Brighter Green

Cattle, Soyanization, and Climate Change

Brazil's Agricultural Revolution

Brazil

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BRAZIL, THE WORLD'S eighth largest economy,[1] has become an agricultural powerhouse. In 2008, the agribusiness sector accounted for one-quarter of Brazil's gross domestic product (GDP), with 7 percent attributed to livestock.[2] Brazil leads the world in exports of beef and veal, with 25 percent of the global market, supplying more than Australia and India, the second- and third-largest beef exporters, combined.[3]

Brazil's expanding livestock sector is intimately linked with global markets for agricultural commodities—be they beef, poultry, pork, soybeans, or leather. Brazil now accounts for 37 percent of global meat exports,[4] and, as the global recession wanes and demand for more highly valued (and priced) meat increases, exports in 2010 of Brazilian beef are expected to rise 14 percent from 2009 levels.[5]

Nearly 100 countries import fresh and frozen beef from Brazil, including Russia, Iran, China (through Hong Kong), Egypt, Algeria, Lebanon, and Venezuela. In 2009, these exports were valued at U.S$6.3 billion.[6] Brazil's cattle herd, numbering about 190 million, is the world's second largest, after India's,[7] and rivals Brazil's human population of 200 million.[8]

In 2003, Brazil ousted the United States to become the top exporter of poultry meat, of which it currently sells 3.5 million metric tons—principally chicken—each year.[9] Brazil's poultry exports account for more than 40 percent of the global market. In addition, Brazil is the world's fourth largest exporter of pork.[10]

Successive Brazilian governments have invested in the development of the soybean sector, with considerable success. Brazil has become the world's second-largest soy exporter, and its land area planted with soybeans keeps growing (up 7 percent in 2010 from 2009).[11] In 2009, trade in soybeans, soybean meal, and soybean oil earned Brazil $17 billion, a nearly five-fold increase from a decade earlier.[12]

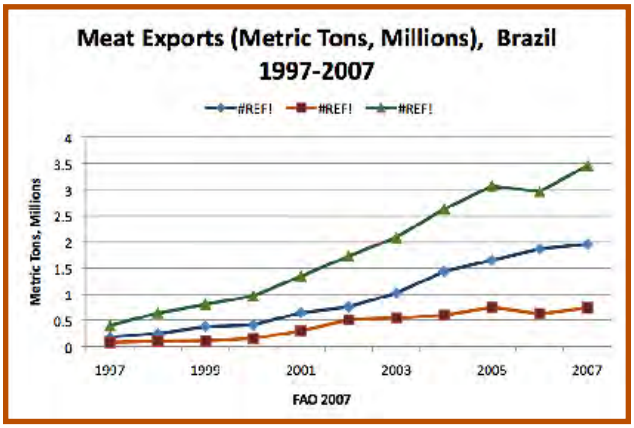
Soybean meal is an integral component of the commercial feed fed to the fast-growing global population of chickens, cattle, pigs, and other domesticated animals bred for meat, milk, and eggs, particularly the billions now raised in intensive confinement systems (factory farms and feedlots). Brazil's 2010 soybean harvest, approximately 68 million metric tons, is the highest ever and 20 percent larger than the previous year's.[13] China is the largest buyer of Brazilian soy,[14] with the European Union (EU) providing another significant market.[15]

To keep pace with international demand along with rising domestic consumption of animal products, Brazil's livestock sector has added animals, production facilities, and processing and transport capacity. Many large-scale, industrial livestock operations are located in southern Brazil, near ample supplies of key feed components, such as soybeans and corn.

Most of the industry leaders in poultry, pork, veal, and eggs in Brazil have adopted standard methods of industrial production: sheds housing thousands of "meat" chickens; stacked rows of cages for egg-laying hens; small pens or stalls for pigs; and two-foot-wide wooden crates for male calves raised for veal.

Feedlots, however, in which thousands of cattle are massed in outdoor enclosures and fed grain, not grass, are still rare in Brazil. Only about 5 percent of Brazilian beef is produced this way, and feedlots are concentrated in Goiás and São Paulo states in the south-central part of the country.[16]

While most cattle are still free ranging, much of the pasture they graze on has been created in areas of great biological diversity, specifically in the Amazon rainforest and the Cerrado—the Brazilian savannah—both of which are enormously important to the global climate. In each ecosystem, millions of cattle now graze in near-treeless drylands, sometimes in sight of the receding forest or grassland horizon. The Amazon and the Cerrado have also been centers of industrial-scale cultivation of soybeans. Large areas of former forest or savannah ecosystens are now



Burning rainforest in the Amazonian state of Pará

demarcated by a patchwork of large, straight-edged fields, akin to those in the U.S. farm belt, and planted with row upon row of soybeans.

Brazil is the world's most biologically diverse nation. But its rapid economic expansion, specifically in the agricultural sector, has resulted in Brazil also being the world's fourth-largest emitter of climate-warming greenhouse gases (GHGs), principally due to the burning of its forests.

Indeed, it is in Brazil that the global warming and myriad other ecological impacts of expanding meat and feed crop production, and the intensification of animal agriculture, are perhaps most evident.

This paper will explore whether Brazil can protect its forests, grasslands, and immense biodiversity and meet its own, and the world's, climate-change goals, even as it as it produces, consumes, and exports more meat products, milk, eggs, and soybeans. It will also ask how Brazil will address the economic and social inequality reaffirmed by the industrialization of its agricultural sector, specifically for mass production of meat and soybeans for animal feed.

Global Markets, Growing Market Share

Brazil's investments in creating an export-oriented, commodity-centered, and increasingly industrialized agricultural economy have borne fruit in the shape of rising production and steadily expanding exports. In 2008, agricultural products accounted for 35 percent of Brazil's exports, half of which came from meat and soy combined.[17] The overall value of Brazil's agricultural exports reached $71.8 billion in 2008, a record, making Brazil the world's third biggest agricultural exporter after the U.S. and E.U.[18]

In the seven years between 2001 and 2008, meat production in Brazil rose by 43 percent.[19] The most significant expansion came in poultry, which saw production grow by 67 percent, and beef, for which production expanded by 32 percent. Production of pork grew too, although to a lesser degree (14 percent).[20]

While the global recession dampened demand for commodities, Brazil's economy was one of the first to show signs of recovery. Brazil's Central Bank projected economic growth in 2010 at 7.3 percent, the highest annual level in two decades.[21]

Climate Change, Forests, and Cows

Seventy-five percent of Brazil's GHG emissions are the result of deforestation and changes in land-use to pave the way for production of livestock and crops.[22]

An estimate deemed conservative concluded that fully half of Brazil's GHG emissions between 2003 and 2008 came from the cattle sector.

Emissions from agriculture have charted a rapid rise, increasing 41 percent between 1990 and 2005.[23] Cattle are a major factor. An estimate deemed conservative and carried out by Friends of the Earth-Amazonia (Amigos da Terra - Amazônia Brasileira), the Brazilian National Institute for Space Research (INPE), and the University of Brasília concluded that fully half of Brazil's GHG emissions between 2003 and 2008 came from the cattle sector.[24] If all parts of the "cattle chain" had been included, the researchers add, the proportion of GHGs attributable to Brazil's cattle would have been even larger.[25]

In addition to the GHGs released when forests are burned, once land is denuded of trees and other vegetation, its ability to capture and store carbon—and thereby slow

global warming—is depleted or lost altogether. The Amazon forests are estimated to capture and hold between 80 and 120 billion tons of carbon dioxide (CO_2).[26]

Between 1995 and 2010, deforestation reduced Brazil's "carbon stock" (the amount of carbon stored in trees and soils) by 6 billion metric tons, according to the World Bank. That's equivalent to roughly two-thirds of all the GHGs produced globally each year.[27]

Greenhouse gases are emitted at each stage of livestock production. Not only is CO_2 released through the clearing of land for ranching or cultivation of feed crops, but also through production of the chemical fertilizers such crops require. CO_2 is also emitted through the burning of fossil fuels to run industrial facilities, which are highly mechanized, and in the processing and transport of farmed animals, animal products, and feed, often over considerable distances.

Methane, a GHG with 23 times the warming potential of CO_2, is released through enteric fermentation—ruminants' digestive processes. These emissions tend to be higher for animals fed on grain than on pasture. Additional methane is emitted by farmed animals' manure.

Animal wastes also release nitrous oxide, a greenhouse gas with 296 times the warming potential of CO_2. As animal agriculture further intensifies in Brazil (and elsewhere), emissions of CO_2, methane, and nitrous oxide from the livestock sector can be expected to increase substantially, too.[28]

Brazil has not been immune to calls for fast-developing nations, along with industrialized ones, to take action to slow or reverse their GHG emissions. In 2008, at the United Nations climate change summit in Poznan, Brazil's then president, Luiz Inácio Lula da Silva (known as "Lula"), pledged to cut Brazil's deforestation levels by 72 percent by

Cattle and the Climate

Several recent scientific studies have documented the large share of Brazilian GHGs attributable to the livestock sector.

STUDY 1

Research by a team of governmental and NGO researchers studying data for the years 2003 to 2008 concluded that 50 percent of Brazil's GHGs are due to cattle production.[44] The Amazon and Cerrado regions had the highest levels of such emissions. The researchers measured only three major sources of GHGs: deforestation to create pasture and burning of cleared trees and other vegetation; burning to create new pasture land; and enteric fermentation. Other emissions attributable to cattle production, including from degraded soils, transportation, or those produced during production of feed, were not included. Measured in Mt (millions of metric tons) of CO_2, the researchers estimated that cattle ranching contributed:

- 1,090 Mt CO_2 in 2003 (the largest value documented)
- 813 Mt CO_2 in 2008 (the smallest value documented)
- 499 Mt (low) to 775 Mt CO_2 (high) each year in the Amazon
- 229 Mton (low) to 231 CO_2 Mt (high) each year in the Cerrado

In 2005 (the midpoint of the years studied), Brazil's overall GHG emissions were between 2 and 2.2 gigatons CO_2 equivalent.[45] A gigaton is one billion metric tons.

STUDY 2

Another team of Brazilian researchers investigated the agricultural and livestock components of Brazil's GHGs, and found that agriculture and livestock were responsible for a large share[46]:

- Between 1994 and 2005, agricultural emissions rose 26 percent.
- Between 2000 and 2005, methane emissions from agriculture increased 21 percent.
- In both 2000 and 2005, the growth in enteric fermentation—principally from cattle—was responsible for more than 93 percent of the methane released.
- Between 2000 and 2005, emissions of nitrous oxide grew more than 20 percent. While the sources are varied, 40 percent of such emissions arise from grazing animals depositing their manure in pastures.
- On average, 53.3 percent of emissions from agriculture is due to enteric fermentation (from ruminants' digestive processes), the highest percentage of any agricultural factor measured. According to the researchers, enteric fermentation "represents the most important source of methane to the atmosphere."

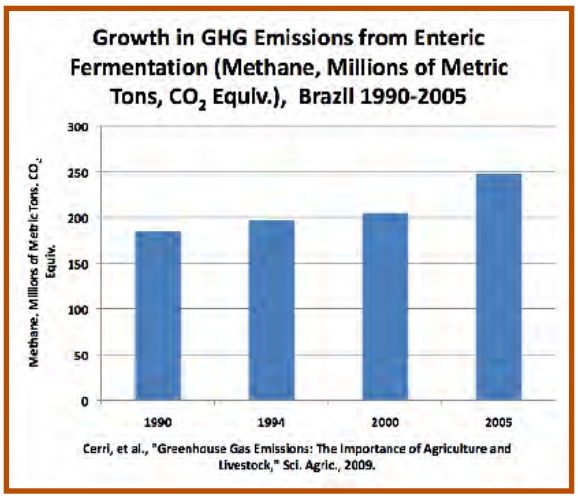
The researchers conclude: "Besides effort to curb emissions from the energy and deforestation sectors, it is now a top priority to implement a national program to incentivize mitigation efforts concerning the agricultural sectors."[47] ■

2018.[29] Just before the 2009 UN climate change summit in Copenhagen, Denmark, the Brazilian government made a commitment to reduce Brazil's GHG emissions 40 percent from projected levels by 2020. Half of the GHG cuts will come from reduced deforestation, and the other half from the industrial and farming sectors.[30]

But the Brazilian government also set another goal for 2018: to double the size of Brazil's cattle herd.[31]

Social and Livelihood Impacts

In addition to incurring significant ecological costs, Brazil's half-century-long agricultural revolution has had marked social and economic effects on millions of Brazilians, including small farmers and rural and forest-dwelling communities.



Control over production of livestock and animal feed is, by and large, concentrated among a small number of powerful agribusinesses, both Brazilian and multinational, and large landowners.

Small-scale, independent farmers increasingly have been pushed to the margins of Brazil's agricultural economy. Some have become *integrados*, or contract farmers, for large conglomerates. Other farmers, lacking the capital to become a contractor, unwilling to give up their autonomy, or facing harassment from large landowners, have joined an ongoing rural-to-urban exodus. This may end in un- or underemployment in one of Brazil's large cities, plus, in some cases, hunger, since they no longer have land on which to grow food.[32]

Monocultures, whether of soy or cattle, worsen economic inequity and inhibit social development, according to João Meirelles Filho, a fifth-generation cattle rancher turned environmentalist who runs the Instituto Peabiru in Pará state. His research found that the cattle industry in Brazil employs on average only one person for every 700 cows. And centers of cattle production, Meirelles documented, have high rates of unemployment and poverty; basic sanitation, schools, and health care are often absent; and enforcement of labor and environmental laws is usually poor or non-existent.[33]

Despite important strides made by the Lula administration to reduce poverty and social stratification, Brazil remains one of the world's most unequal societies when measured by income distribution. An estimated 26 percent of the population, or 50 million Brazilians, lives below the poverty line.[34] Three million children younger than fourteen work, 40 percent of them in agriculture.[35]

And, while considerable natural resources (and capital) have been used to achieve Brazil's leading position in export markets for meat and soybeans, food insecurity in Brazil is still widespread, affecting 37.5 percent of Brazilian households, according to Olivier de Schutter, the UN Special Rapporteur on the right to food. He calls this an "an unacceptable figure for a rich nation such as Brazil."[36]

Moreover, the policies of a number of Brazilian governments and allocation of resources have privileged large-scale, commercial agricultural operations. For example, the Brazilian government has bolstered the agricultural sector—and helped ensure its global competitiveness—by offering plentiful credit, which has become the main source of financing for expansion.

The government's 2008–09 Agriculture and Livestock Plan included 65 billion Brazilian reais ($36.6 billion) in credit for producers, a rise of 11 percent over such funds in the previous year's plan. Of this, 55 billion reais (R$) was directed to large-scale or industrial agriculture, with just R$10 billion for small-scale or family farming.[37]

The allotment of such credit is following a pattern. The Agricultural and Livestock Plan announced in June 2010 nearly doubles available credit from that provided in the 2008–09 plan, to R$116 billion ($61 billion). Again, commercial agriculture is favored: it will receive $53 billion worth of credit (86 percent of the funds), while family

farmers will receive a much smaller share, $8.5 billion (less than 14 percent).[38]

Pattern of Consolidation

In addition to providing credit, the Brazilian government has also invested directly in agribusinesses, including some of the largest. Between 2007 and 2009, for example, the Brazilian National Development Bank (O Banco Nacional de Desenvolvimento Econômico e Social or BNDES) gave the country's three largest beef suppliers, Marfrig, JBS, and Bertin (the latter two have since merged into JBS-Bertin), $2.65 billion dollars in return for company shares.[39] According to the BNDES website: "Supporting competitive Brazilian companies in the international market is a primary objective of the Brazilian government . . . ".[40]

Many Brazilian meat producers are dominant not only in Brazil and other countries in Latin America, but globally, too. JBS-Bertin, for example, formed in 2009, is the world's largest producer of meat and leather.[41]

U.S.-based Tyson has ventured into the Brazilian poultry market, seeing opportunities for growth in exports as well as domestic consumption. Within Brazil's soybean sector, U.S. grain and animal feed leviathans, Cargill and Archer Daniels Midland (ADM), are central actors (Cargill also sells meat products), as is oilseed, grain, and fertilizer giant Bunge (headquartered in the U.S. and Bermuda).

Brazilian agriculture developed to produce high-value export commodities like coffee, tobacco, cotton, and sugar. Food production historically was relegated to small-scale subsistence farmers. Then, as part of the country's policy of import substitution industrialization (ISI) in the latter half of the 20th century, a majority of the profits from Brazil's high-earning coffee sector was used to purchase industrial imports, such as the machinery required for mechanized farming, and to fund research into agricultural technology. By the 1990s, this plan had proven largely successful: the center-west region of the country had become the new agricultural frontier, with farm incomes rapidly increasing and poverty rates falling. But in the process, Brazilian agriculture came to be dominated by large producers, holding vast tracts of land (often bought at low prices, due to close relationships with government officials), as well as domestic and multinational agribusinesses.[42]

Today, while Brazil's ministries of environment and agrarian reform have a "progressive understanding of environmental issues and their relation to farming practices," says Katia Karam Toralles, an anthropologist who runs a small-scale dairy farm in Goiás state, "[i]n terms of where the money and the power are, that's the Ministry of Agriculture, Livestock and Food Supply, and that's basically run by the big guys in agribusiness, as is Congress" So, she adds, "despite internal tensions in the government, the resources and power go to factory farming."[43]

Domestic Demand

"Meat eating is very deeply engrained in the culture," says Simone G. de Lima, a professor of psychology at the University of Brasília and member of the advisory board of ProAnima, a Brazilian animal advocacy organization. "Meat is the meal."[48]

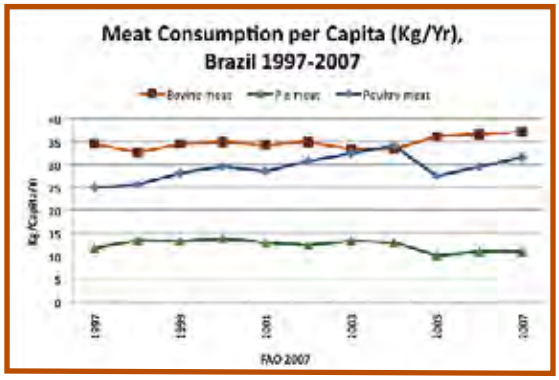
Brazilian *churrascarias*, or steakhouses, are famous for the variety and volume of barbecued meats they serve. At the same time, beans and rice are dietary staples for most Brazilians. Indeed, Brazil's national dish, the stew *feijoada*, is based on beans—but is usually cooked with pork.

A counterpart to Brazil's thriving export trade has been increased consumption of meat, milk, and eggs within the country. As Brazil's economy has expanded, so has the middle

Per capita meat consumption grew by 12 percent in Brazil between 1997 and 2007.

class, to which about 50 percent of Brazilians now belong.[49] This, combined with urbanization and explicit government anti-poverty policies, contributed to a 12 percent increase in per capita meat consumption in Brazil between 1997 and 2007.[50]

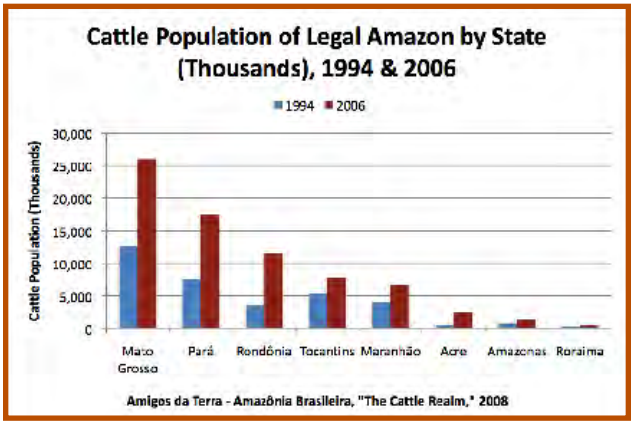
On average, each Brazilian eats just over 80 kilograms (kgs) (176 pounds/lbs) of meat every year. According to the FAO in 2007, about 32 kgs (70 lbs)[51] of this is chicken, not that far below U.S. per capita annual chicken consumption of 39 kgs (85 lbs).[52] Brazilians eat even more beef: just over 37 kgs (81 lbs) per person each year.[53]



Of the approximately 9 million metric tons of beef Brazil produced in 2009, 2 million metric tons were exported; 7.2 million tons were consumed domestically.[54]

Rising demand for meat and dairy products is also due to the success of U.S.-style fast-food outlets, which have secured strong footholds in Brazil. McDonald's, for instance, operates in more than 140 cities across the country; every day, 1.6 million Brazilians eat at a McDonald's.[55]

Lula's administration has sought to reduce the number of Brazilians defined as food insecure or chronically hungry. For many adults and children alike, such conditions are a fact of life. An estimated 11.7 million Brazilians do not receive adequate nutrition.[56]



In 2003, the government launched the *Fome Zero* (Zero Hunger) initiative. A central element is the *Bolsa Familia* (family grant) program, through which poor families receive cash stipends to pay for basic necessities, including food. The program has had considerable success: since the launch of Fome Zero, malnutrition has declined, most markedly for Brazilian children, among whom it has dropped by a precipitous 73 percent between 2002 and 2008.[57]

Bolsa Familia has also been cited as a factor in expanding domestic meat consumption. For many households, the family grants have put not only rice and beans within regular reach, but also meat, principally chicken, which may now be affordable to eat two or three times a week, or even more often.[58]

Even as malnutrition in Brazil declines, consumption of fats, sugars, and protein by Brazilians has spiked, and rates of "diseases of affluence" (so called because until recently these chronic conditions were widespread only in industrialized nations) are increasing. In 2009, 43.3 percent of Brazil's population was overweight, and 13 percent was obese, according to Brazil's Ministry of Health.[59] In 2010, diabetes was diagnosed in nearly 6 percent of Brazilians older than 18,[60] and Brazil ranks eighth in the world in number of people with diabetes, according to the World Health Organization (WHO).[61]

Beef and the Amazon; Cerrado, Too

The Amazon, the world's largest tropical rainforest, traverses eight countries in Latin America, although the majority is found in Brazil. The Amazon forests are home to one in ten of the world's known species and the Amazon is the world's major forest "lung," providing large supplies of oxygen and regulating the global temperature.[69]

Although environmentalists in the 1980s tried to turn consumers away from "rainforest beef," produced by burning the region's forests, the Amazon today remains central to Brazil's cattle industry, the drive to create new pasture is still the primary cause of Amazon deforestation.[70]

Between July 2007 and July 2008, the cattle sector was responsible for the loss of 12,900 square kilometers (sq km) (5,000 square miles/sq mi) of Amazon forest, according to Brazil's former environment minister, Carlos Minc.[71] Studies of land clearing in the Amazon between 2000 and 2005 found that cattle ranching was the cause of an estimated 65–70 percent; small-scale agriculture accounted for 20–25 percent; large-scale agriculture, 5–10 percent; and logging, just 2–3 percent.[72]

In a period of five years, between 2003–08, 110,000 sq

km (42,500 sq mi) of Amazon forest were destroyed,[73] an area equivalent in size to all of Earth's coral reefs.[74]

In 2007, according to research by Friends of the Earth-Amazonia, about 74 million cattle, or 40 percent of Brazil's herd, were living in what is known as the "Legal Amazon," a region that encompasses the Amazon Basin in the north, northeast, and center-west of Brazil, spanning the states of Mato Grosso, Pará, Rondônia, Acre, Amazonas, Roraima, Amapá, Tocantins, and most of Maranhão.[75] The density of cattle in the Amazon is high: 3.3 cows for every person, which is three times the national ratio.[76]

From 1990 to 2003, Brazilian beef production grew by 33 percent, aided by vastly increasing herd numbers in the Legal Amazon states. While various states saw a decline in beef output during this period, those in the northern region, all of which are in the Legal Amazon, saw overall growth in cattle production of 155 percent. States such as Rondônia and Acre experienced huge expansions: 446 percent and 369 percent respectively.[77]

In 2006, the environmental non-governmental organization (NGO) Greenpeace estimated that 80 percent of former forest in the Legal Amazon region, excluding Maranhão state, had cattle on it. Using research by Brazil's Institute of Geography and Statistics (IBGE), Greenpeace concluded that in the decade between 1996 and 2006 pastureland in the Amazon increased by 10 million hectares (ha) (24.7 million acres/ac), an area about the size of Iceland.[78]

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Some analysts suggest that the continued incursion of cattle into the Amazon is why Brazil was able to leapfrog its competitors and become the world's largest beef exporter.[79] Indeed, nearly all, or 96 percent, of the growth in Brazil's cattle population between December 2003 and December 2006 took place in the Amazon, according to Friends of the Earth-Amazonia.[80] Its research also documented at least 200 slaughterhouses within the Amazon, many of them illegal, supplied with cattle by ranchers operating outside existing land tenure, labor, or environmental statutes. In 2007, more than 10 million cattle were slaughtered in the Legal Amazon.[81]

"Amazon beef" is exported around the world, including to Russia (the top importer), Egypt, the U.S., the U.K., the Netherlands, Israel, Iran, Saudi Arabia, Lebanon, China (through Hong Kong), and Côte d'Ivoire.[82] In 2007, beef exports from four major beef producing states in the Legal Amazon (Mato Grosso, Pará, Rondônia, and Tocantins) were valued at nearly $1.1 billion.[83]

In 2010, Brazil and China concluded an agreement to allow Brazilian beef to enter mainland China directly, instead of, as has been the case, through Hong Kong. This will reduce the cost of beef for Chinese consumers, and is likely to lead to increased demand, and consequently, higher beef production in Brazil.[84]

Live exports of cattle from Brazil also have been on a steep

Carbon Capture and Climate Futures

Globally, 20 percent of greenhouse gas emissions (GHGs) result from deforestation and forest degradation. This is second only to the energy sector as a source of GHGs, and just ahead of the livestock sector, which contributes 18 percent of global GHGs, according to the United Nations Food and Agriculture Organization (FAO).[62] A more recent estimate published by the U.S.-based Worldwatch Institute by current and former World Bank environmental specialists puts livestock's share of GHGs much higher, at 51 percent of the global total.[63]

Unlike in other highly urbanized countries, in Brazil a majority of GHG emissions come from rural areas. The average Brazilian emits 8.2 tons of CO_2 a year. But such emissions in São Paulo and Rio de Janeiro, Brazil's two most populous cities, are significantly lower, 1.5 tons and 2.3 tons per capita per year.[64] This reflects the dominance in Brazil's overall GHG emissions of activities in rural areas: specifically the burning of forests and other vegetation (e.g., shrubs and plants) for cattle ranching, production of soybeans and other commodity crops, and illegal logging.

In 2006, deforestation in Brazil resulted in the pumping of close to 265 metric tons of CO_2 into the atmosphere.[65] As trees are burned to make way for pasture or crops, not only is CO_2 released, but the forests' and soils' carbon-capturing capacities are frayed. Also lost is untold biodiversity. In addition, when forests and other vegetation are destroyed or disturbed, the composition of the soil changes, too, losing a range of microorganisms.

Moreover, the destruction of forests changes weather patterns, resulting in less rain and making forests more susceptible to fires that further damage the ecosystem and release yet more CO_2. In 2005, the Amazon experienced a severe drought that led to extensive forest fires in the southwest of the region. When the rains returned in early 2006, the parched ecosystem could not absorb all the water, resulting in serious flooding.[66] A group of international scientists estimated that the 2005 Amazon drought and subsequent fires led to the release of an additional 3 billion tons of CO_2.[67]

The Amazon's survival as a rainforest, and one of the world's main "lungs," is not guaranteed. A study undertaken by the U.S.-based Woods Hole Research Center in 2006 indicated that the Amazon forest ecosystem could not withstand more than two successive years of drought without severe consequences. In such a drought scenario, forest fires would race across the dry ground, denuding the soil. The soil would then be exposed to an unrelenting sun, with the ultimate long-term risk being the Amazon's transformation into a virtual desert.[68]

Such massive change in the Amazon would have global impacts as billions of tons of carbon stored in its forests and soils were released into the atmosphere. ■

Deforestation for agriculture in Mato Grosso

Loans, Leather, and Illegal Slaughter

In its 2009 report, *Slaughtering the Amazon*, Greenpeace tracked the trade of Amazon-produced beef and leather. U.S. and European supermarket giants Wal-Mart, Tesco, and Carrefour were found to have purchased "Amazon beef."[93] Greenpeace also documented that leading Brazilian beef and leather producer, Bertin, had bought beef and leather from Amazon ranches implicated in illegal deforestation, as well as the use of slave labor. A number of high-profile global brands were, in turn, buying "rainforest leather," including Adidas, Nike, and Reebok factories in China. So were car companies Ford, Honda, BMW, and Toyota.[94]

In 2007, despite the objections of environmental groups and past legal controversies over Bertin's sourcing of beef and leather, the International Finance Corporation (IFC), the private sector arm of the World Bank, provided Bertin with a $90 million loan to expand its cattle-slaughtering and processing facilities in the Amazon.[95] The IFC claimed that the project would adhere to high environmental standards and provide a potential model for sustainable cattle production. However, the World Bank's own Independent Evaluation Group recommended against making the loan, concluding that it represented "a grave risk to the environment."[96]

Following publication of *Slaughtering the Amazon*, the IFC rescinded the loan and demanded that Bertin repay the balance immediately.[97] The public prosecutor's office in Pará state warned large purchasers that they would face fines if they continued to buy from meat cattle grazed in illegally cleared land in the Amazon. It also filed a $1 billion lawsuit against numerous Amazon ranches, cattle companies, and Bertin for preventing regeneration of forest illegally cleared.[98] At the same time, the Brazilian Association of Supermarkets (Abras) said it would stop purchasing Bertin's beef until Bertin could prove that it sourced its cattle from legal locations only.[99] Bertin responded to the controversy by issuing a purchasing moratorium on all beef associated with Amazon deforestation, and said that it would map and register all ranches supplying the company with cattle.[100]

After the release of *Slaughtering the Amazon*, Carlos Minc, Brazil's then environment minister, said: "This ministry shares the [Greenpeace] report's view. Cattle ranching today is the main culprit of deforestation."[101] He halted government subsidies put in place to shore up the beef industry during the global recession to cattle ranches, meat packers, and suppliers that had purchased or produced meat in illegally deforested areas in the Amazon. "We can't have public money financing deforestation," Minc said.[102]

Greenpeace consultant and agronomist Tatiana de Carvalho adds: "What we observe is that the potential of the Amazon is not animal and crop farming. [It] has other potentials."[103]

In 2009, Bertin was bought by another Brazilian agribusiness, JBS Friboi. The new company, JBS-Bertin, is the world's largest processor of both beef and leather. Annual revenues for JBS-Bertin are estimated at $28.7 billion, exceeding those of U.S.-based Tyson Foods.[104] ■

upward trajectory, increasing from 1,500 cows in 1997 to almost 450,000 in 2007,[85] and then to 530,000 in 2009. Pará state is the primary source. About 75 percent of the cows are destined for Venezuela, Brazil's northern neighbor. Nearly all the rest, more than 100,000, must travel considerably further, to Lebanon, a distance of 9,500 kilometers (km) (6,000 miles/mi).[86] In addition to cattle, Brazil also produces and exports veal. In 2009, 350,000 male calves were raised in Brazil for veal.[87]

Pará and Mato Grosso in the Legal Amazon are Brazil's two top cattle-producing states. (Each also has vast plantings of soybeans; Mato Grosso harvests more soy than any other state and also has the highest level of deforestation in the Amazon region.)[88]

João Meirelles laments the absence of government incentives for alternate, sustainable economic activities in the Amazon, and the environmental externalities of cattle production in the region. These include soil erosion, water pollution, and the compacting of land under cows' hooves, which impedes the soil's ability to capture and hold rainwater.[89]

Mato Grosso's state borders also place it geographically in the Cerrado, another locus of cattle production in Brazil, although on a somewhat smaller scale than in the Amazon. About 40 million cattle graze in the Cerrado.[90]

By 2008, the region had nearly 600,000 sq km (232,000 sq mi) of pasture, and 56.5 percent of new land cleared was the result of ranching.[91] The soil, though, is becoming exhausted.

Approximately 80 percent of pastureland in the center-west of Brazil, where most of the Cerrado lies, has been degraded, according to the Fundo Constitucional de Financiamento do Centro-Oeste (Constitutional Fund for the Center-west Region).[92]

Soy and the Cerrado

It is, however, the ecological impacts of Brazil's soy boom that are most visible in the rapid, and radical, transformation of the Cerrado. Although little known outside of Brazil, the Cerrado is the most biologically diverse savannah in the world. But grassland, woodland, and riverine ecosystems are disappearing here twice as fast as the Amazon forests.[105]

Extending over 2 million sq kms (722,000 million sq mi) in the center of of the country, the Cerrado about equals Mexico in size and represents 21 percent of Brazil's landmass.[106] It traverses a number of states, some overlapping with the Amazon region: Goiás, Tocantins, and significant areas of Mato Grosso, Mato Grosso do Sul, and Minas Gerais, as well as Bahia, Maranhão, Piauí, and Ceará.

The Cerrado supports 15,000 species of plants, 700 species of birds, and 200 species of mammals, including the jaguar and the maned wolf, many of which are endemic.[107] Brazilians call the region the "birth of all waters" since nearly 80 percent of Brazil's rivers have their origins here.

Almost a million square km (386,000 sq mi), or nearly half of the Cerrado, have been burned[108] and are now cattle pasture, or cultivated for soybeans, corn (another primary ingredient in livestock feed), and sugarcane, for ethanol production. At least one-quarter of Brazil's grain is grown in the Cerrado region.

Each year, 15,720 sq km (6,100 sq mi), or 0.77 percent of the Cerrado's total land mass, is destroyed according to a joint study by Friends of the Earth-Amazonia, INPE, and the University of Brasília.[109] Other researchers put the level of deforestation even higher, at 22,000 sq km (8,500 sq mi) a year.[110] Significant erosion and the silting up of rivers and Amazonian wetlands have also resulted from the clearing of the savannah, while fertilizer and pesticide use associated with monocultures of soybeans have polluted waterways.[111]

Land use in the Cerrado is not governed by the national forest code, so farmers or ranchers can clear as much as 65–80 percent of their plots[112] as opposed to the 20 percent legally allowed in forested areas.

What is particularly troublesome, says Washington Novaes, a Brazilian journalist who writes and broadcasts about the environment and indigenous peoples, is that few contiguous, intact areas remain: "If we consider the viable fragments of the Cerrado, those with at least two continuous hectares (5 acres), only 5 percent of it is left. It's a very severe level of habitat loss."[113]

Even though the Cerrado is not heavily forested, clearing the land still has considerable climate impacts. Trees and other savannah vegetation have deep and extensive root systems, resulting in large quantities of plant matter and a variety of microorganisms under the soil. As the Cerrado burns, the CO_2 stored in underground root systems is released. This has led some scientists who study the Cerrado to suggest that GHG emissions from the destruction

of its ecosystems could rival those from deforestation in the Amazon.[114]

As international pressure to reduce Amazon deforestation has intensified, soybean and cattle production has expanded in the Cerrado. Another factor is the rise in sugarcane production in Brazil's southeast, making that land unavailable for soy. (Sugarcane remains Brazil's largest crop, with annual harvests outpacing both soybeans and corn by a factor of 10.[115]) "Given that there's very little left to burn anywhere else," Novaes observes, "pretty much of the remainder is the Cerrado being burned."

If the transformation continues at the current pace, by 2050 the Cerrado will be completely gone, apart from a few fragments, says Marcelo de Lima, a conservation biologist and project manager at the Brazilian Ministry of the Environment (and brother of Simone de Lima).[116]

Nonetheless, according to WWF (the World Wildlife Fund), Brazil's regional and state inventories designate 70 to 100 million ha (173 million to 247 million ac) across the country as having potential for soy cultivation. A majority of these occur in virgin or lightly disturbed parts of the Cerrado.[117]

Along with the loss of biodiversity, cultures, too, are disappearing from the Cerrado, particularly those of indigenous communities, whose members are leaving or being forced from their land as the agricultural frontier advances.[118]

Cheaper to Burn

A major reason why Brazilian agricultural producers keep moving further into both the Amazon forests and the Cerrado grasslands is that it is cheaper and easier to clear virgin land, often owned by the government, than to reclaim land that has already been used for agriculture. In the Amazon, the soil in older cattle pastures erodes quickly and is rapidly overtaken by vegetation. For small- and medium-size producers, rehabilitating these pastures requires skills they do not have or cannot pay for, and no government subsidies or programs of technical assistance exist that would make this a more viable path.[119]

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Large landowners make another calculation: since it costs less and is faster to burn new land than rehabilitate it, that is what many do. Clearing a hectare of forest, for example, costs R$200–300 ($114–170), while preparing a previously used area for new pasture costs R$700 ($400) per hectare, according to Meirelles. He also notes that "settlers" in Brazil have tenacious cultural associations. Many still see the forest as an obstacle to progress that

Cows being herded along a highway in Mato Grosso do Sul

Milk, Too

Known around the world for its beef, Brazil is also the world's sixth largest producer of cows' milk. Among Brazilian commodities, milk ranks third in overall value, after soybeans and sugarcane.[137] In 2009, Brazil had nearly 17 million dairy cows and produced 31 million metric tons (68 billion pounds) of milk, most of it consumed domestically.[138] The large majority of Brazil's milk is ultra high temperature (UHT) processed.[139] UHT milk can be packed in a carton, does not have to be refrigerated, and has a much longer shelf life than fresh milk. In Brazil, UHT milk is generally sold in supermarkets, while fresh milk is available at smaller shops, convenience stores, or neighborhood bakeries.[140]

Between 2007 and 2008, production of milk in Brazil rose 8 percent, the result of higher domestic and overseas demand and record prices for producers. However, between 2008 and 2009, growth dipped somewhat, to about 5 percent over the previous year, as milk prices declined and concerns about rising costs of inputs and a lack of credit unsettled producers.[141]

The Brazilian dairy industry is keen to make its mark in the global marketplace, including for whole milk powder. In 2007, Brazil exported 42,000 metric tons of dried milk giving it a rank of 14th in the world in dried milk exports, along with 2,000 metric tons of whole cows' milk, up from 71 metric tons in 2006.[142] Such exports are expected to grow, boosted by a 2009 devaluation of the real.[143]

All states in Brazil have some dairy operations. In 2006, 75 percent of production was concentrated in six states: Goiás, Minas Gerais (the top state, accounting for more than 30 percent of Brazil's milk production), Paraná (a key producer of corn and soybeans, as well as pork), São Paulo, Santa Catarina (which is also a locus of pork and poultry production), and Rio Grande do Sul.[144] The biggest increases in milk production between 1998 and 2006 occurred in northern Brazil, including in the states of Acre, Pará, Rondônia, and Tocantins, all in the Legal Amazon.[145]

A large majority of Brazil's farms have 200 or fewer dairy cows, and most cows still graze on pasture. Nonetheless, factory-style semi- and full-confinement systems do exist in Brazil.[146] As operations become more industrialized, the number of cows increases. According to an analysis published in 2006, extensive systems for dairy cows in Brazil had, on average, 37 cows. Semi-confined systems had 110 cows. Confined systems, or factory dairies, in which animals are kept penned in indoor stalls and fed grain-based feed, had 424 cows.[147] This is a comparatively small number when measured against the thousands of cows housed in factory dairies in the U.S., Europe, and in some developing regions.

While dairy cooperatives in Brazil are still numerous, and one of them, Itambé, is a major player in the industry, large agribusinesses, both domestic and multinational, are increasingly active in Brazilian dairy processing. These include DPA (a joint venture of Switzerland-based Nestlé and New Zealand–based Fonterra), Elegê, Parmalat, Bom Gosto, and Perdigão,[148] one of Brazil's largest food companies.

According to the U.S. Dairy Export Council, Brazil is the most promising of five countries it deems well positioned to become major dairy exporters and to challenge U.S. dominance of the sector.[149] The U.S. Department of Agriculture (USDA) notes that Brazil's domestic dairy market is facing increased competition from soymilk and other products free of the milk protein lactose. Health concerns, the USDA says, are the prime reason for expanded consumption of dairy alternatives.[150] ■

needs to be eliminated, an attitude Meirelles contrasts with indigenous communities' more symbiotic relationship with the environment.[120]

For decades the Brazilian government promoted a "frontier mentality" that encouraged people to venture into wilderness areas and claim the land they found as their own, a means of providing "men without land for land without men."[121] As farmers and ranchers settled Brazil's interior in the 1960s and 70s, government policy stated that to qualify for loans to speed agricultural development, 80 percent of the land had to be cleared.[122] (Another objective of the government and the new settlers was to reduce the risk of malaria in the forested interior.[123])

But in 1996, alarmed by persistent deforestation and international criticism of it, particularly in the Amazon, Brazil's government issued a decree: only 20 percent of land could be cultivated, with 80 percent to be reserved as forest.[124] The forest code, however, does not apply to all of Brazil's woodland areas. The Cerrado, for example, is excluded.

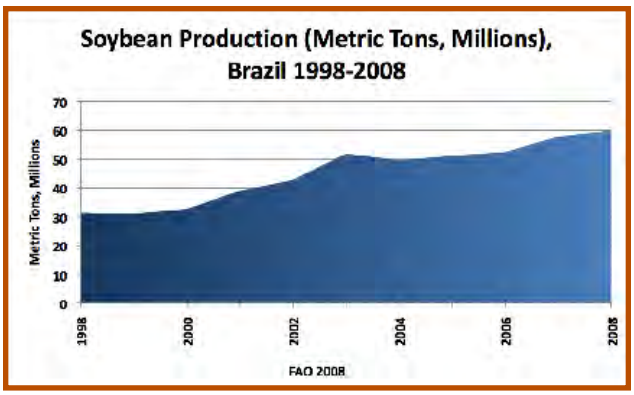
When it was announced, however, the 80 percent decree "created a mass hysteria and a state of civil disobedience

where landowners said 'to heck with this' and just tore down everything," in the view of John Carter, a U.S. cattle rancher who moved to Brazil in 1998.[125]

Indeed, the forest code continues to be widely ignored; the government has not been able to enforce it effectively, and its provisions are challenged regularly by agricultural interests.

Another incentive for continued deforestation is provided by rising land values.[126] Carter, who runs Alliança da Terra (Land Alliance), which is accrediting and marketing the products of Brazilian beef and soybean producers that adopt more sustainable practices, reports that the price of land where he lives in Mato Grosso more than quadrupled between 2000 and 2007. Demand for land in the state is high, both for ranching and cultivation of soy. "The return on land appreciation is so great and the justice system so slow," Carter says, "that by the time you catch a landowner [who illegally deforested his land], he's already sold the land and made a fortune."[127]

The government has charged that local elected officials allow ranchers, large-scale soy producers, and loggers to clear land in violation of the national forest code to ensure votes in future elections. Such institutional corruption often results in the falsification of land titles or in cattle, soy, or timber barons buying land from indigenous peoples living in forested areas at prices well below market rates, or simply taking land through intimidation or force.[128] Some researchers say that an "expectation of impunity" exists in Brazil for those (whether individual or institutional) that flout the forest code, ignore restrictions on grazing cattle on public lands, or violate environmental laws.[129]



An additional challenge is that government agencies charged with enforcing the forest code are woefully underfunded and understaffed. "The monitoring of federal land is absolutely precarious," says Washington Novaes. He points out that while 47 percent of land in the Brazilian Amazon belongs to the government, only 4 percent of it is registered (surveyed, measured, and a legal title issued). The regional director of the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) in the municipality of Floresta, in Minas Gerais state, is responsible for monitoring 82,000 sq km (31,700 sq mi) of forest, "but has only four employees and three broken cars to patrol the area," according to Novaes. The Jaú National Park, in Amazonas state, the largest forest reserve in Latin America, he continues, "has the whole of one guard!" When the government talks about preventing forest loss "it's only paying lip service," Novaes says. "Deforestation is tacitly accepted."[130]

Even as Brazil's Ministry of Environment works to improve monitoring of the deforestation that has occurred and to prevent more, it has met increasing resistance from Brazil's powerful and vocal agricultural lobby. Ahead of the 2009 UN climate summit, Brazil's Ministry of External Relations mediated sessions between the ministries of agriculture and environment, which were at odds over environmental legislation. In the past, the Ministry of Agriculture has succeeded in having the percentage of land allocated to "legal reserves" reduced, and continues to advocate a more lax interpretation and enforcement of Brazil's existing environmental laws.[131]

Forests and Indigenous Communities

Brazil's indigenous peoples, whose numbers total 220,000 in the Amazon region,[132] live closest to the land and often experience the brunt of ecological destruction. They face new and distinct challenges from the expansion of the agricultural frontier and the effects of global warming.

Brazil's Kamayurá, a community in the Amazon Basin, for example, have watched fish stocks collapse due to rising temperatures and water pollution.[133] Reduced forest cover and resulting changes in rainfall patterns in the center- and south-west of the Amazon mean that the Kamayurá can no longer rely on consistent harvests of cassava (manioc).[134]

Gonzalo Oviedo, a senior advisor at the International Union for Conservation of Nature (IUCN), warns of the increasing likelihood of cultural extinction as environments around the world degrade: "Some of those [communities] that are small and marginal will assimilate and disappear."[135]

A recent study by a consortium of research institutes, NGOs, and universities concluded that deforestation rates on indigenous-held lands in the Brazilian Amazon and in protected areas were significantly lower than in land not under indigenous control or without protected status.[136]

Soy field in Mato Grosso

The Story of Soy in Brazil

Brazil's soybean production is increasing steadily: in 2008, soybeans covered 45 percent of Brazil's farmland planted with food grains, and soy exports accounted for 26 percent of agricultural export revenues.[151]

As hectares and harvests have continued to increase, Brazil's comparative advantages are becoming increasingly evident to those who track the global soybean economy: a tropical climate, relatively abundant water resources, higher yielding species, and large tracts of "undeveloped" land. This has led to anticipation that Brazil's steadily increasing production of soy will only accelerate further as demand continues to grow for reliable feed sources for the expanding global livestock population.

The industrialization of Brazil's soy sector is a relatively recent phenomenon, and soy is a comparatively new crop in Brazil. Brazilian farmers began planting soybeans in 1914, then as now for use as livestock feed, but it wasn't until the 1960s that its popularity exploded, helped in large part by government subsidies.[152] In his book *Stuffed and Starved: Markets, Power and the Hidden Battle for the World's Food System*, Raj Patel charts the expansion of the soy industry in Brazil. A key event took place in the early 1970s, following U.S. President Richard Nixon's short-lived embargo on U.S. soybean exports. Japan, seeking a reliable supply of soybeans, courted Brazil.[153]

Sensing a market opportunity—and a way to both develop its interior and challenge U.S. dominance in world agricultural markets—Brazil invested heavily in soy processing plants, transportation infrastructure, and technology. With help from the agro-industrial sector along with government subsidies, from the mid-1970s on, soy production expanded into Brazil's center-west, specifically to the Cerrado, as varieties of soy were developed that could thrive in the region's dry climate. (Between 1968 and 1997, 116 new types of soybeans, tailored to specific soil and weather conditions, were introduced in Brazil.)[154] By 1979, Brazil was producing 18 percent of the global soybean crop.[155]

As the global appetite for meat and dairy products increased, and factory farms became the industry standard, demand for animal feed grew, too. By the 1980s, soybeans had become one of Brazil's main agricultural products, and the promise of lucrative deals and potential for expanded production attracted the interest of Cargill, Bunge, and ADM.

Beginning in 1988, the multinationals capitalized on Brazil's mounting foreign debt and the government's inability to further subsidize the soy sector to buy land and build storage facilities and transportation hubs.[156]

This new infrastructure and relatively low land-prices lured many Brazilain farmers to start or increase cultivation of soybeans. But the shape of the sector was changing in ways that constrained their ability to compete, particularly the influx of foreign investment that fueled the growth of industrial farms and methods of production. For small-scale farmers growing soybeans as well as other grains or vegetables, crop rotation was the norm and labor needs were relatively large. On average, one person was employed for every 8 hectares farmed, a source of jobs for those living with little or no land in rural areas.[157]

But mammoth operations, growing only soybeans, some as large as 10,000 to 15,000 ha (25,000–37,000 ac), and employing just one worker for every 200 ha (494 ac) farmed,[158] came to dominate. A majority of soy production in Brazil now takes place on large, mechanized farms. Some can be enormous, dwarfing small- and medium-sized operations. While the average farm producing soybeans in Mato Grosso spans 1,000 ha (2,471 ac), some soybean operations in the state can extend over 50,000 ha (124,000 ac).[159]

As a result, rural job numbers have shrunk and smaller producers either have been squeezed out entirely, or have become contract soy farmers for agribusinesses. These *integrados* produce soybeans to standards set by the large growers, and are provided by them with seeds, fertilizers, and pesticides to ensure standardization of and predictable levels for the harvest.[160]

Corporate agricultural interests now dominate virtually all of Brazil's soy chain, from decisions over which seed varieties to plant to processing and export of the final product.

Growth of GM Soy

The outbreak of mad cow disease in the U.K. in the mid-1980s also played an important role in the expansion of Brazil's soy sector. Due to widespread public outrage over the public health and ethical consequences of the then-standard practice of feeding meat by-products to cattle, U.K.-based producers searched for new sources of feed for farmed animals. Soy fit the bill.[161] The E.U. is now the second largest importer of Brazilian soy, after China.[162]

Corporate agricultural interests now dominate virtually all of Brazil's soy chain, from decisions over which seed varieties to plant to processing and export of the final product.

Soy shipped to the E.U. is required to be free of genetically modified varieties ("GM-free"), although a 0.5 percent level of contamination is allowed. But many other buyers of Brazilian soy do not impose these restrictions, and plantings of GM soybeans now outstrip those of conventional soy. As of 2008, GM soy accounted for nearly 60 percent of Brazil's soy harvest.[163]

Sixty-seven percent of Brazil's 2009–10 soy crop is Roundup Ready, a breed of soybean developed and sold by U.S.-based agro-science corporation, Monsanto. This soybean seed has been genetically engineered to be resistant to Monsanto's herbicide Roundup. In Mato Grosso, 6 million ha (14.8 million ac) of GM soy are being cultivated.[164]

Along the BR 020 federal highway, one can drive for hours from Goiás in the center of Brazil to Bahia on the coast and see almost nothing but a dense, broad ocean of soy marked with yellow "Roundup Ready" signs stretching to the horizon. (Cultivation of GM corn in Brazil is also rising and now accounts for 40 percent of all corn acreage in the country.)[165]

Brazilian civil society groups have expressed concern about the environmental, public health, and economic impacts of GM soy. "The small rural worker [growing GM soybeans] . . . is made hostage to corporations and technological packages," says Tatiana de Carvalho, an agronomist and consultant for Greenpeace in Brazil, in a 2008 interview with Brazil's Instituto Humanitas Unisinos. "[H]e's forced to buy seeds and the package [of] inputs that increase the costs of production. . . . His profit is going to the corporations."[166]

In the U.S., farmers who have been using Roundup for years on GM soybeans and other crops are now contending with "superweeds." These tenacious plants have become resistant to Roundup and must be eradicated by other

Soy, Water, and China

In the decade between 1994 and 2004, world trade in soybeans doubled. Two-thirds of this expanded market was filled by Brazil and Argentina.[180] China, until relatively recently a net exporter, has become a huge importer of soy for use as livestock feed. In 2010, China is expected to buy 55 million tons of soy in global markets, a record.[181] More than half of soybeans traded on world markets are purchased by China.[182]

China's rising demand for soybeans has been met in large measure by the expansion of soy acreage in Brazil. Currently, China purchases more than 40 percent of Brazil's soy.[183]

Through buying Brazilian soy, China is also importing water, an increasingly precious resource for the country. Researchers estimate that China has less than one-tenth the water resources per capita of Brazil, and in China's northern soy-producing regions, water tables have been dropping dramatically, by between three and ten feet a year, according to the China Groundwater Information Center.[184]

"The easiest way for China to get around its water shortages is to import soybeans," says Chris Mayer of the hedge fund Passport Capital. Through Brazilian soy, Mayer estimates China is importing the equivalent of 14 percent of its water requirements.; according to Washington Novaes, agribusiness in Brazil consumes 80 percent of the country's water, an ecological draw that is not fully accounted for.[185]

In 2010, China's imports of Brazilian soybeans may reach a record level. "The Chinese appetite is increasing and Brazil is ready to supply what is needed," Sergio Mendes of the Brazilian Association of Grain Exporters, which includes Cargill and ADM, told Bloomberg News in July 2010.[186] ■

means, such as stronger pesticides, hand weeding, or plowing up the soil. "We're back to where we were 20 years ago," Eddie Anderson, a soybean farmer in the U.S. state of Tennessee told the *New York Times*.[167]

Another recent development has elicited the ire of climate-change campaigners. Monsanto is seeking to obtain carbon credits for GM crops in any post–Kyoto Protocol global climate agreement, as well as funding from the Clean Development Mechanism (CDM).[168] (The CDM offers saleable credits for emissions-reducing projects in developing countries that industrialized countries can use to meet their GHG reduction targets under the Kyoto Protocol.)[169]

Monsanto's argument in favor of having carbon credits issued is that because fields planted with GM crops are doused with large quantities of herbicides the soil does not have to be plowed, thereby enhancing its potential to capture and store CO_2. (Recent experience with Roundup-resistant weeds in the U.S., however, suggests that fields planted with GM crops may eventually require plowing.) Critics of the proposed scheme argue that herbicides not only negatively affect the soil, water, ecosystems, and other species, but that producing them requires significant amounts of fossil fuels, guaranteeing emissions of GHGs—precisely the opposite of carbon sequestration.[170]

The High Costs of "Soyanization"

Just four multinationals—the U.S.' ADM, Bunge, Cargill, plus Louis Dreyfuss, a French commodity and energy firm—control 43 percent[171] of Brazil's "crushing capacity," the process that separates soybean oil from soybean meal. And since they also are important players in Brazil's livestock sector, they act as supplier, processor, purchaser, and consumer of Brazil's soy.[172] This reinforces the advantages, and power, of the soy conglomerates at the expense of small- and medium-scale farmers.

For contract farmers supplying soybeans to Cargill or ADM, low profit margins, incurring large debts to purchase the required inputs, and high costs and delays in getting soybeans to ports and onto ships for export often are daily realities. "Just because we're producing a lot of beans here doesn't mean we're making money," Rogério Salles, who grows soybeans on a 7,000 ha (17,300 ac) farm near Rondonópolis in Mato Grosso, told the *International Herald Tribune*. "You do all the work, you plant the right crops, but even when you do everything right, you still lose."[173]

In 2007, contract soybean farmers reported a 25 percent rise in the price they were charged for fertilizer by the large producers. "We are becoming slaves of the big trading companies," according to Ricardo Tomczyk, who also grows soybeans in Mato Grasso.[174] Since the *integrados* repay such fee hikes with soybeans, a cycle of increased production to keep pace with increased fixed costs is set in motion, intensifying pressure to clear more savannah or forested land for new plantings.

Due to the consolidation of production, many farmers and other rural workers have moved away from areas with

Cattle and Soy: Push, Pull

In Brazil, cattle and soy production have magnified each other's ecological impact, and spurred additional clearing of land. Once cattle have grazed the undergrowth left after forest is burned, soybeans can grow in the soil.[187]

"Areas previously occupied by cattle farming are taken over by soy fields, pushing cattle further into the forest," according to Tatiana de Carvalho. A common pattern is that a cattle rancher clears land and puts one or two cows on each hectare, which helps establish the property as his. He then sells the parcel, called a posse,[188] to a soybean producer.[189] Whoever burns the forest can get a double benefit: the use of the land itself, plus money from sale of the cleared trees. Trees harvested in the Amazon earn good prices when sold as timber or lumber; those harvested in the Cerrado are usually twisted, so are sold for lower-priced charcoal.[190]

The government has granted easy access to credit to producers of export commodities traded in U.S. dollars, so those wanting to plant soybeans often have the means to purchase cattle ranchers' land.

While not much rainforest has been burned explicitly for soybean cultivation, soy is implicated in considerable indirect deforestation. "People don't knock down the forest and then plant soy, but it is a vector pushing other occupations in the forest," de Carvalho says.[191] In Mato Grosso, a 2010 study found that where plantings of soybeans had increased, pasture area had dropped. But as if to compensate for soy's growth, new pastures for cattle may have been created further north, in rainforest in Mato Grosso, as well as in Pará and Rondônia.[192]

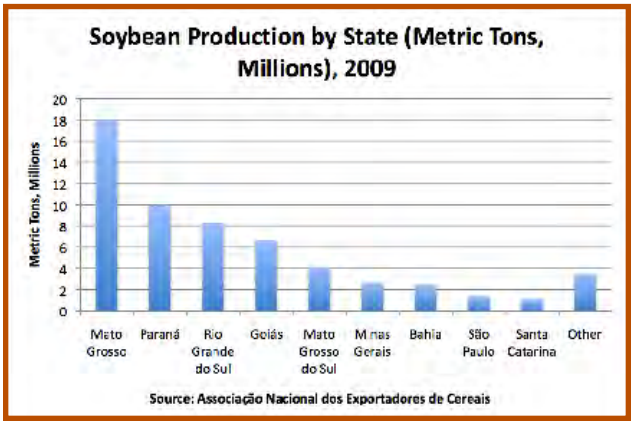
As cattle ranchers and soybean producers press deeper into undeveloped areas searching for cheaper land, agricultural infrastructure follows—and more forest and other vegetation are converted to pasture or crops. Such was the case in the 1970s when the Brazilian government built the BR 163 "soy" highway. ■

extensive cultivation of soybeans to urban centers. Others have relocated to more remote frontier regions, leading to new deforestation.[175]

For those who remain on their land, farming with industrial soy operations nearby is not always easy. "The large landowners don't live on their farms, and they apply chemicals indiscriminately," de Carvalho explains, leading to negative health impacts on the farmers and their families as well as the domestic animals many still raise in extensive systems.[176]

Recent record soy harvests in a number of Latin American countries may depress world soybean prices—and encourage Brazilian producers to plant and harvest even more soy. In this scenario, clearing new land is practically guaranteed.

Some farmers, agro-ecological producers, and advocates for food security in Brazil lament the "soyanization" of Brazilian agriculture. They cite government policies and resources that have resulted in the rapid growth of industrial-scale soybean cultivation and soy's dominant position in the national agricultural economy at the expense of both independent farmers and crop diversity; the concentration of ownership among the large soy producers and the political power they wield; and the heavy reliance on international buyers and the prices for soybeans set by global commodity markets.



Nonetheless, the Brazilian government has initiated federal, state, and regional programs to further develop the soy sector along the current trajectory. One such initiative is Avança Brazil, which was launched in 2000 to improve the agricultural transport infrastructure as a way of lowering the costs of shipping soybeans from production sites in the interior to coastal ports where the soybeans are processed and exported. The program is funded in part by agribusinesses, which, together with the federal government, are developing roads, water, and rail transportation throughout the center-west of Brazil.[177]

Completion of the paving of the BR 163 federal highway from Mato Grosso to link up with Cargill's contentious deepwater port in the Amazon town of Santarém in Pará state is a cornerstone of this effort. Known as the "soy highway," the BR 163 runs 1,770 km (1,100 mi) north–south between Cuiabá in Mato Grosso and Santarém in Pará.

The Santarém port, which opened in 2003, has been judged illegal by environmental NGOs and members of the local community since its construction began without Cargill filing the required environmental impact assessment.[178]

Although the port has been the subject of legal challenges, a Supreme Court ruling that shuttered it temporarily, and a 2007 action by IBAMA (the Brazilian Institute of Environment and Renewable Natural Resources) that closed the port so its effects on the environment could be reviewed, it is operational. Moreover, Cargill has plans to vastly increase the port's handling capacity, in line with Brazil's expanding soybean harvest. Critics of the Santarém port see its presence as the prime cause of increased destruction of rainforest in the region to accommodate new soy production.

The rapid growth of large-scale soybean cultivation in Brazil has led not only to the transformation of large areas of wilderness in the Cerrado and the Amazon, it also has affected ecosystems throughout the country. For example, agricultural firms have planted soybeans in the Campos Sulinos grasslands in the southern state of Rio Grande do Sul, and cultivation of soybeans has contributed to the destruction of large swathes of Brazil's Atlantic Forest.[179]

Big Producers, Big Purchases, Big Profits

Brazilian and multinational agribusinesses have, in a burst of mergers and acquisitions between 2008 and 2010, extended their reach and market share both within Brazil and internationally. In 2009, Sadia and Perdigão, both top Brazilian poultry producers, merged to form Brasil Foods. The new company controls 75 percent of the frozen food market in Brazil and can process 3.5 million chickens a day.[202]

Marfrig Alimentos, a leading Brazilian beef processor (its facilities can slaughter more than 13,000 cattle a day in Brazil, plus 7,800 in other countries), also has considerable market share in Brazil in poultry and pork, and distributes other food products, including pasta and frozen vegetables.[203] In August 2009, Marfrig and Bertin called off negotiations to merge and form Brazil's largest beef-processing operation.[204]

Instead, Marfrig went on to buy Seara Alimentos (Harvest Foods), Cargill's Brazilian poultry and pork venture. This has given Marfrig the capacity to process more than

2 million chickens a day in Brazil.[205] (Cargill's sale of Seara Alimentos did not change the company's "commitment to the continued growth of its beef, pork, poultry, and egg businesses around the world," a Cargill spokesperson said.[206])

Also in 2009, Marfrig purchased the Brazilian turkey operations of French meat producer Groupe Doux,[207] and in June 2010, it bought U.S.-based Keystone Foods, a large meat processor, for $1.26 billion. This acquisition allows Marfrig to become a major supplier of poultry and beef to McDonald's and Subway outlets in the U.S., Australia, France, and other countries.[208] (Marfrig and Brasil Foods already supply meat to McDonald's in Brazil.)

Another leading Brazilian beef producer, JBS, picked up where Marfrig left off. In addition to buying out Bertin, in September 2009 JBS purchased a 64 percent stake in Pilgrim's Pride for $800 million.[209] Pilgrim's Pride, then the U.S.' second largest chicken producer, had filed for bankruptcy, citing in part the high costs of feed grains.[210] This transaction made JBS, now JBS-Bertin, the second biggest poultry producer in the U.S. after Tyson Foods.[211] Tyson calls itself the "world's largest protein producer." Perhaps not to be outdone, JBS uses the tagline: "We feed the world."

Just a year earlier, in 2008, JBS bought Smithfield's U.S. beef operations, as well as the Tasman Group, a major Australian processor of beef and lamb.[212] JBS' purchases have not been limited to beef and poultry. In 2007, it acquired U.S.-based Swift & Company, a leading supplier of pork, as well as beef; through this purchase, JBS became the U.S.' third largest pork producer.[213]

In addition to exercising its international ambitions, JBS has consolidated its position in Brazil. In July 2009, a few months before merging with Bertin, JBS leased five processing units in Mato Grosso from rivals struggling with debt, adding 25 percent to its "slaughter capacity" for a total of 26,000 cattle a day.[214]

The ability to produce fertilizer—an essential input for large-scale production of feed crops—has become economically more attractive, too, as trendlines suggest continuing increases in global demand for animal products. Brazilian firms are not being left out, even if some of the alliances are unusual. In January 2010, for example, Vale, a

Thick Forest No More

Mato Grosso means "thick forest," a name that conjures the vast stands of trees that once covered much of the state. Today, however, soybeans extend in all directions where woodlands, grasslands, and Amazon forest once stood.

Nearly one-third of Brazil's soybeans are grown in Mato Grosso.[193] Between 1999 and 2004, soybean plantings doubled here and in neighboring states Mato Grosso do Sul and Goiás to the south and east. This expansion, displacing forest and savannah, encompassed approximately 54,000 square kilometers (sq km) (21,000 square miles/sq m), an area larger than Costa Rica.[194]

Mato Grosso's former governor, Blairo Maggi, is known as "O rei da soja" (the soy king). (First elected in 2003, Maggi left the governor's job in 2010, near the end of his second term, to run for a seat in Brazil's Senate. He was elected a senator in October 2010.) Maggi also heads his family's agribusiness, Grupo André Maggi, which is Brazil's largest producer of soy. Grupo Maggi's holdings include 142,000 ha (350,000 ac) of agricultural land, half planted with soybeans. Grupo Maggi is also associated with companies that sell soybean seeds and provide water, transport, and civil engineering services for agriculture.[195] In Brazil "Maggi" is a household name, with Maggi soup cubes a particularly well-known brand.[196]

When Maggi took office, he advocated tripling the amount of land in the state used to produce soy.[197] During his first year as governor, deforestation in Mato Grosso increased by 30 percent.[198] As a result, Maggi has been subject to intense criticism from Brazilian and international environmental NGOs, which object not only to the rise in forest loss on Maggi's watch, but his remaining head of Grupo Maggi while serving as governor, and his blunt, often confrontational speech.

"To me, a 40 per cent increase in deforestation doesn't mean anything at all," he told the *New York Times* in 2003. "We are talking about an area larger than Europe that has barely been touched, so there is nothing at all to get worried about."[199]

When visiting Mato Grosso in 2003, President Lula seemed to concur. "The Amazon is not untouchable," he said.[200] The Brazilian government is planning additional soybean cultivation in Mato Grosso, as well as significant growth in soybean production in the north-eastern states of Maranhão (in the Legal Amazon), Piauí, and Bahia.[201] ■

large Brazilian mining company, bought Bunge's Brazilian fertilizer businesses for $3.8 billion.[215]

Along with acquisitions in Brazil, the U.S., and elsewhere, Brazilian agribusinesses have amassed facilities and natural resources to produce meat and feed in other parts of Latin America. JBS-Bertin owns beef- and leather-processing plants in Uruguay and Paraguay,[216] Marfrig has beef-processing operations in Argentina, Uruguay, and Chile. In addition, Brazilian and Argentine agribusinesses reportedly own 20 percent of Uruguayan land, which is used for beef production,[217] and Brazilian producers distribute nearly half of Uruguay's beef.[218]

Brazilian companies also control between 80 and 90 percent of Paraguay's soy. Regional trade rules encourage the processors to import soybeans grown in Paraguay to Brazil, from which they are exported.[219]

"Eat more MEAT"

Expansion of Industrial Animal Agriculture

It is not just cattle and soybeans: Brazil has also experienced a "livestock revolution" in poultry, pork, and egg production that is ongoing. It has centered on replication of the model of industrial animal agriculture practiced in and promoted by producers in the U.S. and E.U., and has been encouraged and sustained by Brazil's ample supplies of soybeans, corn, and water; relatively low-wage labor, affordable and available credit; and supportive government policies and subsidies. Mechanization and consolidation in the global meat, egg, and dairy sectors have led in Brazil, as elsewhere, to more animal products being produced and sold at relatively low cost—but with multiple "externalities" or unsummed costs.

Indeed, the livestock revolution in Brazil (as in many countries) has gained speed and scale by relegating concerns about global warming, water pollution, sustainability, rural livelihoods, concentration of production, equity, animal welfare, and, in some cases, human rights considerations, to the margins.

In recent decades, as its share of global trade in poultry and pork has increased, the size and intensity of Brazil's livestock sector have increased considerably. Factory farms are now commonplace in Brazil for chickens (egg-laying hens and chickens raised for meat) and pigs. Intensive confinement is also commonplace for the male calves raised for veal. They are housed in small crates in which they cannot turn around and are fed a diet that induces near-anemia to ensure meat that is pale and lacking in muscle.

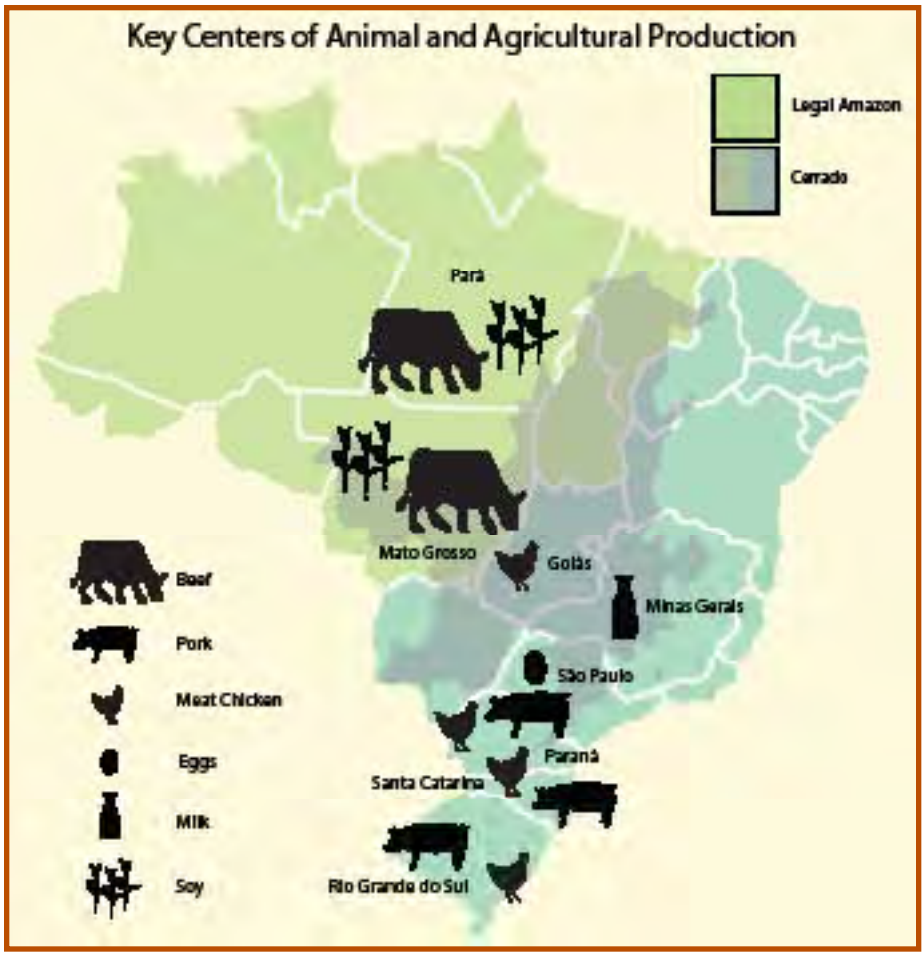
Given the need for large quantities of feed for factory-farmed animals, industrial-scale livestock facilities are most numerous in Brazilian states with plentiful supplies of soy and corn.

Soybeans and maize together account for more than 80 percent of Brazil's grain production, with a majority of each crop's harvest sold and processed into animal feed. Between 2004 and 2005, 90 percent of Brazil's corn and 80 percent of its soy were used by animal feed processors.[220] Despite its major role in the global soy market, well over half of Brazil's soybean harvest is used domestically for livestock feed, and this proportion is increasing.[221]

In 2010, Brazil is expected to export a record level of nearly 30 million metric tons of soybeans, leaving almost 40 million metric tons for domestic use.[222] Brazil's 2010 corn harvest is expected to yield 51 million metric tons, of which 38 million metric tons will be used within Brazil to feed livestock. (Paraná is the top corn producing state, while Mato Grosso leads in production of winter corn or *safrinha*).[223]

In addition to securing supplies of feed grains, large poultry and pork producers also have successfully secured government financing to expand their operations, often at the expense of smaller producers.

In 2006, for instance, BNDES provided R$213 million



($121 million) in loans to 132 contract farmers in Lucas do Rio Verde in Mato Grosso that supplied agricultural giant Sadia (now part of Brasil Foods) with slaughtering and fattening facilities for pigs and chickens. While 20 percent of the farmers who received the BNDES financing were defined as small, with annual revenue of up to R$160,000 ($91,000) a year, 30 percent were defined as large, with annual revenue of over R$1 million ($567,000).[224] (*The Economist* magazine has written that BNDES "transfers money from low-paid workers to the balance sheets of Brazil's large companies."[225])

In 2010, agriculture minister Reinhold Stephanes said that Brazil is moving to adopt even more intensive livestock production: raising greater numbers of animals in larger facilities, but each one in a smaller space.[226]

"Industrial farming practices generate a product that's destined for the consumption of a minority," small-dairy farmer Katia Karam observes. "[It] is directed at exports only and doesn't consider the social and environmental impacts that this standard has on our country, which are not adequate or feasible for the great majority of Brazilian farmers."[227]

Factory farms and feedlots, which may appear efficient, since the animals are kept in small enclosures that cover relatively small areas, thereby seemingly using less land, have enormous feed requirements that must be met by using other land, such as the Cerrado. In addition, due to the concentration of large populations of animals who are fed intensively to reach slaughter weight as quickly as possible, each operation produces a vast amount of waste. A multi-year study of industrial animal agriculture in the U.S. concluded that factory-farm facilities

have produced an expanding array of deleterious environmental effects on local and regional water, air, and soil resources. Those effects impose costs on the society at large that are not "internalized" in the price paid at the retail counter for meat, poultry, dairy, or egg products. The large concentration of animals on the typical industrial farm presents a major waste management problem. The volumes of manure are so large that traditional land disposal methods can be impractical and environmentally threatening. Excess nutrients in manure contaminate surface and groundwater resources.[228]

Chickens…

The center of Brazil's poultry industry is in a handful of states in the very south of the country, as well as in the state of Goiás in the center-west, and its scale is enormous.[229] More than 100 million broiler chickens are produced in Brazil every week, an annual total of more than 5 billion.[230] At any one time, 1.2 billion chickens are alive in the country. Chickens raised for meat live only about six weeks, enabling numerous cycles of production in a year.

The Brazilian Poultry Exporters Association (ABEF) has undertaken an aggressive marketing effort, which includes a strong presence at poultry industry trade shows in Europe, Asia, and the Middle East.[231]

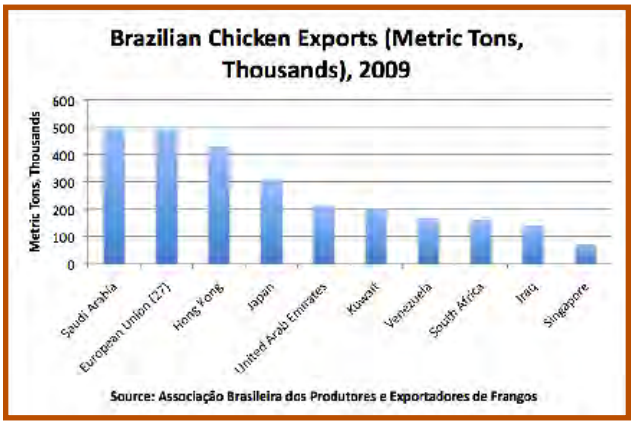
Brazil exports poultry to 150 countries, with Saudi Ara-

bia, the E.U., Hong Kong (China), Japan, and the United Arab Emirates the main importers.[232] In 2009, Brazil sold about 1.4 million metric tons of chicken, valued at $1.9 billion in world markets, an increase of 23 percent over 2008 levels, and further growth is anticipated.[233]

The E.U.'s adoption of higher welfare standards for chickens raised for meat or eggs has created an opportunity for expansion in Brazil's poultry sector, since the standards need not apply to imported poultry, a situation that has been heralded by Brazilian producers. Exports from Brazil of halal chicken to countries in the Middle East also have been rising.[234]

China offers another huge market, with the potential for growth. Now, much of the poultry Brazil ships to Hong Kong ends up in China, but a 2009 agreement between Brazil and China allows direct export of Brazilian poultry to China. This is likely to expand an already thriving market further.

Brasil Foods is Brazil's leading chicken producer. Sadia, which merged with Perdigão to form Brasil Foods, pioneered the vertical integration of poultry production in Brazil, and Brasil Foods coninues to rely on legions of contract farmers.[235] U.S.-based Tyson and Cobb-Vantress, a Tyson subsidiary and the world's leading supplier of broiler chicken breeding stock, also helped shape Brazil's industrial poultry sector, and continue to do so. Cargill, too, is a significant producer of poultry in Brazil, mainly for export.[236]



Cobb entered the Brazilian market in 1960 and now operates a wholly owned subsidiary in the country.[237] In 2008, Tyson, following the trend of consolidation in the global meat sector, bought two Brazilian poultry corporations, Macedo Agroindustrial and Avícola Itaiópolis (Avita), after several years of trying to enter the Brazilian market. It also acquired a 70 percent stake in a third, Frangobrás.[238] In 2008, 5 percent of Tyson's sales of chicken outside the U.S. came from Brazil.[239]

Macedo and Avita are located in Santa Catarina state, and Frangobrás is in adjacent Paraná, Brazil's second largest soybean-producing state. A Tyson press release announcing the purchases acknowledged the importance of feed to profitable operations, noting that, "grain represents about half of the cost of raising a chicken."[240]

In addition to supplying domestic markets, Macedo exports chicken to the U.K., Hong Kong (China), Japan, South Africa, and Yemen. Avita and Frangobrás, newer entities, also export chicken as well as sell it to Brazilian consumers, including the food service industry. Tyson's investment will allow both Avita and Frangobrás to ratchet up processing capacity to more than 300,000 chickens a day. The acquisitions offered another geographic benefit. Both states have "excellent access to major ports for exporting products."[241]

In 2010, Tyson do Brasil expects to generate 40 percent of its sales through exports.[242] Government bodies seem keen to make Tyson's investment a success.

In 2009, when the Tyson-controlled plants were having trouble keeping up with demand—not enough chickens were being produced by *integrados*—Brazil's southern regional development bank (Banco Regional de Desenvolvimento do Extremo-Sul or BRDE) stepped in, in the form of a R$100 million ($51.4 million) credit line to support contract poultry farmers within a 100 km (62 mi) radius. Tyson do Brasil encouraged other Brazilian banks to take similar action.[243]

At the same time, however, advocates for small farmers and rural communities critique the contract-grower system in the Brazilian poultry industry as inherently exploitative, since it requires farmers to make costly investments in construction of sheds to house the birds, buy required feed and drugs, and settle for slim profit margins, or even losses. Critics also cite the repetitive actions and high line speeds that are features of the large-scale slaughtering and processing facilities that characterize the poultry sector in Brazil as causing injuries and illness to workers.[244]

In addition, the factory-farm facilities that house thousands of birds and the plants that process them produce significant amounts of waste that can foul nearby land and water. Even if the waste is used on crop fields as fertilizer, if the soil gets saturated, large quantities of manure can enter rivers and streams. The animals' wastes also emit methane and nitrous oxide, two potent GHGs, along with a strong stench.

One of the poultry slaughtering plants Tyson do Brasil owns is located in São José in Santa Catarina, in 13 ha (32

Sadia and Perdigao merged to form Brasil Foods, the country's leading poultry producer.

ac) of Atlantic forest, "protected by environmental laws," according to the company's website.[245]

...And Eggs

Egg production in Brazil is also expanding. In 2008, it reached nearly 2 million metric tons, up about 30 percent from the 1.4 million metric tons produced in 1998.[246] Egg exports rose five-fold between 1997 and 2007, to nearly 25,000 metric tons.[247] Despite some fluctuations in the intervening years, consumption in Brazil in 2007 is about what it was in 1997: just under 7.5 kgs of eggs per capita a year.[248]

Like the poultry industry, the egg industry is also centered in states in southern Brazil, and relies principally on industrial means of production: birds kept in indoor sheds in small, stacked cages; commercial feed; and mechanized provision of food and water along with egg collection. In 1957, the town of Bastos in São Paulo state opened itself up to industrial livestock operations, principally for eggs. Today, Bastos calls itself the "national egg capital" of Brazil. [249]

Production levels—4.2 million each day—surpass that of any other Brazilian town by a wide margin (Bastos itself has only 20,000 residents). In fewer than two months, the eggs produced in Bastos exceed the size of Brazil's human population. The city's website reports that the chickens consume more than 400 tons of corn each day and produce 4,800 tons of manure each month.[250]

Pork: Realities and Prospects

The use of large, confined facilities is common throughout the Brazilian pork industry; extensive systems are now found only in villages. In 2008, the number of pigs slaughtered and processed for meat in Brazil reached 40 million, up from 30 million ten years earlier.[251]

Since 1990, large pig farms have expanded steadily in the three adjacent southern states of Rio Grande do Sul, Santa Catarina, and Paraná. In Santa Catarina, the number of these facilities grew by more than 60 percent between 1990 and 2003.[252] Some operations produce up to 330,000 animals a year. While southern Brazil is at the heart of the country's pork production, industrial pig facilities have also been established in the Legal Amazon states of Mato Grosso and Maranhão.[253]

Leading Brazilian pork producers include Brasil Foods and Aurora. Marfrig Alimentos is also gaining market share, having bought an enormous pig operation in Mato Grosso that was once co-owned by Carroll Foods, the Brazilian subsidiary of U.S.-based Smithfield, a major producer of pork.

Until recently Brazil's pork industry was seen as having significant price advantages over large-scale U.S. and Canadian producers, due to lower labor and building costs and the availability of relatively low-cost soy and corn for feed. But the industry has become less globally competitive as the value of the Brazilian real has risen against the U.S. dollar. As a result, Brazilian producers, once happy to sell large quantities of low-priced pork to countries in central and south-east Asia, parts of Africa, and closer to home in Latin America, are now turning their attention to developing new, higher-value export markets.[254]

The city of Diamantino, in Mato Grosso, claims to be Brazil's "capital of swine culture," according to a prominently displayed billboard erected by one of the city's mayors. The Diamantino Industrial Complex, an operation of almost epic proportions, is Brazil's largest pork-producing facility. It has a pig population of about 125,000, spread across 76 sheds or barns (an average of 1,650 pigs in each structure). The entire cycle of production is integrated, from milling feed to breeding, slaughtering, processing, and packing hundreds of thousands of pigs each year.

In June 2009, Marfrig bought Carroll Foods' share of the Diamantino complex, and invested R$128 million (U.S. $72 million) in its expansion. The facility is now run by a Marfrig subsidiary, Mabella. The Diamantino complex can produce up to 100 metric tons of processed pork, such as ham and sausages, each day. It also includes one of the largest feed plants in Mato Grosso, capable of providing 50 tons of feed an hour. Two facilities, one in Diamantino and another in nearby Petrovina, can each house up to 22,000 female pigs (called sows) used for breeding and can slaughter 3,000 pigs a day.[255]

Like the poultry sector, the pork industry relies on contract farmers. For the Diamantino complex, 1,000 *integrados* provide Mabella with essential elements of production, including soy for feed and pig-termination facilities.[256] As in the poultry industry, enormous quantities of waste are produced by intensively fed factory-farmed pigs—four times that of an adult human—and in southern Brazil, much of it goes untreated.

"Fifty percent of the pig residues are unprocessed [and] the pigs are so overfed their systems don't have a chance to process the food," Washington Novaes observes. "The amount of feces is immense . . . [this] is very taxing on the environment and, in most cases, there is no adequate destination [for the waste]."[257]

The Brazilian ministries of development, agriculture, and agrarian development have documented water and land pollution caused by industrial pig facilities. Hardest hit are the three states where the industry is concentrated: Santa Catarina, Paraná, and Rio Grande do Sul.[258] Rivers in the west of Santa Catarina, for example, have "been completely degraded by the high concentration of poultry and pig farms in the area," Novaes says.[259]

Authorities in some counties, including Concórdia in Santa Catarina, Toledo in Paraná, and Santa Rosa in Rio Grande do Sul, have prosecuted pork producers, seeking compensation for environmental damage. But agricultural interests, including those within the pork industry, continue to resist state environmental protections and often work to overturn them. In Santa Catarina, lobbyists succeeded in reducing the size of protected areas along rivers and other waterways from 30 meters to just five, increasing the risk of water pollution from factory-farm wastes.[260]

The pork industry in Brazil has not yet been pressed by authorities to address its impacts on climate change, which, like the poultry and egg industries, include methane and nitrous oxide emissions from animals' wastes and CO_2 emissions from growing and processing feed crops and the energy used to run facilities, and for transport and processing.

Nonetheless, a biogas power plant has been installed at the "Diamantino 1" complex to turn wastes produced by 11,000 breeding sows and stored in aerobic and anaerobic lagoons into electricity, an estimated 14,000 megawatt hours a year. The project, which cost just over $1 million and will require just under $500,000 to maintain each year, became operational in March 2010. Funds for the biogas plant came from the Kyoto Protocol's Clean Development Mechanism (CDM), and the plant will generate CDM emission reduction credits that can be traded or sold. As it happens, such projects are not that unusual for the CDM. In fact, it has supported many biogas initiatives at large-scale pig-producing operations, although Diamantino's is the biggest to date.[261]

Fast-Food Brazil

Expansion of large-scale animal agriculture has solidified Brazil's position in the international meat economy and has ensured a steady supply of animal products domestically, and with it, a thriving fast-food culture. With 86 percent of Brazilians living

Pigs being transported to slaughter

Welfare of Animals . . . and the Environment

Awareness is increasing within Brazilian civil society, and to some extent the public, of some of the negative environmental, public health, and animal welfare aspects of the production of meat, dairy products, and eggs, as well as soybeans for livestock feed.

And, despite the prominence of meat in traditional Brazilian cuisine, as well as the popularity of U.S.-style fast food, in a recent survey by the Ipsos Institute, a market research firm, 28 percent of Brazilians said they wanted to reduce their meat consumption.[295]

In October 2009, the Sociedade Vegetariana Brasileira (the Brazilian Vegetarian Society or SVB) launched a "Segunda sem Carne" ("Meatless Mondays") campaign in São Paulo,[296] asking people to forego meat for a day each week for their own health, the environment, and animals. The initiative, which was supported by São Paulo's secretary for the environment, has generated substantial interest and high-profile support, including from Gilberto Gil and Marisa Monte, two of Brazil's best-known singers.[297]

In response, the Brazilian Poultry Union (União Brasileira de Avicultura) sent a letter to the São Paulo government defending the health, social, economic, and environmental benefits of meat consumption.[298] The SVB, however, is not deterred. It is expanding "Segunda sem Carne" to other cities across Brazil. In March 2010, the campaign was launched in Curitiba, Brazil's "eco-capital" (well-known for its extensive public transit system), with the support of the municipal government.[299] Interesingly, Curitiba is the capital of Paraná, one of Brazil's top corn- and soybean-producing states, and where many large-scale livestock facilities are located.

In the mid-2000s, conditions for factory-farmed animals in Brazil were not a serious concern of the country's animal welfare movement, a situation that caused some acrimony and rifts among NGOs. That has changed. "It's gotten to the point that most animal organizations in Brazil are talking about farm animals and using aspects of the environmental impacts as an outreach tool," says Simone de Lima.[300]

For example, the Instituto Nina Rosa, an animal rights organization in São Paulo, has produced several videos that document the conditions for factory-farmed animals in Brazilian facilities and explore the ecological and health impacts of meat consumption.[301] The Humane Society International's (HSI) Brazil office is, along with ARCA Brazil, an animal welfare organization, urging producers of eggs and pork to institute higher standards of animal welfare in industrial operations through a certification process. The initiative also includes outreach to food retailers and consumers.[302]

Another HSI effort is seeking to create partnerships between environmental and animal welfare NGOs to address the ecological, health, and welfare consequences of industrial animal agriculture, and openly question Brazil's adoption of factory farming. The first in a series of workshops for the project was held in São Paulo in May 2010.[303]

The World Society for the Protection of Animals (WSPA) in Brazil has focused on making the slaughtering process for farmed animals more humane, seeking improved animal welfare in farming practices and ending the live transport of animals from Brazilian ports.[304]

Consciousness of the role of meat production in climate change and other ecological challenges has been growing in environmental circles in Brazil. "This doesn't mean that environmentalists have embraced the idea of eating less meat," Simone de Lima says. "But I am seeing it cited more."[305] ■

in urban areas,[262] access to American-style quick-serve food is virtually assured for those who can afford it.

Unlike in most industrialized nations, in Brazil fast-food outlets are frequented most often by those in the middle and even upper economic classes. "You would not see a poor person in a McDonald's in Brazil," Simone de Lima says. "It's seen as a cool place for young people to go, or a place for people to take their kids."[263] Affluent urbanites have flocked to American and Brazilian fast-food chains, which are often located in trendy settings in upscale neighborhoods or indoor shopping malls and feature Internet access and tasteful décor.

Fast food's popularity in Brazil has also been enhanced by clever branding (some Burger Kings print customers' pictures on their hamburger wrappers[264]) and intensive marketing, including the use of Brazilian celebrities in advertising and to open new locations.

The market leader is McDonald's, with 2,400 restaurants, kiosks, and McCafes around Brazil.[265] Second to McDonald's is Bob's, a brand launched in the 1950s by a U.S. tennis player who settled in Rio de Janeiro. It offers a "homegrown" take on American hamburgers, fries, and milkshakes and has 640 restaurants and 270 kiosks throughout Brazil (plus locations further afield in Chile and Angola).[266]

U.S. fast-food chain Burger King opened its first outlet in Brazil in 2004 in São Paulo and now has 78 locations run by

franchisees.[267] In September 2010, Burger King was bought for $3.25 billion by the hedge fund 3G Capital; among 3G Capital's leading investors are three Brazilian billionaires.[268]

Concerns about the in-roads fast food has made in Brazil have been raised, particularly on the grounds of public health. In June 2009, a federal prosecutor in the state of São Paulo asked a judge to enact a national ban on the sale of children's toys at fast-food outlets, including McDonald's, Bob's, and Burger King. Among his reasons were that the sale of toys with meals encourages children to eat high-fat fast food and adopt poor eating habits that can persist throughout their lives.[269]

Other Brazilians complain about the sameness of fast food and the displacement of varied regional cuisines by burgers, chicken nuggets, and fries. But when TGI Friday's, another U.S. chain that features burgers and chicken on its menu, opened its first restaurant in Brazil, major Brazilian newspapers wrote about it as if the event were a "gastronomical delight," says Simone de Lima, and people lined up around the block to get in.[270]

Food Origins

For the most part, Brazilians' knowledge of where their food comes from and the environmental or social consequences of its production remain limited. "Average middle-class citizens, the majority of the consumers, have no consciousness of these impacts whatsoever," Karam observes. "The poor sectors of society consume little and have even less awareness, [while] in the rich sectors of society there is no awareness or there's another point of view."[271]

According to Novaes, the relationship between Brazil's livestock sector, deforestation, and climate change, "doesn't show up as an issue at all in the news . . . the links aren't made." Instead, what is covered are trade barriers other countries may have raised against Brazilian exports, including meat.[272]

If it was informed, most of the Brazilian public would be quick to condemn the burning of the Amazon and lax enforcement of environmental laws, João Meirelles observes. But, he argues, no one seems to be making them aware that their consumption, particularly of beef, fuels deforestation, and not many people themselves are seeking out the origins of what they eat. Meirelles is also skeptical of occasional "green" food promotions undertaken by large supermarket chains in Brazil, which he views as lacking in substance and a desire for real impact.[273]

Issues of Equity: Land and Power

"People speak about the growth in environmental destruction, but what of the social inequities, the increase in the number of people who go hungry?" as a result of Brazil's embrace of industrial agriculture Katia Karam asks.[274] Olivier de Schutter, the UN Special Rapporteur on the right to food, has questioned whether Brazil's export-led agricultural model has resulted in more, or less, equity in the country. It is not apparent, he said, that any advantages had "trickled down to the food insecure groups, such as daily rural workers, the landless, or the urban poor."[275]

"I think we must now be the country with the most concentrated land ownership in the world," João Pedro Stédile, a leader of Brazil's Landless Workers Movement (MST), said in 2009. "Brazilian agriculture has become dominated by international capital, which has joined forces with the estate owners to farm according to the agribusiness model."[276]

Indeed, the contours of Brazil's current agricultural economy have reinforced historic inequities in land ownership. Forty-six percent of agricultural land in Brazil is

A McDonald's on Copacabana Beach in Rio de Janeiro

comprised of farms 1,000 ha (2,471 ac) or larger. By contrast, farms 10 ha (25 ac) or smaller account for just 2.7 percent, according to a 2006 agricultural census conducted by the Institute of Geography and Statistics (IBGE). The census also found that land ownership was more unequal in Brazil than it had been a decade earlier, and that rural employment had declined since 1996.[277]

The concentration in land ownership in the state of São Paulo resulted from the growth of intensive agriculture there, including large plantings of soybeans and maize destined for export, according to the IBGE researchers.[278] They also documented particularly high inequality in land-holding in Mato Grosso do Sul, where cattle and soybean production have been expanding, and Alagoas,[279] a center of large-scale sugarcane cultivation.

Struggles Over Reform, and Recognition

"The folks in agribusiness are not concerned," about the environmental, public health, rural livehood, or animal welfare impacts of industrial agriculture, Katia Karam says. "They view their activity as financially positive for them and the country, and that's the position of the Ministry of Agriculture: agribusiness brings profits and opens commercial frontiers."[280]

But opening those frontiers has meant a dismaying litany of violent, deadly disputes over land. Ecological destruction is also tied to violations of human rights. Regions in Brazil with the highest rates of deforestation and adjacent areas register some of the country's highest murder rates.[281]

Usually pitting large landowners against small-holders or land-reform advocates, securing land for cattle or soybean production often provides the flashpoints for conflict.

One case that attracted international attention and outrage was that of 73-year-old nun Dorothy Stang who was killed in 2005 in Anapu in Pará state. A naturalized Brazilian originally from the U.S., Stang had, since the 1970s, been working to help poor, rural communities in Brazil protect their livelihoods and the environment.[282]

On her way to a community meeting, Stang came across two men illegally planting grass for cattle. When she confronted them and told them to stop—the land, she reminded them, was not theirs—one of the men reportedly asked her, "So, you don't like to eat meat?"

"Not enough to destroy the forest for it," Stang replied. As she turned to leave, one of the men shot her in the back.[283] A cattle rancher was subsequently charged with ordering the murder.

Stang was far from alone; Pará has been a locus of murders over land, although most do not attract the same level of attention Stang's did. Indeed, on the same day in April 2010 that a court postponed the Stang murder trial, a land reform advocate in Pará, Pedro Alcantara de Souza of the Federation of Family Farmers was shot and killed.[284] In 2008, 13 advocates for land reform in Pará were murdered.[285] A Catholic Church–based commission estimates that at least 1,400 rural workers have been killed in Brazil since 1985 as a result of land disputes.[286]

Cows resting on the dunes of Jericoacoara in Ceará state, in Brazil's north-east

Large-scale, commercial agriculture in Brazil has not ended other egregious violations of human rights, including slavery. Instead, industrial producers of cattle and soybeans have been implicated in rights abuses.

According to a 2007 report by Brazil's Ministry of Labor, Amazon ranches accounted for 62 percent of enterprises dependent on slave labor.[287] Greenpeace's report *Eating Up the Amazon* described a set of abysmal conditions at Roncador Farm in Mato Grosso, where workers are responsible for maintaining more than 100,000 cattle and 4,000 ha (9,000 ac) of soybeans:

> Working 16 hours a day, seven days a week, the laborers were forced in live in plastic shanties with no beds or sanitary provision. Water for washing, cooking and drinking came from a cattle watering hole and was stored in barrels previously used for diesel oil and lubricants. There was no opportunity to leave the farm. Goods had to be bought from the farm shop at extortionate prices, putting laborers into ever-increasing debt, which they would never be able to pay off—a form of slavery known as debt bondage.[288]

Between 1995 and 2010, government operations freed 37,000 enslaved workers in Brazil.[289] However, charges are brought against only a minority of the owners. Most are simply notified that they are not in compliance with the law and advised to follow it in future.[290]

In 2010, Brazil's Senate debated the persistence of slave-like conditions in the agriculture sector, and the continued flouting of the amended penal code that criminalized four conditions: forced labor, being forced to work into debt, an exhaustively long workday, and degrading work.[291] While slavery was broadly denounced, not all senators were in agreement with the amended penal code; at least one described its proscriptions as evidence of an ideological prejudice against private property.[292]

Alternative Visions

The industrial agriculture model is also being called into question on the grounds of food security, food safety, and the livelihoods of family farmers. Small- and medium-scale farmers are concerned primarily with production of food crops, such as manioc (cassava), a root vegetable that is a staple in Brazilian diets, or beans, not commodity crops for export. But they are often excluded from marketplaces due to the economies of scale agribusinesses have and perceptions about the benefits of food produced by "modern" industrial methods.

"Theoretically, there's a high level of quality control in industrial farming practices, but in reality it's not so," Karam observes. In addition, little in the way of training, technical support, education, or credit exists for small farmers. With such inputs, Karam says, they could "have a much better product [than that provided by the industrial food system] with the added benefit of social justice and low environmental footprint."[293]

In 2010, UN Special Rapporteur on the right to food Olivier de Schutter urged the Brazilian government to provide more public support to family farming, which, he said, still has an important place in the country's socio-economic fabric, accounting for nearly 40 percent of the value of agricultural production in Brazil. De Schutter added that small-scale or family farming is more productive per hectare than industrial agriculture and also creates more jobs.[294]

Agroecological Farming

The number of ecological and organic producers of food in Brazil is growing, providing an alternative, and possibly a rebuke, to industrial agriculture. Agroecology, also called sustainable agriculture, is the application of ecological principles to agriculture.

In southern Brazil, the Rede Ecovida de Agroecologia (Ecovida Agroecology Network) links small-scale producers of vegetables, fruits, cereals, and animal-based foods practicing agroecology. Thousands of family farmers are in the network, as are cooperatives and NGOs. Farmers' products, stamped with an Ecovida label, are sold in Brazilian shops, as well as supermarkets and institutions, and some are exported.[306]

Lettuce growing on an organic vegetable farm in São Paulo state

ASPTA-Brazil, an NGO, works with agroecological producers throughout Brazil and raises awareness about the principles and impacts of agroecology. It also tracks the use of genetically modified soybeans and corn in Brazil.[307]

"An ideal situation for those areas [of the Amazon] that are degraded is agroecology," Greenpeace's Tatiana de Carvalho says. But, she notes, obstacles exist, including that much of the degraded land has been heavily contaminated by agricultural chemicals (pesticides and fertilizers).[308]

The Slow Food Movement, started in Europe and now active in a number of countries, is present in communities throughout Brazil. Small-dairy owner Katia Karam is a member. Its network includes a variety of agroecological producers, and projects designed to protect biodiversity. But it has not yet engaged in discussions of animal welfare, or the conditions under which animals used for meat, milk, or eggs are raised, Karam says.[309]

Smoke Clearing?

In September 2009, then environment minister Carlos Minc[310] shared good news: Brazil was experiencing the lowest deforestation rate in the Amazon in 21 years. Rates had dropped 46 percent from those recorded in 2008—even as the scale of the forest loss retained its potential to shock: an area between 8,500–9,000 sq km (3,000–3,500 sq mi), just slightly smaller an area than the land mass of the island of Cyprus.[311]

That was, however, about one-third of the record high forest loss recorded in 2003–04: 27,000 sq km (10,500 sq mi), or about the size of the nation of Haiti. The largest reductions in deforestation were documented in the states of Mato Grosso and Rondônia, each with large cattle populations (and, in Mato Grosso, huge areas dedicated to soybean cultivation). Minc credited better policing for the September 2009 results. While welcome, Minc's announcement immediately raised questions. Chief among them: had the global recession, which depressed commodity prices and demand, been more important in slowing deforestation than government action? "Government measures seem to have had a positive impact," according to Paulo Moutinho, coordinator of the Amazon

Focus on Global Forests, and the Trees

Safeguarding the world's standing forests has climbed much higher up the international global-warming agenda. A growing number of scientists, policy-makers, governments, and members of civil society agree that climate change cannot be arrested or reversed successfully without reducing emissions from forest loss. Protecting the world's forests has become an important facet of discussions about a post–Kyoto Protocol agreement on climate change.

At the 2009 UN climate change conference in Copenhagen, governments agreed to support and fund a global initiative to protect and restore forests, known as REDD (Reduced Emissions from Deforestation and Forest Degradation). Through REDD, countries with significant, intact forests, like Brazil, would receive carbon credits if they succeed in preserving them.[323] The credits essentially act as financial compensation for any economic development foregone in the service of forest protection.

While REDD and a related effort, REDD+, which includes sustainable management of forests, forest conservation, and the replenishment of forest "carbon stocks,"[324] can be seen as positive steps in consolidating international will to protect the world's forests, neither initiative is expected to do much to conserve the biodiversity or carbon-capturing potential of the Cerrado. In addition, some environmentalists worry that the global focus on forests will result in accelerated destruction of non-forest, biologically diverse ecosystems, with agribusinesses moving in and planting monocultures of commodity crops.

Moreover, sustainable forest management may do little to protect the rights of indigenous communities living in forested areas, and could even undermine them. Nor does such management preclude the creation of industrial tree plantations—such as those to produce palm oil that are being planted in Brazil as part of the country's vibrant biofuels sector—in areas previously covered by indigenous forest.[325] And ironically, sustainable forestry programs may even encourage further deforestation.

"I'm wary of the feasibility of what's being carried out as sustainable [in Brazil]," says Washington Novaes, noting a recent report indicating that only 3 percent of forest labeled "sustainable" really is. Sustainable forestry can entail selective harvesting of the best specimens from a forest, through which, Novaes says, "you're actually manufacturing involution by leaving the worst specimens."[326]

He also points to research by the National Institute on Amazon Research on the Amazon's primary forests—some more than 1,000 years old—and their sensitivity to even small alterations, including those considered "sustainable."[327] The sustainable harvesting paradigm is not as simple as it seems, Novaes says, adding: "I've visited quite a lot of [such] projects, but most of them are pretty precarious."[328] ■

Institute for Environmental Research. But, he continued, "We need to see [this] trend confirmed during an upswing in demand for commodities."[312]

By 2010, global prices for beef and soy had edged up. Credit, which had been scarce for agricultural producers, became more available in Brazil as the recession waned. In early 2010, environmentalists' fears were confirmed. INPE (the Brazilian National Institute for Space Research) reported that Amazon deforestation in March and April 2010 was twice as extensive as during the same period in 2009. The biggest losses, accounting for 75 percent of the total, were registered in Mato Grosso and in Pará, which has second largest cattle population of any state in Brazil, along with vast acreage of soy. The increased deforestation in Mato Grosso reversed the lower rates of forest loss in the state in 2009.[313]

Amazon forest destroyed in Pará for cattle pasture

INPE's research confirms that clearing of forest in Brazil is correlated with global market demand for meat as well as animal feed. When demand and prices for each increase, producers in Brazil respond, even if to do so entails further degradation of the Amazon or the Cerrado.

Decrees, Debates, and Countering Forest Loss

For years, Brazil has felt considerable pressure, within and outside the country, to take action to slow or reverse deforestation, especially in the Amazon region. One response is a plan developed by Brazil's federal and state governments to reconfigure the country's murky land-title system, which has allowed farmers and ranchers to occupy land illegally through squatting or the forging of land titles.

A 2009 presidential decree calls for a central land-title registry and regularization of 80 percent of private land titles. Small plots of 100 ha (247 ac) will be given to the farmers working them, while larger plots of 100 to 2,500 ha (247 to 6,200 ac) will be legalized through sale. The government will reclaim illegal plots larger than 2,500 ha.[314]

As another means of countering deforestation, in August 2008, the government unveiled the Fund for the Protection and Conservation of the Brazilian Amazon.[315] The fund accepts contributions from donors throughout the world concerned about protecting the Amazon, using the monies to support efforts to prevent further deforestation. In return, the fund issues GHG emission reduction certificates. But, unlike other carbon credit initiatives, the certificates are not tradable in global carbon markets. This has led skeptics to question whether the fund offers a sufficient incentive to attract the $21 billion it seeks to raise over 13 years.[316]

At its launch, the Brazilian government deposited $150 million for the fund in BNDES, which will administer the fund, and the Norwegian government pledged $100 million.[317]

"That kind of money is not going to change anything," according to Carlos Nobre, a senior scientist at INPE. But the initial contributions could help create a new economic paradigm for the Amazon. "The Amazon lacks badly entrepreneurs . . . to go there with good ideas and translate biodiversity wealth into economic wealth," Nobre says.[318]

The fund's governing body includes NGOs, the National Confederation of Agricultural Workers, the National Confederation of Industry, as well as several Brazilian government ministries, including the Ministry of Agriculture. This presence of the agriculture ministry has raised some concerns that agribusiness interests will be overly represented in the fund's governance.[319]

Yet, even as national initiatives to slow or reverse the deforestation are put in place, other efforts within the government to dilute forest protections are underway that could seriously undermine Brazil's conservation and climate change initiatives. In July 2010, a key committee

of the Brazilian Congress approved changes to the national forest code that would loosen the existing framework significantly.

The proposed revisions would allow individual states to determine how much forested land could be cleared and how much remained forested and would allow them to set levels lower than the 80 percent required by the current national code. Landowners also would be able to cultivate larger areas of land than they can now. Finally, landowners fined for illegal deforestation under the new land registry system would be granted an amnesty.[320]

These changes have been promoted by the "Ruralistas," a constituency comprised mainly of the titans of Brazilian agriculture. They contend that the current forest code unnecessarily constrains the agriculture sector and with it, Brazil's prospects for continued economic growth. One of the politicians advocating most vocally for the revisions has framed the issue as one of national sovereignty, charging that other countries want Brazil to protect its forests as a way to constrain its development.[321]

Environmentalists fear that, if passed, these amendments to the forest code could put 80 percent of the Amazon region at risk of being burned. If this were to occur, 25–31 billion metric tons of CO_2 would be released, according to a joint estimate by the Amazon Institute for Environmental Research and Greenpeace.[322] This would certainly scramble Brazil's ability to meet global targets for protecting biodiversity as well as its 2009 pledge to reduce its greenhouse gas emissions by 40 percent by 2020.

Burning of tracts of former forest in a Mato Grosso soy field

Plan Cerrado

Efforts by the Brazilian government to reduce Amazon deforestation have an unintended consequence: shifting agricultural production to the Cerrado. When rates of land clearing fall in the Amazon, they often rise in the Cerrado.[329]

While about 40 percent of the Amazon region has some kind of protected status, either through designation as a conservation area or an indigenous-administered reserve, only about 10 percent of the Cerrado has such status.[330] Until 2010, just the Amazon and four other biomes, not including the Cerrado, were declared part of Brazil's natural heritage, meaning care should be taken to preserve the environment in each biome. But in July 2010, Brazil's Congress passed a constitutional amendment adding the Cerrado to the natural heritage list (along with the Caatinga, a semi-arid forest in northeast Brazil). The practical effects of the designation are not yet clear.[331]

Some conservation biologists working in the Cerrado lament its relative lack of glamour compared to the Amazon and tropical forests in general. They point to this as one of the reasons why such little public alarm has been expressed within Brazil about the pressures large-scale agriculture has put on the region. To the outside world, the Cerrado, one biologist adds, is "virtually invisible."[332]

Brazil's environment ministry has sought to give some voice to concerns about the Cerrado's future by launching the "PPCerrado" or Plano de Ação Pará o Controle e Prevenção dos Desmatamentos e Queimadas no Cerrado (Plan of Action for the Control and Prevention of Deforestation and Fires in the Cerrado). The plan, presented in September 2009, seeks to address rapid agricultural expansion in the Cerrado, and the fires used to clear vegetation to prepare the land for ranching or crops.[333]

Defining elements of the plan became a collaborative exercise, discussed among ten government ministries, state environmental agencies in the Cerrado region, academics, and NGOs, with public input sought via the Internet. According to Carlos Minc, the environment ministry intends to develop and deploy in the Cerrado a tracking

system similar to that used in the Amazon to monitor land clearing, prosecute environmental crimes, establish incentives for sustainable activities, and create protected areas.[334]

Brazil's government has set a target of reducing by 40 percent the destruction of ecosystems in the Cerrado by 2020.[335]

The Soy Moratorium and "Soja Plus"

Given the linkages between global commodity markets, the international financial system, and Brazil's ecosystems, raising consumer awareness and harnessing market forces to pressure companies into more responsible actions are being explored as another means to protect the Amazon forests from further destruction. One such effort is the 2006 "soy moratorium," enacted shortly after the release of Greenpeace's *Eating Up the Amazon.*

The moratorium calls for an end to the purchase of Brazilian soybeans grown on Amazon land deforested after 2006.[336] These soybeans had been sold mainly by Cargill to animal-feed suppliers across Europe, including Cargill Meats Europe, formerly Sun Valley, which in turn provides feed for factory-farmed animals sold to a long list of clients, among which McDonald's featured prominently.[337]

ABIOVE (the Brazilian Vegetable Oil Industry Association), which accounts for 94 percent of Brazilian soy production,[338] and ANEC (the Brazilian Grain Exporters Association) signed on to the moratorium. So did major soy processors and purchasers, including Cargill, Bunge, and ADM, which together account for 60 percent of soy exports from Brazil, according to Greenpeace.[339] As awareness of the soy–Amazon connection increased and concern grew among consumers, McDonald's agreed to abide by the moratorium and stopped buying chicken fed on soy from newly deforested areas.

The moratorium appears to be holding. Previously, producers growing soybeans on illegally deforested land were often unable to receive government credit and would then ask the multinationals for it; often, they complied. Now, however, according to Tatiana de Carvalho, "The [soy] traders are also restraining their credit, demanding that their suppliers use only legal [soy] products."[340]

In 2009, ABIOVE and environmental groups, including Greenpeace, reported that only 12 of 630 sample areas of Amazon forest cleared since 2006 were planted with soybeans. By contrast, 200 were pasture for cattle.[341]

Better monitoring has led to better identification of producers flouting the ban. In 2010, 75 farms were found growing soy in recently deforested areas, up from the 12 identified in 2009. According to Greenpeace, soy traders have stopped buying soybeans from all of these farms. The moratorium was extended once, through July 2010, and the partners agreed to extend it again, for at least another year.[342]

But about 10 percent of Brazil's soy production is not covered by the moratorium, and loopholes remain. When asked in 2009 about what would happen to soybeans planted illegally by a farmer on recently deforested land, Carlo Lovatelli, who heads ABIOVE, replied: "He'll sell to a Chinese trader on the spot [cash] market."[343]

In addition, the moratorium applies only to the Amazon—and only to soybeans. New grazing land for cattle is still being carved from the Amazon, while large-scale cultivation of soybeans in the Cerrado is expanding, too.

Still, efforts to improve soy's environmental record in Brazil are continuing, with an incentive provided by increased demand from some overseas markets for products produced in more sustainable ways.

In April 2010, Lovatelli of ABIOVE announced the launch of the "soja plus" label. Applied to soybeans and other soy-derived products, a "soja plus" designation will indicate

The contentious Cargill port in Santarém; the soy moratorium took effect in 2006.

production in line with a set of environmental and social criteria. The E.U. is one of the markets Brazilian producers plan to target.[344]

Clarifying Costs

So, is the tide turning? In 2009, "*O rei da soja*" Blairo Maggi, then governor of Mato Grosso, called for balancing reductions in deforestation levels with "efficient growth" of cattle ranching and agricultural production, specifically soybeans. (In 2009, Mato Grosso exported nearly 11 million metric tons of soy.[345]) An important element in this, he said, was enforcement of Brazil's national forest code. Maggi also conceded that continued growth of industrial agriculture in the Amazon over the longer term is not economically viable, given ecological realities. Farmers, Maggi said, increasingly recognize that without forests, weather and rainfall patterns change, with negative effects on Brazilian agriculture.[346]

The World Bank argues that Brazil could pursue low-carbon growth and drastically reduce deforestation and related GHGs without negatively affecting economic development or employment.

"EMBRAPA has repeatedly stated that to advance agriculture, [more] deforestation would be completely unnecessary," Washington Novaes says. "But the issue is that it's cheaper to slash, burn, and plant in forested areas than to use legalized, already deforested areas."[347] Greenpeace's position is also that no new land needs to be deforested for Brazil to maintain or expand agricultural production.

But Brazil's cattle industry in particular continues to rely on on a glaring inefficiency: using, depleting, and then burning more and more land. Expanding cultivation of soybeans to supply animal feed domestically and for world markets has a role in this, too. But with 75 percent of GHGs in Brazil stemming from deforestation and land-use changes, and 50 percent from cattle production alone, it is hard to see how such a cycle of waste and destruction can be sustained.

A recent study by EMBRAPA (the Brazilian Agricultural Research Corporation) determined that each cow in Brazil released more than 220 kgs (100 lbs) of methane a year. Multiplied by Brazil's nearly 200 million cattle, that's up to 44 billion kgs (20 billion lbs) of methane annually. José Lutzenberger, Brazil's legendary former environment minister, had been, before his death in 2002, working on a book about the unsustainability of meat production from the perspective of its energy requirements, according to Novaes, which is, he says, "another troublesome indicator [of] non-sustainability."[348] Energy input is four times protein output for meat chicken; for pork, the ratio is 17:1, and for grain-fed beef, an outsize 54:1.[349]

The World Bank argues that Brazil could pursue low-carbon growth and drastically reduce deforestation and related GHGs without negatively affecting economic development or employment.[350]

But Novaes notes a common critique in Brazil of any agreement to binding GHG reductions: that Brazil, along with other fast-growing developing nations, is being made a scapegoat for the industrialized world, which used its resources foolishly. This attitude, Novaes says, "leads to a terrible scenario."[351]

Novaes is not optimistic about a course correction in the near future. "The federal government goes on in the direction of fostering 'growth,' pure and simple, at whatever cost, [and] the environment is seen as an obstacle to development," he says. He notes that Brazil has not yet adopted alternative strategies to what exists at a large-scale: "It's all about expansion of the agricultural frontiers, new hydroelectric power plants to power new enterprises, and new roads to allow people to get to the new frontiers. . . . I don't think a lot will change."[352]

Conclusions and Recommendations

Brazil's success in capturing an ever-larger share of the global market for meat and soybeans has come, it is fair to say, with immense ecological costs. It has also reinforced some of the key forms of the economic and social stratification that has characterized Brazil for decades, and left Brazil's economy heavily reliant on commodities, markets that tend to reward low-cost production.

Given the current shape and scale of Brazil's agriculture sector, arriving at a national consensus that ensures the survival of Brazil's forests, savannah, and immense biodiversity, and slows or reduces the growth in GHGs, will not be easy.

Indeed, government policies are confirming the direction toward "Big Ag," in which short-term profits outweigh long-term concern for sustainability or equity. And the Ministry of Agriculture projects that by 2020 Brazil will increase its share of global trade in beef, poultry, and pork to 44.5 percent, and levels of meat production by 37 percent.[353]

Brazil's most recent Agricultural and Livestock Plan, announced in June 2010, includes support for development of "low-carbon emission agriculture," including no till systems and alternating production of crops, livestock, and forestry.[354] But the funding for the program is, at $1.1 billion,[355] tiny compared to the credit lines extended to large, "high carbon" meat and soybean interests. Will such

approaches truly protect Brazil's environment and the global climate, or instead offer new avenues to government largesse for agribusiness?

An indication that Brazilians themselves, not just the international community, may be hungry for a new paradigm is the surprisingly strong showing in Brazil's 2010 presidential election of Green Party candidate and former environment minister Marina da Silva. She captured nearly one-fifth of the votes cast in the first round of balloting, well above expectations. A "green tsunami" read a headline about result in *O Dia*, a newspaper in Rio de Janeiro, where da Silva captured nearly one-third of the votes.[356]

Today, Brazil is an emerging economic superpower, with the confidence and resources to determine a new paradigm for its development. Such a direction would rely less on extraction of resources and more firmly on restoration and regeneration, and could become a model for other nations in Latin America as well as a world contending with the realities of climate change. Rubens Ricupero, a former Brazilian environment minister and finance minister who also headed the UN Conference on Trade and Development (UNCTAD), envisions Brazil as a future "environmental power."[357]

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Based on the exposition and analysis contained in this paper, the following recommendations are made:

- **The Brazilian government should embrace as a key priority reducing GHG emissions from the cattle sector and associated deforestation, forest fires, and land degradation.** Feedlots are not the answer. Emissions from enteric fermentation would increase substantially as cows are fed grain, rather than grass. In addition, producing feed would require considerable land resources—and ecological devastation akin to that already seen as a result of large-scale cultivation of soybeans.

- **The government needs to alter existing incentives so that burning new forest or vegetation is no longer more cost-effective—and easier—than reusing or restoring already cleared land.** New programs for training and technical assistance in land management and conservation ought to be established, along with legal frameworks that are enforced. Public education campaigns targeted at agricultural producers should also be instituted.

- **Economic models that make conservation and reduction of GHGs more remunerative than destruction and emission are needed, particularly for the Amazon and Cerrado regions.** Primarily, these should be initiatives focused on increasing levels of GHG sequestration, reafforestation, control of fires, and accelerated regeneration and forest management. Strategic use of emerging carbon markets and payments for forest protection (such as the Amazon Fund), could be utilized to access resources and sustain their flow. The goal of all such efforts should be ensuring real climate impact—the danger of "greenwashing" is considerable.

- **The government should put a price on major GHGs, including carbon dioxide and methane.** This would have multiple benefits, including, principally, dethroning large-scale cattle ranching as a prime growth strategy, and boosting job creation in other sectors, including reafforestation for carbon sequestration. The GHG balance of these proposed initiatives should be estimated in advance. The pricing of GHGs would inhibit projects emitting large amounts of GHGs, while promoting projects emitting few or even no GHGs. Projects sequestering GHGs could attract international financing, such as that provided through the REDD mechanism, the Yasuni ITT Trust Fund (established in August 2010 and administered by the United Nations Development Programme), and others, including those yet to be established.

- **The externalities of industrial agriculture should be fully accounted for, priced, and paid by producers, including land degradation and forest loss**; harm to or destruction of ecosystems and biodiversity; the use of water; water and air pollution, waste disposal, and GHG emissions.

- **Other avenues for economic development should be explored,** such as ecotourism and small- and medium-scale enterprises that are environmentally friendly, including in agriculture

with priority given to those who generally lack access to capital or credit, including women and members of indigenous communities. Employment opportunities in food crop production and sustainable agricultural intensification should be created outside the Amazon forest, where agriculture is more efficient and far more sustainable than it is within the Amazon.

- **Land tenure arrangements that lead to protection of forests, grasslands, and other ecosystems**—i.e., conservation for carbon sequestration—and more sustainable agricultural practices (such as agroecology) ought to be promoted and supported by national and state-level policies.

- **The national forest code should not be weakened,** and its enforcement should be enhanced through the appropriation of new resources, including for personnel and technology.

- **The Cerrado should be covered by the national forest code, or an equivalent code for the savannah developed and enforced.** GHG sequestration and ecosystem restoration projects should be launched in the region, with a focus on increasing contiguous, intact areas.

- **Populations of cattle and other farmed animals ought to be reduced.** Current levels, let alone projected increases, including in intensive production, are not sustainable.

- **The government should move Brazil away from its heavy reliance on commodity crop production, specifically soybeans,** and work to counter the negative effects of "soyanization," including through greater collaboration with small- and medium-size farmers and creation of incentives to promote cultivation of a diversity of crops using sustainable methods.

- **With civil society support and advice, the government ought to adopt a set of far-reaching animal-welfare policies** that would end the abuses inherent in the factory-farm system. Brazil could be an important leader in shifting such policies and practices internationally, too.

- **Protecting the human rights of agricultural workers ought to be a high priority for national and state government officials,** with a policy of zero tolerance instituted for the practice of slave- or bonded labor.

- **The government, in collaboration with civil society, ought to lay out alternatives to the industrial agricultural system that would be better for the climate, the environment, family farmers, and income equality.** These would shift the focus of investment and incentives to non-industrial farmers and away from monocultures (of livestock and crops) and toward an array of produce cultivated through the use of agroecological methods. It could also lead to considerable new employment opportunities.

- **Creation of new labels for food products and commodities, based on robust environmental, climate, labor, and ethical criteria, should be encouraged** and their broad adoption supported by government policies, institutional purchasing practices, and export initiatives.

- **The government ought to support NGO campaigns like "Segunda sem Carne" to extend their reach and impact,** and encourage the development of other efforts to encourage healthy eating centered on plant-based foods. It also ought to assemble a commision of key ministries to develop a national policy for Brazilian food security that incorporates sustainability criteria over the long-term. This could build on anti-hunger and anti-poverty initiatives established by the Lula administration, but put emphasis on expanding all Brazilians' access to a broad array of nutrient-dense, plant-based foods. This would have multiple benefits for public and individual health, the climate, ecosystems, biodiversity, and the welfare of farmed animals.

- **Brazilian NGOs—spanning conservation, climate, development, food security, hunger, small farmers, sustainable food, and animal welfare, among others—should initiate a national dialogue on industrial agriculture and alternatives to it.** The groups could also collaborate on public awareness and corporate campaigns focused on the links between meat and animal-feed production and climate change, deforestation, land degradation, food security, resource use, public health, livelihoods, and animal welfare.

- **Government and civil society ought to undertake efforts to demystify the "frontier mentality"** and encourage adoption of a new national identity and aspirations more suited to the concerns, constraints, and opportunities of the times. ■

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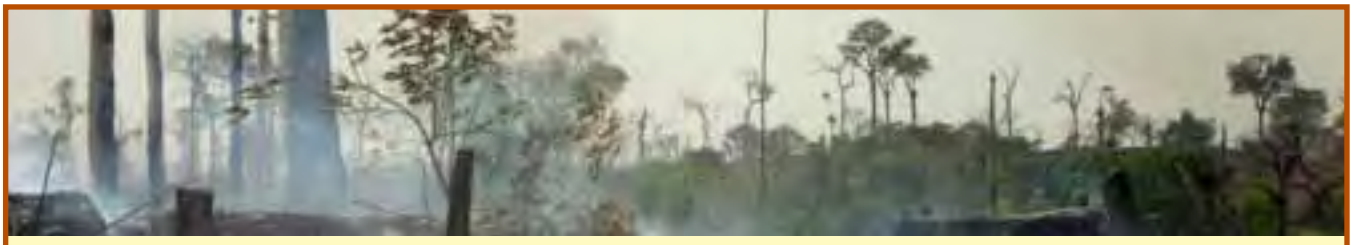

Recently deforested Amazon in Pará