‘Meet the New Boss . . . Same as the Old boss?’ Technology, toil and tension in the agrofuel frontier

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Abstract

Agrofuels are increasingly sourced and sold as a socially and environmentally beneficial solution to oil dependence. The promotion of sugar-derived ethanol as a substitute for petroleum has thus been key to state development and international trade policies by Brazil and EU respectively and subsequent investment by leading energy and food transnational corporations has transformed socio-spatial relations in the new sites of production. Brazilian rural worker testimonies, however, point to large scale labour exclusion rather than reform and a deepening, rather than disruption, of historic power inequalities in the sector. Labour contestation challenges a converging institutional discourse of responsible technological innovation and social upgrading associated with emerging commodity chains and the ‘green’ economy. Although corporate and statutory response has been market-orientated certification and ‘more technology’ the idea of the ‘techno-institutional fix’ provides a power relation-attentive analysis that invites the further exploration of socially committed alternatives to food and energy production.

Keywords: labour, agroenergy, Brazil, technology, rural, commodity chains.

Introduction

In the wake of the global financial crisis, policy concerns regarding resource security are accompanied by changing relations between states and (global) markets and corporations. Peak oil horizons and transnational mandates for reducing the rate of greenhouse gas emissions have coaxed governments and private corporations to pursue sources and markets for new energy forms. At the same time, energy and mineral extraction are strongly linked to current and prospective state developmental strategies amongst emerging nation-states. New models of state-capital relations in, for example, Brazil and China, are also thereby gaining greater influence over global political economic trends and norms. This is true also in the pivotal socio-economic arena of technological ‘innovation’ that has been given an elevated role as key *both* to resolving the current challenges (of economic growth, climate change, resource security) *and* to the continuation of national development projects.

The promotion of high-end technologies linked to 'sustainable development', lower carbon outputs and hence the 'green' economy reflect an institutional aspiration that further economic growth (or socioeconomic development more broadly) does not simply exacerbate other problems, such as pollution and climate change. In addition, issues of work and employment were, for the first time, formally incorporated into the climate agreements at the Rio+20 UN Conference. There is, therefore, a new transnational emphasis upon 'green' innovation being 'responsible' in vaguely specified ways: protecting the environment and upgrading marginalised land, providing development and decent work in rural areas and assisting towards poverty eradication (EC, 2009; ILO and UNEP, 2012).

In the European Union's turn to the southern hemisphere to source the biomass required to meet Kyoto renewable fuel targets, nowhere has this emphasis been more evident than in the institutional discourses promoting the emerging global commodity chain for ethanol as a substitute for fossil fuel (Franco et al., 2010). Boasting the world's first integrated energy matrix and a world leader in sugar-derived ethanol production, the Brazilian government's enthusiasm for agrofuel has been paralleled by global organisations promoting business, jobs, the environment, trade and development (EC, 2009; IEA, 2011; ILO and UNEP, 2012).

Research objectives

Against the backdrop of a threefold increase in international investment in Brazil's ethanol sector, a reconfiguration of social and spatial relations and subsequent market concentration by transnational oil and food majors, this paper questions the converging institutional discourse of responsible technological innovation and social upgrading associated with the emerging commodity chain for ethanol. By taking a more systemic and power-relation-attentive analysis of the sectors' development, the study asks firstly, (i) how do systematic blind spots in even sophisticated theoretical perspectives concerned with technological change and global commodity chains risk making invisible the reproduction of highly unequal power relations in locales of biofuel production with significant implications regarding the actual (social) 'responsibility' and how work is organised and experienced? Secondly, by turning specifically to capital, state and labour relations in the modern history of the ethanol sector, the study considers the familiar but crucial role that innovation and technology play under capitalism in

transgressing challenges to profit accumulation presented by labour (e.g. Burawoy, 1979; Braverman, 1998; Harvey, 2014: ch.8) and questions, (ii) how does a new technological and institutional 'fix' for agrofuels represent a continuation (rather than a disruption) of market, territorial, wealth and power concentration by oil majors, albeit through a diversification into non fossil fuels? Thirdly, In light of specific worker contestation within the emerging ethanol commodity chain and the massive exclusion of Brazilian rural labour in particular, the paper outlines the corporate response by the 'new bosses' to social and environmental concerns through market certification and more technology the paper and explores (iv) how are powerful corporations with increasing control over leading technologies reworking state-capital relations, requiring new techno-institutional fixes amidst market and political instability? Finally we highlight how, despite growing power asymmetries between capital and labour, social innovations by rural workers protesting the hegemonic model of monoculture are embracing modern technology in these regions of production. In doing so they offer a disruption to incumbent models of agrofuel production and invite further investigation of socially as well as ecologically committed alternatives.

In what follows, the recent theoretical developments in relation to two key concepts that underpin this study are considered, namely techno-institutional lock-in (Unruh, 2002) and global commodity chains (GCCs) (e.g. Gereffi and Korzeniewicz, 1994) but where both of these are read through a lens attentive to power relations and the 'ecologically dominant' systemic logic of the inherent challenges of regularizing capital accumulation on an ever-expanding global scale (see e.g. Porto-Gonçalves, 2006; Selwyn, 2013; Jessop, 2014; Tyfield, 2014). Attention is then drawn to the systemic structures within which path-dependent technologies, corporations, the state and labour have developed and are embedded. Following an overview of the research methods, the idea of a techno-institutional (and socio-political) 'fix' is explored in the subsequent analysis of morphing state, capital and labour relations in Brazil's ethanol sector over time. The experiences, struggles and perspectives of rural workers provide the prism through which the contemporary, contested concentration of technology, territory and power in the specific sites of production is interpreted, linked both to global techno-institutional systems of energy production and consumption and to international finance and markets. Finally, a contrasting paradigm of agricultural production of food with energy is presented, reflecting the contemporary struggles of rural workers and their collective organisations for resource distribution and alternate visions of work and production.

Theoretical considerations

In seeking to relate concrete empirical evidence concerning agroindustrial working conditions in Brazilian biofuel production to the broader issues of transforming systems and structures of energy production and consumption and (global) political economy, this paper turns to and modifies two theoretical literatures. These address two key aspects of contemporary biofuel production, namely the technological and institutional aspects of energy systems and the interweaving of biofuel production in globally-spanning networks. Yet in each case, the dominant literatures in these fields pay insufficient attention to two key elements that critical labour studies would seek to prioritize. These concern the constitutive role of technologically-mediated power relations, rather than abstract 'structures', in the dynamic formation and reproduction of such systems and commodity chains; and the pervasive and insistent presence of the logic of capital accumulation. Only by incorporating these concerns in this theoretical frame can the actual predicament, conditions and aspirations of labour be illuminated, especially the systemic *empowerment* of (specific fractions) of workers – may be unchanged or even deteriorating as a seemingly 'progressive' systemic changes in policy, energy and technology are taking place.

The techno-institutional lock in

A growing normative literature on the required 'transition' from high-carbon, path-dependent energy systems to a lower-carbon economic infrastructure commonly assumes an expert-led, elite process from one technological system to another, within or across benign states. While not denying the goal, Unruh (2002) critiqued this way of thinking about it by introducing the concept of 'techno-institutional lock-in' in order to highlight that system dominance of a particular technological system may continue, not necessarily as a result of superior product design, utility or quality, but by its ability to lower economic, social and psychological costs of relative to potential competitors who are 'locked-out' (Foxon, 2002). Path dependencies, positive feedback and asymmetries of power meant dominant systems or configurations of technologies and social forms are resistant to change. These characteristics and potential for inertia are shared with institutions, the formal or informal constraints 'that human beings devise to shape human interaction' (Foxon, 2002: 2). Indeed as a result of economies of scale, learned

behaviours, established networks and infrastructures co-evolving interaction between these systems and political institutions culminates in a 'techno-institutional complex' (Unruh, 2002).

Unruh explained that when environmental externalities such as climate change arise from locked-in systems, of which fossil fuel combustion is a prime example, favoured solutions are those that minimise change to the existing system by treating emissions or making incremental, intra-system innovations that seek 'to maintain as much similarity as possible between the existing system and the new configuration' (Unruh, 2002: 318). This process can be observed in the transition to bioenergy. Among the many possible sources of lower carbon, 'renewable' energy, liquid biofuels have been the focus for a new techno-institutional 'fix' by successful lobbies by automobile, energy, agriculture and biotechnology corporations who have found suitable partners at the levels national and transnational governance (Franco et al., 2010). Unsustainable transport infrastructures and growth patterns are thus also left largely untouched by the substitution of a percentage of conventional hydrocarbon fuels with liquid biofuels to meet lower carbon requirements. (Indeed they are key to the Brazilian model for agrofuel transition.)

While adding a welcome dose of social and political realism to analysis of potential low-carbon energy transitions, however, the framing of the challenge of constructing a viable biofuel energy system in terms of techno-institutional lock-in arguably has veered too far to the other extreme: one is left with the choice of either defeatist acceptance that system transition depends upon institutionalized power structures that are, ex hypothesi, *against* any such transition, or an entirely wilful and naïve (hence inevitably disappointed) 'hope' that change can emerge 'from outside' 'somehow'… The ['new boss'] is broadly cheered, while the 'old boss' is booed, and one is understood as succeeding entirely at the expense of the other.

By contrast, where power in such systems is understood in broadly Foucauldian terms as productive, strategic and relational, a different picture emerges without the need to repudiate the analytical dividends of the systemic perspective (Tyfield, 2014). Here, then, the system is dynamically co-produced by and with emerging forms of power relation that are themselves in turn shaped, enabled and constrained by both the incumbent and emerging systems. And the persistent presence (and expansion) of a particularly important form of contemporary social relation, the capitalist wage form upon which the political economic regime of global capital accumulation rests, affords incorporation into the analysis historically one of the most powerful

of motors for such change and the 'constant revolutionizing' of society, labour. From this perspective we may attend to how changing labour relations are fundamentally constitutive of and themselves co-produced with the emerging system 'lock-in' or 'fix'.

Global commodity chains and the techno-institutional fix

These concepts resonate with the 'spatio-temporal' fixes of capital accumulation, whether in terms of physical fixing of surpluses in order to preserve profitable investment opportunities (Harvey, 2001a), political, socioeconomic and cultural settlements to afford continuing capital accumulation despite its inherent improbability (Jessop, 2014) or the (always temporary) 'fixing' of the various contradictions of (global) capitalism more generally (Arrighi, 2005). Hence, where new enclosures characterise in a vigorous global drive for minerals and grains, the 'new boss' may look very much like the 'old boss' as capital proves remarkably adept in acquiring, institutional support to ensure further profit accumulation and expansion, while 'old' capital, technology, space and labour are destroyed to make way for new developments creating new tensions, social challenges and only postpones internal crises.

The failure of techno-scientific and GCC studies to incorporate into their analysis the crisis ridden, cyclical character of capitalism, the systemic reproduction of inequality and the ability of labour to contest this in its own interest has been recently reiterated (Brewer, 2011: 321; Selwyn, 2013; Taylor et al., 2013). That social implications of spatialised capital accumulation strategies point to a not uncommon divergence between economic and labour benefits (Harvey, 1982; Taylor et al., 2013) provides a counterpoint to the emphasis on social upgrading adopted in the literature on global commodity chains (e.g. Milberg and Winkler, 2011) and more specifically to the assumptions of the social gains from new biofuel commodity chains based on best case labour scenarios by influential international organisations (EC, 2009; ILO and UNEP, 2012; see Lerche, 2012 for a critique). Responding to the international mandates for reducing carbon emissions that followed the Kyoto Protocol, the European Commission's Renewable Energy Directive (REDD+) (2009: 1-2), for example, pertains that bioenergy markets will favour localised, decentralised producers bringing a 'positive impact on regional and local development opportunities, export prospects, social cohesion and employment opportunities, in particular as concerns SMEs and independent energy producers'. Trade in new energy forms will 'contribute significantly to sustainable development in rural areas and offer farmers new income opportunities'. In turn, the ILO and UNEP forsee that, 'Transfers

such as those envisaged for REDD+ will help developing countries to create much-needed employment through investment in environmental services' (p. x), will 'enable smallholder farmers to adopt greener and more productive farming practices could boost food security, lift tens of millions out of poverty and prevent accelerated rural–urban migration' (p. ix) while the 'organization of farmers and workers is an important stepping stone to give rural communities a voice in policy- making for rural development and greening agriculture' (p. 19). The Brazilian Sugarcane Industry Association (UNICA) singled out as exemplary for 'aiming' to retrain some 7,000 cane cutters annually for a range of occupations (p. 84), and commitment to a voluntary scheme to improve labour conditions. While these particular best case scenarios will be critically reviewed in light of worker testimonies below, the assumption that workers and, in turn, their communities will make material gains from their integration and inclusion in new transnational networks of bioenergy production typify the logic of social upgrading that has gained traction in global commodity chain studies (e.g. Milberg and Winkler, 2011).

The developmental or indeed 'modern-colonial' thrust of this assumption has brought its share of critics for ignoring how the inception and application of technological innovation carries the mark of the socially and economically powerful (Dunaway and Clelland, 1995; Smith, 1985; Porto Gonçalves, 2002; Selwyn, 2013; Howcroft and Taylor 2014), requires credit in abundance (Arrighi et al., 2003: 18) and how corporations align technological innovation with nation state and transnational policy while their financialisation is increasingly linked to risk-adverse shareholders. Crucial to understanding a techno-institutional fix, however, is that innovation cannot dispel or dissolve the inherent contradictions in the process of capital accumulation (Jessop, 2014), including labour's capacity to disrupt the production process in pursuit of improved wages and conditions (Cumbers et al., 2008; Wright, 2000). (In a 2007 review of global networks for biofuel by Mol, for example, labour is referenced only in relation to its low cost). Although the constitutive and conflictual role of labour is increasingly recognised in GCC studies (Cumbers et al., 2008; Selwyn, 2013; Taylor *et al*., 2013) the analysis presented here that is attentive to systemic and relational power structures in sites of commodity production requires consideration beyond the supply chain's fields and factories and to the broader and contested social relations in the frontiers (geographical, political and technological) of bioenergy production (Stewart and Garvey, forthcoming).

From this perspective it becomes possible to conceive how *new* forms of power relation, coalitions, institutions and power-knowledge technologies may emerge out of the incumbent

system in various ways that are incompatible with its existing form and are also capable of reinforcing each other, even to the point of being able to challenge that system lock-in or 'fix'. So for our purposes, 'What are the successive and specific forms of techno-institutional fix emerging around Brazilian biofuels?' 'How do these relate to transformations in the power relations and politics of labour?' What alternatives are being presented by rural workers, the very subjects to have most benefited from new biofuel trade, demanding social, policy and technological innovation?' These questions are returned to following an overview of the research methods.

Field work in Brazil

Field work was carried out over a 26 month contiguous period in the municipalities of Assis, Maracaí, Paraguaçu Paulista and Tarumá in the Mid Paranapanema region in western of São Paulo, an area of relative industrial concentration, and the municipalities of Quirinópolis and Jataí in southwest Goiás State, a region of rapid frontier expansion in the Central South region of Brazil. Interviewees were employed directly by, or by sugar cane suppliers to, NovAmérica, Agroterenas, Raizen (Shell/Cosan) Maracaí, Raizen Tarumá, Raizen Paraguaçu Paulista, Raizen Jataí, Agua Bonito, Boa Vista (Petrobras), São Francisco (Cargill), and Odebrecht Agroindustry. Brazilian companies have historically had a strong command over research and development and the four key nodes of the supply chain which begins with the agricultural preparation, cultivation and harvesting of sugar cane from an area of at least 30,000 hectares, its transport (normally of distances up to 70km) to the mills/distilleries where sugar, ethanol and gas are produced and then its distribution to national networks and eastern ports. Workers involved in the agricultural divisions of labour were the focus of the fieldwork and one-to-one and focus group interviews were conducted with 64 workers currently and seasonally employed in manual and mechanised sugar cane planting, maintenance, harvesting and pesticide application. Twelve one-to-one interviews with now redundant manual workers were conducted across the camps of six land occupations and in the poor housing areas on the 'periphery' of rural towns. Participant observation took place at the landless occupation camps with between 80 and 200 families in each, over a period of four months. Twenty one workers employed within the ethanol distilleries as maintenance workers, machine operators and auxiliary staff were also interviewed along with 12 trade unionists at a local branch and state

federation level representing the those involved in rural work (affiliated to the Federation of Rural Salaried Workers-FERAESP, São Paulo), chemical processing (affiliated to the Federation of Workers in Chemical and Pharmaceutical Industries São Paulo), food/drink processing (affiliated to Federation of Workers in Food Industries São Paulo) and outsourced transport drivers. A survey regarding work security, quality and satisfaction was conducted with 58 workers across the agricultural and industrial divisions of labour. Six leaders of the Landless Workers Movement of Brazil were also interviewed. A leading industrial consultancy firm provided an interview with three staff members. Requests for interviews with managers of BP and three Raizen (Shell) plants were declined and in one case discontinued. In the following section the morphing state, capital and labour relations in Brazil's sugar and ethanol sector are traced through the worker's testimonies.

Brazil and an emerging commodity chain for agroenergy

Labour and the old bosses

The memories of manual cane cutting in four São Paulo plantations in the 1980s shared by Pedro, Carlos, Sandra and Diogo are vivid. But then, childhood recollections often are. Sandra was 12 when she had shyly confessed to her mother how little sugar cane she had cut on her first of many days in the cane fields of Maracaí. Diogo was 15 when he was hidden amidst the tall stands of cane grass in the NovAmérica, Tarumá, when the authorities visited. For Pedro and Carlos, their young age was the norm on the plantations; school was something to be done in the evenings, or later in life. Pedro was 13 when he joined his father in the NovAmérica plantation at Tarumá in 1983. He could recall little of the strike, three years later, when 2,300 cane cutters put down their machetes in the same plantation. Their work stoppage had opposed the "colonial style" management on the plantations and followed significant strikes in 1984 and 1985 elsewhere in São Paulo state as sugar cane cutters sought to exert greater control over their productivity, income, transport and work conditions. These were years of the military government's post-oil crisis ProAlcohol programme (1975-1990) during which an agro-industrial elite had been subsidised to adapt sugar producing technologies to the production of ethanol in both new and existing plants, hence tying oil-substituting production and technology development to historic, large scale, sugar cane plantation agriculture. The 'senhors' further

consolidated their economic, political and social power while labour in general endured a 60% reduction in real wages, a criminalisation of militant trade unions and political parties and co-option of the trade union structure by the Ministry of Trade and Employment.

Labour suppression did little to assuage escalating foreign debt in Brazil and in 1982 a renegotiation of foreign debt repayments with the International Monetary Fund was tied to a rigid programme of economic structural adjustment. The new rules dismantled protection measures, forbade direct government subsidy of the sugar and ethanol industry and demolished credit availability to rural poor. Brazil's agricultural and industrial sectors were further prised open following membership of the World Trade Organisation in 1995. For those landowners who had developed a dependency on direct government support, and for rural workers generally, the new terms were a disaster. The number employed in agriculture in Pernambuco, in Brazil's northeast, was carved in half between 1987 and 2002 (240,000 to 120,000) (Hirsch *et al*., 2002), 1.5 million left the state in just five years as plant closures and rural exodus further concentrated land ownership (Santos, 2006). Brazilian unemployment doubled during this period of deregulation, favelas swelled and 25 million rural workers relied on temporary and informal work (Latimer, 2014), leaving poorer states for the fields and factories in and around São Paulo state. By 1998, 66% of the rural working population lived in city peripheries or slums and provided a pool of labour suited to the more technically advanced companies in São Paulo state that had the economies of scale sufficient to buffer the crisis in the sector as consumers reverted to competitively priced petroleum fuel.

Although direct subsidies were phased out, government credit was provided to new research institutes and for modernisation of sugar cane plantations and distilleries. Seventy per cent of this capital was commanded by firms in this central south region who by the 1990s had transplanted, to varying degrees, 'lean' ideas and techniques of 'Total Quality' from Brazil's metallurgy and auto sectors to the sugar cane fields and the new factories that could switch between sugar and ethanol production in line with fluctuating market demand (Thomaz Júnior, 2002). In the 1995/6 harvest 81% of 143 independent, Brazilian owned distilleries producing ethanol and a further 203 plants producing sugar from 4.7 million hectares (about 250 million tons of cane sugar) were in the central south region around São Paulo state. Amidst economic liberalisation and aside microelectronically managed workflows and digitised performance systems, however, two interlinked strategies; those of mechanisation and the seasonal

contracting of rural labour, once again been made flexible and abundant, served to undermine the struggles for secure work by rural workers actions in São Paulo state.

Marcio was one of those who left his northeastern home and, now living in Maracaí, São Paulo, reflected,

> We would come [from Alagoas] by bus, over 3000 km. Many came for the season and returned to their small farms or to try and buy a small plot of land, or construct a house before returning again the following season. Ah, many from the poorest towns of Bahia, Pernambuco, Minas Gerais, Paraíba.

By the 1990s, 390,000 workers (of a total workforce of around 600,000) were contracted, most often through third party agents, into the São Paulo cane fields. For seasonally employed migrant workers who returned annually to underemployment or subsistence agriculture in their distant homes the pressure to augment poor wages and earn an annual wage from the seven month harvest season meant manual productivity increased demonstrably by the insertion of these workers into the cane fields (Alves, 2006). The shortening of breaks and lengthening of working days were, and continue to be, accommodated by employers (Thomaz Junior, 2002; Garvey and Barreto, forthcoming), while scandalous, indentured working and living conditions of subcontracted migrant workers that made labour organisation so difficult have been well documented, implicating large producers such as Brenco, Cosan and Luis Dreyfuss (*Reporter Brasil*, 2011).

In the view of the rural labourers, the second device introduced to compromise their organisational capacity that had taken everyone, including the trade unions, by surprise in the 1980s was in intensified mechanisation of sugarcane planting and harvesting. One harvester replaces 80 to 100 workers and, in contrast the undulating northeast of the country, the flat terrain of São Paulo state's interior proved suitable to their operation. NovAmérica wheeled in the harvesting machines in the 1990s, beginning an annual cull of round 10% of the workforce, meaning the stronger, faster, least troublesome stood the best chance of being selected for the following year's harvest (interview, Dani, May 2013) and leading to a staggering intensification of work. Whereas cane-cutters were cutting on average 5-8 tonnes per day in 1980 (and indeed in the days of slavery), a tally of 18-20 tonnes per day among the remaining cutters is not uncommon at present, while mechanisation has, in their view, limited

their ability to protest historic superexploitation: "We struck before, various times. Sometimes we got something, other times nothing, but now with machines they say they just don't need you" (Pedro, 2013).

Labour and the new bosses: entry of the energy majors

The sector was rejuvenated in 2003 after newly elected President Lula da Silva embraced both the large internal market and home-grown technological innovation, promoting the production and consumption of 'flexi-fuel' vehicles (FFVs) that could run on petrol or low carbon emitting ethanol. By the early 21st century, leading firms assisted by publicly funded research centres were managing a cultivation cost of sugar cane of US$150/tonne compared to US$300/tonne in the Northeast of Brazil and US$450/tonne for US maize based bioethanol. Technological advances in soil treatment and the development of new strains of sugar cane meant that cultivation of raw sugar cane per hectare increased from 50 tonnes to 80 tonnes, while the area planted in sugar cane would double in ten years, bringing the new pioneers into conflict with previously remote rural and indigenous communities (Porto-Gonçalves, 2009). Between 2003 and 2008 the sugar and ethanol sector had been growing at around 10% per year, 100 new distilleries were built (bringing the total to 378) and President Lula's vision of modernisation and internationalisation seemed to be materialising. An increase in foreign direct investment in ethanol production from $4 million in 2002 to $1.64 billion in 2008 (Pretto, 2009: 55) was in large part to the state re-promotion of ethanol as a component of energy security and economic growth that was given environmental credibility following the Kyoto Protocol of 2002. Forbes list favourites such as James Wolfenshen (former World Bank president), George Soros and Vinad Kholsa (Sun Microsystems) invested in the sector while Noble (China), Abengoa (Spain), Cargill, ADM, Bunge (USA), Louis Dreyfus and Tereos (France), Shell (Holland-UK), BP (UK) and Mitsubishi and Sojitz (Japan) were among the transnational brands cashing in on a staggering $28.2 billion credit line. Brazilian oil and construction giants, Petrobras and Odebrecht, also entered the biofuel sector. In the 2007-2008 sugar harvest, only 7% of the mills had the participation of external capital. For the 2010-2011 crop, this percentage rose to 22% (Olivon, 2012). Cosan's $12 billion venture with Shell to form the company Raizen in 2010 was one of over 100 mergers that took place since 2000.

It became apparent in the early 21st century, however, not least from the deaths through overwork of 14 young, male cane cutters in just two seasons in the heartlands of the

modernising industry for renewable energy production, workers were becoming less able to reproduce their own labour under the conditions that were being set by the leading companies (Alves, 2006). A historic disregard for worker rights was again displayed as workers protesting a drop in their real wages after the recession of 2008 state were sacked from plantations across São Paulo (*Reporter Brasil*, 2011), yet the rural trade unions exerted increasing pressure on the regulatory power of the Ministry of Work and Employment, recognising the leverage afforded by the international visibility of multinational companies beginning to dominate the sector (interviews, 2013). An example of the latter came in 2012 when, following pressure from indigenous protests and the Brazilian government, Shell was forced to sign an agreement to end the illegal sourcing of sugarcane from traditional lands of the Guarani people of Mato Grosso do Sul, drawing international attention to the ongoing land conflicts in that state Furthermore in 2009, when the Brazilian Industry Association, UNICA, received no less than 162 guests from 82 countries, concerns over labour conditions were raised (Chaddad, 2010).

The new techno-institutional fix

More flexibility, more technology, no more Mr Nice Guy

The response by leading companies in the sector, now more than 50% controlled by foreign capital, to pressure for improved work conditions, debates over food versus energy production and market instability have been large scale labour exclusion, credit capture for more technology in line with international policy reform, the promotion of voluntary and market orientated certification in place of more rigorous labour protection, and further pressure for restructuring existing laws for labour and land rights.

In an address to the International Energy Agency (2011), a Raizen spokesperson affirmed,

> As a large company, Raizen contributes substantially to social sustainability. There is less reliance on manual labour – in the harvest of 2011/2012 more than 70% of the cane will be harvested mechanically

Raizen echoes the official line of the industry by inferring that the prospective elimination of 450,000 jobs through mechanisation translates as socially responsibility as it disappears the stigma of slave like conditions for cane cutters that the trade unions had contested for decades …by eliminating employment altogether. In the 2006-2007 harvest, only 18.6 % of the sugarcane in Brazil was mechanized. In 2008-2010 the figure rose to 45.3%. In São Paulo state full mechanisation will take place within two years. Contrary to the publicised successful retraining of manual workers into new positions in the industry (ILO and UNEP, 2012), only 7% of 40,000 surveyed sugar cane cutters made redundant in São Paulo state between 2008 and 2011 secured alternative jobs in the industry (Baccarin, 2011). Raizen employed 5000 fewer people in 2013 compared to 2012 and in the municipality of Maracaí, the where the Raizen distillery earned the worlds' first 'Better Sugar' certification (see below), entitling the factory to export sugar and ethanol to EU countries, there has been a 65% reduction in those employed in cane cultivation in three years (2010-2013). The rural population has fallen from 14% to 4% since 1980 reflecting an intensified rural to urban migration in key regions of monocultural expansion, contradicting the institutional aspiration of rural work and population retainment in policy documents.

Notably, in its takeover of the plants of Tarumá, Maracaí, and Paraguaçu, Raizen retained direct control only of the industrial process avoiding responsibility for the labour involved in agricultural harvesting. This it left in the hands of the former owners (NovAmérica and a sister company) who seek to supply 10 million tonnes of sugar from over 100,000 hectares exclusively to Raizen by 2015. In these plantations the cutters complain that while breaks, protective equipment and safety measures have improved, the reduction in the volume of raw cane cut manually means that those still tied to the pay-by-production strategy have endured a significant fall in annual income (interviews 2014). Ironically, the fact that they can still augment their basic monthly income (R$900 / £250) by the bonus systems offered in the fields means these poorly skilled workers earn more than many of their counterparts in the Raizen distillery. Against the backdrop of plant closures, continuous automation that dispenses of around 10% of agricultural and industrial workers annually and structured unemployment, unions find it increasingly difficult to bargain for improved wages (interviews 2013). The basic wage of R$935 per month in Raizen Maracaí distillery is lower than all other meat, food or drinks factories in the region.

As Selwyn (2013) points out, claims of social upgrading as a result of commodity chain integration must be tested against the general changes in work and wages in the region within which workers are embedded. While the Ministry of Labour has been energetic in tackling child and slave like labour and modest state reforms have overseen a continual increase in Brazil's minimum wage since the turn of the century to the present (from $R180 to $R724), wages in several distilleries visited have not kept track with inflation, vary widely within and between states and remain below the average required to sustain a family. The trade union research organisation, DIEESE, calculates that the minimum wage necessary to meet living needs in Brazil is R$2967.07, more than three times that of the basic salary in the Raizen distilleries. Furthermore, striking patterns emerge from the employment statistics in the five municipalities of our study that correlate with the feeling of work insecurity reported throughout the study and recorded by 48 of 56 of rural workers surveyed. Firstly, although promising to dispense of the third party sub-contracting of agricultural labour, the multinationals have maintained the seasonal throughput of labour, with as much as 30% of the now directly employed workforce dismissed at the end of each harvest (Figure 1), with the well behaved rehired the following year when they reapply.

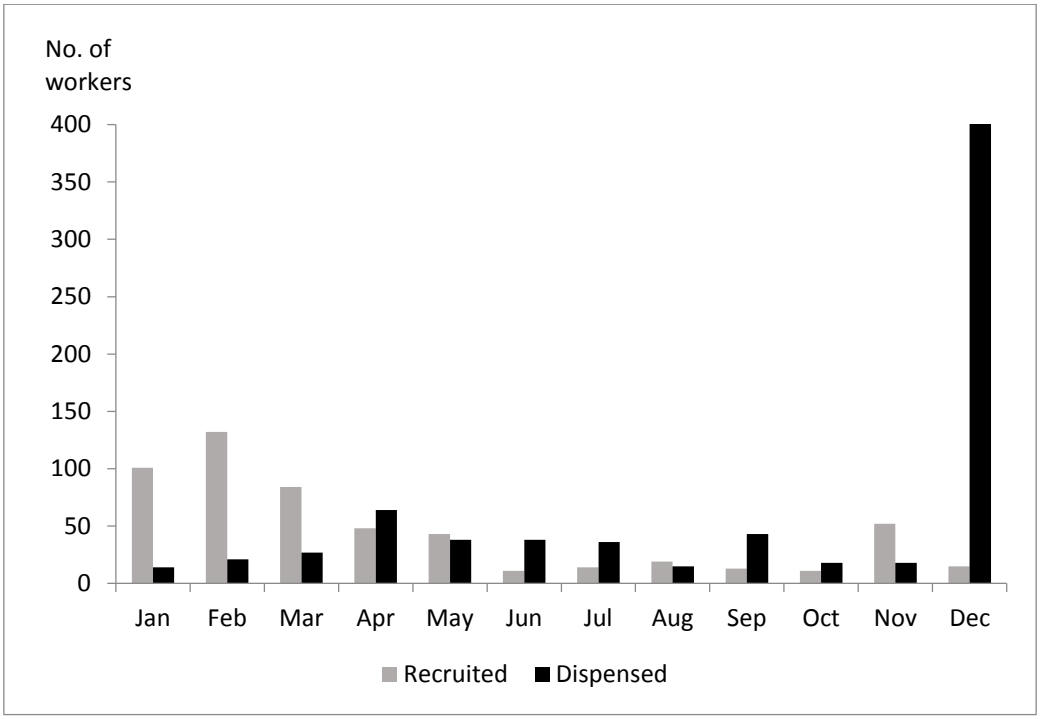

Figure 1. The monthly turnover of employees in the sugar and ethanol sector in Maracaí, São Paulo state, 2013. Source: Ministry of Work and Employment, 2013, organised by W. Ferreira.

Secondly, in the new and fully mechanised frontiers of sugar cane production in Goiás state, without a recent history of confrontational trade unionism, this seasonal flux is overshadowed

by the continual turnover of staff. In Quirinópolis for example, the São Martins group of Petrobras and the São Joao group of Cargill (US) together employ around 4,500 workers. On average 154 workers per month were replaced in 2013, 1860 replaced during the year (Figure 2) as entire teams were dismissed for reasons of 'cost cutting' and replaced by contracted teams from distant states the following day. Not unlike the sugar cane cutters of the 1980s, the variable salary and bonus system for these qualified workers who earn up to 160% less than those in the adjacent São Paulo state means staff are never sure of their monthly wage, nor for the reasons for deductions.

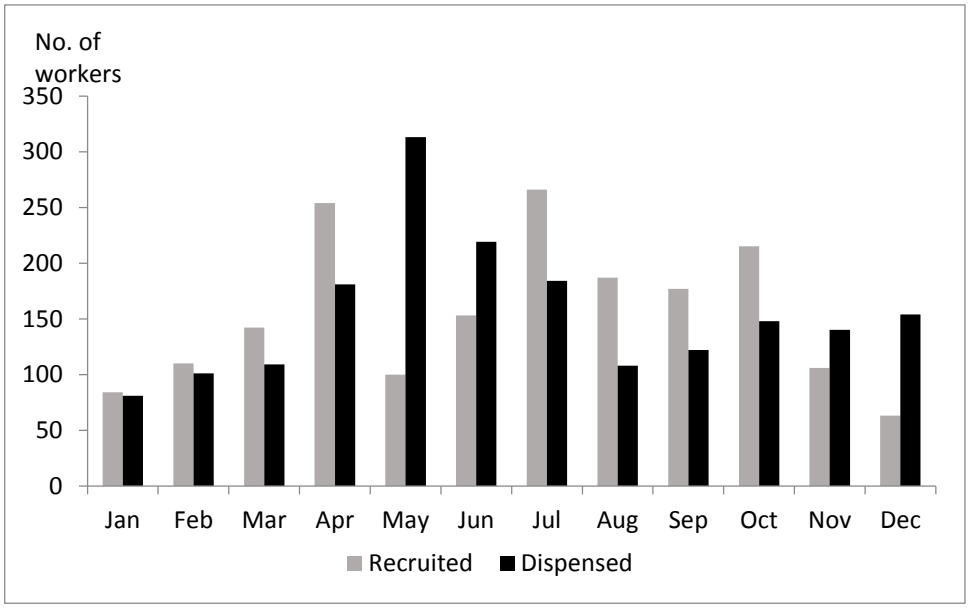

Figure 2 Monthly turnover of employees in the sugar and ethanol sector in Quirinópolis 2013. Source: Ministry of Work and Employment 2013, organised by W. Ferreira.

Perhaps inevitably these trends have been met with resistance and in Araraquara, São Paulo, close to the now legendary cane cutters strikes of the 1980s, the entire workforce in the São Martins plant went on strike for 13 days in 2010, hence ending the variable salary and outsourcing of key tasks within the distillery and surrounding plantations. The strike was noteworthy for the success that the rural workers in the agricultural section had in convincing their counterparts in the distilleries to also strike (despite the reticence of the latters' unions), since their actions were going to halt production in any case. This was part of a broader strategy by their Federation (FERAESP) to counter corporatist labour law which entrenches geographical and occupational divisions within and across the workforce (Garvey and Barreto, forthcoming) and to centralise collective bargaining with the multinationals.

The leading companies, however, have persistently avoided a national collective agreement across the industry. In its place they heavily publicised a voluntary tripartite National Commitment for the Improvement of Labour Conditions (NLC) in Sugarcane Production, signed by the employer's association, the federal government and labour representatives in 2009. Twenty two distilleries followed Raizen in also obtaining the Better Sugar certification (twenty of which were multinational firms) that 'guarantees' compliance with national labour law, ILO labour standards and a range of environmental measures. Within one year of attending a 2012 award ceremony with President Rousseff for their renewed commitment to labour standards, 60 of 169 NLC certified companies were being investigated through the courts for serious labour violations that included the exhaustion, illegal sub-contracting and degrading treatment of workers, leading to the collapse of the NLC. Raizen Energía, the largest plant in the country, faced 35 violations and had one conviction on appeal relating to inadequate provision of rest for workers and for dismissing workers in the *mechanized* harvesting sector only to rehire them through an agency the following day at 63 % of the wages (*Journal of Araraquara*, 2012). The company was more recently fined for keeping 'black lists' of militant rural workers while the Zilor group, a beneficiary of the Better Sugar seal, was fined US$500,000 for degrading treatment of workers in its distilleries.

Labour on the frontier: tensions, paradoxes and possibilities

Harvey (2001b) highlights the 'structural coherence' that binds global institutions, corporations, and labour in regions of capital accumulation is nonetheless imbued with power inequalities and hence subject to consistent tension. Amidst ethanol market instability, corruption scandals enveloping the Petrobras energy company, unprecedented political and social instability manifesting itself on highly publicised protests in capital cities, and less popularly visible actions by homeless, indigenous and agrarian movements, corporations have sought new 'fixes' through policy, financial and technical adjustments.

Firstly, the international biofuel market has not taken off as expected, in part due to the post 2008 recession, low oil prices and the European Union amending its renewable energy mandates to cap its sourcing of renewable energy from primary biomass (e.g. from corn or raw sugar cane), requiring that 5% would come from advanced or secondary techniques (e.g. extracted from the cellulose of leaves or woody tissue of the plant). Raizen availed of a R$1 billion credit line from Brazil's development bank and incorporated Canadian biotech firm

Iogen into its growing portfolio to begin the commercialisation of cellulosic ethanol. Under this stewardship, however, production and future commercialisation of 'second generation' ethanol from 'waste' organic material is dependent on maintaining, intensifying and expanding the cultivation of the primary material, the sugar cane, from which the waste matter will be extracted. Industry estimates that a further foreign investment of R$44 billion is required for its expansion of 3.1 million hectares in sugarcane in the next four years.

As the food and energy multinationals extend their operations, product diversification and continue to record impressive profits, fifty-one smaller companies with lesser access to international finance have ceased operations in Brazil since 2007, with 30 of these folding in just two years (2011 and 2012) and a further 60 closures anticipated. By 2012 these closures had extinguished an estimated 13,000 direct and 32,000 indirect jobs (*Folha de S. Paulo*, 2012; see Mendonça et al., 2010), causing crises in small towns reliant on the sector (Garvey and Barreto forthcoming). Escalating debts in the sector (to R$54 billion is São Paulo) and are a backdrop to calls for state support and a dismantling of labour laws to allow more flexible employment. The government's ongoing support for agribusiness (sugar and ethanol companies donated more than US$3 million to the three main political parties for the 2014 campaign) is demonstrated by a R$115 billion investment plan for corporate agriculture (less than 16% of this was allocated for small farming), a US$3 billion credit line for sugar plantation renewal, the appointment of successive agricultural ministers with ties to large landowner interests and increasing the compulsory percentage blend of ethanol in all commercial fuel to 25%. The corporate lobby has succeeded in passing it controversial bill on outsourcing work, thus extending and regularising the practice.

While at the time of writing still disparate groups of rural, landless an indigenous social movements are protesting stalled agrarian reform and renewed threats to the indigenous land ownership in Brasilia, opposition to further outsourcing is a key battleground on which labour organisations have coalesced. In this context the creative strategies by FERAESP are intriguing on a range of levels. The Federation continues to advocate rural workers' job quality and security at local, state and national levels but also recognises that structural unemployment, a narrowing of alternative rural work opportunities and longer term water and soil exhaustion are inherent to the mode of agrofuel production. In leaving the Central Trade Union Confederation (CUT) with other disillusioned trade union organisations and campaigning for a general strike and an alternative form of labour unionism with CSP-Conlutas, Intersindical

and others, the Federation's energies are also spent amongst landless occupations and settlements that it helps to organise. By straddling the swaying sugar cane fields of the ethanol supply chain (Figure 3) and the encampments/settlements of low- and semi-skilled, current and former cane harvesters and transporters (Figure 4), it articulates a vision for farm scale, integrated food and energy innovation that departs from an often disappointing return to familial agriculture, embraces new bioenergy and biofertiliser technologies and is gaining some traction with local media and researchers from locales affected by agroindustry.

Figure 3 and 4. Rural workers supplying cane to Raizen Maracaí and a camp with former and current rural workers near Araraquara, São Paulo

The realisation of such initiatives invites and requires sustained technical and political engagement between these communities, researchers and policy makers willing to make an analytic shift and measure the viability and longer-term contribution of farming systems across a range of biophysical, economic and social indicators while no longer taking for granted the deeply uneven, globalised socio-political systems within which key stakeholders and shareholders are currently embedded in specific nodes and regions of production.

Conclusion

This paper has sought to address blind spots in the literatures of global commodity chain analyses (e.g., Gereffi and Korzeniewicz, 1994; Milberg and Winkler, 2010) and techno-institutional lock in (Unruh, 2002), exploring how existing loci of strategic agency across an emerging global commodity chain for ethanol (via corporations and their interconnections with

the state and intra-state institutions) and, in particular the not-to-be-questioned logic of capital accumulation, privilege a momentum of 'socio-technical system change' that is effectively 'everything changing so that everything may remain the same'. While marketed as part of a 'responsible' transition to a lower-carbon economy (e.g. EC 2009; ILO and UNEP, 2012), hi-tech innovation is aligned with new alliances between energy and food corporations and state and intra-state institutions, policies and investment strategies. Not only are incumbent energy infrastructures (and south-to-north primary commodity flows) kept intact by the new alliances but, by presenting the reconfiguration of social and spatial relations through the prism of worker experiences, it has been demonstrated how increasing corporate market and territorial control have deepened conditions for power asymmetries between labour and employers. 'More' technology and market-orientated, voluntary certification has proved inadequate in addressing the distinct, social challenges emerging from this transition. It is suggested that this is indicative of how a morphing techno-institutional fix for agrofuel struggles to contain inherent contradictions the increasingly capital-intensive model of large plantation-scale monoculture, contested most loudly by the very rural labourers that agrofuel innovation was proclaimed to benefit. In conclusion, by adopting the theoretical break of conceiving techno-institutional fixes in terms of dynamic and co-produced power relations, a greater empirical attention to socially committed alternatives is made possible and actively invited by the action and practices of these workers. In this way, critical labour research of techno-institutional change may help unlock further possibilities for ecologically sensitive food and fuel production and socially committed societies that they could help constitute.

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