**Agrofuels and Food Sovereignty: Another Agrarian Transition is Possible**

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Thus far, most debates on agrofuels revolve around energy balances, economic and environmental cost-benefits, and food and energy security. Few analysts have focused on the ways in which the industrial development of agrofuels is fundamentally transforming the world's food & fuel systems. The new corporate partnerships and increased market power of a handful of industry giants fosters corporate influence over research & development agendas, national agricultural and fuel policy, and global factor and product markets along the length and width of the food value chain. The convergence of these powerful industries has far-reaching implications that may not only lead to irreversible environmental impacts, but will exacerbate problems of land tenure, food security, migration and poverty worldwide.

Agrofuels production has already had profound impacts on the global food system. Profits in agribusiness have risen dramatically in recent years, an increase the industry itself credits to the agrofuels boom. While industrial, mass produced, globally traded agrofuels are relatively new, the pattern of industrial transformation is a continuation of the last 200 years of industrialization of the food system. The agrofuels boom is only the newest development in the relationship between agriculture and industry that began with the Agrarian Transition, transformed the planet's food and fuel systems, and led to the global industrialization of agriculture itself. Over the last 50 years, capitalism's recurrent crises of overproduction and accumulation have resulted in steadily declining rates of profit in agriculture. Agrofuels are the perfect answer to the falling rate of profit to agrarian capital because-they inflate prices of basic grains and further concentrate market power in the hands of oligopolies. Like the agrarian transition fueled by the Green Revolution, the agrofuels boom will likely lead to an "Agrofuels Transition" that will enclose the much of the world's forests and drive most smallholders, family farmers, and indigenous peoples from the land. However, unlike the Agrarian Transition, there is no expanding industrial sector waiting to sop up excess labor. Neither will agrofuel itself subsidize the energy costs in the dramatic way petroleum has done. The expansion of agrofuels amount to an cross-sector, agrarian “involution” (Geertz 1963).

This paper examines the myths around which agrofuels have been politically re-packaged from a channel for excess production to a policy for “environmental and rural development.” We contend that these myths hide the agrarian transformation of our food systems behind the agrofuels boom. We then discuss the economic drivers, corporate consolidation, and the role of international finance in the agrofuels boom. We end with a discussion of the territorial restructuring taking place under the guise of “green technology,” discuss what this transition means for movements for food sovereignty, and outline the challenges to building sovereign food systems in the agrofuels economy.

**Myths of the Agrofuels Transition**

In order to understand how this transformation may take place, largely against political will and despite mounting resistance, we must look examine the discourse that makes agrofuels politically tractable. “Biofuels” invoke an image of renewable abundance that allows industry, politicians, the World Bank, the UN, and even the Intergovernmental Panel on Climate Change to present fuel from corn, sugar-cane, soy and other crops as a smooth transition from peak oil to a renewable fuel economy. Myths of abundance divert attention away from powerful economic interests that benefit from this biofuels transition, avoiding discussion of the growing price that citizens of the Global South are beginning to pay to maintain the consumptive oil-based lifestyle of the North. Myths around agrofuels production obscure the profound consequences of the industrial transformation of our food and fuel systems.

Myth #1: Agro-fuels are clean and green

Because photosynthesis from fuel crops removes greenhouse gases from the atmosphere and can reduce fossil fuel consumption, we are told fuel crops are green. But when the full "life cycle" of agro-fuels is considered—from land clearing to automotive consumption—the moderate emission savings are undone by far greater emissions from deforestation, burning, peat drainage, cultivation, and soil carbon losses. Every ton of palm oil produced results in 33 tons of carbon dioxide emissions—10 times more than petroleum (Monbiot 2007). Tropical forests cleared for sugarcane ethanol emit 50% more greenhouse gasses than the production and use of the same amount of gasoline (Tillman and Hill 2007). Commenting on the global carbon balance, Doug Parr, chief UK scientist at Greenpeace states flatly, "If even five percent of biofuels are sourced from wiping out existing ancient forests, you've lost all your carbon gain."

There are other environmental problems as well. Industrial agro-fuels require large applications of petroleum-based fertilizers, whose global use has more than doubled the biologically available nitrogen in the world, contributing heavily to the emission of nitrous oxide, a greenhouse gas 300 times more potent than $CO^2$ (Crutzen et al 2007). In the tropics—where most of the world's agro-fuels will soon be grown—chemical fertilizer has 10-100 times the impact on global warming compared to temperate soil applications (Altieri and Bravo 2007). To produce a liter of ethanol takes three to five liters of irrigation water and produces up to 13 liters of waste water. It takes the energy equivalent of 113 liters of natural gas to treat this waste, increasing the likelihood that it will simply be released into the environment to pollute streams, rivers and groundwater (Aslow 2007). Intensive cultivation of fuel crops also leads to high rates of erosion, particularly in soy production—from 6.5 tons/hectare in the U.S. to up to 12 tons/hectare in Brazil and Argentina (Altieri and Bravo 2007).

Myth #2: Agro-fuels will not result in deforestation

Proponents of agro-fuels argue that fuel crops planted on ecologically degraded lands will improve, rather than destroy, the environment. Perhaps the government of Brazil had this in mind when it re-classified some 200 million hectares of dry-tropical forests, grassland, and marshes as "degraded" and apt for cultivation (Moreno 2006). In reality, these are the bio-diverse ecosystems of the Mata Atlantica, the Cerrado, and the Pantanal, occupied by indigenous people, subsistence farmers, and extensive cattle ranches. The introduction of agro-fuel plantations will simply push these communities to the "agricultural frontier" of the Amazon where deforestation will intensify. Soybeans supply 40% of Brazil's diesel-fuels. NASA has positively correlated their market price with the destruction of the Amazon rainforest—currently at nearly 325,000 hectares a year (Morton et al 2006). Called "The Diesel of Deforestation," palm oil plantations for bio-diesel are the primary cause of forest loss in Indonesia, a country with one of the highest deforestation rates in the world. By 2020, Indonesia's oil-palm plantations will triple in size to 16.5 million hectares—an area the size of England and Wales combined—resulting in a loss of 98% of forest cover (Aslow 2007). Neighboring Malaysia, the world's largest producer of palm oil, has already lost 87% of its tropical forests and continues deforesting at a rate of seven percent a year.

Myth #3; Agro-fuels will bring rural development

In the tropics, 100 hectares dedicated to family farming generates 35 jobs. Oil palm and sugarcane provide 10 jobs, eucalyptus two, and soybeans just one half-job per 100 hectares, all poorly paid (FBOMS 2006). Until this boom, agro-fuels primarily supplied local markets, and even in the U.S., most ethanol plants were small and farmer-owned. Big Oil, Big Grain, and Big Genetic engineering are

rapidly consolidating control over the entire agro-fuel value chain. These corporations enjoy immense market power. Cargill and ADM control 65 percent of the global grain trade, Monsanto and Syngenta a quarter of the $60 billion gene-tech industry. This market power allows these companies to extract profits from the most lucrative and low-risk segments of the value chain—inputs, processing and distributing. Growers of fuel crops will be increasingly dependent on this global oligopoly of companies. In the long run, farmers are not likely to receive many benefits (Dufey 2007). Smallholders will likely be forced off the land. Hundreds of thousands have already been displaced by soybean plantations in the "Republic of Soy,", a 50+ million hectare area covering southern Brazil, northern Argentina, Paraguay, and eastern Bolivia (Bravo 2006).

Myth #4: Agro-fuels will not cause hunger

Hunger, said Amartya Sen, results not from scarcity, but poverty. According to the FAO, there is enough food in the world to supply everyone with a daily 3,200-calorie diet of fresh fruit, nuts, vegetables, dairy and meat. Nonetheless, because they are poor, 824 million people continue to go hungry. In 1996, world leaders promised to halve the proportion of hungry people living in extreme poverty by 2015. Little progress has been made. The world's poorest people already spend 50-80% of their total household income on food. They suffer when high fuel prices push up food prices. Now, because food and fuel crops are competing for land and resources, high food prices may actually push up fuel prices. Both increase the price of land and water. This perverse, inflationary spiral puts food and productive resources out of reach for the poor. The International Food Policy Research Institute warns that the price of basic food staples could increase 20-33% by the year 2010 and 26-135% by the year 2020. Caloric consumption typically declines as price rises by a ratio of 1:2. With every one percent rise in the cost of food, 16 million people are made food insecure. If current trends continue, some 1.2 billion people could be chronically hungry by 2025—600 million more than previously predicted (Runge and Senaur 2007). World food aid will not likely come to the rescue because surpluses will go into our gas tanks. Last year, world food aid reached its lowest level since 1961(Holt-Gimenez 2008), forcing the World Food Programme to cut back on rations in Darfur and other conflict zones.

Myth #5: Better "second-generation" agro-fuels are just around the corner

Proponents of agro-fuels argue that present agro-fuels made from food crops will soon be replaced with environmentally-friendly crops like fast-growing trees and switchgrass. This myth, wryly referred to as the "bait and switchgrass" shell game, makes food-based fuels socially acceptable. The agro-fuel transition transforms land use on a massive scale, pitting food production against fuel production for land, water and resources. The issue of which crops are converted to fuel is irrelevant. Wild plants cultivated as fuel crops won't have a smaller "environmental footprint." They will rapidly migrate from hedgerows and woodlots onto arable lands to be intensively cultivated like any other industrial crop, with all the associated environmental externalities. Further, major discoveries in plant physiology are required that permit the economically efficient breakdown of cellulose, hemi-cellulose, and lignin. Industry is either betting on miracles or counting on taxpayer bail-outs. A recent University of Iowa study found that without the largess offered by the U.S.'s 2007 Energy Act, cellulosic ethanol would never get off the ground (Baker, Dermot and Babcock 2008). Even with the Renewable Fuels Standard, the authors claim that the U.S. will fall drastically short of targets, producing around 4.5 billion of the mandated 21 billion gallons of "advanced biofuels" per year, and then only if the government triples the already enormous per gallon subsides to the ethanol industry (Baker, Dermot and Babcock 2008). Asking taxpayers to launch cellulosic is simply a gift to industry, especially considering that a 3-4% increase in fuel economy would save the same amount of fuel the Iowa study predicts will be displaced

by cellulosic even with massive subsidies (Baker, Dermot and Babcock 2008).

**A Solution for Agribusiness**

The agrofuels boom is a solution for crises of capital creatively re-branded as a solution to the climate crisis. In recent years global purchasing power has not kept up with rising agricultural production, leading to a steady decline in food prices and (most important to agribusiness) profit margins. In the past, corporate agrifoods has responded to the falling rate of profit by increasing productivity through technological improvements (e.g., the Green Revolution) or by adding value to raw commodities by transforming them (e.g., corn into beef), or "vertically integrating" their operations from production to market to capture more of the food value chain.

Agrofuels is an industrial one-stop-shop to solve agribusiness' problem with the falling rate of profit. The transformation of food into fuel a) opens up new market space for overproduced commodities like corn and sugar cane; b) inflates the value of those commodities in both food and fuel markets, and; c) creates more processing steps that allow corporate players to both add and capture more value. Little wonder that the agrofuels is steaming full speed ahead, despite its serious social and environmental drawbacks.

Agrofuels has already sparked a run-up in the value of raw commodities. The FAO food price index rose 60% in the past two years (FAO 2008). In December of 2007 the Economist's food price index was at the highest it has been since its creation in 1845 (Economist 2007). In March of 2008 before the global financial crisis introduced extreme market volatility wheat prices were up 137% from the year before, soy was up 87%, rice rose 74%, and maize went up 31% (Holt-Gimenez 2008). A leaked World Bank report charged that agrofuels were responsible for 75% of food price inflation (Chakrabortty 2008). Other reports claim between 5% and 30% of the increase is due to the conversion of agricultural production to fuel (Holt-Gimenez 2008). While the past few months have seen a fluctuating boom-bust cycle in commodities prices, demand for agrofuels has already successfully inflated the value of agricultural goods.

While some agribusiness, like the feedlot operator Tyson, have been hurt by inflation of grain prices, the global grain traders are doing well. Corporations like Cargill and ADM both buy and sell grain. Because of their vast market power – Cargill and ADM together control 75% of the global grain trade (Vorley 2003) - they buy when prices are low, and can withhold grain from the market until prices recover. This resilience to market fluctuations is clear in earnings. In a time of severe economic downturn when most companies are suffering enormous losses, Cargill's earnings increased 62% for the quarter ending August 31, 2008 over the same quarter 2007 (Black 2008). Net income at Bunge, one of the top three global grain traders, increased 471% in the first half of 2008 (Ugarte and Murphy 2008), through earnings have taken a dive in the recent market collapse. Nestle's profits were up 6.1% in the first half of the year. Monsanto's net income was up 83% in the first nine months of fiscal year 2008 (Ugarte and Murphy 2008).

Archer Daniels Midland (ADM), the largest U.S. (and global) grain processor, now gets 25% of its operating profit from agrofuels, including both ethanol and biodiesel (Scully 2007). In anticipation of the passing of the 2007 U.S. Energy Bill, ADM's stock surged nearly 20% from August to mid-December (Philpott 2007). The company announced that it was "optimistic about the expanded role [agrofuels] will play in improving energy security, strengthening rural economies and helping to

improve our environment"(ADM 2007).

According to the Renewable Fuels Association (RFA), the ethanol industry's lobbying group, out of a total of 176 operational ethanol processing plants in the U.S., 40 are were locally owned as of October 2008. Out of a total of 28 plants now under construction, 85% are owned by large corporations. (note: RFA and the USDA were recently accused of underreporting the number of ethanol plants under construction (Barrionuevo 2007) so the degree of corporate control may well be higher).This is vastly different from where the industry started. As recently as May 2007, farmer owned plants were responsibel for 40% of overall production (Hasan 2007). Five corporations control roughly 47% of all ethanol production in the U.S. ADM and POET, the two largest corporate ethanol producers, control 33.7% of all ethanol production. The top 10 producers together control an estimated 70 percent (Hassan 2007). Because of the economies of scale of its plants, and the fact that it can dominate the grain market in both food and fuel crops, ADM is emerging as the hegemonic player in the U.S. While other ethanol companies are struggling with shrinking margins due to high corn prices, ADM has strengthened its market share, and its profits (Birger 2008).

Concentration of ownership of global agrofuels production by U.S. agribusiness is proceeding apace. Having recently bought the majority shares in Brazil's largest ethanol distillery, U.S.-based Cargill is now the largest shipper of both raw sugar and soybeans from Brazil—the former for ethanol feedstock, the latter either feed or biodiesel. Cargill also has the largest capacity for processing oil seeds in Paraguay.[1] Over the past three years, venture capital investment in agrofuels has increased by nearly 700% (Reeves 2007). Private investment in agrofuels is pouring in to public research institutions, setting the agenda not only for agrofuels, but for public research in general (Altieri and Holt-Gimenez 2007). New corporate partnerships are being formed between agribusinesses, biotechnology companies, oil companies and car manufacturers.[2] Billions of dollars are being invested in the agrofuel sector in a development often likened to a 'green goldrush', in which countries are rapidly turning land over to agrofuel crops and developing infrastructure for processing and transporting them. New corporate partnerships and mergers are being formed at a dizzying rate: ADM with both Monsanto and Conoco-Phillips; BP with DuPont and Toyota, as well as with Monsanto and Mendel Biotechnology; Royal Dutch Shell with Cargill, Syngenta, and Goldman-Sachs, and DuPont with British Petroleum and Weyerhauser (ETC 2007). In June 2007, BP, Associated British Foods Plc and chemicals producer DuPont Co. announced that they will invest $400 million to build an agrofuels plant in England (Voss and Weeks 2007).

**A New Venue for International Finance**

With the global economy in tatters, agrofuels and the higher values for agricultural surplus they create offer an attractive investment space for international capital. Leading venture capital firms in the U.S. such as Goldman Sachs, Kholsa Ventures, Warburg-Pincus, and Soros Fund Management have invested heavily in the new industry. International investment in agrofuels presents a risk however, with

[1] With an estimated 13 silos and an illegal port facility built in the Amazon, Cargill is leading soy's invasion into the region - spurring the incursion of illegal farms and infrastructure to deliver soy to global markets. In 2005, Cargill became the majority shareholder of two palm oil plantations in Indonesia, on the islands of Sumatra and Borneo, and three more in Papua New Guinea.

[2] For example see the October 2007 announcement of cooperation between ADM and ConocoPhilips, April 2007 cooperation between Chevron. For analysis see: The EU's Agrofuel Folly: Policy Capture By Corporate Interests. Briefing paper, Corporate Europe Observatory, June 2007.

resistance to agrofuels development mounting from both civil society and small farmers' groups. International financial institutions have stepped in to mitigate some of this risk to capital. Institutions like the Interamerican Development Bank and the International Finance Corporation are using their nominal accountability to global civil society to politically legitimize investment in agrofuels (Jonasse *forthcoming*). The Interamerican Development Bank is providing direct loans to the second largest ethanol conglomerate in Brazil: Santelisa. Santelisa is a huge conglomerate that includes investments from all over the globe, including Goldman Sachs and the Carlyle Group. It's also involved with Cargill, BP, and a whole host of Brazilian agro-industry leaders. The International Finance Corporation is providing direct loans to the largest Brazilian sugar conglomerate, Número Um (Jonasse *forthcoming*).

The IFC has US$200 million invested in Brazilian ethanol. One $50 million loan recently went to Cosan S.A. Industria e Comercio, the largest sugar (and ethanol) company in the world and part of billionaire Rubens Ometto Silveira Mello's Ometto Group, which owns several Brazilian sugar companies. Cargill also owns a majority share in Cosan. Cosan is attracting international capital investments from Tate & Lyle, Mitzubishi, Hong Kong's Kuok Group (palm growers), and French sugar companies, Sucden and Tereos. Ometto also holds stakes in sugar breeding and biotech companies (Grain 2007). Its 2006 IPO raised US $ 405 million (Magalhães 2006). The IFC, aside from its capital, which Cosan apparently has no lack of, proved its value to the group by granting the project a "B" classification for moderate environmental impacts and labor conditions. The IFC set the guidelines, and allowed Cosan to perform its own audits on labor and environmental standards. The IFC monitored Cosan's compliance by reviewing copies of corporate memoranda and "management-certified completion of top priority corrective measures" (IFC 2005).

In investing in one Brazilian ethanol project, the Dutch Rabobank specifically cited the IFC certification as the reason it felt safe to invest: ""Rabobank's reasoning was that if IFC approves this project and they classify it only as a class B, low risk project, we can safely invest [an additional] $230 million… in this corporation (Lilley 2004). The lingering rosy glow of agrofuels in the public eye has made investments in highly destructive projects, like their now infamous 2004 loans to Soybean King Blairo Maggi (of Ammagi Soy) for a project that was found to have destroyed large swaths of the Amazon Rainforest (Lilley 2004), possible for IFI's to rate favorably, securing the territory for further capital investment and ensuring both inflated agricultural values and the accumulation of those higher values to international agribusiness.

It is interesting to note, the agrofuels boom comes at an especially opportune moment for international financial institutions and the project of neoliberalism itself. With the Doha round of WTO negotiations stalled, a new wave of Latin American governments elected on anti-neoliberal platforms, and increasing competition from banks that will give loans without the nominal social and environmental safeguards – or demands for further liberalization – IFI's are at risk of losing some of their political dominance. It is precisely the nominal social and environmental standards of the big development banks that gives them the political power to blaze the trail for further international investment in agrofuels. By grading agrofuels projects favorably in terms of social and environmental accountability, the international finance institutions are not only establishing supportive political and economic conditions for agrofuels development, but reinforcing the neoliberal structure that after the Green Revolution opened the political space to expand extractive, export based agriculture under structural adjustment.

**Territorial Restructuring**

The Agrofuels boom must be understood in the context of the fundamental changes it creates in both physical places and political and economic spaces (Harvey 2003). The analytical concept of territorial restructuring - a re-shaping of both places and spaces at the national, international and regional levels (Holt-Gimenez 2007), can help explain the changes occurring under the agrofuels transition and what they mean apart from the rosy discourse of "alternative energy." International finance institutions, corporate agribusiness, large landowners, governments, and market forces are all engaged in re-drawing the lines of power and ownership – restructuring places and spaces not through some broad consensus, but through the interaction between the interests and activities of the different actors. While international finance institutions restructure political and economic spaces by blazing the trail for international agrofuels investment, physical territory is being restructured by agribusiness and biotech firms on the ground.

Smallholders in the Global South have already tend to occupy land on the productive margins (Holt-Gimenez 2006). These "marginal" lands are now being appropriated in the political discourse of agrofuels proponents, and increasingly, physically appropriated on the ground. Proponents of agrofuels claim that "abandoned cropland" and "marginal" lands will be crucial to producing agrofuels. One study using satellite imagery and historical data claims that 386 million hectares of such abandoned cropland exists. (Field et al 2008) Such estimates ignore that fact that degraded, marginal and "abandoned" land is often the basis of subsistence for rural populations. (Berndes 2003). In a recent report by several civil society groups[3], Jonathan Davies of the World Initiative for Sustainable Pastoralism puts the problem of marginal lands succinctly. "These marginal lands do not exist on the scale people think. In Africa, most of the lands in question are actively managed by pastoralists, hunter-gatherers and sometimes dryland farmers. ...given the current cavalier approach to land appropriation, or the disregard of the land rights of rural inhabitants in many countries, it is inevitable that agrofuel production will be done by large investors at the expense of local communities." The report decried the discourse around marginal lands claiming the discussion has "ignored the presence of pastoralists, indigenous peoples, small scale farmers and women on these lands, and failed to understand that intensive agriculture/monoculture is not the only form of land use."

Reports of territorial displacement for agrofuels are already rampant. In Columbia, according to one report, "93 percent of the land under palm cultivation...is located in the collective territorial zone of black communities." The report claims that nearly all traditional villages have been cleared and are being resettled with former paramilitaries and outsiders (Zimbalist 2007). In the Eastern Cape of South Africa 500,000 hectares of communal farmland is being fenced and planted to canola for biodiesel. Locals have been forced to forgo their diverse food gardens and grazing lands, while Monsanto collects heavy subsidies for providing its chemicals and seeds "on the farmer's behalf" (African Centre for Biosafety 2008). A British company has taken 3000 hectares of communal pasture land in Ethiopia for a jatropha plantation in a populated area where 39% of the population already depends on emergency food aid.

In another example, Aracruz Cellulose, a leading supplier of eucalyptus paper pulp and one of the new

[3]for the full report see: Agrofuels and the Myth of Marginal Lands. A briefing by The Gaia Foundation, Biofuelwatch, the African Biodiversity Network, Salva La Selva, Watch Indonesia and EcoNexus September 2008. available at www.gaiafoundation.org/documents/Agrofuels&MarginalMyth.pdf

players in cellulosic ethanol, evicted 8,500 indigenous families from their land in the Brazilian state of Espirito Santo, converting 11,000 hectares to “Green Desert” (Meirelles 2005). The plantations have dried up several rivers and streams, seriously threatening the water supply to small farmers (FOEI 2008). If the technology to commercialize cellulosic ethanol from wood products becomes widely available, as companies like Aracruz hope, more small farmers will be displaced into the agricultural frontier or worse, to urban slums, by the march of fuel crops into the Brazilian landscape. Eucalyptus plantations if planted over existing small farms, could displace 17 farmers for every poorly paid job they create.

This type of territorial restructuring is nothing new. The Green Revolution favored raising production through technological intensification, rather than through redistribution of land to smallholders. By pushing the “surplus” peasantry out of agriculture, this concentrated agricultural land in fewer and fewer hands. The same is true for agrofuels. The difference this time is there is no "new" industrial revolution. This time, fuel will not subsidize agriculture with cheap energy. There are no production breakthroughs poised to flood the world with cheap food. No expanding industrial/manufacturing sector waits to receive the displaced rural masses. Small farmers and indigenous people pushed off the land by the current round of restructuring will have nothing on which to fall back.

**Enclosing the Genetic Commons**

The agrofuels transition, unlike previous incarnations of the agrarian transition/industrial revolution, will also enclose vast genetic resources in the private sector and create new economic space under the dominion of agribusiness. Biotechnology companies are aggressively using the agrofuels boom to extend intellectual property rights over a greater percentage of the world's agricultural genetic resources, and consolidate more market power, by horizontally integrating seed, chemical packages, and processing of agro-fuels. Both Monsanto and Syngenta have recently come out with genetically modified varieties specifically for processing corn into ethanol, while development of “second generation” agrofuels is proceeding under the direction of large biotechnology firms.

In 2006, Monsanto and agribusiness giant Cargill launched a joint venture called Renessen, a new corporation with an initial investment of $450 million dollars. Renessen is the sole provider of the first commercially available GM dedicated energy crop, “Mavera High-Value Corn.” Mavera corn is stacked with foreign genetic material coding for increased oil content and production of the amino acid lysine, along with Monsanto's standard Bt pesticide and its Roundup Ready gene. The genius of this operation, and the danger to farmers, is that farmers must sell their crop of Mavera corn to a Renessen-owned processing plant to recoup the “higher value” of the crop (for which they paid a premium on the seed). Cargill's agricultural processing division has created a plant that only processes their brand of corn. Further, due to the genetically engineered presence of lysine, an amino acid lacking in the standard feedlot diet, they can sell the waste stream as a high priced cattle feed. Renessen has achieved for Monsanto and Cargill nearly perfect vertical integration. Renessen sets the price of seed, Monsanto sells the chemical inputs, Renessen sets the price at which to buy back the finished crop, Renessen sells the fuel, and farmers are left to absorb the risk. This system robs small farmers of choices and market power, while ensuring maximum monopoly profits for Renessen/Monsanto/Cargill.

Biotech's foray into energy does not stop with corn. The industry promises a “second generation” of new cellulose-based energy crops that can grow on the marginal land passed over by previous green

revolution technologies. Cellulosic energy crops can conceivably be produced from any plant material: corn stalks, trees, sugar cane biomass, or grasses. Unlocking the key stumbling blocks to cellulosic energy – processing efficiency and yield – offers the industry unprecedented opportunity to extend their market power and enclose more genetic material – the building blocks of agricultural production – under private patent.

**The Second Generation**

Like first generation biotech traits, many of the energy traits being developed are designed for opening and dominating markets. In fact, many of these traits will create markets from scratch, augment the already lucrative markets for chemical inputs, and deliver the full control of these markets to the tightly integrated corporations of the biotech industry.

*Range expansion, drought/freeze tolerance, growth on marginal land* – Some of the most highly advertised traits being developed allow a plant to escape its own physiological limitations to grow on poor soils, in water scarce regions, and to withstand freezing temperatures. In other words, these traits aim to make industrial monocrops grow where they otherwise could not. Mendel Biotechnology, a privately controlled firm with heavy investments by Monsanto and British Petroleum, has already identified and isolated genes for these new traits.

*Increased biomass and faster growth* – Another set of traits the biotech industry is working on code for faster growing plants that put more energy into producing biomass than products like sugars, nuts, oils, and tubers. Plants like the GE sorghum being developed by Ceres Incorporated (a small biotech start up with significant equity investment from Monsanto), trade their ability to produce a food product for increased biomass. Farmers growing this crop in the future will likely have to accept the price offered by the nearest ethanol refinery, instead of having diverse local and international food markets to fall back on when commodity prices inevitably fluctuate.

*Reduced lignin content in trees* – Lignin is the woody compound in the cell wall that gives trees both their structural integrity and their resistance to pests. Lignin is also what makes it difficult to pulp trees into paper and potentially unlock cellulose in wood to produce ethanol. ArborGen, a biotechnology firm with heavy investments from the industrial forestry industry, is developing trees with 20% reduced lignin content. Because genetic modification of tree species is a relatively new field, only a few companies have invested in GM trees. The CEO of Rubicon, an industrial forestry company and one of three owners of ArborGen, notes “the annual unit sales of forestry seedlings are well into the billions, recur every year, and span the globe. ...there are no global competitors to ArborGen” (Langelle and Peterman 2006).

*Proprietary enzymes, bacteria and catalysts* – Processing cellulose into sugars is the largest hurdle in making cellulosic ethanol practical. At its current stage, processing is vastly inefficient. Regardless of doubts about the technology, the engineering of new enzymes and bacteria that can break down cellulose is a multi-million dollar race. Corporate partnerships, and not competition, is the norm in this sector. Codexis, one of the leading developers of GE enzymes is partnering with Syngenta and Shell Oil for its research and development. Some enzyme biotechnology firms also own ethanol processing plants, like the Kholsa Ventures funded company, Range Fuels. Patents on this technology will essentially put a stranglehold on the cellulosic ethanol market: whoever controls the most efficient catalysts will have a virtual monopoly on processing fuel.

The development of second generation fuel crops threatens to enclose more of humanity's patrimony, seed, in private spheres. Inserting one or two novel traits effectively extends ownership over all the genetic material contained in an altered seed. While this has been ongoing since the mid-1990's when biotech products first began to go commercial, the scale of the restructuring of ownership of genetic resources the agrofuels boom allows is without precedent. Second generation ethanol also allows more vertical integration in the industry than any previous incarnation of biotechnology.

**The New Agrarian Transition**

The scale of the restructuring in the agrofuels boom presents pressing challenges to movements for food sovereignty. Food sovereignty, understood as the democratization of food systems in favor of smallholders and low-income consumers; the spread of agroecological farming methods; the localization of production; and the equitable distribution of the wealth in the food system, is anathema to industrial agrofuels. The nature and the structure of the agrofuels boom however presents some very concrete hurdles for food sovereignty as both a movement and a framework for re-constructing food systems.

The brilliance of agrofuels for industry, and the peril for movements, is how well it fits into the capitalist model of agriculture. The risks inherent in farming, seasonality, and dependence on the land are all disincentives for bringing agriculture directly into the industrial fold. (see Mann 1990). One analytical concept that explains this process is appropriation and substitution (see Goodman, Sorj, and Wilkinson 1987). On one end, the management of fertility and pests, traditionally preformed through crop rotations, manure applications, intercropping and other on-farm processes, are replaced by products off-farm inputs like chemical pesticides, fertilizers, and herbicides. This swap of traditional farm labor processes in favor of agribusiness products is called appropriation. On the consumers end, agribusiness has transformed farm produce into raw commodities for processed foods and consolidated control over processing, importing, distribution, and retailing to add and capture value from production. In this process, called substitution, the greatest portion of the value of production accrues in the industrial food chain, not on farms.

Agribusiness and industry has been especially adept at capturing profits from agriculture through these processes, so much so that even with higher food prices, farmers are still having difficulty meeting the costs of production (Craig 2008)(Conner et al *forthcoming*). There is only so far this model can expand however. Global purchasing power has not kept up with production capacity, demand for food is inelastic, grain has been cheap, and subsequently, the industry has had very little room to grow. Agrofuels come in at the end of this industrial chain to mitigate diminishing returns and again add value to be captured by agribusiness.

We think the agrofuels transition is reflective of a new phase in agrarian capitalism, only this time there is no expanding industrial sector, no rapid global economic growth to support displaced farmers, and no subsidy from cheap petroleum. Perversely, this phase is more involuted than expansive – involuted in terms of net energy output, yields, and return on investment. Rents, however, will be captured anyway, because the agrofuels transition concentrates land ownership and industrial and market power under one big roof.

Food sovereignty as a political discourse is quite powerful. But what analytical power does the concept of food sovereignty have in the face of the agrofuels transition? How does it help us to understand the spaces being occupied by agrofuels, the places being restructured by agrofuels, and they ways that restructuring occurs, in order to mount effective resistance?

Movements for food sovereignty are already pushing back on capitalist appropriation and substitution in the agri-foods chain. On one end, movements related to food sovereignty are substituting consolidated retail and processing outlets with Community Food Security and Food Justice initiatives, CSA's, farmer's markets, and solidarity trade. These initiatives attempt to capture more value in the agri-foods chain for consumers and farmers. One initiative of this kind, the Oakland Food Policy Council in Oakland, California, wants to "turn the food system into an engine for local economic development," to effectively capture more of the value chain in low-income communities (Harper). On the other end, movements like La Via Campesina and Movimiento Campesino a Campesino are re-appropriating privatized labor processes with agroecological methods, on-farm inputs, local seed, and labor.

In order to gain more ground from the agrofuels transition, food sovereignty movements will likely need to form strong alliances to counter the alliances between corporate sectors in the agrofuels industry. The political and economic resistance to agrofuels coming from many environmentalists, conservationists, and food activists, potentially coincide with the agrarian livelihood demands of the world's smallholders, peasants and indigenous peoples. Push back on agrofuels from some sectors in the food and energy industries (e.g., petroleum companies, beef, grocery retail, etc.) does not.

In the face of this rapid change, can food sovereignty bring together and guide these movements? Is it the unifying concept politically? Analytically? Push-back on the forces of appropriation and substitution alone may not get at the root of the conceptual challenges the agrofuels transition presents to food sovereignty. But food sovereignty is inherently a strong redistributive concept. Can food sovereignty engage in the places and spaces under attack by the agrofuels boom to make them redistributive? What does it mean to be redistributive at different parts of the value chain? What kind of analytical tools can food sovereignty avail itself of in order to help guide effective resistance and mobilization? Can food sovereignty provide a lens, a framework, and a negotiating platform for identifying and building broad-based alliances for advancing "another" possible agrarian transition?

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