU market, which, despite reform, still offers prices above the world market price. Because of this trade initiative, called 'Everything but Arms', virtually all sugar exported from Cambodia is heading for Europe, and was initially processed in Tate & Lyle's refineries but is now processed in Bulgaria and Romania too. While the gap between EU and world market prices is expected to narrow due to further domestic liberalization of EU sugar policy effective from 2017, almost ten years of substantive economic incentives has undoubtedly underpinned the formation of a sugarcane industry in Cambodia. Investments have taken place in Laos for similar reasons, and indeed in Southern Africa, where Mozambique and Zambia among others also qualify for Everything But Arms status.

Anticipating attenuating returns from sugar exports, attention is now turning to marketing sugarcane's other products. In April 2014, Phnom Penh-based Smart International Consulting, which offers services on agricultural land acquisition, presented an investment project together with an unnamed international investor for sugarcane flexing in Cambodia. Their presentation suggests that the project had already secured 5,000 hectares of land in Pursat Province.

In their investment plan they explain: "The sugar refinery and bio-ethanol plant investment project in Cambodia is motivated by [...] the high demand on the international market for refined sugar and bio-ethanol". They also highlight that "The project will benefit from 8 years Income Tax Exoneration" and a Foreign Direct Investment License will be applied granting "free import tax and free corporation tax for a period up to 9 years". Once again we see the importance of state policy, although this suggests that unlike in Brazil, where industry support is exercised in a more bureaucratic form, in Cambodia we see a much more patrimonial style of intervention.

CONCLUSIONS: IMPLICATIONS FOR ACADEMIC RESEARCH AND SOCIAL ACTIVISM

In a remarkably prescient book on the capitalist penetration of agriculture, Goodman *et al.* (1987) noted how capital seeks to reduce the agricultural product to an industrial input, which then tends to be replaced with non-agricultural components. They called this process 'substitutionism' and argued that it would lead to 'integrated biomass production systems' freed from the constraints of pre-determined product and marketing channels. This, in turn, would result in a rising proportion of value accounted for by industrial capital and the elimination of the quintessential rural base of agriculture. What we see unfolding via sugarcane flexing in Brazil, Southern Africa and Southeast Asia is confirmation of this process, albeit with agro-industrial inputs replacing (or at least supplementing) fossil-fuel based products, rather than the other way round. The accrual of wealth to industrial capital is also hinted at in the recent declaration of Rubens Ometto Silveira Mello, Chairman of Cosan, as the world's 'first ethanol billionaire' on Forbes magazine's rich list. Meanwhile, the increased control and industrialisation of sugarcane production by these same actors, along with the steady strangulation of rural and indigenous communities marginalized by its expansion, indicates the incompatibility of mechanised monocrop flexing with traditional agrarian livelihoods.

Yet as much as such developments might be impelled by the logic of capital accumulation, they are also beholden to politics. In this paper we have focused on politicising the 'commodification and commercialization' of sugarcane by bringing in the state. On the one hand, we identified various forms of industrial policy – consumption mandates, tax breaks, research and development support, trade politics, and, most importantly, credit provision – as ways in which the state has underpinned the transforming of the sugarcane milling industry into a multi-functional raw materials supplier. As in other cases of technological innovation and structural economic transformation, public institutions and funding will also continue to be essential to the construction of a 'green' or 'bio-economy'. On the other hand, we located some of the distinctive tensions raised by sugarcane flexing and thereby rejected the blithe assessments of this as a 'win-win' strategy. These included questions over consumer prices for fuel, control of distribution infrastructure and conditions and implications of land conversion – areas in which the state has actively intervened, and not always in the interests of industrial capital. In other words, the state remains a vital site for the contestation of, as well as support for, sugarcane flexing.

What implications do these findings have for future academic research? We suggest three lines of enquiry:

1) To what extent has flexing eroded the distinction between crop regimes?

Due to their substitutability as final products (e.g. sugarcane or maize-based ethanol in the US; ethanol or gasoline in Brazil) flexing has further eroded the functional distinction between particular crop regimes, and even between agricultural resources and fossil-fuel resources. One result, as reported by analysts at the Intercontinental Exchange, the world's major soft commodities trading group, is that the prices of sugar, corn, ethanol and gasoline are becoming more tightly correlated in international markets (ICE 2012). Controlling food price inflation might thus become increasingly contingent on controversial oil extractions. In addition, research is needed on the link between flexing and food security (in our Brazilian case, attention was very much focused on the wage-good of fuel rather than food). Based on market signals, investors might shift vast amounts

of crops from food to fuel markets (and vice versa) within days. In turn, this could have substantive implications for food availability and accessibility, as well as inducing deepening financialisation as market actors seek to manage or speculate on price volatility. Going further, the erosion of distinct crop regimes might be accelerated by the emergence of flex-fuel power stations that can alternate between natural gas and sugarcane ethanol (e.g. the joint venture in Brazil between US-based General Electric and Petrobrás) and flex-crop ethanol facilities that can alternate between maize and sugarcane (e.g. the Usimat facility in Mato Grosso, also in Brazil). These are likely to make primary processing increasingly independent from specific supply bases, allowing for continuous production (e.g. synching the sugarcane harvest with the maize harvest to create a year-round crush) and a greater degree of locational autonomy. Yet at the same time, at the systemic level, it also creates additional web-like links between the major fungible crops and fossil fuels, which are essentially turned into interchangeable forms of living/dead 'biomass'.

2) Where does decision-making for flex-oriented investment and production lie?

The integration between sugarcane millers and oil producers at a corporate level raises questions about the changing nature of company decision-making. For example, managers at BP, Petrobras and Shell might be expected to push for greater ethanol production within the sugarcane mills, even if relative prices would suggest that more sugar be produced. Alongside new management structures, the locus of power in global agriculture might also be moved by changes in ownership. The boom-and-bust dynamics of the sugarcane industry, heavily influenced by the financing demands of flexing, have ousted many of the traditional plantation-owning families and cooperative milling groups in favour of publicly traded corporations funded by shareholder equity.¹⁰ Might this lead to different organizational imperatives and approaches to sugarcane production? Finally at the sectoral-level, the trend toward monopolization poses important questions not just about the concentration of economic power and potential for rent-seeking, but also about the concentration of political power and changes in the state-market relationship.

3) On what basis do state actors support sugarcane flexing and the bio-refinery concept?

We touched on various possible reasons in this paper. These included: belief in the 'bio-economy' as a general capitalist fix; narratives of flexing as a renewed and renewable mode of accumulation for the sugarcane sector specifically; lobbying by the agro-industrial fraction of capital and its suppliers; attempts to deliver environmentally-friendly energy or rural development; the bureaucratic interests of particular state ministries or agencies; and the pecuniary interests of politicians with a financial stake in such projects. These need not be mutually exclusive, but it is important to distinguish in what contexts these combine and become significant in order that they might be put under greater scrutiny.

Finally, and following on from this last point, we finish by outlining some arguments that might be wielded by social activists wishing to oppose the class bias of this latest phase of industrial agriculture:

- Contest food security narratives linked to 'flex crops', utilising structural and case-related lenses to expose the tenuous links between multiplying and flexing sugarcane commodities and meeting individuals' basic material needs on a universal basis.
- Link land grabs, land concentration, the social struggle for land and related human rights violations to the emerging 'flex crop' economy and show the basis of primitive accumulation on which the latter depends.
- Highlight that farmers and workers in the sugarcane industry do not benefit as much as industrialists from the shift into non-food markets.
- Identify alternative uses of the taxpayer-funded finance (and debt write-downs) currently allocated by the state to flexing investments.
- Address the discriminatory levels of support provided to flex mills (e.g. demand-side guarantees in the form of blend mandates and purchase power agreements) vis-à-vis the limited public policy to assist small-scale food producers.
- Reinvigorate debates over the use of genetically-modified organisms both in industrial fermentation and in seeds being specially bred for use in flex-operations.
- Target new financial actors implicated in the abuse of human rights and labour rights (e.g. Deutsche Bank's divestment from KSL in 2011) and expose the hypocrisies of existing brand-name manufacturers (see Coca-Cola's use of indigenous people in its World Cup adverts).
- Question the benefits of promoting techno-fixes to replace fossil-fuel energy with sugarcane energy instead of structural initiatives that reduce, re-use and recycle consumption (see the debates over the environmental utility of introducing bio-plastic drinking bottles).
- Challenge the idea that leftover biomass is 'rubbish' as an inevitable result of industrialised forms of agriculture that are unable to function in a closed-loop fashion, like agro-ecological systems, where 'waste' does not exist as such since it is readily reincorporated into other processes.
- Unpack the additional limits that flexing puts on policy tools based on specific commodity-chains (e.g. the Roundtable on Sustainable Biomaterials, Bonsucro) and supplant this approach with the need for a holistic, socially and environmentally just land-use agenda.

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Endnotes

- 1 In 2014, Copersucar also launched a joint venture with Cargill to strengthen its sugar marketing. This venture is the biggest sugar trading operation in the world.
- 2 Brasil Álcool was established in 1999, ostensibly in response to deregulation, by 84 fuel ethanol producers accounting for 70 per cent of Centre-South production. Led by Copersucar, this was designed to collectively sell their output and store any excess supply (OECD no date).
- 3 It ultimately decided against the idea in the face of industry criticism and doubts over its effectiveness.
- 4 The Logum Logistica project has since suffered from the withdrawal of Petrobras, which has turned attention away from the development of ethanol and toward oil – reiterating our earlier point about the close-knit relationship between these two fuels.
- 5 The ZAE Cana mapping exercise concluded that Brazil has 64.7 million hectares of total land available for the expansion of sugarcane. Of these 64.7 million hectares, 19.3 million were classified as having high productive potential, 41.2 million with medium potential and 4.3 with low potential. The area of land that was used for pasture in 2002 that is now suitable for sugarcane expansion represents 37.2 million hectares (Manzatto *et al.* 2009).
- 6 This has been superseded by the Green Protocol, signed by the sugarcane industry and the São Paulo state government in 2007. It establishes a faster phase-out of sugarcane field burning than originally anticipated in the State Law, moving the deadline from 2021 to 2014 for mechanizable areas over 150 hectares, and from 2031 to 2017 for other areas.
- 7 Phase I was between 2004 and 2011, Phase II between 2012 and 2021. The frameworks are to encourage in developing biobusiness and investment in biotechnology research. Among the six goals of the framework are “Emergence and Development of New Bio-Business”, “Utilization of Biotechnology to Conserve the Environment and to Produce Clean Energy” and “Biotechnology as the Key Factor for Self-Sufficient Economy”. In 2007 the government funded biotechnology research with US\$120 million (Waramit 2012).
- 8 The Greater Mekong Subregion is: Cambodia, Yunnan Province and Guangxi Zhuang Autonomous Region of China, Laos, Myanmar, Thailand and Viet Nam.
- 9 Ly Yong Phat also held shares in the Koh Kong concessions until 2010.
- 10 The decision to turn Copersucar from a cooperative into a corporation was linked to the need to raise extra capital to fund the groups expansion (see DataMark 2008).

AGRARIAN JUSTICE PROGRAMME

In recent years, various actors, from big foreign and domestic corporate business and finance to governments, have initiated a large-scale worldwide enclosure of agricultural lands, mostly in the Global South but also elsewhere. This is done for large-scale industrial and industrial agriculture ventures and often packaged as large-scale investment for rural development. But rather than being investment that is going to benefit the majority of rural people, especially the poorest and most vulnerable, this process constitutes a new wave of land and water 'grabbing'. It is a global phenomenon whereby the access, use and right to land and other closely associated natural resources is being taken over - on a large-scale and/or by large-scale capital - resulting in a cascade of negative impacts on rural livelihoods and ecologies, human rights, and local food security.

In this context TNI aims to contribute to strengthening the campaigns by agrarian social movements in order to make them more effective in resisting land and water grabbing; and in developing and advancing alternatives such as land/food/water sovereignty and agro-ecological farming systems.

Layout: Ricardo Santos

Amsterdam, Transnational Institute (TNI)



Agroecology by the Filipino painter Boy Dominguez, 2013

TNI Think Piece Series on Flex Crops & Commodities

The convergence of multiple crises (food, energy and fuel, climate and financial) in the midst of the rise of newer hubs of global capital (BRICS countries and some middle income countries) – and the various responses to these by states and corporations – have paved the way for the emergence of 'flex crops and commodities'. Flex crops and commodities are those that have multiple and/or flexible uses: food, animal feed, fuel, and other commercial-industrial uses. In fact the contemporary global land rush is intertwined with the rise of flex crops and commodities: sites of large-scale land deals tend to be sites of expansion of production of these crops and commodities, e.g. soya, sugarcane, palm oil, corn, cassava, industrial trees. What are the implications of this phenomenon for how scholars, civil society and grassroots social movements undertake 'engaged research', public actions and policy advocacy around agrarian justice issues? The issues are compelling and urgent, yet still largely under-researched. TNI is launching the TNI Think Piece Series on Flex Crops & Commodities to jump-start collaborative action and a critical dialogue between engaged academics, civil society and grassroots movement activists on this issue.

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In the context of rising resource demand, agricultural crops such as sugarcane are being promoted for their multiple uses in different commodity markets and as alternatives to oil-based equivalents (i.e. as a source of biofuel, bioelectricity and bioplastic). These commodities are also produced on an increasingly flexible basis, as sugarcane mills respond to price signals and switch between different crop uses. This paper explores the politics of this latest development in the capitalist industrialization of agriculture. It does so by focusing primarily on sugarcane flexing in Brazil and highlighting the role of the state, both in making markets for non-food products and managing the tensions that arise from this. These tensions are related to consumer prices for fuel, control of distribution infrastructure and conditions of land conversion, each prompting political interventions by the state. The paper then points to some wider implications of this analysis for the comparative study of flexing in the regional sugarcane complexes of Southern Africa and Southeast Asia, and for social activists seeking to promote the interests of agrarian and indigenous communities in the face of this new flex agenda.

Keywords: **flex crops** **sugarcane** **Brazil** **ethanol**

