

Introduction: Western Promotion of Biofuel and a “Greening” Economy

As the causes of global climate change become more clearly anthropogenic and its effects are already being felt, there is a growing imperative to cut down our greenhouse gas (GHG) emissions in the near future. This growing world crisis, coupled with rapidly increasing demand for oil leading to price hikes, has made the economic and political climate ripe for a major overhaul in the world energy structure¹. Biofuel is one of the many initiatives that these nations have turned to as a transitional fuel and as a way to ease their dependence on foreign oil. However, as biofuel demand goes up in the developed world, more costs are disproportionately incurred in the developing world. According to current trends, the biofuel industry is not a viable option for widespread alternative energy in developed countries like the US and the EU because their demand is too high and the environmental, social, and economic consequences are disproportionately deleterious to the countries and ecosystems rushing to fill the demand.

The US and EU, for varying reasons, have become ever more interested in alternative forms of energy and ways to break their dependence on foreign oil. The European Union (EU) has accepted the science of global warming and has led the diplomatic drive to actively change its consumption patterns to reduce its greenhouse gas emissions. The EU, along with every country in the United Nations, except for the US, has signed and ratified the Kyoto Protocol, which would require designated developed nations to bring their greenhouse gas emissions about 5.2% below their 1990 levels between the years 2008 and 2012². While the US still refuses to sign the Kyoto Protocol

¹ Roberts, Paul. The End of Oil: On the Edge of a Perilous New World. New York: Houghton Mifflin Company, 2004, pg. 5.

² “PRESS RELEASE: Industrialized countries to cut greenhouse gas emissions by 5.2%,” UNEP, <http://unfccc.int/cop3/fccc/info/indust.htm>.

and therefore has no mandated emissions reductions, political and economic motivators have caused the US to look into alternative fuel sources. Energy security has been a serious source of concern since the attacks of September 11th and the US federal government has made it a priority in its recent policies, speeches, and international agreements³. Both the US and the EU have made alternative energy top priorities in their policies. They have different approaches and many different options available; however, many of these initiatives are shared by both nations.

One of the clearest steps taken towards a new source of fuel has been the promotion of biofuel in the form of ethanol, grown and extracted from plants such as corn, sugarcane, oil palm, and beets. Ethanol is used in gasoline blends for a more diluted, cleaner burning gas for cars and other forms of transportation. Since biofuel comes from crops that convert CO₂ into oxygen, promoters of the fuel contend that it has a carbon-neutral lifecycle because what CO₂ is put into the atmosphere is ultimately reabsorbed by other biofuel crops. There are many benefits to ethanol that make it very appealing to the US and EU, as well as the international community as a whole. First, ethanol can be produced from preexisting agricultural commodities, which means that most of the infrastructure needed to create mass amounts of ethanol are already in place. This also means a shift away from oil, coal and reserves of natural gas, which are all fossil fuels and cannot be grown in a matter of months and therefore makes ethanol a renewable, possibly sustainable resource. Blended gasoline also reduces the dependence on foreign oil by extending the use of each imported barrel of oil and gallon of gas. The extent that the gas is diluted ranges from just 2% to 100% ethanol-run cars that are used

³ “Energy Security for the 21st Century,” The White House, *Energy for America's Future*, <http://www.whitehouse.gov/infocus/energy/>.

primarily in Brazil. In the US, the two major blends in commercial use are E10 and E85, which have 10% and 85% ethanol respectively⁴. Since ethanol can be put into gasoline and used by cars, our traditional transportation infrastructure needs very little retooling as well. Brazil's development and widespread use of entirely ethanol-run cars shows that similar technological advances are possible for the US and the EU as well.

One last aspect of ethanol that is particularly desirable is the fact that it is cleaner burning than gas and therefore better for the environment and in combating anthropogenic global warming. Ethanol burning in place of gasoline gives off lower carbon dioxide, methane, and nitrous oxide, which are all powerful greenhouse gases and regulated by the Kyoto Protocol. The relative difference between ethanol and gas depends on what source ethanol is derived from and other lifecycle contributing factors like transportation and processing emissions. For corn-based ethanol in the US, the Environmental Protection Agency estimates that the reduction in GHG emissions per BTU between gasoline and ethanol is 21.8% processed at an ethanol-run plant. However, that figure goes down to 4% reduction in GHG emission when corn is processed in a coal-burning plant⁵. The potential to improve our impact on the environment by switching from gas powered cars to ethanol and from coal-fired factories to ethanol could be significant, but we must keep ethanol's full lifecycle in mind.

In addition to these desirable attributes of ethanol, there is a lot of money and profit involved in this burgeoning industry. The ethanol industry has grown massively in just a few short years, and now comprises a multi-billion dollar industry. In the US alone, biofuels bring in approximately \$3 billion revenue and over two hundred companies have

⁴ Ibid

⁵ US EPA, "Greenhouse Gas Impacts of Expanded Renewable and Alternative Fuels Use | US EPA," April 10, 2007, <http://www.epa.gov/OMS/renewablefuels/420f07035.htm>.

stakes in the commodity; the industry is also growing at 25 to 50% per year⁶. In 2007, US production of ethanol reached 6.4 billion gallons. This recent and rapid increase in the US domestic biofuel industry has been a result of a few initiatives started by the federal government. In the 2005 Energy Policy Act, Congress established levels of biofuel and biodiesel output requirements and suggested gasoline blend levels. The act required that 7.5 billion gallons be utilized by 2012⁷. As a complement to the energy bills, the US farm bill has also had incentives to produce crops for biofuel production since the Farm Security and Rural Development Act passed in May of 2002⁸. More recently, President Bush and Congress put through a piece of legislation called the Energy Independence and Security Act of 2007. There were two major parts of the bill, which first included raising the Corporate Average Fuel Economy (CAFÉ) standards to 35 miles per gallon by 2020. Secondly, the bill required an increase in domestic alternative fuel production to 36 billion gallons by 2022⁹. This legislation would require a six-fold increase in domestic ethanol production in the next fourteen years. This level of increase will require a great deal of technological and agricultural changes in the coming years, but certainly shows the United States government's commitment to biofuel in our energy portfolio. However, with all the energy and effort going into ethanol production, so far just over 4% of all US gasoline consumption has been replaced by ethanol use¹⁰.

⁶ *Biofuels Production - Industry Profile* (Research and Markets, January 2008), http://www.researchandmarkets.com/reportinfo.asp?report_id=356356.

⁷ Environmental and Energy Study Institute, "2005 Year in Review, U.S. Biomass Energy Policy," *Renewable Energy World*, April 1, 2006, <http://www.renewableenergyworld.com/rea/news/infocus/story?id=41189>.

⁸ Ibid

⁹ "Energy Security for the 21st Century"

¹⁰ *Biofuels in the US Transportation Sector* (Energy Information Administration, October 15, 2007), <http://www.eia.doe.gov/oiaf/analysispaper/biomass.html>.

The EU has also put forth its own legislation that outlines ethanol production and use. The EU has championed biodiesel as its primary domestic biofuel production, with 80% of its biofuel market made up of biodiesel and just 20% made from ethanol¹¹. In its Directive 2003/30/EC, the European Union established target levels of renewable fuel as a proportion of its transportation sector. The guideline is set for 2% renewable transport fuels by 2005, which increases to 5.75% total renewable fuel use by 2010¹². While these steps have been taken, they are relatively minimal compared to the EU's entire energy portfolio. Still, these small steps have already had a significant impact on world markets and commodity prices.

Both the US and EU have significantly changed their agricultural consumption requirements in the last few years. With more land and crops being designated for biofuel production, both the US and the EU have simultaneously increased their domestic land and commodity prices. This has induced them to look outside their own borders for cheap and plentiful commodity crops, both in the form of biofuel and agricultural crops. Because these rich, developed nations have rapidly increased their consumption demands, poorer nations rich in land resources have responded by quickly ramping up production of biofuels and other commodity crops to capitalize on record high prices. In the process, biologically significant ecosystems are being clear cut to make way for new plantations that are far less biologically active and less productive carbon sinks. This phenomenon is seriously undermining the positive benefits of biofuel, especially from an environmental perspective. With rapid deforestation in the Amazon and Borneo rainforests, there have probably already been significant and irreversible repercussions

¹¹ Von Lampe, Martin "Agricultural Market Impacts of Future Growth in the Production of Biofuels," February 1, 2006, <http://www.oecd.org/dataoecd/58/62/36074135.pdf>.

¹² Ibid

for the rest of the world as a result of these few pieces of legislation in the US and the EU.

Two countries, Brazil and Indonesia, have been deeply affected by the new biofuel craze that is sweeping the world's markets. Brazil is a unique study, because it has a long history with its own domestic ethanol industry that has been relatively stable and beneficial to its economy and local people. However, the current worldwide fascination with biofuels has caused major restructuring of the Brazilian agricultural industry that is leaving the biologically diverse and unique Amazon rainforest in serious threat of being deforested. With world oil and food prices the way they are, Brazil stands to gain a large market share and economic surplus from rapid expansion of its agricultural output. In fact, Presidents Bush and Lula just last year forged a diplomatic tie to promote renewable energies through a sharing of technology and expertise as well as developing common guidelines for the new fuel. They will use the new tie to promote their agenda in other countries, concentrating in Latin America and the Caribbean¹³. The EU also has a strong connection to Brazil, as the country conglomerate is a major importer of Brazilian crops, including ethanol and soy. Brazil's agricultural industry has undergone significant changes since biofuel legislation was first promoted and its shifts in agricultural output are a true testament to the globalized era in which we live as well as the policy externalities that exist in this new system.

Indonesia is another revealing case study when analyzing the global biofuel industry. While it is a far less developed nation, Indonesia has quickly capitalized on this new demand for biofuel in the form of its oil palm plantation proliferation. The observed

¹³ Baker, Peter, "U.S., Brazil Team Up To Promote Ethanol," *Washington Post*, March 10, 2007. <http://www.washingtonpost.com/wp-dyn/content/article/2007/03/09/AR2007030902102.html>

expansion of this industry in Indonesia is a telling sign of what is to come for future developing nations that wish to become involved in the international market. Indonesia has earned a lot from its agricultural expansion, but at a great cost. Together, Brazil and Indonesia tell the more inclusive biofuel story. Energy security and environmental degradation were the major motivators for the US and the EU to initiate their policies, but many other negative factors come into the equation and multiple externalities of these policies must be analyzed to really understand the total effects of the biofuel industry on the rest of the world.

Brazil Case Study: An Example of Good Government Practices and Undermining Globalization Influences

Brazil has been a leader in the biofuel industry, in production and consumption levels, as well as in driving technological innovation that relies on ethanol as fuel. Brazil has had a rapidly growing and robust domestic ethanol industry since the 1970's, when its government first stepped in to provide more economic and energy security for itself in the wake of the oil crisis of 1973¹⁴. Starting in 1975, the Brazilian government began an ethanol production initiative called PROALCOOL. The original policies gave economic incentives to sugarcane farmers and mill owners to grow and process extra sugarcane into ethanol. The government also started instituting regulated ethanol blend levels for gasoline. This policy initiative has been maintained in some form since its inception and has been a major driver in its domestic ethanol consumption. It is also this policy that has been a significant inspiration for the recent policies that both the US and the EU have established. Additionally, the Brazilian government made tax credits for building new

¹⁴ Sandalow, David B. "Ethanol: Lessons from Brazil a High Growth Strategy for Ethanol." The Brookings Institute, Washington DC. May 2006
http://www.brookings.edu/views/articles/fellows/sandalow_20060522.htm Accessed 03/19/2007.

ethanol refineries to provide a solid infrastructure for industry. By creating a marketing campaign, subsidizing ethanol fuel and taxing gas, the government made the fuel attractive and economically viable for its people¹⁵.

To further encourage ethanol consumption over gasoline, the Brazilian government started partnerships with various leading car companies to invent ethanol-enabled converted cars as well as 100% ethanol vehicles. Before these vehicles could gain a solid footing, though, market forces between the mid-1980's to mid-1990's presented a series of hurdles for the ethanol industry. A combination of historically low gas prices and high sugar prices caused a change in refining from ethanol to sugar in order to capitalize on the shifting market¹⁶. While the Brazilian government did abandon most of its costly incentive programs for the ethanol industry, it still maintained the ethanol blend levels in gasoline at 25% and at points actually had to import the fuel to sustain the demand. Even though this was a difficult time for the ethanol industry in Brazil, the country still maintained an admirably high level of ethanol blend in its gasoline (much higher than the US and EU biofuel targets today). Also, the level of ethanol importation that occurred during this time showed a decent level of sustained demand even in times of elevated costs, which was driven primarily by ethanol friendly technology like flex-fuel and ethanol converted cars¹⁷.

The period of stall and downturn in the ethanol market reversed in the late 1990's and domestic demand has drastically increased since 2001. A combination of factors, including a downturn in sugar prices, increases in oil prices, and a rapid increase in purchasing of ethanol-related technology has meant a significant jump in the domestic

¹⁵ Ibid

¹⁶ Ibid

¹⁷ Ibid

ethanol economy. Current and sustained high oil prices have made Brazilian ethanol not only popular domestically, but also its biofuel has been in high demand in the rest of the world as well. With such a robust and mature ethanol industry, Brazil stands to gain richly from its prescient economic policies of the 1970s.

The outlook for Brazil's ethanol industry is a positive one and its economic growth has reflected this trend as well. The Brazilian economy has grown rapidly since the millennium and brought the country into the upper echelons of international leadership¹⁸. In many ways, Brazil and its ethanol industry are the leading example of the next energy economy centered on green, renewable technologies. In fact, a study comparing the biofuel industries of the US, Canada, EU, Brazil, and Poland (separated from EU for its large quantity of biofuel) found that Brazil was the only country that could feasibly and without detriment to its economy, environment, or land use patterns, provide 10% of its energy needs through biofuel use¹⁹. In fact, that level is already well below the currently set blend level of 25% for all gasoline sold in Brazil. The study found that Brazil's land use requirements to provide 10% of its energy needs through biofuel would be just 3%, in contrast with the US and the EU, which were speculated to need between 30% and 70% of their agricultural land to fulfill 10% of their energy needs with current technologies²⁰. The current US biofuel legislation aims to provide about 25% of its energy needs from biofuels in the next fifteen years, which would account for huge land use levels²¹. In addition, Brazil is the only country in the study that had an economically viable industry (without heavy government subsidies) below \$39 per barrel

¹⁸ *Country Strategy Paper 2001-2006* (European Commission External Relations Directorate-General), http://ec.europa.eu/external_relations/brazil/csp/02_06en.pdf.

¹⁹ Von Lampe, Martin, 15.

²⁰ *Ibid*, 5.

²¹ "Energy Security in the 21st Century"

of oil²². This amount was used because it has been the world average cost of oil for the past couple years and is near historic highs.

The evidence from this study shows that Brazil has the most stable, mature and economically efficient biofuel industry. Specifically, its industry is least susceptible to volatility due to crude oil prices and changes in domestic government policies. It is different than other countries because it is able to produce its ethanol at a fraction of current gasoline prices, making it the clear choice for consumers without heavy taxation or subsidies. As a result, Brazil's biofuel industry and consumer demand are not significantly affected by slight fluctuations in gasoline prices or from changes in government funding that, when removed, would make the fuel more expensive than its major competitor, gasoline. From these characteristics, it may be safe to say that the Brazilian biofuel industry is, in fact, relatively stable and self-sustaining. For the most part this is a true statement, and from this perspective, Brazil is actually a model for countries like the EU and the US to follow. However, Brazil's ethanol industry has proven to be susceptible to changes in feedstock prices, as we saw in the late 1980s, and export demand. While the Brazilian market appears to be well-developed, there remains the inescapable fact that sugar and ethanol come from the same feedstock, sugarcane. Even though the environment for ethanol production is ideal right now, with historically high oil prices, a mature, efficient ethanol infrastructure, and sustained demand for ethanol, only 51% of sugarcane crops are turned into ethanol and the rest is devoted to sugar production²³. This reality is true for all major biofuel crops and will continue to be a hindrance to the growth and maintenance of the industry for years to come. Another

²² Ibid, 12.

²³ Perkins, Morgan, "Brazil Sugar- Ethanol Update 2006," *USDA Foreign Agricultural Service, GAIN Report*, 8 February 2006.

weakness that the Brazilian ethanol industry has exposed is the less responsive capability of changes in supply to meet demand. Brazil has a vast agricultural capacity, more than 175 million acres currently, with room to double that amount to equal US agricultural output²⁴. However, Brazil still struggles to meet increases in demand and recent spikes have even increased ethanol prices to close to those of gas in the major ethanol producing state of Paraná²⁵. Biofuel industries, no matter how economical or efficient, will always be plagued by the fact that they come from agricultural crops that have restraints on land and time to be created. The Brazilian case, which has decades of experience on the US and EU, is a foreboding example of the future of biofuel.

In the last few years, since the US and EU have significantly increased their demand and domestic industries for biofuel, Brazil has moved quickly to capitalize both on ethanol sales and other historically high commodity prices. It has been this recent development that has been most concerning and has caused significant damage to its natural environment. Brazil has historically been the second largest producer of soybeans, trailing behind the US. Soybeans are used for a variety of applications, from a range of food and industrial uses to feedstock for the meat and biodiesel industries. Seeking to capitalize on record high soy prices, Brazil has doubled its soy production since 1999 and has taken over the US as being the world's largest exporter of soybeans²⁶. The reasons for this major shift in Brazilian agricultural output, as well as soaring prices, is a true testament to the ever-interlinked world of globalization. Since the US enacted

²⁴ Barrionuevo, Alexei, "To Fortify China, Soybean Harvest Grows in Brazil - New York Times," *New York Times*, May 6, 2007, sec. World Business,

²⁵ Perkins, Morgan

²⁶ Schneyer, Joshua "To Fortify China, Soybean Harvest Grows in Brazil - New York Times," *New York Times*, May 6, 2007, sec. World Business,
http://www.nytimes.com/2007/04/06/business/worldbusiness/06soy.html?_r=2&pagewanted=2&ref=americas&oref=slogin.

biofuel legislation, US farmers have cut back on soy production in favor of the gains to be had by corn production for ethanol. Since 2006, US corn production has gone up by 19%, taking away from land previously used for soy production, which is concurrently down 15% since 2006²⁷. Simultaneously, Chinese demand for soy has doubled in the last five years and Brazil has been its main provider by doubling its exports every year since 2004²⁸. Additionally, the EU has been a source of further pressure on the Brazilian soy industry because of its preference for non-genetically modified (GM) crops, which make up just 10% of Brazil's soy harvest, as opposed to the US's nearly 100% GM soy industry²⁹. As a result, Brazil has quickly doubled its exports since 1999. While this development has been an economic boon for Brazil, there are a number of problems with the rapid increase.

Brazilian soy production has traditionally been concentrated in an ecosystem known as the cerrado, which is a sort of savannah or scrubland habitat. It is not especially productive and large-scale crop production did not develop widely on the cerrado until the 1960's and has quickly increased since then³⁰. The cerrado has customarily highly acidic soil, full of aluminum, low in phosphorus and with little water-retaining capacity. Due to increases in technological inputs including fertilizers, pesticides, and specially formulated seeds, Brazil has been able to raise yields and viable

²⁷ "Increase in US Corn Production for Ethanol Helping Drive Amazon Deforestation," *Green Car Congress*, January 1, 2008, <http://www.greencarcongress.com/2008/01/researcher-incr.html>.

²⁸ Barrionuevo, Alexei

²⁹ "GM soybean sales slow in Brazil," ProQuest. *International News on Fats, Oils and Related Materials: INFORM* 16, no. 9 (September 2005): 573.

³⁰ Marty McVey, Phil Baumel, and Bob Wisner, "Brazilian soybeans - What is the potential? Marty McVey, Phil Baumel, Bob Wisner," *AgDM newsletter*, October 2000, <http://www.extension.iastate.edu/AGDM/articles/others/McVOct00.html>.

cultivable areas³¹. Unfortunately, only 20% of the original cerrado remains intact today³². With increasing soy demand and significantly less cerrado to expand into, the Amazon rainforest has emerged as the next agricultural frontier to be exploited. Helped by newly adapted soy varieties that flourish in tropical climates, rapid soy expansion into the rainforest has led to further deforestation of the Amazon³³. While the level of direct deforestation for soy production land is small, there are many other ways that the Brazilian soy industry has indirectly caused deforestation. As large-scale soy producers develop more of the cerrado, smaller-scale farmers are pushed out and must resort to slash-and-burn rainforest cultivation³⁴. Scientists estimate that this activity has historically resulted in 20-30% of Amazon deforestation. Increased demand for land is also pushing cattle ranchers further into the Amazon. Cattle-ranching is the primary industry responsible for Amazonian deforestation, with 60-70% of total deforested acreage directly linked to cattle-ranching³⁵. Large-scale cultivators buy large expanses of converted rainforest pasture-land for soy production, which drives cattle-ranchers further into the rainforest. Also, with increased prices for feedstocks of corn and soy, the beef market prices have jumped recently as well. To capitalize on these favorable market conditions, the cattle-ranching industry is increasing its own output and taking up more Amazonian habitat³⁶. The combination of these two industries, along with other contributors, has resulted in a deforestation rate of 1.3 million hectares per year and has

³¹ Ibid

³² “Facts about soy production and the Basel Criteria,” *World Wildlife Foundation*, http://assets.panda.org/downloads/factsheet_soy_eng.pdf.

³³ Ibid

³⁴ Rhett Butler, “Biofuels driving destruction of Cerrado savanna in Brazil,” *Mongabay.com*, August 21, 2007, <http://news.mongabay.com/2007/0821-cerrado.html>.

³⁵ Rhett Butler, “Deforestation in the Amazon,” *Mongabay.com*, <http://www.mongabay.com/brazil.html>.

³⁶ Sills, Jennifer. “Switch to Corn Promotes Amazon Deforestation.” *Science*. Vol. 318, pg. 1721, 14 December 2007.

also added to Brazil's carbon emissions, which are currently the fifth highest in the world³⁷.

To make matters worse, the Brazilian government has been rather lenient on these big, money-making industries and has succumbed to their powerful lobbying. The other major impact that the soy industry has had on deforestation is through this power. By way of lobbying, the soy industry has rapidly increased the complex infrastructure needed to maintain such a massive agricultural trade. Road construction and river diversion projects are among the most notable developments that have contributed to degradation of the Amazon habitat. While this part of deforestation may contribute the least amount of acreage, it opens much more land to human interaction and exposes much more Amazonian habitat to outside invasion³⁸. Also, studies show that when roads and other infrastructure penetrate Amazonian regions, rural poor follow by first populating proximal land and then engaging in subsistence agriculture that further drives deforestation³⁹. Overall, these factors have contributed to deforestation increases of between 30 and nearly 50% over the past four years⁴⁰.

A recent study published in *Science* magazine has researched the complex impacts of deforestation in the Amazon and found many negative results, some much more serious than previously thought. Climate change is already and will continue to play a divisive role in the intricate Amazon ecosystem, and this study found that deforestation and climate change seem to have a synergistic effect that could heavily impact the vitality of this crucial habitat in the future. The study found that deforestation

³⁷ Branford, Sue, Rocha, Jan, "Death of the Amazon," *New Statesman*, ProQuest, London: July 2, 2007. Vol. 136, Iss. 4851, pg 36-38.

³⁸ Rhett Butler, "Biofuels driving destruction of Cerrado savanna in Brazil"

³⁹ Rhett Butler, "Deforestation in the Amazon"

⁴⁰ Ibid

in the Amazon, 80% of which has been in Brazil, has significantly contributed to the current vulnerabilities developing in the ecosystem⁴¹. The Amazon is a significant terrestrial carbon sink, responsible for 15% of terrestrial photosynthesis, and deforestation takes away from that potential. In addition, the primary manner that rainforest is converted to crop or pasture-land is through slash-and-burn technique, whose nutrient-rich ash provides good soil conditions for two to three years for soy production or pasture cattle grazing. When forest is burned, carbon is released into the atmosphere and further accelerates the levels of high carbon dioxide in the air. While the US and EU's increased production of biofuels has slightly reduced their environmental impact, their biofuel legislation is indirectly causing deforestation of the Amazon. Their policies are compromising a much more effective carbon sink and causing increased carbon dioxide levels from slash-and-burn deforestation practices.

In addition to current elevated carbon emissions from soy expansion, the study also found significant impacts due to climate change and deforestation on Amazonian vitality. Increased temperatures have already and will continue to lengthen the dry season, which reduces the amount of precipitation and internal climate drivers that the Amazon creates for itself⁴². With reduced precipitation and longer dry seasons, the rainforest is more susceptible to tree fatality and drying of the understory, which leads to damaging fires. Deforestation only further exacerbates this problem. It is estimated that 25-50% of precipitation is recycled through tree root systems and fuels further precipitation in the rainforest itself and in the larger South America continent⁴³. With

⁴¹ Malhi, Yadvinder, Roberts, J. Timmons, Betts, Richard A., Killeen, Timothy J., Li, Wenhong, Nobre, Carlos A. "Climate Change, Deforestation, and the Fate of the Amazon." *Science*, vol. 319, pg. 169-72, January 11, 2008.

⁴² Ibid

⁴³ Ibid

fewer trees to draw up water from the ground, less water is regenerated for local precipitation. According to the *Science* study, models of the rainforest suggest that if 30 to 40% of the forest is removed, much of the Amazon would be pushed into a permanently drier “climate regime”⁴⁴. As of 2001, 87% of the habitat had been removed, with record breaking deforestation rates since that time⁴⁵. If the trend continues, coupled with the longer dry seasons from climate change, the threshold will likely be met and irreparable damage will be done to the Amazon.

Fragmentation is another major impact that the expanding soy industry has on the Amazon habitat. More roads and other infrastructure have been directly linked to higher forest fire rates in recent years⁴⁶. The Brazilian soy lobby significantly contributes to rainforest fragmentation through infrastructure building. Based on 2002 estimates, Brazil adds between 20,000 and 50,000 square kilometers of new forest edge annually⁴⁷. With recent increases in soy production, that number has probably jumped even higher.

Because of the man-made fragmentation to the forest habitat, about 28% of Brazilian Amazon faces added fire risk by being within 10 kilometers of a fire source.

Fragmentation causes an opening of the canopy and drying of understory that can lead to further fire vulnerability. Perhaps more destructive than the fragmentation itself is the access that roads give for human expansion into these virgin rainforest territories. Below is a sequence picture of a section of rainforest after a road is created through it.

⁴⁴ Ibid

⁴⁵ Ibid

⁴⁶ Ibid

⁴⁷ Ibid



http://assets.panda.org/downloads/factsheet_soy_eng.pdf

While the initial road has little impact on the vibrant ecosystem, years of human contact turned it into a monocultural wasteland. With more and more roads and other infrastructure projects penetrating deeper into the Amazon, more scenarios like this one will likely happen in the future.

Another consequence of the rapidly expanding soy and cattle industries has been the various consequences of intensive agricultural practices on the environment and the Brazilian people. In addition to disrupting local precipitation rates, the actual removal of forest cover severely limits soil retention ability. Soil erosion has become a major problem in the agriculture-intensive states of Brazil. Each year, Brazil loses 55 million tons of topsoil, which is a dangerously high soil erosion rate⁴⁸. Soil erosion is also quite detrimental to nearby waterways, which suffer from heavy siltation and whose organisms often cannot survive in the changed habitat. Topsoil erosion affects the fertility of the soil and fertilizer use is increased drastically to compensate. Currently soy production is responsible for 25% of all pesticide consumption in Brazil, and nationwide pesticide sales

⁴⁸ "Facts about soy production and the Basel Criteria," *World Wildlife Foundation*, http://assets.panda.org/downloads/factsheet_soy_eng.pdf.

have tripled over the past ten years⁴⁹. The intensive use of pesticides and fertilizers has translated to very high exposure rates for people, which is estimated at about 10% of the Brazilian population. Pesticide use has also caused very high rates of waterway contamination. Records show that between 150,000 and 200,000 people get pesticide poisoning each year, 4,000 of which result in death⁵⁰. While little data is available on the socio-economic status of those exposed to pesticides, it is pretty safe to assume that most of those significantly harmed by these dangerous chemicals are poor, landless farmers that work directly with chemicals on many large-scale plantations. On top of the grave environmental impacts that US and EU agricultural policy is having on Brazilian habitat, environmental justice issues are also now being raised.

Indeed, the prolific expansion of Brazilian soy and cattle industries, as well as more intensive sugarcane production has made the environment much more suitable and lucrative for big business and foreign investment rather than on small-scale farmers. In addition, the growth biofuel industry has shown collusion between big business and government that is even harder on smaller farmers⁵¹. The numbers of landless peasants and seasonal, low-wage farmers have grown in recent years. Currently, nearly half (46.8%) of cultivable land in Brazil is owned by just 1.6% of the landowner population and just 3% owns two-thirds of all arable land in this expansive country⁵². These statistics show that while Brazil is a large and fertile country with many resources, they are inequitably distributed among the people. It is unfair to say that the biofuel industry is the only contributing factor to this extreme situation but it certainly exacerbates the

⁴⁹ Ibid

⁵⁰ Ibid

⁵¹ “Bio-Energy for Whom?” *Sem Terra Magazin*, March 23, 2007. <http://www.mstbrazil.org/?q=mstinformal30>

⁵² “About,” *Brazil’s Landless Workers Movement*, <http://www.mstbrazil.org/?q=about>

problem. When an industry such as biofuel evolves, it provides opportunities to gain significantly from a reliably high demand for energy. Large corporations are best equipped to position themselves favorably with governments to get the contracts to produce such high levels of specialized seeds, pesticides, infrastructure, and industrial agriculture that the biofuel industry requires. As we have seen, the biofuel industry has a synergistic effect on other commodity markets that also lend themselves well to large-scale, monoculture agricultural output. In turn, smaller-scale farmers and the rural poor are pushed out of their communities and onto increasingly marginalized land or no land at all and forced to work for low wages, often seasonally for large corporations. The Brazilian government has been relatively non-responsive to this concern because large agribusinesses are earning so much taxable capital for the country and rapidly increasing its standing in the world export trade. This problem will only continue to get worse as land and commodity prices get higher.

In addition to many powerless, landless peasants resulting from this new system, there are also now incidences of violence and injustice against this poor population. In the first half of 2003 alone, twenty peasants were killed over land disputes, with forty-three similar murders occurring in 2002⁵³. Even when the government does try to impose policies to protect the environment and foster small-scale farming communities, the large corporations find and work with their inevitable loopholes. Some shameful stories have come out recently in which loggers created phony rainforest communities on marginal land and brought unknowing landless peasants there just to be left stranded without food or water to survive⁵⁴. The logging companies have carried on like this because the

⁵³ Osava, Mario, "Agriculture-Brazil: Amid Big Harvests, A Fight for Land Heats Up," *Global Information Network*, ProQuest. New York: August 6, 2003, pg. 1

⁵⁴ Branford, Sue, Rocha, Jan

Brazilian government, under its Project for Sustainable Development (PDS) program, enacted policies in which sustainable logging enterprises could be established in small, rainforest communities or “conservation units” inhabited by previously landless peasants⁵⁵. Worse still, loggers and large-scale farmers that participate in these scams can officially mark their products as sustainably harvested and even get higher prices for them in both the domestic and international markets⁵⁶.

This program, along with other biofuel legislation, sounds very progressive and positive on paper, but has been undermined and manipulated in practice, resulting in the effects opposite those intended. One researcher found that of the one hundred or so “conservation units” established since 2005, nine-tenths are actually facades for logging and large-scale farming enterprises⁵⁷. Brazil’s attempts to counteract destructive forces on its richly diverse Amazon ecosystem are similar to the underlying reasoning for biofuel legislation in the US and the EU. Unfortunately, the world is far more complex and interconnected than at any other time. This interconnectedness has benefited greedy opportunists at every point, often in the form of multinational corporations, even if they achieve their objective in a divisive and underhanded way.

Indonesia Case Study: Poverty and Environmental Degradation in Practice

Indonesia is another interesting and revealing case study in the biofuel story. In one sense, it shows the lack of foresight in policy planning by developed nations, and at the same time, Indonesia exemplifies the destructive greediness that a high profit potential can have on a country’s land management policies. There are certain inequities in Indonesia’s country profile that are largely explained once the oil palm market is

⁵⁵ Ibid

⁵⁶ Ibid

⁵⁷ Ibid

included. While Indonesia is the sixth most populous nation in the world (ranked behind the European Union as a whole entity), it is far less developed than many other nations. Specifically, Indonesia's per capital GDP for 2007 was \$3,400, which was behind both the Republic of Congo and Iraq⁵⁸. So it is intriguing and rather shocking to learn that Indonesia is now the third largest carbon emitter, behind the giants of China and the United States⁵⁹. Unlike the EU, India and Russia, Indonesia's transportation and industrial sectors are not well developed and so contribute little to its dubious ranking. Deforestation and peat land draining are the primary reason for such a disproportionately high level of carbon dioxide release⁶⁰. For years now, Indonesia has used its rich Borneo rainforest and extensive peat lands for large-scale agricultural cultivation, which has contributed to its impressive economic growth in recent years. Recently, biofuel production has entered the Indonesian market, derived from the high-yield oil palm plant.

The international market has had a major role in this crop's success in Indonesia. Financed largely by international banks and foreign investment, oil palm was strongly encouraged as a cash crop under the World Bank's (WB) and the International Monetary Fund's (IMF) structural adjustment programs⁶¹. While the national government and international community made money from this crop program, most citizens did not benefit. More recently, the international community has influenced Indonesia's oil palm industry with increased demand for non-trans fat oils and biofuel sources. As a very

⁵⁸ "CIA - The World Factbook -- Indonesia," *Central Intelligence Agency*, April 15, 2008, <https://www.cia.gov/library/publications/the-world-factbook/geos/id.html>.

⁵⁹ Howden, Daniel, "Deforestation: The hidden cause of global warming - Climate Change, Environment - The Independent," *The Independent*, May 14, 2007, sec. Environment, <http://www.independent.co.uk/environment/climate-change/deforestation-the-hidden-cause-of-global-warming-448734.html>.

⁶⁰ Ibid

⁶¹ Brown, Ellie, Jacobson, Michael, "Cruel Oil: How Palm Oil Harms Health, Rainforest, and Wildlife," *Center for Science in the Public Interest (CSPI)*, Washington: May 2005, pgs. 1-40, pg. 9

high-yielding crop, oil palm is the most efficient biodiesel crop around, which makes it quite attractive for multinational corporation investors⁶². Under the Kyoto provisions, there is a section called Clean Development Mechanism (CDM), which rewards countries that develop clean, green technology or energy sources⁶³. Biofuel is one of the primary suggested options under this category. Because biofuel cultivation is currently seen as a “green” alternative to gasoline, official funds from the Kyoto Protocol could be allocated for Indonesian oil palm production, at the expense of billions of tons of carbon emissions from deforestation, peat drainage and fires. The Indonesian oil palm industry like Brazil’s sugarcane had already been around for quite some time as a source of domestic cooking oil. In the international community, oil palm has been a hot commodity as a common vegetable oil in foods and of late as a source for biofuel⁶⁴. Its price has driven up concurrently with US and EU biofuel legislation and demand. As a result, Indonesia has quickly ramped up its oil palm plantations, derived mostly from rainforest and peat land habitats. As mentioned earlier, the major contributor to Indonesia’s high level of carbon emissions is the agricultural industry, whose slash-and-burn and peat land drainage policies used to convert virgin land into oil palm plantations have released significant levels of carbon back into the atmosphere. With reference to its rainforest, deforestation in Indonesia has effects similar to those in Brazil. Removal of photosynthesizing trees not only takes away effective carbon sponges; it also causes a quick release of the carbon stored in the trees themselves back into the atmosphere. There is also evidence in Indonesia of the same trends observed in Brazil toward increased forest fires after human intervention in the habitat. Also, the Borneo rainforest

⁶² Ibid, 26

⁶³ Ernsting, Almuth

⁶⁴ Ibid, 2

is a major climate driver for the Southeast Asian region. Tracking Indonesia's deforestation over time shows very rapid rates of removal: as late as 1977, 77% of the country's original forest cover was still intact, but that level dropped to about half in 1997. If current rates continue, all of Indonesia's lowland tropical forest habitat will be deforested by 2010⁶⁵.

Peat land habitat is another ecosystem that is commonly used for oil palm plantations. When the land is converted for agricultural uses, it must be drained. Scientists have found that peat land drainage contributes to carbon emissions in two major ways. Firstly, as water is removed from the habitat, the peat oxidizes and gives off carbon previously stored in it. While the effects of oxidation appear relatively benign, they are far from it. In a recent study on peat land drainage, it was found that peat oxidation emits 516 megatons/year of carbon into the atmosphere. This level of emissions is responsible for nearly twice as much of the emissions given off by fossil fuel burning annually in Indonesia⁶⁶. While peat oxidation cannot be discounted when calculating the effects of drainage on climate change, another effect contributes more severely to carbon emissions. When peat oxidizes, it dries out and becomes highly flammable, especially in the dry season now prolonged due to climate change⁶⁷. Shortly after the practice was started in 1996, widespread fires swept through 11.6 hectares, constituting 6% of total Indonesian land. Those fires alone were responsible for between 13 and 40% of the global carbon dioxide emissions for that year⁶⁸. Fires of this kind

⁶⁵ Ibid, 8.

⁶⁶ Hooijer, Aljosja, Silvius, Marcel, Wosten, Henk, Page, Susan, "Peat-CO2: Assessment of CO2 emissions from drained peatlands in SE Asia" *WL Delft Hydraulics*, December 7, 2006

⁶⁷ Ernsting, Almuth, "Agrofuels in Asia- Fuelling poverty, conflict, deforestation, and climate change," *GRAIN Seedling*, July 2007, <http://www.grain.org/seedling/index.efm?id=479&print=yes>

⁶⁸ Ibid

remain so commonplace in Indonesia that they are listed as one of the major environmental hazards of the country⁶⁹. It is estimated that yearly carbon emissions from peat land drainage and fires average about one billion tons of carbon, and that number will only accelerate as more oil palm is required for biofuel consumption⁷⁰. The Indonesian government has done a few things to slow the rapid progression of peat land drainage, but to little avail. It has tried instituting policies that regulate the depth of allowable drainage. Not only is this policy technically complex to verify, it is rarely enforced⁷¹.

Forest and peat land fires are so frequent and severe in Indonesia that they even pose a health and environmental hazard risk to its people. For example, in the 1997 and 1998 fires, the haze and air pollution from rampant wildfires affected the health of some 70 million Indonesians⁷². Of those affected, an estimated twenty million now suffer from acute, long-term health conditions as a direct result of the fires⁷³. Wildfires from peat land and rainforest degradation do not just affect the Indonesian population but also the people and industries of neighboring countries; that is how far reaching its effects are. For instance, the Singapore airport had to shut down for periods during those 1997 fires because of visibility problems⁷⁴. The Asian Development Bank estimated the overall economic effects of the fires, including healthcare costs, environmental degradation, and interference with business as usual, cost the region \$9.3 billion⁷⁵. Because wildfires have been so rampant and widespread in Indonesia in the last few years, the Association of

⁶⁹ “CIA-The World Factbook—Indonesia”

⁷⁰ Ernsting, Almuth

⁷¹ Hooijer, Aljosja, Silvius, Marcel, Wosten, Henk, Page, Susan

⁷² Brown, Ellie, Jacobson, Michael, 24

⁷³ “Historic Fire Haze Pact Takes Effect in Southeast Asia,” *Environment News Service*, November 25, 2003, <http://www.ens-newswire.com/ens/nov2003/2003-11-25-01.asp>

⁷⁴ Ibid

⁷⁵ Brown, Ellie, Jacobson, Michael, 24

Southeast Asian Nations (ASEAN) created a wildfire prevention and mitigation program, known as the Agreement on Transboundary Haze Pollution⁷⁶. The provisions of the agreement include collaborative reporting mechanisms and high-tech monitoring systems to cut down on incidences of arson, as well as concerted fire-fighting provisions⁷⁷.

Hopefully this transboundary policy can mitigate this worrying trend.

Biodiversity considerations are another major problem with the proliferation of oil palm plantations in this biologically rich country. Indonesia is also home to some of the world's most biologically diverse and largely untouched rainforest. Oil palm industry proponents say that since oil palms are native to the area, the plantations provide a natural habitat for many species native to the rainforest. In reality as Indonesia cuts down its pristine rainforest and converts it into oil palm plantations, just 20% or less of the original biodiversity remains⁷⁸. Of the over 400 identified land mammals native to Indonesia's rainforest, 140 (32%) are officially threatened and fifteen are critically endangered⁷⁹. The Borneo rainforest is exclusively home to the Asian elephant, Sumatran tiger, Sumatran orangutan, and Sumatran rhinoceros, all of which are either endangered or critically endangered and on the brink of extinction⁸⁰. Because their habitat is being converted so quickly, these majestic animals are also posing problems to the local plantation workers. Rather than try and foster a symbiotic relationship with these native species, some oil palm plantation owners have been known to put bounties on the heads of orangutans because they wander hungrily onto plantations and eat the oil palm⁸¹. Similarly, as Asian elephants' habitats are taken up more by oil palm, they are driven in closer to human

⁷⁶ "Historic Fire Haze Pact Takes Effect in Southeast Asia"

⁷⁷ "Historic Fire Haze Pact Takes Effect in Southeast Asia"

⁷⁸ Ibid, 12

⁷⁹ Ibid, 12

⁸⁰ Ibid, 13-16

⁸¹ Ibid, 17

settlements. The number of elephant attacks on humans has spiked in recent years, and has corresponded to increases in elephant killing. One account found six wild elephants in a mass grave, all of which had been sickened by rat poison fed to them by plantation workers⁸². The rampant fires of Indonesia are also very harmful to these fragile populations. In the massive fires of 1997 and 1998, fully one-third of the Borneo orangutan population was wiped out⁸³. To be sure, with the increasing conversion, fragmentation, and degrading of the Borneo rainforest, all of these species could go extinct very quickly.

In addition to the health risks posed by fires, large-scale agribusiness in Indonesia has problems similar to those we have seen in Brazil. Indonesia's oil palm industry is half owned by agribusinesses directly, 17% by state-owned enterprises, and 33% by small landholders. This distribution appears promising until it is clarified that those small landholders grow oil palm for the large agribusiness and rely on these companies for seeds, pesticides, sale of the crops (whose prices are set by the companies) and the original processing of the crop into oil⁸⁴. Therefore, agribusinesses effectively control over 80% of Indonesia's robust oil palm industry. With such a concentration, power is taken away from the native population and placed into the hands of disconnected outsiders. Plantation owners have come into established, relatively stable communities with the promise of capital infusion and better standard of living through oil palm sales. However, the wealth from the plantations stays primarily in the hands of very few, and often foreign owners. When small landholders were interviewed by a local NGO, many affirmed that the controlling plantation owners did not provide a sustainable livelihood⁸⁵.

⁸² Ibid, 18

⁸³ Ibid, 19

⁸⁴ Brown, Ellie, Jacobson, Michael, 8

⁸⁵ Ernsting, Almuth

The wage gap between the select few that benefit and the many that turn into poor wage laborers has been known to create social strife and community discord. In the year 2006 alone, there were 350 land conflicts in Indonesia⁸⁶.

Also, plantation owners have unfairly exploited the traditional lands of indigenous people by forcibly taking them over⁸⁷. Indeed, displacement concerns are another major argument against the widespread expansion of the oil palm industry. There are about five million indigenous people currently living in traditional lands in the Borneo rainforest of Indonesia⁸⁸. Those populations will likely be driven out of their lands in the coming years. On a larger scale, about 45 million people live in and rely on Indonesia's rainforest habitat for food and a livelihood. The United Nations Environment Programme (UNEP) estimates that under current conversion rates, 98% of the rainforest will be destroyed in the next fifteen years. If this prediction comes true, both the five million indigenous people and the forty million native Indonesians will be without a home and a livelihood⁸⁹.

Another major concern for the local Indonesian people has been the rapid increase in the cost of their cooking oil. Because oil palm is such a premium on the international market, plantation owners are continually restricting the amount of oil that remains for domestic cooking uses. In a very short time, the price of a kilo of cooking palm oil has gone up from 6,500 rupiah to over 9,000⁹⁰. On top of the price hike that has left some unable to afford cooking oil at all, there is also now a major shortage in supply. People are forced to wait in long lines to purchase the oil, and local businesses are feeling the

⁸⁶ Ibid

⁸⁷ Brown, Ellie, Jacobson, Michael, 22.

⁸⁸ Ernsting, Almuth

⁸⁹ Ibid

⁹⁰ Ernsting, Almuth

crunch as well. Recently a potato chip company had to shut down because its costs had gotten too high⁹¹. Higher food prices have become a huge and growing problem for the international market, and a lot of the increase can be linked back directly to the demand for biofuels competing with that of traditional food crops. In recent months the rising commodity prices have brought on a global food crisis.

World Commodity Prices: A Growing Crisis

We have seen the globalized effects of changes in demand that biofuel has had on widely different countries and for different reasons. In addition to the clear social and environmental impacts that this new demand has spawned, sky-rocketing food prices are also a major problem linked to biofuels. Because biofuels are derived from traditional commodity crops, the increased demand for these crops as biofuels, coupled with the increasing demand for the same crops as food sources, has caused global commodity prices to spike drastically in the past few years. These high food prices have caused protests and riots in countries as diverse and far apart as Mexico, Haiti and Pakistan. In Mexico, there were protests last February due to price hikes on tortillas of over 400%⁹². The tortilla is a staple in the Mexican, especially low-income diet, where people are now spending up to one-third of their earnings on it. The Mexican population blames ethanol for the price hikes because it has relied on US corn imports from NAFTA trade agreements, which have slowed since the introduction of biofuel legislation⁹³. President Felipe Calderon has set a non-binding price ceiling on the staple, but many tortilla distributors have not brought down their prices. In the last month, there have been a

⁹¹ Ibid

⁹² "Mexicans stage tortilla protest," *BBC News*, February 1, 2007, sec. Americas, <http://news.bbc.co.uk/2/hi/americas/6319093.stm>.

⁹³ Ibid

series of deadly riots raging in Haiti over food prices and aid delivery, five people were killed. In April of 2008, the central government of Haiti fell from power due to its inability to address food shortages⁹⁴. Food price increases are even hitting home, with over a 50% increase in the cost of milk between the summer of 2006 and 2007⁹⁵. Commodity investors point to increased transportation costs and demand for corn, the main feedstock for dairy cows, as the sources of price inflation. The crisis is even causing major figureheads from the United Nations and World Bank to say that the global food situation is becoming a grave emergency. An expert at the UN even went as far as saying that the conversion of food crops into biofuel is a “crime against humanity”⁹⁶. The International Monetary Fund (IMF) released a report last month in which it found that world food prices had gone up by 83% in the past three years and that conflict over food was threatening to destabilize entire countries’ governments⁹⁷.

Earlier this month the US Department of Agriculture (USDA) and US Agency of International Development (USAID) cosponsored a summit on the “Future Pathways for Food Aid”⁹⁸. The summit discussed many current issues having to do with the agricultural economy, including the current US farm bill, global agricultural infrastructure, World Trade Organization negotiations, and emergency food aid.

Government officials discussed the efforts being made to ease the tension of famine

⁹⁴ Guyler Delva, Joseph, Loney, Jim, “Haiti's government falls after food riots,” *Reuters International*, April 12, 2008, sec. International News, <http://www.reuters.com/article/homepageCrisis/idUSN12217781.CH.2400>

⁹⁵ “Forget worries about \$4 gas ... now it's \$4 milk - Food Inc.- msnbc.com,” *MSNBC*, May 30, 2007, sec. Business, <http://www.msnbc.msn.com/id/18946296/>.

⁹⁶ Lederer, Edith, “UN Expert Calls Biofuel ‘Crime Against Humanity’,” *Live Science*, October 27, 2007, <http://www.livescience.com/environment/071027-ap-biofuel-crime.html>.

⁹⁷ Victoria Sizemore Long, “USDA chief links energy, food costs while pledging US aid boost,” *McClatchy-Tribune Business News*, April 17, 2008, <http://proquest.umi.com/proxyau.wrlc.org/pqdweb?index=1&did=1464076321&SrchMode=1&sid=1&Fmt=3&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1208636059&clientId=31806>.

⁹⁸ Ibid

throughout the world and addressed the issue of rapidly rising food prices. In fact, the US has had to increase its distribution rate of emergency aid, drawing down on its stocks of available emergency food. The bottom line, experts said, was that food prices were on the rise because of increased transportation costs from fossil fuels. While biofuels have aggravated the problem, they said, record high oil prices, growing populations and escalated food preferences, and a bad growing season have been a significant factor and no ease in prices is likely in the near future⁹⁹. While this summit and the proclamations of several influential leaders have opened up the conversation about the future of the food economy, biofuels still remain major initiatives for the US, EU, and Kyoto Protocol for at least the next ten years. Save for a major change in policy towards biofuels, the current state of affairs is likely to continue, with untold catastrophe to the environment, social structure, and economies of the developing world.

Conclusions and Lessons for the Future

As we have seen through these two case studies and in reflecting on recent world food prices, biofuel has a much deeper impact on our world system than is commonly thought. Clearly there are glaring environmental and social injustices linked to the biofuel industry that the international community has thus far failed to address appropriately. Also, there seems to be little concerted effort on the part of either the US or the EU to repeal or modify the biofuel legislation that they have in place. As matters stand, both countries will continue their promotion of biofuels for at least the next ten years. From the evidence laid out above, there may well be a breaking point reached within that time span for many of these biologically diverse ecosystems, fragile economies, or disenfranchised populations. After holistically researching the effects of

⁹⁹ Ibid

biofuels on the world scale, there are a number of inequities and weaknesses that have been discovered.

General environmental degradation is obviously a major undermining influence on the effectiveness of biofuel. Deforestation is an especially glaring example of this fact. Two independent, scholarly studies recently found that forests are the single most cost-efficient resources available to combat the effects of climate change¹⁰⁰. Yet here is another case in which public policy does not reflect simple logic and whose consequences do the opposite of protecting our natural resources. The original structure of the Kyoto Protocol does not include standing forests in its calculations and they are excluded from the carbon market system, which would give much needed value to this crucial diminishing resource¹⁰¹. Common logic would lead one to believe that when both cultural and economic values are placed on a natural resource, its conservation becomes much easier to maintain. It seems completely irrational, then, to learn that the leading international treaty dealing with global climate change is structured in such a foolish way. By closing this loophole with international treaties and with the support of developed nations, the world's most ecologically productive ecosystems could be preserved and climate changes effects slowed.

The Kyoto Protocol is an example of the myopic legislation in place regarding the environment. Regulation is a major weakness for the biofuel industry worldwide. While the US and the EU take minor steps to improve their energy portfolios, they are causing major imbalances in the world order. It is impossible in this globalized world to extricate policy initiatives in one country from the rest of the world. The case of biofuel

¹⁰⁰ Howden, Daniel

¹⁰¹ Ibid

legislation has made it abundantly clear that a policy shift that changes agricultural output in one country will affect not only the world price of that commodity, but many others linked to it *and* it can change the agricultural priorities of countries around the world. By displacing production into the developing world, concerns of unregulated and destructive agricultural practices arise and are very hard to curtail. It is therefore imperative to include the international community when considering domestic policy initiatives. This seems like a simple solution, but the reality is far from easy. Legislation is already very difficult to pass even in the US, harder still in the EU. With the international community included in the discussion, very little would get passed indeed. However, both countries can adopt more precautionary mindsets when dealing with policies. It may have been hard to predict that Brazil would have increased its Amazonian deforestation as a result of biofuel legislation in the US. Yet, the trading tendencies of these countries were well known and the US could have gradually increased its corn production to ease that tension on the world markets. Biofuel legislation shows that any policy that causes rapid changes in the output of an industry has significant ripple effects around the world.

The role of the developing world is especially interesting to look at in this study. It is apparent how malleable and vulnerable a society and its economy can be when international demand and multinational corporations are involved. Indonesia is a prime example of this phenomenon, and the biofuel industry even showed effects on a relatively well established economy like Brazil. The current globalized system does not regulate exploitation. When countries are in dire straits and economic opportunities present themselves, an unequal leveraging occurs. Multinationals dominate and the countries endure environmental degradation, widening social inequalities, and colonial-type

relationships over their resources. This system is not conducive to long-term development. The biofuel industry is an even greater insult to global inequality because it is literally taking food away from the poor and putting it into the gas tank of a rich nation.

The main problem that the biofuel industry boils down to is the fact that this globalized world is based on conquering and consumption. The developed world has established the framework and indicators of success in the current global economy. The outlook for all manners of life and rule of law are based on conquering our problems and consuming more. This is very different than establishing equilibrium and self-restraint. The biofuel industry is a prime example of this phenomenon. When oil prices began to rise, instead of looking inwards and promoting a smaller carbon footprint through less consumption, the developed world instead turned to alternative energy to fuel our every growing consumption and economies. Now we are growing fuel at the ultimate sacrifice, food and the land we grow it on. Just because someone is willing to grow and sell biofuel does not mean that it is the right thing to do. The fact of the matter is we cannot always remedy shortages in the market and a weakening environment with more consumption and by conquering the environment. Maybe a “green” economy is not a pipe dream, but the answer cannot be found in further consumption with biofuels.