

**Conservation Management Strategies of Ethanol Crop Production:**

**A Brazil-US Comparison**

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**Vita**

A lifetime of outdoor pursuits first sparked an interest in environmental matters for Hazen. With that passion, he has studied such varied topics as nitrogen deposition in the forests of Northern Michigan to the regulations that manage commercial spring water extraction in the foothills of the Sierra Nevada. At Brown, Hazen has been comparing the environmental management strategies farmers employ in Brazil and United States in the production of ethanol crops. Hazen holds a BS from the University of California at Berkeley.

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## **Executive Summary**

Brazil and the United States are the world's two largest ethanol producers, and in both countries the majority of crops for this kind of biofuel are grown in areas of fragmented ecosystems--the Atlantic Forest in Brazil and Prairie Pothole region of the United States. The recent emphasis on ethanol as an alternative fuel has only increased this strain, as the feedstock crops--sugarcane in Brazil and corn in the United States--have claimed more land. With this in mind, this thesis examines the consequences of the ethanol boom on environmental management practices on farms in Brazil and the United States. This project seeks to capture individual farmers' decision-making processes and worldviews to better understand this question. In the comparison, the two regulatory structures for conservation the two sets of farmers face are very different. Brazil mandates a certain percentage of native vegetation on farms, and in Paraná it is 20%, as well as "Areas of Permanent Protection" with its Forestry Code. In contrast, conservation in the United States, including native ecosystem maintenance, is voluntary and involves cost-sharing and other programs with the government. The research design is advantageous because it highlights the benefits and drawbacks of each system. The wide regulatory structure also allows for greater opportunities that other countries will find some component familiar to their own agricultural land laws.

A remarkable amount of scholarship devoted to the environmental, social, and economic effects of this sector in Brazil and in the United States has been generated as a result of the ethanol boom. Yet, the literature remains incomplete, especially on the

subject of human management of these fragmented biomes. The perspective of farmers is invaluable because what habitat remains of these ecosystems is in their hands, and how they use their land and their conservation choices will determine the future state of these natural regions. The research presented here fills this gap. This pilot study has additional practical applicability because Brazil and the United States will act as guides to other countries if their ethanol production techniques are reproduced elsewhere. In this sense, this research acts as guide for farmers in Brazil or Iowa to understand their counterparts better, and for other growers elsewhere to understand the regulatory and economic climate farmers in these case studies face.

In this study, I interviewed 11 farmers in the state of Paraná who grew sugarcane and 11 farmers in the state of Iowa who grew corn. Interview questions focused issues of land tenure, labor, and biodiversity and soil conservation management. In addition, the questionnaire contained general land management questions. They consisted of what sorts of agricultural practices are used (i.e. crop rotation, no-till methods, etc.) and how the price of the commodity affects the land use patterns. I also asked the farmers the rationale for their various courses of action. The evidence this work gathered is quantitative and qualitative.

I also interviewed farmers in Paraná who grew sugarcane as raw material for brown sugar and cachaça and not at all for ethanol. These farmers were paid to implement certain conservation techniques and practices by the Paraná Biodiversity Project. Overall, these farms were smaller and less industrialized. I compared the smaller Paraná Biodiversity Project farmers and their alternative mode of sugarcane

production to the sugarcane farmers that produced for ethanol.

Due to the small and non-random interview samples, the findings of this pilot study are exploratory and intended to guide further research. Findings are grouped into three broad categories: environmental aspects, social and economic aspects, and evaluations of future developments. In terms of environmental aspects, Iowa farmers were found to be in better compliance with environmental regulation than Brazilian farmers. At least 7 of 11 farms in Paraná failed to meet a legally mandated threshold of 20% of farmland to be dedicated to its natural state, which also may include maintaining “Areas of Permanent Protection,” such as adequate buffer strips. Nine of the eleven Iowa farmers used various retired and working lands conservation programs, and planned on reenrolling rather than switching to crop production despite currently high commodity prices. However, the noncompliance seen in Paraná does not mean they are inherently less conservation minded than their counterparts in Iowa: it just means the Brazilian conservation laws are very stringent and could be bolstered, perhaps with pricing attached to the value of native vegetation habitat. In both case studies, more land for the respective biofuel feedstocks came at the expense of other crops such as coffee in Paraná or soybeans in Iowa, rather than native ecosystems since in these places not much of that land type remain. Additionally, in 2007, the year of the interviews, nearly all of the corn growers experimented with “corn-on-corn” rotation on subplots, which increases corn in the rotation but removes the nitrogen fixing soybean crop from rotation and increases inputs. In both areas, most farmers described their way of life in financial terms, but they considered conservation issues as well. This is an important result. In both Paraná and Iowa, a smaller set of farmers espoused a

progressive worldview of farmland management, which included novel soil contouring, no till techniques, and the need for bottom-up, holistic agricultural policy. In fact, one conclusion from this experimental work illustrates that farmers can reconcile the current boom in the agricultural sector with a conservation ethic.

These questions not only generated conversations on conservation issues, but also revealed the farmers' thoughts on social and labor issues, the general economics of their agricultural business, and the future of their livelihood. Labor and social issues are prominent in Paraná, but not in Iowa, because sugarcane production there is much more intensive. As a result, labor organizations have a much more conspicuous role in Brazil than in the United States and groups like the Movimento dos Trabalhadores Rurais Sem Terra (MST), which translates to the Landless Worker's Movement are active in the promotion of labor and social causes. Yet, some farmers complained about the work habits of their workers and thought they were not getting enough labor out of them. In Iowa, only one farmer mentioned labor in the context of wages, and thought that if he pays his workers well, their attention to detail would be greater. In sum, there is significant tension among the farm owners and operators, the labor force, and outside interested groups in Paraná and Brazil, but not in the more mechanized agricultural system in Iowa.

The farmers also talked about the economics of the farming. A handful of farmers in both case studies talked about being close to the margin on operating costs and revenues, and these particular farmers had operations on the smaller side. One farmer in Paraná said he was "a slave to the [ethanol and sugar] market." One smaller

farmer in Iowa described how he farmed in “a dog-eat-dog” world. Inflation may also be a concern for farmers. In Iowa, farmers were split over whether the high commodity prices drove general inflation for input and production costs and in their local farming communities. The Iowa farmers were, however, all grappling with higher land prices. One or two farmers in both Paraná and Iowa described how they were apprehensive about increased farm size in their area accelerated consolidation in the ethanol and agricultural sector and what that mean for their operations.

When the farmers talked about the future of their field or the intangible motivations for being a farmer, they evoked hope, optimism, and in few cases in Paraná, disapproval toward corn ethanol production in the United States as a barrier to a new market. There were farmers in both Paraná and Iowa who saw the strategic value for national and energy security and mentioned it as a reason for growing the crops they did. In both places, there was also optimism for the future. In Paraná, the interviewed farmers overwhelmingly desired to export more ethanol. In Iowa, two or three farmers were hopeful cellulosic ethanol would advance sufficiently that a market would emerge for the corn cobs and corn residue that would otherwise stay in the field.

In summary, Paraná has the potential to implement more sustainable ethanol production methods that would more fully integrate biodiversity and native habitats into the process, especially if exportation increases to environmentally oriented customers like certain European nations, who may facilitate these farmers to transition to more conservation minded practices. Iowa also shows promise for environmental protection with its strong suite of conservation programs, but any new energy or agricultural

legislation should give due consideration to issues of conservation. For optimal biodiversity management, both countries should build into their ethanol policies the continued health of local farm economies and satisfactory advances in technologies for cellulosic ethanol.

## **Chapter 1 Introduction**

### **1.1. The Research Question**

Recent high oil prices, unease about energy security, and climate change concerns have helped drive the burgeoning alternative fuel sector.<sup>1</sup> Biofuels, which are fuels derived from living material, have played a notable role in the search to replace petroleum. Ethanol and biodiesel are probably the most important biofuels.<sup>2</sup> While ethanol and other biofuels are seen as “green,” it is important to determine how the surge in production of these new fuels affects the physical landscape.

The world’s two largest ethanol producers, the United States and Brazil, have seen the acreage of ethanol crops (sugarcane in Brazil and corn in the U.S. Midwest) increase in response to the heightened demand for ethanol. According a United States Department of Agriculture (USDA) report, 2007 saw 93.6 million acres or 37.9 million hectares of corn planted. This area was the most since 1946. This area was an increase of 15 percent over 2006.<sup>3</sup> Although the USDA expects the area devoted to corn to

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1 Stack, James., with Balbach, John, Epstein, Bob, and Haggis, Teryn. “CleanTech Venture Capital: How Public Policy has stimulated Private Investment.” May 2007. <http://www.e2.org/ext/doc/CleantechReport2007.pdf>

2 Hill, J., Nelson, E., Tilman, D., Polasky, S., and Tiffany, D.: Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels, *Proc. Natl. Acad. Sci.*, 103,11 206–11 210, 2006. Farrell, Alexander E., R. J. Plevin, B.T. Turner, A.D. Jones, M. O’Hare and D.M. Kammen. 2006. Ethanol can contribute to energy and environmental goals *Science* 311: 506-508.

3 National Prospective Plantings. USDA-NASS. Plantings USDA-NASS. March 30, 2007. <http://usda.mannlib.cornell.edu/usda/current/ProsPlan/ProsPlan-03-30-2007.pdf>

decrease in 2008, it may rebound in 2009 or later.<sup>4,5</sup> In Brazil, the most recent agricultural census data shows that in 2006 6.18 million hectares of sugarcane were grown, which is somewhere between 6 and 7 percent more than in 2005.<sup>6</sup> These increases have an ecological significance because the agricultural regions in each country where these crops are grown are located on top of fragmented ecosystems. In Brazil, the main region of sugarcane production carpets lands once rich in biodiversity such as the Mata Atlântica, or the Atlantic Forest, and nearby interior semi-deciduous forests. Additionally, many environmentalists are concerned that increased sugarcane production will encroach upon the Cerrado, a type of savannah of Southwest Brazil.<sup>7</sup> In the United States, persistently elevated prices for corn as a result of ethanol mandates may cause changes in land use. Although corn has been grown in the region for many years, previous generations of farmers produced corn in rotation with other crops. The push for corn may bring new land into crop production, but more likely corn production will

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4 Streitfield, David. "Farmers cut back on corn and add soybeans." *New York Times*. Business. March 31, 2008.  
[http://www.nytimes.com/2008/03/31/business/01crop-web.html?\\_r=1&scp=3&sq=corn&st=nyt&oref=slogin](http://www.nytimes.com/2008/03/31/business/01crop-web.html?_r=1&scp=3&sq=corn&st=nyt&oref=slogin)

5 USDA Agricultural Projections to 2017 Report. Interagency Projections Committee. Office of the Chief Economist. USDA. February 2008.  
[http://www.usda.gov/oce/commodity/archive\\_projections/USDAgriculturalProjections2017.pdf](http://www.usda.gov/oce/commodity/archive_projections/USDAgriculturalProjections2017.pdf)

6 Censo Agropecuário Instituto Brasileiro de Geografia e Estatística (IBGE)  
<http://www.sidra.ibge.gov.br/bda/agric/default.asp?t=4&z=t&o=11&u1=32&u2=1&u3=1&u4=1&u5=1&u6=1>

7 Valle, Sabrina. "Losing Forests to Fuel Cars. Ethanol Sugarcane Threatens Brazil's Wooded Savannah." *The Washington Post*. Tuesday, 31, July 2007. Page D01

replace other crops, such as soybeans.<sup>8</sup> Nevertheless, there is some concern that an increase in the intensity of corn production may further adversely impact the “prairie pothole” habitat that is vital for birds that traverse the Central Flyway.<sup>9</sup> In view of these ecological concerns, several issues emerge: **What are the biodiversity and wildlife consequences of increased biofuel crop acreage? What are the incentives and disincentives for farmers in the US and Brazil and how do they manage their lands with these economic and conservation pressures? How do the two national systems of conservation laws and regulations differ?**

These questions are important because although Brazil and the United States have comparable ethanol outputs and contributions to the demand for biofuels, the climate of regulations and conservation enforcement differ markedly in each country. For one thing, Brazil exists in a “developing nation” stage, and the United States exists in a post industrial stage. As a result, the differences and similarities regarding how Brazil and the United States approach farmland conservation have large implications for future biofuel production. Both nations are figuring out a way to capitalize on the ethanol rush while maintaining biodiversity suitable for their heritage and the security of natural capital. How they strike this balance now could inform the way places such

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8 National Prospective Plantings USDA-NASS. March 30, 2007. <http://usda.mannlib.cornell.edu/usda/current/ProsPlan/ProsPlan-03-30-2007.pdf>  
Hart, Chad E. "Acreage Shifts Follow Price Signals." Agricultural Situation Spotlight. Iowa Ag Review Online. Iowa State Agricultural Summer 2006. Vol. 12 No. 3. [http://www.card.iastate.edu/iowa\\_ag\\_review/summer\\_06/article3.aspx](http://www.card.iastate.edu/iowa_ag_review/summer_06/article3.aspx)

9 Roger Claassen, Ralph E. Heimlich, Robert M. House, Keith D. Wiebe Review of Agricultural Economics, Vol. 20, No. 2 (Autumn - Winter, 1998), pp. 390-405 Biofuels and Ducks Ringelman, Jim.  
[http://www.ducks.org/DU\\_Magazine/DUMagazineMayJune2007/3213/BiofuelsandDucks.html](http://www.ducks.org/DU_Magazine/DUMagazineMayJune2007/3213/BiofuelsandDucks.html)

as India, South Africa or even they themselves manage their agricultural systems in the future.

## **1.2 Significance for Current Ethanol Policy**

The significance of this work stems from the globalized and globalizing nature of ethanol production and policy. Ethanol and other biofuels have become international commodities. Global economic drivers, such as persistent and elevated demand for ethanol and biodiesel now affect farmers and local land use choices everywhere. In addition, how a government supports or does not support its farmers is another crucial and contentious factor when considering how global ethanol trends and its influence over what land use and crop selection choices a farmer makes. Many governments offer both direct and indirect assistance to its farmers and that fact has raised issues of fair and free trade. For instance, the fact the U.S. ethanol production chain is supported by subsidies and tax breaks at the state and federal level has upset many countries including Brazil.<sup>10</sup> Many of these critics argue the United States and Europe (which similarly offers support for its farmers) are doing more harm than good with their protectionist policies. Research on whether or not the North and South can cooperate on biofuels issues is extremely fresh. The UN FAO actually is considering organizing a convention in 2008 to lay the “ground rules” for biofuel production.<sup>11</sup> One goal is to

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10 “WTO Disciplines and Biofuels: Opportunities and Constraints in the Creation of a Global Marketplace.” IPC Discussion Paper. IPC and Renewable Energy and International Law. [http://agritrade.org/Publications/DiscussionPapers/WTO\\_Disciplines\\_Biofuels.pdf](http://agritrade.org/Publications/DiscussionPapers/WTO_Disciplines_Biofuels.pdf)

11 High-level Conference on World Food Security and the Challenges of Food Security and Climate Change and Bioenergy.  
“<http://www.fao.org/foodclimate/>”

ensure that smallholder farmers can organize themselves to produce, process, and market bioenergy feedstock on the scale required to stay in business. Another goal should be the shared, global responsibility or at least acknowledgement of the effect of global economics on local ecological issues, like conservation or biodiversity.

Some commentators are harsher on the current state of ethanol and trade policy than others. Claude Mandil, the chief of the International Energy Agency, complains that the policies for U.S. corn and European sugar beet production are detrimental to the overall world economy and specifically to the agricultural sectors of developing nations, specifically. He states the "two methods are the worst imaginable" because of their economic and environmental comparative disadvantages. He goes on to say "they are confusing agricultural policies and energy policies, mixing them up in a cocktail that "has no advantages." He instead believes that if the United States and the European Union "are serious about biofuels, they must turn to the South for their supplies."<sup>12</sup> This thesis will illustrate the pressures on American and Brazilian farmers (Global North and South) side-by-side.

### **1.3. Brief Literature Review**

Scholars and analysts have sought to understand many of its environmental, economic, and social implications as ethanol emerges onto the scene. These lines of

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<sup>12</sup> "IEA Chief: Europe and the United States should import ethanol from the developing world" Monday, October, 16, 2006.

<http://biopact.com/2006/10/iea-chief-europe-and-united-states.html> L'Europe devrait importer de l'éthanol du Brésil." AFP. 10/16/2006.

inquiry include investigations into what is happening in the field right now, on issues of soil conservation, net greenhouse gas emissions, worker conditions, and rural development. Researchers are also looking to the future, and how to incorporate the second generation of biofuels, such as cellulosic ethanol into the mix. While the ethanol sector has not yet matured, the importance of these myriad topics has given rise to a discussion in the political, academic, governmental and private sectors over the appropriate role of ethanol in any new energy portfolio. Despite the widespread interest in biofuels, and because the sector is quickly changing, holes in certain areas of knowledge remain. Notably, the literature fails to address the how the economic and regulatory climate affects the decision-making process individual farmers may make when they balance considerations between profits (~ increased yields) in an era of high crop prices-a situation in which increased biofuel demand plays a critical role-and sound environmental management strategies.<sup>13</sup> There is also a larger, unanswered question: how would two different agricultural systems influence the answers these farmers give? In this case the two agricultural arrangements are in the United States- a developed country with subsidies for its ethanol feedstock and Brazil,-a developing country without direct governmental support for sugarcane production.<sup>\*14</sup> Despite the

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13 Hipple, Patricia C. Discussion Paper. The Human and Social Dimensions of a Bioeconomy: Implications for Rural People and Places. USDA-CREES March 29, 2007. [http://www.csrees.usda.gov/about/white\\_papers/pdfs/bioeconomy\\_discussion\\_paper.pdf](http://www.csrees.usda.gov/about/white_papers/pdfs/bioeconomy_discussion_paper.pdf)

\* Brazil still has a few tax incentives for the purchase of flex fuel vehicles that run variable blends of ethanol and gasoline and has instituted a requirement that service stations offer fuel with a minimum blend of ethanol.

absence of a comprehensive answer to these concerns, they are vitally important to grasp the full picture of environment management strategies farmers employ, especially those farmers who grow sugarcane and corn, crops that may end up in the ethanol production chain and are subject to global drivers of biofuel economics. In this globalized and globalizing world, the ethanol market has no place to go but international and new sets of farmers may need to address these issues.

Keep in mind trade imbalances and types of government assistance distort and differentiate the Brazilian and American markets from one another. The different parameters under which these two groups of farmers exist can have ramifications for environmental management strategies. If ethanol or other crop-based biofuels assume a larger slice of the energy matrix, then where they are grown and under what sorts of institutional framework will be needed to be taken into account to assess how well conservation efforts will fare. This report attempts to bridge the gap between the local level situation a Brazilian sugarcane farmer and a corn grower from United States would face when working with ethanol, an international commodity. At its heart, this project examines how nascent international ethanol market influence farmers from different countries differently.

#### **1.4. Ecological Stewardship in Age of Biofuels:**

Right now there is a spirited debate over the fundamental costs and benefits in

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14 Martines-Filho, J., H.L. Brunquist, and C.E.F. Vian. (2006). "Bioenergy and the Rise of Sugarcane-Based Ethanol in Brazil." *Choices* 21(2): 91-96

Sandalow, D., 2006, Ethanol: Lessons from Brazil, in: A High Growth Strategy for Ethanol, Aspen Institute.

<http://www.aspeninstitute.org/atf/cf/%7BDEB6F227-659B-4EC8-8F84-8DF23CA704F5%7D/EEEthanol7.pdf>

the expansion of biofuel production. Often there are disagreements about roles of monoculture farming in developing countries and how that affects community development and the environment. Looking at how farmers manage their lands to prevent soil erosion and maintain wildlife habitat would shed light on that question. If the world commits to a comprehensive, across the board biofuels strategy the research and analysis in this report would contribute to the question of how biofuel production affects the local ecology as well as the economy.

The answer is important and is, in some cases, shocking. For instance, the acreage devoted to palm oil plantations in Indonesia has increased dramatically.<sup>15</sup> Supposedly, these agricultural systems will help make the world's energy portfolio more carbon-friendly. However, the destruction of the tropical forests is actually counterproductive in the attempt to reduce greenhouse emissions. According to Greenpeace, to make room for these plantations, forests and peat areas are burned and dismantled. As a consequence of these land use changes, 1.8 billion tons of greenhouse gas are emitted, which is a phenomenal amount; as they point out. It is 4 percent of the total of worldwide emissions on just 0.1 percent of the land.<sup>16</sup> These greenhouse gas emitting land use changes in Indonesia are partially driven by increased global demand for biofuels.

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15 Gelling, Peter "Forest Loss in Sumatra becomes a Global Issue." The New York Times. December 6, 2007  
[http://www.nytimes.com/2007/12/06/world/asia/06indo.html?\\_r=1&oref=slogin](http://www.nytimes.com/2007/12/06/world/asia/06indo.html?_r=1&oref=slogin)

16 "How the Palm Oil Industry is cooking the Climate." November 8, 2007.  
<http://www.greenpeace.org/canada/en/campaigns/boreal/resources/documents/cooking-the-climate>

Although the Brazilian and American ethanol programs might not have as nearly a grim impact on climate change or even biodiversity as the Indonesian case, if the world commits to biofuels it is important to understand the full range of implications for those actions.

### **1.5. Brief History of Ethanol as a Biofuel**

Despite its recent upsurge in public attention, ethanol has been around for a long time. There have been policymakers in both countries who have advocated for a strong ethanol presence in their respective nations' energy portfolio for decades. In the United States, there have been at least three cycles of farmer interest in ethanol- in 1906, 1925, and in the 1970's, due to legislative and technological actions. Even Henry Ford promoted ethanol, not only as a fuel, but as a way to ensure the stability of rural economies. Brazil had similar periods of ethanol interest during early and mid twentieth century.<sup>17</sup> It was during this last event, in the fallout of the 1973 OPEC oil embargo, that Brazil fully incorporated ethanol as a gasoline alternative and set a course for government subsidies and programs that positioned ethanol as an important source for vehicular fuel. During the same time and in the same spirit of urgency, the United States passed legislation making renewable energy fuels, including ethanol, more tax-friendly.<sup>18</sup>

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<sup>17</sup> Kovarik,Bill. "Henry Ford, Charles Kettering, and the "Fuel of Future." PhD 1009. <http://www.runet.edu/~wkovarik/papers/fuel.html>

<sup>18</sup> "Legislation Affecting the Renewable Energy Marketplace." <http://www.eia.doe.gov/cneaf/solar.renewables/page/legislation/impact.html>

How environmental and rural development may change due to the tidal wave of ethanol enthusiasm and increased production of this liquid fuel is not well known.<sup>19</sup> How do and would developing countries regulate or manage conservation differently than, say, the United States? It is important to evaluate local issues and conditions as well as larger institutional evolutions to determine if it is worthwhile for the rural communities to grow corn and sugarcane for ethanol. It would be important to understand how the farmers think the recent Brazilian-United States collaboration will bode for their local economy and environment.

### **1.6. Ethanol and Ecosystem Destruction**

As mentioned earlier, increased ethanol production has a precarious relationship with other ecological and environmental concerns. In the United States, the matter is one of scientific and political importance. Congress and the President have grasped the need for conservation in agriculture, and starting in the 1985 version, each new Farm Bill promotes the retiring of marginal or exhausted lands from agricultural use. This program, known as the Conservation Reserve Program (CRP) has acted as a successful place for wildlife habitat.<sup>20</sup> As of November 2007, when the Iowa interviews took place, 1,834,776 acres or 743, 084 hectares in Iowa farmland were enrolled in the

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19 Pimentel, D. 2003. Ethanol Fuels: Energy Balance, Economics, and Environmental Impacts are Negative. *Natural Resources Research*, Vol. 12, No 2, June, 2003.

20 Best, L. B., H. Campa, III, K. E. Kemp, R. J. Robel, M. R. Ryan, J. A. Savidge, H. P. Weeks, Jr., and S. R. Winterstein. 1997. Bird abundance and nesting in CRP fields and cropland in the Midwest: a regional approach. *Wildlife Society Bulletin* 25:864-877. "Conservation Programs." Farm Services Agency. <http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp>

program.<sup>21</sup> To enter into the CRP, the USDA and the individual farmer sign a contract, under which in exchange for a payment the farmer withdraws the land from crop production and may also implement other conservation measures.<sup>22</sup> However, depending on how strong and consistent demand for ethanol exists, and whether or not corn remains a primary feedstock, farmers may be disinclined to renew their CRP contracts if they believe they can get a better deal out of using those lands for corn. Much of the Corn Belt overlaps with the Prairie Pothole region and many ornithologists and ecologists are concerned that as CRP lands expire over the next couple of years, which they are expected to do, and if corn claims those acres, then bird and other wildlife will be adversely impacted.<sup>23</sup> CRP lands are the most conspicuous type of conservation assistance the federal government has at its disposal. Others include the Conservation Security Program and Environmental Quality Incentives Program (EQIP), which unlike the CRP, are working lands programs, which mean if the landowner enrolls in CSP or EQIP, the farmer does not necessarily retire the conservation land, but merely builds in a set of conservation practices and methods to the preexisting use of

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21 Conservation Reserve Program. Monthly Summary—November 2007. USDA-FSA. [http://www.fsa.usda.gov/Internet/FSA\\_File/nov2007.pdf](http://www.fsa.usda.gov/Internet/FSA_File/nov2007.pdf)

22 "Conservation Reserve Program." USDA Farm Services Agency. <http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp>

23 Roger Claassen, Ralph E. Heimlich, Robert M. House, Keith D. Wiebe. Review of Agricultural Economics, Vol. 20, No. 2 (Autumn - Winter, 1998), pp. 390-405 Biofuels and Ducks Ringelman, Jim. [http://www.ducks.org/DU\\_Magazine/DUMagazineMayJune2007/3213/BiofuelsandDucks.html](http://www.ducks.org/DU_Magazine/DUMagazineMayJune2007/3213/BiofuelsandDucks.html)

the property.<sup>24</sup> Conservation practices (such as riparian buffers and habitat protection) are overwhelmingly voluntary and up to the individual landowner or operator in the United States to implement, but in order to qualify for CRP, CSP, or EQIP or other certain cost sharing or “green payment” programs, the managing agricultural agency requires that certain environmental standards be met.<sup>25</sup>

In Brazil, conservation on private property is mandatory, as authorized by the Forestry Code. The Forestry Code for Brazil was first enacted in September 1965 and one of the main pieces of legislation that regulate general natural resource management on private land. Among other things, it attempts to preserve native ecosystems. This law requires differing thresholds and benchmarks for different parts of the country. For instance, the Forestry Code requires that landowners in the Amazonian region set aside 80% of their land, but elsewhere, including where this project’s case study is located, the percentage is 20 %. Additional to the so-called “legal reserve”, it requires certain minimum buffers around certain geographic features such as water bodies, streams in units known as "Areas of Permanent Preservation."<sup>26</sup>

In short, conservation in Brazil is mandated but in the US it is based on incentives. One purpose of this study is to determine how effectively farmers react to

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24 Conservation Reserve Program.” <http://www.nrcs.usda.gov/programs/crp/> “Conservation Security Program”  
<http://www.nrcs.usda.gov/programs/csp/>

25 “Conservation Reserve Program.” <http://www.nrcs.usda.gov/programs/crp/>

26 “Código Florestal Brasileiro” [http://www.controleambiental.com.br/codigo\\_florestal.htm](http://www.controleambiental.com.br/codigo_florestal.htm)

those regulatory conditions.

### **1.7. Possible Farmer-Environmentalist Reconciliation?**

Are the goals of farmers and environmentalists fundamentally at odds? Cook, Beva, and Keeler believe that protection of ecologically sensitive areas such as those found in Brazil and the United States may require “submaximal” biofuel crop yields-lowered production for the sake of the environment. They further contend for farmers to deliberately reduce their harvest, they would require incentives and regulations.<sup>27</sup>

These authors develop a case for cooperation between farm advocacy and conservation advocacy groups, who may not see eye to eye on conservation and CRP land issues, but should both rally around the mutual danger posed by climate change.

Cook, Beva, and Keeler argue that the threat to biodiversity from climate change (a problem ethanol use may mitigate) may be even more pressing than from land use changes that would accompany increased biofuel production. Climate change would not only adversely affect wildlife, but the agricultural systems themselves. Therefore, farmers and conservationists should work together to promote environmentally and climate friendly biofuels. These authors warn if farmers fail to manage the natural resources effectively, there may be a backlash, at least in the United States, which could endanger biofuels from playing a significant role in any low-carbon energy mix.<sup>28</sup>

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<sup>27</sup> Cook JH, Beva J, Keeler KH. 1991. Potential impact of biomass production in the United States on biological diversity. *Annu. Rev. Energy Environ.* 16: 401–31

## **1.8. My Thesis/Argument**

Increased ethanol production has put pressure on farmers to find ways to manage both profits and conservation, specifically in the states of Paraná in the Center-South of Brazil and the Midwest in the United States. The results show that in the framework of the respective conservation programs, there is more participation in conservation programs in Iowa than there is compliance of natural cover and “Areas of Permanent Protection in Paraná. However, the Forestry Code is much more strict than any conservation programs in the United States. In addition, farmers in Paraná grapple with more systemic social problems. Despite this, a conservation ethic is apparent in at least some farmers of both groups.

Overall, I contend the Paranáense\* farmers are less likely to manage a balanced approach to conservation and output due to the stringent Forestry Code mandate and the social, class, and land tenure framework in which they operate. Their Iowan counterparts, even though they have their own pressures, can manage their land with the assistance of federal, state, and local conservation programs, which make conservation there more economical and feasible.

## **1.9. Research Strategy**

### **1.9.a. Research Design**

The design of this research is a comparative case study focusing on the

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\* The native, adjectival form of Paraná

conservation, social and economic conservation consequences of ethanol production in Brazil and the United States. Two sets of interviews, one from Brazil and one from the United States make up the heart of my data. To supplement what I discover "in the field," I also interviewed agricultural and policy experts in a number of fields. These individuals included analysts in Curitiba, Paraná or Ames, Iowa who may not see much field work *every* day, to extension and agricultural specialists in Diamante do Norte, Paraná or Spencer, Iowa who **would** encounter and work with farmers closely.

There were a few constraints at the outset of the study. One limitation was that, while in Brazil, I used a translator because of my lack of Portuguese and even though the translator did a stellar job, the interview data from Iowa was more comprehensive, but not by a degree that distorts the comparison. Finally, while some interesting data emerged, this pilot study is suggestive-not definitive-and works best to frame and inform future research.

### **1.9.b. Cases**

The two geographic areas used to compare ethanol production for this study are Northwest Paraná and Western Iowa. In Paraná, I focused on the two municipalities of Diamante do Norte and Nova Londrina, within 50 kilometers of the convergence of three states: Paraná, Mato Grosso do Sul, and São Paulo. In Iowa, I interviewed farmers from one southwest county, Cass County, and in north central Iowa mainly interviewed farmers in Clay and Palo Alto counties.

Northwest Paraná and Western Iowa offer a valid comparison because they are both at the heart of their respective nations' ethanol production systems and are based

within threatened ecosystems (Atlantic forest and prairies, respectively) (figures 3, 4, and 5). This comparison is one of the most-different systems kind because when it Brazil mandates native habitat on private land whereas the United States offers voluntary conservation programs, their policy mechanisms create very different regulatory climates. Any differences in outcome would be traced to the

Each case study location is also relevant because they have tracked the larger trend in recent years for greater areas devoted to crops that are biofuel feedstocks. In the municipalities of Diamante do Norte and Nova Londrina, Paraná, the sugarcane area has increased from 3323 in 2001 to 5292 hectares in 2006. In a similar fashion, the four counties in which the Iowa farmer interviews took place recorded an increased area of corn production, from 58,624 in 2001 to 63534 hectares in 2006.<sup>28,29</sup>

How representative are the farms under investigation of the larger agricultural systems in which they are found? The samples were not random so there is some deviation. According to IBGE, the Brazilian Statistics Service, the average farm size in the two municipalities in the case study is 175 hectares. The average farm size for my sample is 547 hectares, but includes two massive farms. If they are removed from the calculation, the average drops to 130 hectares. The difference in Iowa was greater. The USDA-National Agricultural Statistics Service determined the average farm size for

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28 Censo Agropecuário Instituto Brasileiro de Geografia e Estatística (IBGE).

<http://www.sidra.ibge.gov.br/bda/agric/default.asp?t=4&z=t&o=11&u1=32&u2=1&u3=1&u4=1&u5=1&u6=1>IBGE

29 “USDA-National Agricultural Statistics Service-Quick Stats Iowa County Data-Crops.” USDA-NASS.

[http://www.nass.usda.gov/QuickStats/Create\\_County\\_Indv.jsp](http://www.nass.usda.gov/QuickStats/Create_County_Indv.jsp)

those four counties was 182 hectares, but the average for this study was 502 hectares.

The ecological evaluation in Paraná and Iowa are analogous and the same global demand and market forces would theoretically influence these two areas in a similar way. There are additional parallels as well: both areas support family farm-based agriculture and compete with corporate concentration. Both areas are also in places noted for their rich soil. Southern Brazil is covered in with fertile soil known as “terra roxa.”<sup>30</sup> Terra roxa is formed from the basalt and sedimentary material eroded from the rock formations that originated during the rifting between South America and Africa. Iowa also has rich soil material, but it is glacial, rather than volcanic, in nature. In the two study areas of Iowa, the North-Central and Southwest regions have two general soil types. The fertile Des Moines Lobe extends over Northern Iowa, Southwest Minnesota, and South Dakota.<sup>31</sup> Southwestern Iowa is hillier.

### **1.9.c. Data Collected**

I interviewed twelve ethanol sugarcane farmers in two municipalities of the Northwest region of the state of Paraná, Brazil which is a center of sugarcane production. In Iowa, I interviewed eleven corn growers whose harvest, at least partially, went to ethanol production. Additionally, I interviewed eight sugarcane farmers in Southwest Paraná, who grew the crop not for ethanol but for more niche,

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30 Moran, Emilio, F. *People and Nature: An Introduction to Ecological Human Relations*. Malden, MA: Blackwell Publishing. 2006.

31 Hudson, John C. *Across this Land: A Regional Geography of the United States and Canada*. Baltimore: The John Hopkins University Press. 2002.  
pg.214

consumable goods such as melado, which resembles honey, and cachaça, which is a spirit similar to rum. The Paraná Biodiversity Project, a World Bank financed organization, assisted these growers with technical knowledge and money in exchange for increased ecological stewardship, particularly in riparian corridor management. These farmers acted in a way as a baseline of what conservation measures could be achieved in sugarcane production in Paraná.

The evidence from the primary research is quantitative and qualitative and is from questionnaires given to farmers in Iowa and Paraná (Appendices 1 and 2). It includes size of the farms, how many workers each landowner employs, how long they have owned the property. In addition, the questionnaire contained general land management questions. They consisted of what sorts of agricultural practices are used (i.e. crop rotation, no-till methods, etc.) and how the price of the commodity affects the land use patterns. These questions asked why the farmers chose to take their course of action. Translators and agricultural extension agents have facilitated the Brazilian questions.

My research includes the institutional (what kinds of government agencies) are involved in environmental management. I asked how the two countries differ in agricultural research, and how is it funded.

Besides the actual farmers, I interviewed professionals in the field of ethanol crop agriculture in assorted agricultural ministries, such as those charged with environmental protection or rural development. In Brazil, I interviewed economists, soil scientists, lawyers, and other experts. In Iowa, I interviewed economists and farm

policy experts. I used these interviews first to get some background on the Brazilian and Iowa ethanol production story and to ask these authorities about the future of the ethanol field. These interviews allowed the research include an institutional overview (what kinds of government agencies are involved in environmental management) as well. Lastly, by talking to these individuals I gained wise second-hand experience of the ethanol production situation. (These interviews have been dependent on access to Brazilian government officials in Curitiba, a large metropolitan area in Southern Brazil.).

Secondary research will come from newspaper and magazine articles, peer reviewed research on the environmental and social ramifications of ethanol, and government documents, including published accounts of hearings of legislative sessions from the US House of Representatives and Senate. With these documents and newspaper articles I can track how ethanol moved on to the agenda of each country and to what extent environmental and social considerations were taken into account. I will see from these secondary sources, how public perception and policy and the “reality on the ground,” differ from one another in order identify where my own research can make a difference.

### **1.10. Chapter Summary**

This thesis compares certain parts of Brazil and the United States on the merits and drawbacks of ethanol production in terms of how well, and to what extent, farmers comply and use environmental laws and programs for conservation and wildlife support in biofuel agriculture. This introductory chapter has set up the issue/question (how well

are farmers managing their lands in the face of ethanol-driven increases in total crop areas?)

It also explains the importance of the situation: Brazil and the United States are the trailblazers in biofuels, which are emerging as a significant component of the global energy matrix and what these powers do will influence ethanol production systems for years to come. As part of the literature review, Chapter 2 discusses the basics of the agriculture of sugarcane in the “Center-South” of Brazil and corn in Iowa and nearby states (figures 2 and 5). Chapter 2 also evaluates what researchers have already discovered about greenhouse gas emissions, net energy balances, and the environmental footprint of ethanol production in Brazil and the United States. In Chapter 3, after an introduction on the process of growing the ethanol feedstock, a brief overview of the history the sugar and corn markets will be made to see how those commodities historically have shaped rural communities and environments. Then afterward, the chapter will examine the contemporary pressures that have “set the ethanol agenda.” Chapter 4 will present the results of the farmer interviews in Brazil. Afterward, Chapter 4 will analyze what the environmental implications of the farmers’ decision-making and assess what the future holds. Chapter 5 will address the same issues as Chapter 4, except will focus on the results from data collection from Iowa. Chapter 6 will explain the results of the questionnaires and their implications for the environment and rural economies of the two regions, and actually make the comparison between what is going in Brazil versus the United States. Ultimately, Chapter 6 will address the broader policy of ethanol as a viable energy source and explain how conservation measures of farmers may differ from these certain locations in Paraná and Iowa.

Finally, I will propose a series of recommendations based on the results of the research and interviews.

## **Chapter 2 Literature Review**

### **2.1. Introduction**

Ethanol production has exploded over the last five years largely as a result of three, interrelated factors: increased oil prices, worries about climate change, and a heightened awareness about national security in the aftermath of the September 11<sup>th</sup> attacks. Not surprisingly, interest in the environmental and social consequences of expanded ethanol production has risen in tandem with the rise of this new fuel. These researchers have scrutinized the social, environmental, and economic dimensions in ethanol production in both Brazil and the United States. Additionally, ethanol and agricultural policy analysts have investigated those ecosystems that underlie the ethanol producing agricultural regions of the United States and Brazil. However, research into how individual farmers make land use choices and the consequences for conservation and biodiversity has been underrepresented in the literature. This pilot study seeks to fill that vacuum.

### **2.2 . Ethanol and the Environment**

#### **2.2 a. Area Increases in Crop Production**

As mentioned in the Introduction, greater mandates and higher demand for biofuels, and ethanol specifically have increased the cropland area devoted to biofuel feedstock commodities. In response there have been both positive and pessimistic

assessments of these changes. One optimist, John Matthews, believes tropical countries are up to the challenge. Matthews argues that by 2050, biofuels from tropical developing countries (the "South") could meet the demand for oil by OECD countries (what he calls the "North.") The developing "South" would need to ratchet up its production dramatically to where the output of 432 billion liters of ethanol per year, or how he paints it, "18 Brazils." Basically, Matthews lays out the case that it is possible to reproduce Brazil's success by a factor of 18.<sup>32</sup> However, as mentioned earlier, if ethanol production scales up where does conservation management efforts fall in the new agricultural regime? This thesis responds to this question, not in whether these programs are indeed scalable, but supplies a yardstick to how the farmers are doing in respect to conservation.

### **2.2 .b. Greenhouse Gas Emissions and Net Energy Balance**

As topics, the impact on greenhouse gas emissions from ethanol production and the net energy balances are highly debated. The fact that ethanol is touted as part of the solution to climate change make the greenhouse gas emissions are an important environmental facet of their production. Most recently, along with the Searchinger paper, another by Fargione et al, both out in the journal *Science*, lay out the case that land use changes for increased ethanol production would create unneeded carbon

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<sup>32</sup> Matthews, John A. "Biofuels: What a Biopact between North and South Could Achieve." *Energy Policy*. Volume 35. Issue 7, July 2007. p. 3550-3570.

debts.<sup>33,34</sup> Tim Searchinger and his colleagues might contend Matthews' call for the reproduction of “18 Brazils” for biofuel production would have a devastating impact on greenhouse gas emissions. However, not all agree with assessment of these two papers. In response, the Department of Energy released a rebuttal arguing many modeling techniques and assumptions of those papers were wrong.<sup>35</sup> For instance, this paper contests the magnitude of land use changes Searchinger claims the Energy Independence and Security Act would have and also claim these authors overstate the amount of CRP land of which farmers would opt out. One point to remember is the DOE paper does not have the same level of peer reviewed scrutiny that the Science articles do.

Another critic of ethanol production, David Piementel has coauthored papers with Tad Patzek, and they have also published a number of articles contending ethanol production from corn emits more greenhouse gases overall than it stores.<sup>36</sup> However, a 2006 report by Alex Farrell et al suggest corn ethanol can mitigate climate change, with

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33 Searchinger et al. “Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change.” Science Express. February 7, 2008. <http://www.sciencemag.org/cgi/rapidpdf/1151861v1.pdf>

34 Fargione et al. "Land Clearing and the Biofuel Carbon Debt." Science 29 February 2008:Vol. 319. no. 5867, pp. 1235 - 1238

35 New Studies portray Unbalanced Perspective on Biofuels. DOE Committed to Environmentally Sound Biofuels Development. Office of Biomass Program; Argonne National Lab, National Renewable Energy Lab, Oak Ridge National Lab, Pacific Northwest National Lab; USDA [http://www1.eere.energy.gov/biomass/pdfs/obp\\_science\\_response\\_web.pdf](http://www1.eere.energy.gov/biomass/pdfs/obp_science_response_web.pdf)

36 Piementel, David and Patzek, Tad W. “Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower” Natural Resources Research. Volume 14, Number 1 / March, 2005

moderate reductions in emissions.<sup>37,38</sup>

In the global scheme of things, Pacala and Socolow discuss ways to stabilize worldwide carbon dioxide emissions, which would allow emissions to level out  $500 \pm 50$  parts per million (ppm) by the middle of this century. Many scientists predict this atmospheric concentration as the point between more manageable climate change and more uncontrolled and harmful state of affairs. In order for stabilization to occur, the world cannot emit more than 7 billion tons of carbon (GtC) per year into the future (GtC/year). They describe how biofuels could contribute to this effort. Under one of their scenarios, in 2054 34 million barrels of carbon-neutral ethanol could substitute for all the gasoline usage. However, if there are carbon emissions associated with the ethanol, more land would be needed, which would limit other uses of that land. They calculated that to meet this ethanol requirement, the world would need to increase what the current output of Brazil and the United States by a factor of 50, which is reminiscent of Matthews' proposal.

Pacala and Socolow also mention the effects of land use change. Reduced tropical deforestation can also contribute to a carbon reduction wedge. In this way, and as Searchinger's team would explain, the deforestation occurring in Indonesia, and any increase in deforestation in Brazil, due to biofuel production, are at odds with the

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37 Farrell et al. "Ethanol Can Contribute to Energy and Environmental Goals." *Science* 27 January 2006: Vol. 311. no. 5760, p. 506 - 508

38. Shapouri H., et al., *The 2001 Net Energy Balance of Corn-Ethanol*, USDA: 2004

ultimate goal of limiting greenhouse gas emissions.

In their paper, they also state 55 GtC have been released into the atmosphere from soil carbon loss during tillage. Conservation tillage could reverse some of the increase.<sup>39</sup> To determine the scope of this market, Babcock et al from the ISU CARD estimate if a farmer converts cropland to grassland they will sequester 750 kg CO<sub>2</sub>eq per acre per year.<sup>40</sup>

The net energy balance of ethanol production is related to greenhouse gas emissions. This balance measures energy output versus the energy required to grow, transport, and distill the ethanol. The energy balance for ethanol production using sugarcane in Brazil has been calculated to be somewhere between 3.7 and 9.<sup>41</sup> Most estimate this value to be around 8. A value of 8 would indicate that for every one joule of energy needed to produce some unit, say a liter, of ethanol, 8 joules are available afterward. The extent that ethanol production from corn sequesters carbon, and therefore its net balance of greenhouse gas emissions has been a contested topic. USDA and DOE scientists calculate that corn based ethanol has a net energy balance of

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39 Pacala, S. and R. Socolow. "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies." *Science*, 2004, 305, pp. 968-72.

40 Babcock, Bruce, A., Rubin, Ofir., Feng, Hongli. "Is Corn Ethanol a Low Carbon Fuel?" [http://www.card.iastate.edu/iowa\\_ag\\_review/fall\\_07/article1.aspx](http://www.card.iastate.edu/iowa_ag_review/fall_07/article1.aspx)

41 Dias De Oliveira, Marcelo, E., Vaughan, Burton E., and Rykiel Jr., Edward J. Ethanol as Fuel: Energy, Carbon Dioxide Balances, and Ecological Footprint. *Bioscience*. Volume 55, Issue 7 (July 2005)

approximately 1.25-1.3.<sup>42</sup>

### **2.2 c. Water and Ethanol Production**

Energy and water resource issues interact in at these two important ways.<sup>43</sup> First, energy allows certain water improvement processes, such as desalination or purification to take place. Energy also drives water transportation, a necessity where water resources in one location must travel to another location where humans demand it. Second, certain energy generation systems require water to run, and ethanol is no exception. Water is needed to grow sugarcane and corn and run ethanol mills.

In spite of sugarcane being water-intensive, currently water shortages do not pose a problem for ethanol production in Brazil.<sup>44</sup> One reason is that one of the main sugarcane growing areas of Brazil, the Center-South, has ample water resources. There, farmers rely on the extensive Guarani Aquifer.<sup>45</sup> It holds 40, 000 cubic kilometers of water. Brazil contains 70% of its volume, but it sprawls under Argentina, Uruguay, and Paraguay as well. These four countries recently set up a project, the

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42 Shapouri, H. Duffield, J. A. Wang, M. Trans. "The energy balance of corn ethanol revisited." ASAE 46, 959 (2003). "US DOE Energy Efficiency and Renewable Energy (EERE) Biomass Program." <http://www1.eere.energy.gov/biomass/>

43 Gleick, Peter H. "Water and Energy." Annual Review Energy and Environment. 1994. 19:267-299

44 Moreira, Jose Roberto. "Water Use and Impacts Due [sic] Ethanol Production in Brazil." [http://www.iwmi.cgiar.org/EWMA/files/papers/Jose\\_Moreira.pdf](http://www.iwmi.cgiar.org/EWMA/files/papers/Jose_Moreira.pdf)

45 Galindo Leal, Carlos., and Câmara, Ibsen de Gusmão. The Atlantic Forest of South America: Biodiversity Status, Threats, and Outlook. Washington: Island Press. 2003.

Guarani Aquifer System (the acronym in Portuguese and Spanish is SAG) to manage this transboundary resource.

In contrast to the situation in Brazil, water resources for corn production in the United States are more stressed. Geography and geology delineate the water resources in the major corn growing areas of the United States. In western, drier Great Plains, which encompasses the states of Kansas, Nebraska, and the Dakotas, water is relatively scarce. The corn grown in the Great Plains region requires irrigation. In the United States Great Plains, water for irrigation from the underground stores of water, which includes the sprawling the Ogallala aquifer which covers 8 states.<sup>46</sup> According to a report by the Natural Resources Defense Council, these resource must be managed wisely because it concludes that continued ethanol production and the accelerated water drawdown of the Ogallala would result will have serious repercussions for soil erosion and wildlife.<sup>47</sup> In contrast, the Corn Belt has more abundant water resources and counts Minnesota, Iowa, Illinois, Missouri, and Indiana. Irrigation there is not needed in any widespread way.

As a consequence of being wetter than its western neighbors, Iowa has not yet considered water as critical a resource. The water sources available for Iowa corn growers are both local and state-wide in scale. At the local level, farms can use alluvial

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46 Norwood, Charles, A. "Water Use and Yield of Limited Irrigated and Dryland Corn." *Soil Science Society of America Journal*. Vol 64. issue 1. p. 365.

47 Roberts, Martha, G., Male, Timothy D., Toombs, Theodore P. "Potential Impacts of Biofuels Expansion on Natural Resources." *Environmental Defense*. 2007. [http://www.environmentaldefense.org/documents/7011\\_Potential%20Impacts%20of%20Biofuels%20Expansion.pdf](http://www.environmentaldefense.org/documents/7011_Potential%20Impacts%20of%20Biofuels%20Expansion.pdf)

water, which is basically a pocket of water that has been trapped by sediment adjacent to river systems.<sup>48</sup> In addition, there are also larger state-spanning aquifers. For instance, farmers draw on water from the Mississippian and Dakota aquifers, which underlie large areas of Western and North-Central Iowa.

Ethanol production also contributes to water pollution both in the United States and Brazil. In Brazil, the processing of sugarcane creates vinhoto or vinasse, which is a form of liquid waste. Farmers use this material in fertigation, the combined fertilization and irrigation of fields. However studies suggest fertigation with vinasse negatively affects the surrounding surface water. For instance, Gunkel et al have shown that vinasse leads to high levels of coliform bacteria.<sup>49</sup> Additionally, they discovered vinasse decreased oxygen concentration in the water. Vinasse causes potassium to accumulate in the soil, impairing its fertility.<sup>58</sup>

Corn production requires a lot of fertilizer. Its use in the Midwest United States causes water pollution. Increased nitrogen runoff from fertilizer degrades water quality, by among other processes, decreasing the oxygen content.<sup>50</sup> In fact, with all the fertilizer throughout the Mississippi River Basin funneling toward New Orleans, all

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48 Van Dorpe, Paul. "Well Forecasting and Aquifers in Iowa." Iowa Department of Natural Resources Geological Survey.  
<http://www.igsb.uiowa.edu/service/wellbro/wellbro.htm>

49 Gunkel, Gunter et al. "Sugar Cane Industry as a Source of Water Pollution – Case Study on the Situation in Ipojuca River, Pernambuco, Brazil"  
Water, Air and Soil Pollution. Volume 180, Numbers 1-4 / March, 2007

50 Piementel, David and Patzek, Tad W. "Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower" Natural Resources Research. Volume 14, Number 1 / March, 2005

that nitrogen loading has created a “dead zone” that encompasses the mouth of the river and also a large section of the adjacent Gulf of Mexico.<sup>51</sup> In all, 21,000 square kilometers of aquatic ecosystem are affected.<sup>52</sup>

#### **2.2 d. Biodiversity**

There has been work on the impact of conservation programs in the United States and in Brazil. The Conservation Reserve Program (CRP) and Conservation Security Program (CSP), is administered by the Farm Service Agency and the Natural Resource Conservation Service.

In the United States, Best et al. describe how wildlife has used CRP land successfully.<sup>53</sup> Ronald Reynolds of the Northern Prairie Wildlife Research Center, which is part of the USGS, also has published a study of how migratory bird species benefit from CRP lands.<sup>54</sup> He writes that the CRP lands in the Prairie Pothole region have generated an additional 10.5 million ducks, which account for 30% of the total population in the Northern Great Plains. The author predicts at least five million acres

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51 Dinnes et al., 2002 D.L. Dinnes, D.L. Karlen, D.B. Jaynes, T.C. Kaspar, J.L. Hatfield, T.S. Colvin and C.A. Cambardella, Nitrogen management strategies to reduce nitrate leaching in tile-drained Midwestern soils, *Agron. J.* 94 (2002), pp. 153–171

52 Rabalais NN, Turner RE, Scavia D. 2002. Beyond science into policy: Gulf of Mexico hypoxia and the Mississippi River. *BioScience* 52: 129– 42

53 Best, L. B., H. Campa, III, K. E. Kemp, R. J. Robel, M. R. Ryan, J. A. Savidge, H. P. Weeks, Jr., and S. R. Winterstein. 1997. Bird abundance and nesting in CRP fields and cropland in the Midwest: a regional approach. *Wildlife Society Bulletin* 25:864-877.

54 Reynolds, Ronald E. “Waterfowl Responses to the Conservation Reserve Program in the Northern Great Plains.” Northern Prairie Wildlife Research Center, USGS. <http://www.npwrc.usgs.gov/resource/birds/wfrespon/index.htm>

of CRP lands will have to remain intact in the Prairie Pothole region to allow duck populations to continue to increase. However, these publications explain what the states of ecosystems are currently and what sorts of inputs and continued ecosystem services are needed to preserve the status quo of the ecological fragments, but not what farmers might do to impact the environment.

In Brazil, Dr. Kenneth Chomitz of the World Bank has done work on improving the mechanisms for improving the effectiveness of the Forestry Code's conservation mandates through transferable development rights regimes. Right now, farmers have incentives to develop and grow crop including sugarcane for ethanol in Paraná with few, if any incentives, for conservation and wildlife habitat preservation. As the head of the Farm Bureau for Mato Grosso, a neighboring state to put it, "If you [the developed countries] don't want us to tear down the forest, you better pay us to leave it up!"<sup>55</sup> Dr. Chomitz's work with tradable development rights tries to match willing buyers and sellers of the right to develop among groups of neighboring landowners. A transferable development right in the context of this forest-reservation law would enable one landowner to develop more than 80% of the property-legally-by paying another landowner to cover their own 20% natural cover requirement plus however much the buyer needs. In this way, the first landowner pays the second for the right to develop. Recent regulatory changes have paved the way for this type of market to

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<sup>55</sup> Grunwald, Michael. "The Clean Energy Scam." Time Magazine. Thursday 27, 2008.

<http://www.time.com/time/magazine/article/0,9171,1725975-1,00.html>

emerge, particularly in the state of Minas Gerais.<sup>56</sup> In an efficient transferable development rights program there would not be any net loss of overall conserved land.

### **2.2 e. Air Quality**

The use of ethanol as a fuel can affect air quality both at its production and combustion stages. Producers who grow sugarcane in Brazil without much mechanization rely on their workers to burn leftover leaves and other plant material in the field to repel against snakes and to clear the field. These agricultural practices affect air quality. A study by Kirchoff suggests that carbon monoxide and ozone levels can be twice as high in an airshed surrounding these fires as in a pristine area.<sup>57</sup> Additionally, these burnings release organic compounds into the atmosphere.<sup>58</sup> As a result, human health has been affected. Depending on the weather conditions, smoke and partially burned debris from these fields float into nearby cities and towns. This has become an environmental justice issue.

Researchers also report ethanol combustion in vehicles can reduce some air pollutants but raise others.<sup>59</sup> Jacobsen reports that a scenario where all vehicles run on

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56 Chomitz, K.M. et al. (2004) 'Creating Markets for Habitat Conservation When Habitats Are Heterogeneous', World Bank Policy Research Working Paper 3429, October 2004.

57 Kirchoff WMJH. 1991. Enhancements of CO and O3 from burning in sugar cane fields. *Journal of Atmospheric Chemistry*. 12:87-102.

58 Godoi AFL, Ravindra K, Godoi RHM, Andrade SJ, Santiago-Silva M, Vaeck LV, and Grieken RN. 2004. Fast chromatographic determination of polycyclic aromatic hydrocarbons in aerosol samples from sugar cane burning. *Journal of Chromatography A*. 1027:49-53

59 Patzek, Tad, W et al. "Ethanol from Corn: Clean Renewable Resource for the Future or Drain on Our Resources and Pockets?" *Environment, Development, and Sustainability*. Volume 7. Number 3. 2005.

E85-85% ethanol, formaldehyde and acetaldehyde levels in the atmosphere would be higher than in an all gasoline fleet.<sup>60</sup> This report supports an earlier paper that investigated the air pollution of gasoline with ethanol as an additive contributed to some forms of air pollution.<sup>61</sup>

### **2.2.f. Soil Erosion**

Both production of sugarcane in Paraná and corn in Iowa can lead to soil erosion if proper management techniques are not followed.<sup>62,63</sup> Innovative soil management techniques are used including no till corn production. No till techniques can dramatically decrease soil erosion. According to Montgomery, leaving the ground covered with organic debris can bring soil erosion rates down close to soil production rates-with little to no loss in crop yields.<sup>64</sup>

One source of cellulosic ethanol is from corn cobs or corn stover which composes the crop residue in the field. However, the removal of crop residue has also

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60 Jacobson, Mark, Z. "Effects of Ethanol (E85) versus Gasoline Vehicles on Cancer and Mortality in the United States." *Environmental Science Technology* . 2007. 41. p. 4150-4157.

61 Gaffney, J. S.; et al. "Potential Air Quality Effects of Using Ethanol-Gasoline Fuel Blends: A Field Study in Albuquerque, New Mexico." *Environ. Sci. Technol.* 1997, 31, 3053.

62 Piementel, David and Patzek, Tad W. "Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower" *Natural Resources Research*. Volume 14, Number 1 / March, 2005

63 Christoffoleti, P.J. ; Carvalho, S.J.P. ; Lopez-Ovejero, R.F. ; Nicolai, M. ; Hidalgo, E. ; Silva, J.E. . Conservation of natural resources in Brazilian agriculture: implications on weed biology and management. *Crop Protection*, v. 26, p. 383-389, 2007.

64 Montgomery, David, R. *Dirt: The Erosions of Civilizations*. Berkeley: University of California Press. 2007.

been shown to reduce crop yield.<sup>65</sup> Crop residue is a significant source of what becomes soil organic carbon. The fact that crop residue contributes to soil erosion management and is at the same time, a potential feedstock for cellulosic ethanol means at this point, there could be a conflict between local erosion management and addressing the worldwide climate change problem.<sup>66</sup> To address this potential predicament, Robin Graham of the Oak Ridge National Laboratory wrote a paper outlining the best places in the United States for corn stover removal that would balance the need for cellulosic ethanol feedstock and appropriate soil erosion management.<sup>67</sup> She and her colleagues additionally calculate that corn stover from these areas can supply some proportion for the ethanol energy needs of the United States. W. Wilhelm and his colleagues also calculate if the maximum amount of corn stover in Iowa is used, then that source of cellulosic ethanol can contribute to 3.7 billion liters.<sup>68</sup> Whether or not a farmer decides to use residue for cellulosic technology affects soil quality and quantity.

In Brazil, Pinto and his co-authors find that certain agroforestry practices can

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65 Wilhelm, W.W., J.W. Doran, and J.F. Power. 1986. Corn and soybean and A.E. Peterson. 1994. Surface residue and in-row treatment on yield response to crop residue management under no-tillage prolong-term no-tillage continuous corn. *Agron. J.* 86:711-718.

66 Wilhelm, W.W., Johnson, J.M.F., Hatfield, J.L., Voorhees, W.B. and Linden, D.R. 2004. Crop and soil productivity response to corn residue removal: A review of the literature. *Agronomy Journal* 96:1-17

67 Graham RL, Nelson R, Sheehan J, Perlack RD, Wright LL "Current and potential U.S. corn stover supplies." *Agronomy Journal* 99, 1-11 (2007).

68 Wilhelm, W.W., Johnson, J.M.F., Hatfield, J.L., Voorhees, W.B. and Linden, D.R. 2004. Crop and soil productivity response to corn residue removal: A review of the literature. *Agronomy Journal* 96:1-17

mitigate soil erosion in the sugarcane fields of São Paulo. They specifically recommend operators or farmers plant perennial vegetation like trees along the contours of the land, in order to lessen soil erosion. They also value the power of innovative farmers to spark wider adoption of beneficial conservation measures.<sup>69</sup>

### **2.3. Policy Debates on Ethanol**

The costs and benefits of ethanol production are a topic of hot debate not only in academia, but other policy communities as well. Policymakers at the national level in the United States and Brazil have at one time or another have or will pass agricultural and energy legislation offering government based incentives, create regulatory frameworks, and advocate for the interests of their particular agricultural constituency. Recent legislation in the United States affecting ethanol in society and the national energy portfolio includes the 2005 Energy Policy Act, the 2002 Farm Bill, the 2007 Energy Independence and Security Act, and will include the 2007 Farm Bill when Congress and the President come to a compromise. After the passage of these bills, different agricultural policy analysis groups scrutinized these laws to assess what their on-the-ground impacts would be. The Food and Agricultural Policy Research Institute, managed jointly between the Center for Agricultural and Rural Development at Iowa State University and the University of Missouri-Columbia, for instance, found that the 2005 Energy Policy Act can play out in a number of ways, but most simulated outcomes result in higher ethanol production and land use for corn going up

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<sup>69</sup> Pinto et al. "Feasibility of cultivation of sugarcane in agroforestry systems." *Scientia Agricola*. 2003.

accordingly.<sup>70</sup>

The Center for Agricultural and Rural Development also wrote a report, in May 2007, detailing how ethanol production will evolve and change how farmers use their lands assuming current “tax credits and trade policies are maintained.”<sup>71</sup> In the paper, with the current state and federal mandates corn-based ethanol production will increase to 14.7 gallons by 2011. To meet this demand, acreage committed to corn will increase to 94 million acres. Additionally, they predict higher oil prices will create greater incentives for farmers to produce more corn on more land, and as one consequence farmers will opt out of CRP contracts, pulling more grassland into agricultural production. These authors are pessimistic about cellulosic ethanol breaking through because as point out a study by Babcock et al. show that the price that makes switchgrass, one main sources of cellulosic ethanol are higher than the highest price mills can bid. They conclude that with the current set of subsidies and incentives, corn will always trump switchgrass ethanol because it will always be cheaper. Using their assumptions, another potential source of cellulosic ethanol, corn stover, is similarly too expensive for farmers to consider. More recently, the Energy Independence and Security Act has further expanded the ethanol mandate. One result will be corn prices

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70 “Implications of Ethanol Production for U.S. Agriculture.” Food and Agricultural Policy Research Institute of the University of Missouri-Columbia [http://www.fapri.missouri.edu/outreach/publications/2005/FAPRI\\_UMC\\_Report\\_10\\_05.pdf](http://www.fapri.missouri.edu/outreach/publications/2005/FAPRI_UMC_Report_10_05.pdf)

71 Tokgoz, Simla et al. “Emerging Biofuels: Outlook on Effects on U.S. Grain, Oilseed, and Livestock Markets.” Staff Report 07-SR 101. May 2007. Center for Agriculture and Rural Development. Iowa State University. Ames, Iowa.

will remain elevated.<sup>72</sup> In conclusion, commodity prices are in flux.

In recent years, Non governmental Organizations (NGO's) have contributed widely to the knowledge base of the field of interest. This process is particularly true for both international and domestic environmental issues.<sup>73</sup> In Brazil, the Movimento dos Trabalhadores Rurais Sem Terra (Landless Workers Movement) or MST, the Paraná Biodiversity Project, and SOS Mata Atlântica have done work on ethanol policy. The MST takes hard stand against sugarcane production for ethanol because it because it considers “food versus fuel” issue a real problem, largely to the detriment to low-income and the underprivileged individuals and groups. The MST sees ethanol production as a way for the Global North to exert influence over the Global South. Both of these topics will be discussed in upcoming sections. The Paraná Biodiversity Project and SOS Mata Atlântica, for their part, focus on ethanol production as it affects the Atlantic Forest ecosystem. Many conservation oriented organizations such as the Izaak Walton League, Ducks Unlimited, the National Wildlife Federation and the Theodore Roosevelt Conservation Partnership also have published reports on how the Farm Bill or the Energy Policy Act of 2005 may trigger increase agricultural output, but also at the same time decreased wildlife habitat.<sup>74</sup> This project attempts to combine their

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72 McPhail, Lihong, Lu. And Babcock, Bruce A. <http://www.card.iastate.edu/publications/DBS/PDFFiles/08wp464.pdf>

73 Jasanoff, Sheila, *Third World Quarterly*, 01436597, Sep97, Vol. 18, Issue 3.

74 Hovorka, Duane “Hidden Treasures: The Conservation Security Program and Wildlife.” Izaak Walton League of America, National Wildlife Federation, and the Sustainable Agricultural Coalition. January, 2007. [http://www.iwla.org/publications/agriculture/hidden\\_treasures.pdf](http://www.iwla.org/publications/agriculture/hidden_treasures.pdf)

hypotheses about what *might* happen with the farmer's thought process and their individual situation.

Recent legislation and support for the ethanol industry the Brazilian government has pursued includes a blending mandate for vehicles and cost of production support to farmers in the Northeastern region, ensuring sugarcane production in that area stays competitive with the Center-South production region, which has lower costs of production.<sup>\*75</sup> There also has been renewed activity at the national level with international trade agreements. The Brazilian President, Lula da Silva has gone abroad to build South-South alliances with India and South Africa specifically.<sup>76</sup> Brazil recently won a case against the U.S. cotton industry at the World Trade Organization and said they might bring a similar suit against U.S. corn growers. In response, scholars have begun to detail how biofuel and trade policy intersect.<sup>77</sup> One conclusion is that biofuels will become much more prominent in WTO proceedings in the future.

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\* In fact the Center-South of Brazil has the lowest cost of production of sugarcane in the world.

75 Knapp, Robert. "Brazilian Sugar." USDA-Foreign Agricultural Service. October 2003. <http://www.fas.usda.gov/ftp/sugar/2003/Brazilsugar03.pdf>

76 Llana, Sara Miller. "Brazil eyes ethanol as fast track to power." The Christian Science Monitor. June 6, 2007.

77 Deshpande, RS. "Biofuels and WTO: An Emerging Context." Research and Information System for Developing Countries. [http://www.ris.org.in/article5\\_v8n2.pdf](http://www.ris.org.in/article5_v8n2.pdf)

## **2.4 Social Issues**

### **2.4.a. Land Activism and Ethanol Policy**

Agricultural activities and private property matters are interrelated, and Brazil and the United States have very different private property distribution patterns. A major difference arises from the way each country moved away from slavery. Both the United States and Brazil had long-standing systems of slavery through the 19<sup>th</sup> century. However, after the United States abolished the institution, they instituted a policy of “40 acres and a mule,” under which former slaves were offered some resources to start a new life. Brazil, on the other hand, did not assist the freed slaves in any way because the elites of European ancestry did not want to give up any power.<sup>78</sup> This discrimination was nothing new; it echoed a long standing pattern of where wealth and privilege in Brazilian society, including access to property, was handed down generation to generation in the cases of a few, advantaged families.<sup>79</sup> Despite the failure of the “40 acres and a mule” policy and the larger Reconstruction, the United States did not experience the same level of racial inequality in property ownership as was the case in Brazil. Brazil’s institutionalized racial hierarchy accounts for the landless struggle in its current political scene, which is absent in the United States.

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<sup>78</sup> Personal Communication. Green, James. Brown University Professor. November 1, 2007.

<sup>79</sup> Metcalf, Alida. *Family and Frontier in Colonial Brazil. Santana de Parnaiba. 1580-1822.* Austin: University of Texas Press. 2005.

The Catholic Church in Brazil has been a major actor in land issues.<sup>80</sup> Ever since Lula signed the ethanol agreement with President Bush, many bishops have come out against the plan saying the new program would be terrible for workers. Other opposition groups to Brazilian ethanol include the Landless Rural Workers' Movement (LRWM), a group instrumental in organizing recent protests in Brazil during President Bush's visit. "Bush is coming to Brazil as a messenger boy for the multinational companies, the agribusiness companies, the oil companies and the automobile companies that want to control the biofuels," said the head of the LRWM, Joao Pedro Stedile.<sup>81</sup> Bishop Tomas Balduino echoed Stedile, saying, "it's (ethanol production) just going to promote death, marginalization, poverty and the destruction of the environment because it defends the interest of large multinationals."<sup>12</sup> Their sentiment is shared by many in Brazil, judging by the crowds that turned out into the streets to protest. The rise of ethanol brings a promise of increased environmental benefits; however, its influence on the social dimension of countries needs to be explored.

#### **2.4.b. Workers in the Ethanol Industry**

Although there has been a surge in ethanol plant construction in the United States over the last few years, 50 (about 60% of new plants) of these are in rural

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80 Cousineau Adriance, Madeleine. "The Brazilian Catholic Church and the Struggle for Land in the Amazon." *Journal for the Scientific Study of Religion*, Vol. 34, No. 3 (Sep., 1995), pp. 377-382.

81 Merlini, Lisa. Brazilians Protest Upcoming Bush Visit. *The Guardian*. 8 March 2007. [http://www.catholicmediareport.org/story.php?story\\_id=3202](http://www.catholicmediareport.org/story.php?story_id=3202)

counties with negative population growth.<sup>82</sup> Rural communities hope that the ethanol boom will turn the tide in the efforts for civic and regional revitalization. Despite this optimism, however, the energy sector faces a lack of young, ambitious employees. Emily Stove DeRocco, assistant secretary of labor for employment and training spoke before the Senate Committee on Energy and Natural Resources and explained that, "Stereotyping of energy careers as low-skilled causes qualified workers, especially youth, to be unaware of the many highly skilled, well-paying career opportunities the industry has to offer."<sup>83</sup> <sup>84</sup> In general, worker shortages are expected to increase.

Another matter is employee treatment, especially those who might be temporary or migrant. Migrant workers in all parts of the United States have at least some sort of union representation. In the case of the Midwest, when tomato picker Baldemar Velásquez founded the Farm Labor Organizing Committee (FLOC) in 1967, he was following in the footsteps of people such as Caesar Chavez. FLOC and similar organizations fight for improved working conditions and wages and against perceived racism.<sup>85</sup> The problem is not nearly as bleak here in the United States as it is in Brazil.

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<sup>82</sup> "Over half of all Ethanol Plants are located in Declining Nonmetro Counties." USDA-ERS.  
[http://www.ers.usda.gov/Publications/EIB31/EIB31\\_full.pdf](http://www.ers.usda.gov/Publications/EIB31/EIB31_full.pdf)

<sup>83</sup> "DeRocco Testimony." Energy and Public Works Committee, United States Senate.  
[http://energy.senate.gov/public/\\_files/DeRoccoTestimony110607.doc](http://energy.senate.gov/public/_files/DeRoccoTestimony110607.doc)

<sup>84</sup> Ibid.

<sup>85</sup> Barger, W.K. and Reza, Ernesto M. *The Farm Labor Movement in the Midwest*, University of Texas Press, 1994.

There, the sugarcane industry in Brazil faces a persistent and brutal underground agriculture, where workers live and work in inhumane conditions. It resembles slavery.<sup>86</sup> The situation has occurred due to usury: the worker becomes so indebted to the plantation managers who supply them with housing, food and tools that they find themselves working “virtually for free.” These plantations are also often in remote areas of the Amazon. The victims of these illicit plantations are seasonal workers, often of a lower socioeconomic stature from the poorer, Northern regions of Brazil. The problem is so grave that the Brazilian government has a roving, Mobile Verification Task Force that breaks up these illegal operations.

However, many critics feel that even legitimate sugarcane farms treat their workers poorly. With Brazil’s new role as an energy exporter, international attention to the conditions of sugarcane workers in Brazil will only increase. For instance, Gröna Bilister, the Swedish association of Green Motorists sent a handful of its members to the state of Sao Paulo in the spring of 2006 to investigate the possibility that international pressure from eco-groups could be brought on the ethanol producers.<sup>87</sup>

### **2.5.c. Food or Fuel**

Corn and sugarcane are versatile crops and have been used for a wide array of

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<sup>86</sup>“ ‘Slave’ labourers freed in Brazil.” Tuesday, July 3, 2007. <http://news.bbc.co.uk/2/hi/americas/6266712.stm>

<sup>87</sup> Lagercrantz, Jakob. “Ethanol Production from Sugarcane in Brazil. Review of Potential for Social and Environmental Labelling of ethanol production from sugarcane.” Gröna Bilister. March 2006. [http://www.gronabilister.se/file.php?REF=39461a19e9eddfb385ea76b26521ea48&art=376&FILE\\_ID=20060511084611.pdf](http://www.gronabilister.se/file.php?REF=39461a19e9eddfb385ea76b26521ea48&art=376&FILE_ID=20060511084611.pdf)

food products. The agriculture industry in both Brazil and the United States has taken advantage of the flexibility by creating new markets and products. Corn, for instance, has been used in such unrelated sectors as food (both livestock and humans), building and construction, clothing, and fuel.<sup>88</sup> The ease of switchover from one product to another depends on what type of distillery or mill the operator uses. In the Brazilian ethanol industry, distilleries are either “annexed” to the larger sugar mill, which would allow the manufacture of both refined sugar and ethanol. Autonomous distilleries, on the other hand, are entirely separated from the sugar refining process and only produce ethanol.<sup>89</sup> There is an analogous situation in the processing of corn in the United States. Here, corn mills are either “wet” or “dry.” In recent years more dry mills than wet have been constructed, allowing ethanol production to expand.<sup>90</sup>

As a result of the versatility of corn and sugarcane the crops can be used for fuel as well as food. Recently, with more of the material going to meet energy rather than sustenance needs, a loud and contentious “food or fuel” debate has emerged. As agricultural lands that previously were dedicated for food production are converted into fields for energy production, simple economics explains food will become scarcer and

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88 “News Direct From the Stalk.” <http://www.ncga.com/news/notd/2001/october/101201.htm> October 12, 2001. “Research and Business Development.” <http://www.ncga.com/research/main/index.asp>

89 Rusk, Kevin. “The Social Costs of Ethanol Production in Brazil: 1878-1987. *Economic Development and Cultural Change*. April. 95.Vol. 43 Issue 3, p627

90 “Analysis of Selected Transportation Fuel Issues Associated with Proposed Energy Legislation – Summary.” <http://www.eia.doe.gov/oiaf/servicerpt/fuel/rmf.html>

prices will rise accordingly. The competition for resources to provide for the two needs, energy and sustenance, has broken down along lines of nationality and class. The United States produces 40% of the world's corn, and with more emphasis on ethanol production less goes into foodstuffs. This trade-off has strained at least one bond with an international trading partner already--our neighbor to the south. In Mexico, which has a close relationship with the United States under NAFTA, the rising cost of food has become an inflammatory topic. Since corn plays a central role in Mexican culture and cuisine, Mexicans have become upset over the surge in prices for items like tacos and tortillas. President Calderón instituted price controls in response.<sup>91</sup> In the United States, hog and cattle farmers are now worried that the cost of corn (since it can be used for fuel) will affect the market for their own operations.

Food security divides biofuels policy between developed and developing countries.<sup>92</sup> The Economic Research Service, an arm of the USDA defines food security as “access by all people at all times to enough food for an active, healthy life.”<sup>93</sup> The percentage of those in the United States, who did not meet the broad definition and were food insecure, was 11 percent in 2005 and 2006. Brazil, in contrast, has a

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91 Roig-Franzia, Manuel. “A Culinary and Cultural Staple in Crisis.” *The Washington Post*. Saturday, January 27, 2007.

92 Dong, Fengxia. “Food Security and Biofuels Development: The Case of China.”  
<http://www.card.iastate.edu/publications/DBS/PDFFiles/07bp52.pdf>

93 Ibid.

food insecurity percentage somewhere between 20 and 40 percent.<sup>94</sup> Essentially, the United States meets its citizens' food needs better than Brazil. This difference accounts for the larger emphasis on food security and, by extension, the attention the food or fuel debate receives in Brazil compared to the United States.

The “food or fuel” debate is especially noticeable in Brazil where social groups such as the MST (a group that works on behalf on landless workers) and the Catholic Church have mobilized to publicize the issue. One of the major points of conflict between groups like the MST that are skeptical of biofuels and those who promote biofuels is the international economic effect the shift from petroleum based fuels to ones that are based on crops such as corn sugarcane will have. Will the balance of power in the Global North and South be ultimately distorted or equalized? Where many optimists see ethanol and other biofuels as a golden opportunity for Brazil and other tropical agricultural countries to catch up to the level of affluence enjoyed in the North, MST sees ecological and cultural exploitation and corporate dominance. The executive director of FoodFirst, Eric Holt-Giménez, summarized their concern, when he wrote “The North cannot shift the burden of overconsumption to the South because the tropics have more sunlight, rain and arable land.”<sup>95</sup>

Although a full examination of the “food or fuel” topic is outside the scope of

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94 Meade, Birgit, Valdes, Constanza, and Rosen, Stacey. Food Security Assessment GFA-15. May 2004.  
<http://www.ers.usda.gov/publications/GFA15/GFA15h.pdf>

95 Holt-Giménez, Eric. “The Biofuel Myths.” International Herald Tribune. July 10, 2007.  
<http://www.iht.com/articles/2007/07/10/opinion/edholt.php> <http://www.mstbrazil.org/?q=holtgimenezonagrofuelsherald>

this conservation-focused paper, it nevertheless is crucial issue to understand the politics and policy of biofuels.

## **2.6 The Decision-making of Farmers**

The decision-making process and the individual considerations of farmers is an underdeveloped research area. As the ethanol sector has emerged there have been a number of papers that argue a need for greater research into the broad based implications of ethanol production. For instance, Robertson et al. believe agricultural research needs to be an agenda that is more “anticipatory; promotes long-term, systems-level research at multiple scales; better incorporates important interactions between the biophysical and social sciences; and provides for the proper evaluation of deployed solutions.”<sup>96</sup> A recent paper by the Collaborative State Research Education Extension Service of the USDA (USDA-CSREES) held that “broad systems changes [the like one ethanol mandates bring] require a systems approach to research, including interdisciplinary discussion among social and biophysical scientists, agricultural producers, community planners, industry experts, state and local governments, and others.”<sup>97</sup> The paper also indicates farms, landowners and managers, firms, and communities will face many decisions about participation in the bioeconomy. What factors should they consider and what information do they need? Through the farmer

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96 Robertson, G. Phillip et al. “Rethinking the Vision for Environmental Research in U.S. Agriculture,” *BioScience*, 54(1), January 2004.

97 Hipple, Patricia C. Discussion Paper. “The Human and Social Dimensions of a Bioeconomy: Implications for Rural People and Places.” USDA-CSREES March 29, 2007. [http://www.csrees.usda.gov/about/white\\_papers/pdfs/bioeconomy\\_discussion\\_paper.pdf](http://www.csrees.usda.gov/about/white_papers/pdfs/bioeconomy_discussion_paper.pdf)

interviews, this project sheds light on these questions in respect to conservation management.

Are vibrant conservation practices and farm financial stability at odds? Cook, Beva, and Keeler write that the “implementation of biomass cropping systems that preserve naturally diverse ecosystems may require producers to accept submaximal biomass yields.” Incentives or regulations may therefore be necessary to ensure economic viability and adequate implementation.<sup>98</sup> To what extent is this true? This project seeks to clarify the issue. All together this literature calls out for more work on the effects of the ethanol boom on the individual farmer’s thought process concerning conservation.

Whatever form biofuel or ethanol policy takes in Brazil or the United States, the individual farmer will be responsible for not only carrying out the production of the crops, but at the same time, making considered choices on conservation as well. Robert Costanza and his colleagues explain this importance, stating that the need for environmental management (of issues like greenhouse gas reductions, biodiversity protection, and soil maintenance) are global in scale, but the solutions are local.<sup>99</sup> In this way, when ethanol is produced farmers play a key role in addressing these environmental issues. This framework also encourages a comparison between the two

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98 Cook JH, Beya J, Keeler KH. 1991. "Potential impact of biomass production in the United States on biological diversity." *Annu. Rev. Energy Environ.* 16: 401– 31

99 Costanza R et al. *An introduction to ecological economics*. By Robert Costanza, John Cumberland, Herman Daly, Robert Goodland and Richard Norgaard. Florida: St. Lucie Press, Boca Raton; International Society for Ecological Economics-ISEE, 197. 275p

sets of ethanol producing farmers in Brazil and in the United States in order to tease out the benefits and drawbacks of their efforts and strategies for conservation management.

## **2.7. Conclusion**

This thesis sets out to determine what the opinions and considerations farmers of Brazil and the United States use to when they use land for ethanol production and determine if there is any connection in the larger international ethanol market.

Currently, there is a solid set of literature that delves into the social, environmental, and economic dimensions in ethanol production in both countries. Additionally, ethanol and agricultural policy analysts have undertaken a number of studies to determine what the state of the ecosystems that underlies the ethanol producing agricultural regions of the United States and Brazil. The thesis ties these threads to together and presents a picture of the state of current conservation efforts in the fields of ethanol crops. In this way, it acts a reference point for future actions on conservation for different types of agricultural and biofuel programs.

## **Chapter 3 Background**

### **3.1. Introduction**

Two countries, Brazil and the United States dominate global ethanol production. Two crops, sugarcane in Brazil and corn in the United States, are the principal ethanol feed stocks, despite the fact that ethanol can also be derived from other common crops, such as rice, wheat, or potatoes. With its rich culture of sugar production, which originated when the Portuguese colonized the area, and its tropical and its subtropical

climates, which are ideal for sugarcane, Brazil has emerged as an “ethanol superpower.”<sup>100</sup> Despite Brazil’s apparent advantages, in recent years the United States actually has produced more ethanol than its South American counterpart, but it is a close rivalry: each has an annual output of around 4200 million gallons.<sup>101</sup> While sugarcane is a more efficient feedstock, the United States has managed a slight edge over Brazil during the past two years because American farmers plant twice the acreage in ethanol-producing crops than the Brazilians do.<sup>102</sup> Additionally, each country has made significant investments in research and development on a quest to tap the potential of “cellulosic ethanol,” a fuel type derived from woody residues and cellulose wastes such as citrus detritus. More research still needs to be done until “ethanol 2.0” as it is called, becomes viable and profitable.<sup>103</sup> Until then, corn and sugarcane will continue to reign supreme.

These dominant agricultural systems have a number of ecological, economic, and social impacts. To appreciate where biodiversity and conservation issues fit into the

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100 Clendenning, Alan. “Brazil is the World’s Ethanol Superpower.” CBS-News. Sci-Tech. 13 March 2006.  
[http://www.cbsnews.com/stories/2006/03/13/tech/main1394254\\_page2.shtml](http://www.cbsnews.com/stories/2006/03/13/tech/main1394254_page2.shtml)

101 Industry Statistics. Renewable Fuels Association. <http://www.ethanolrfa.org/industry/statistics/>

102 Ibid. Pimentel, D. 2003. Ethanol Fuels: Energy Balance, Economics, and Environmental Impacts are Negative. *Natural Resources Research*, Vol. 12, No 2, June, 2003.

103 Patel-Predd, Prachi. “Fueling the Future with Citrus Waste.” Pg. 5170-5171. *Technology Solutions*. *Environmental Science and Technology*. September, 2006.

larger picture, it is necessary to review the broader story of fuel ethanol in these countries.

### **3.2. Ethanol in the United States and Brazil**

Before one examines the history and scope of ethanol production in the two countries, a primer on the industry is in order. In the growth/harvest cycle of each crop, there are some differences and similarities. In Brazil, farmers can cut sugarcane up to five times over a six year period before replanting is needed. However, each successive “recut” has a lower yield. In contrast, corn provides a harvest every year and is replanted every spring. All together, Brazil has a dedicated acreage to ethanol production of 7 million acres. In the United States this figure is approximately 14 million acres. However, this acreage is not necessarily permanently assigned for ethanol production. Land use reflects the highest valued use or uses, and currently biofuels are the largest new source of demand. If the demand for another commodity or service begins to out-compete ethanol crop production, then the land use would change to meet that new need.

One result of the competition among agricultural crops, and the mandates for ethanol is the fact that in order to increase corn acreage, the United States most likely would need to reduce the acreage of other crops such as soybeans. Brazil, on the other hand, has room to expand its sugarcane acreage for increased ethanol production without sacrificing other crops. Sugarcane has the advantage over corn in that it yields around 35 tons per acre, while corn produces up to 4.2 tons per acre (150 bushels). However, the ethanol quantity/crop mass ratio favors corn. In this metric,

one gallon of ethanol corresponds to about 20 pounds of corn or 100 pounds of sugarcane.<sup>104</sup>

Despite plans to increase production, barriers in the infrastructure hinder widespread ethanol use in the United States. An important obstacle is the lack of an efficient ethanol transport system from the Midwest to the rest of the country. Brazil does not face this problem. The fact that Brazil has two separate regions for ethanol distribution allows it to avoid the bottleneck that the ethanol market in the United States faces. Additionally it has dedicated pipelines for ethanol transportation which the United States lacks.<sup>105</sup> Two elements further differentiate the Brazilian and American vehicular fleets. Brazil can more easily achieve independence from foreign oil because it has a much smaller fleet composed of a higher proportion of flexible fuel vehicles (FFVs).<sup>106</sup> While most new cars can handle E10 fuel (10% ethanol blend), higher ethanol/gasoline ratios require different technology, which E85 (85% ethanol blend) and other flexible fuel vehicles possess.<sup>107</sup> Another related obstruction is the shortage

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104 Hofstrand, Don. "Energy Agriculture-Brazilian Agriculture." AgDecisionmaker. June 2007.  
<http://www.extension.iastate.edu/agdm/articles/hof/HofJune07.html>

105 Karnowski, Steve. "As ethanol production grows, some experts forecast oversupply." The Associated Press. Wednesday June 13, 2007

106 Hofstrand, Don. "Energy Agriculture-Brazilian Agriculture." AgDecisionmaker. June 2007.  
<http://www.extension.iastate.edu/agdm/articles/hof/HofJune07.html>

107 "Backgrounder on Flexible Fuel Vehicle." July 24, 2007. API.  
[http://www.api.org/aboutoilgas/otherfuels/upload/ffvs\\_e85\\_backgrounder07\\_24\\_07\\_final.pdf](http://www.api.org/aboutoilgas/otherfuels/upload/ffvs_e85_backgrounder07_24_07_final.pdf)

of gasoline stations that carry ethanol throughout the United States.<sup>108,109</sup>

The trajectories along which the United States and Brazil have developed their biofuel and ethanol policies follow similar paths--confront the issue of climate change, break oil dependence, and strengthen rural economies. The two paths also share common themes: private-public collaboration, government funded research, and keeping an eye on the ethanol developments in the international arena. However, the Brazilian sugarcane based ethanol program is more advanced, for a number of reasons. Chief among these is that Brazil vigorously invested in ethanol as a major fuel source in the 1970's. The US did not seriously invest until the dawn of the 21<sup>st</sup> Century.

### **3.3. History of Sugarcane Ethanol in Brazil**

Brazil has had an ethanol program since the 1920s and 30s, when it first mandated that imported gasoline would be blended with 5 percent ethanol. Throughout the 20<sup>th</sup> century, sugar and gasoline prices fluctuations determined the level of ethanol blend.

Brazil's contemporary ethanol program accelerated after the hard line military regime, which held power at the time, faltered in the wake of the 1973 oil crisis.<sup>12</sup> Fearing a turn toward socialism or communism, the military toppled democratically elected President João Goulart in 1964, and commenced twenty years of

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108 "National Ethanol Vehicle Coalition." <http://www.e85fuel.com/>

109 "Backgrounder on Flexible Fuel Vehicles and E85." API. July 24, 2007.

[http://www.api.org/aboutoilgas/otherfuels/upload/ffvs\\_e85\\_backgrounder07\\_24\\_07\\_final.pdf](http://www.api.org/aboutoilgas/otherfuels/upload/ffvs_e85_backgrounder07_24_07_final.pdf)

junta rule. During this period, there was a succession of military leaders who took the post of President, each for approximately 5 year terms. In the years, 1969-1973, Brazil went through an era of robust economic growth, known as the “Brazilian economic miracle.”<sup>113</sup> When President Ernesto Geisel took over from President Médici, in 1973 he led the country through the economically perilous period. During the 1970s a combination of factors occurred that would lead Brazil to promote a large-scale ethanol program. The cost of Brazil’s oil imports tripled in late 1973 due to decreases in oil production by the Organization of the Petroleum Exporting Countries and the Arab oil embargo. In parallel, world sugar prices declined sharply in 1974. Faced with these problems, President Geisel sought to maintain a steady economy and promote energy independence by instigating the Brazilian National Alcohol Program in 1975. Government subsidies were offered to shift the processing of cane sugar from sweetener to fuel alcohol. In that way the program reduced the need for oil imports and provided an additional market for Brazilian sugar cane.<sup>110</sup>

Because Geisel’s government was a military dictatorship, economic policy changes could be made rapidly with underlying threat of force if necessary. The government offered low-interest loans to encourage construction of new refineries. Gasoline prices were set to give ethanol a price advantage. The state-owned oil company, Petrobras, made investments in the infrastructure for improved distribution of ethanol throughout the country.

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<sup>110</sup> Oliveira JAP. 2002. The policymaking process for creating competitive assets for the use of biomass energy: The Brazilian alcohol programme. *Renewable and Sustainable Energy Reviews* 6: 129-140.

Soon governmental research arms were experimenting with higher ethanol/gasoline blends and President Geisel released Decree # 76593, which established the National Alcohol Programme (PNA) also known as PROÁLCOOL, which directed the large scale integration of ethanol into Brazil's energy mix. Motivated by an iron fisted government, Brazil moved quickly and ethanol production skyrocketed by 500 percent from 1975-1979.<sup>14</sup> As ethanol distilleries successfully produced more and more alcohol for fuel use, the military government reached out to carmakers to provide vehicles capable of using their increasing supply of ethanol. In 1979 the Brazilian government signed agreements with automobile companies including Fiat, Volkswagen, Mercedes-Benz, General Motors and Toyota to produce cars that could run on 100 percent ethanol.<sup>111</sup> In this period, these automakers benefited from favorable government policies. They kept the cost of ethanol significantly lower than the cost of gasoline between 1979 and 1985, and as a consequence, ethanol production tripled. During the 1980s, ethanol made up about half of Brazil's fuel supply.<sup>112</sup>

At the end of the 1980s Brazil's ethanol program ran into problems that had a significant impact on ethanol production. World oil prices dropped sharply resulting in less need for a cheaper home-grown supply of energy. Brazil also began to experience

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111 "A HIGH GROWTH STRATEGY FOR ETHANOL." The Report of an Aspen Institute Policy Dialogue 2006 The Aspen Institute Queenstown, MD 21658 [www.aspeninst.org/EEE](http://www.aspeninst.org/EEE)

112 Ibid.

monetary inflation that required economic reforms including a cut back on subsidies and elimination of the price differential between ethanol and gasoline. Ethanol production declined slightly, as a rise in world sugar prices increased the profitability of processing cane into sugar. Even so, the government continued to require that all gasoline sold in Brazil contain roughly 20 percent ethanol by volume.<sup>113</sup>

In 2001, with growing environmental and economic pressures on energy production once again, the Brazilian government adopted strategies that would encourage use vehicles that could use either ethanol or a mix of ethanol and gasoline. These flex-fuel vehicles (FFVs) were entitled to a 14 percent sales tax, as compared to a 16 percent sales tax on non-ethanol cars.<sup>114</sup> The FFVs that now account for nearly half of Brazil's new cars and were first available to the mass market in 2003 were built with an engine-sensing device that allows them to burn either 100 percent ethanol or a blend of 75 percent gasoline and 25 percent ethanol. Filling stations in Brazil offer both types of fuel and motorists generally alternate between the types at each fill-up to get the best mileage and tax advantage. Pure ethanol gives 20% to 30% fewer kilometers to the liter but may be less expensive to use depending on the current prices and the local tax rates.<sup>115</sup>

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<sup>113</sup> Ibid.

<sup>114</sup> Ibid.

<sup>115</sup> Ibid.

During the 1970's, the Brazilian government was active in the ethanol market in the same sorts of ways as the United States is now. Oliveira writes that there were four mechanisms in which the Brazilian government encouraged ethanol use as a fuel. These policy instruments included: creating agricultural and industrial policies to support the Proalcool program, spending money on research, facilitating innovation by offering incentives to the private sector to work around ethanol as a fuel, and finally directly increasing consumer demand for alcohol fuels by offering car drivers/owners incentives of their own.<sup>116</sup> Even though sugarcane production in Brazil is concentrated, in two areas in what Schmitz et al. call the Center-South and the North-East,<sup>117</sup> these policies make sugarcane ethanol, like corn ethanol in the United States, a national topic.

### **3.4. History of Corn Ethanol in the United States**

The role of ethanol in the energy policy in the United States throughout history is one of technology and legislation. Ethyl alcohol, as ethanol is sometimes called was known to be a viable vehicular fuel source since the dawn of the Automobile Age. Luminaries such as Alexander Graham Bell, Thomas Edison, and Charles Kettering all promoted ethanol as an alternative fuel. In 1925, Henry Ford said ethanol was the "the fuel of the future."<sup>118</sup> Although research into cellulosic ethanol took place during this

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116 Oliveira JAP. 2002. The policymaking process for creating competitive assets for the use of biomass energy: The Brazilian alcohol programme. *Renewable and Sustainable Energy Reviews*. 6:129-140

117 Schmitz, Troy, G.; Seale, James G. Jr.; and Buzzanell, Peter. J. Brazil's Domination of the World's Sugar Market. Morrison School of Agribusiness and Resource Management. Faculty Working Paper Series. Arizona State University. Polytechnic Campus. (no date.)

time, the focus remained on corn ethanol. Later as gasoline price declines in the 1980s wiped out corn ethanol plants, skeptical commentators derisively transformed Ford's quote to ethanol is the "fuel of the future -- and always would be."<sup>119</sup>

However, these critics were too quick to judge, because ethanol's luck was about to change. At 1990 approached, lawmakers became aware of ethanol not as a fuel source, but as a solution to air pollution. The 1990 Clean Air Act gave ethanol in the United States a boost after its fade during the 1980s. This legislation required reductions in air pollution, especially carbon monoxide.<sup>120</sup> Oxygenates are a class of compounds that balance out the fuel/air mixture in internal combustion engines and, as a result, cut tailpipe emissions. Methyl Tertiary Butyl Ether (MTBE) was one such oxygenate and soon became widespread as a gasoline additive. However, researchers soon found MTBE contaminating groundwater.<sup>121</sup> As a consequence, California, and later other states banned MTBE. It was replaced by ethanol, another oxygenate that does not pollute groundwater.<sup>122</sup> Even though ethanol had been an oxygenate additive

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118 "Ford Predicts Fuel from Vegetation," New York Times, Sept. 20, 1925, p. 24.

119 Kovarik, Bill. "Henry Ford, Charles Kettering, and the "Fuel of Future." PhD 1009. <http://www.runet.edu/~wkovarik/papers/fuel.html>

120 "Gasoline: Methyl Tertiary Butyl Ethanol." <http://www.epa.gov/mtbe/gas.htm>

121 Squillace, P.J., Zogorski, J.S., Wilber, W.G. and Price, C.V., 1996. Preliminary assessment of the occurrence and possible sources of MTBE in groundwater in the United States, 1993-1994. *Environmental Science and Technology* 30 5, pp. 1721-1730

122 DiPardo, 2000. J. DiPardo, Outlook for biomass ethanol production and demand, Energy Information Administration (EIA), Washington, DC (2000).

before the ban, the mandate from California and the other states to replace MTBE created great demand for ethanol and spurred farmers into action. They had amassed considerable working knowledge of corn production and how to convert it into ethanol, so it was only natural they would pick it for the source of ethanol.<sup>123</sup> Ethanol can also work as a vehicular fuel in its own right and by the time Congress elevated ethanol as a viable replacement and substitute for gasoline under the 2005 Energy Policy Act, and later the 2007 Energy Independence and Security Act, it had a preexisting infrastructure and supply pool to fill its new role. Additionally, Congress has recently hammered a version of the Farm Bill that the House of Representatives and the Senate.<sup>124</sup> If President Bush signs it there would be additional support for ethanol through that legislation. It appears the future has arrived for ethanol. Here in the United States, the national policy toward ethanol has focused on creating a new market through government incentives. These laws contain language to ensure appropriate environmental management practices. To this end, the United States Congress has enacted many pieces of legislation and numerous federal agencies have taken administrative actions. The Farm Bill is the cornerstone of national agricultural policy in the United States.<sup>125</sup> The first one to have an energy section was the 2002 version

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<sup>123</sup> Talk of the Nation: Science Friday. October 5, 2007.

<sup>124</sup> Herszenhorn, David, M. "Tentative Deal Reached in Congress on Farm Bill." The New York Times. April 26, 2008.  
[http://www.nytimes.com/2008/04/26/washington/26farm.html?\\_r=2&ref=us&oref=slogin&oref=slogin](http://www.nytimes.com/2008/04/26/washington/26farm.html?_r=2&ref=us&oref=slogin&oref=slogin)

<sup>125</sup> No Author. "History of the Farm Bill." [http://www.public.iastate.edu/~tbuckley/NREM%20385/history\\_of\\_the\\_farm\\_bill.htm](http://www.public.iastate.edu/~tbuckley/NREM%20385/history_of_the_farm_bill.htm)

and it cemented the marriage between agricultural and energy policy.<sup>126</sup> In July of 2007, the United States House of Representatives passed its version of the 2007 Farm Bill.<sup>127</sup> However, conflicts between the President and White House stymied any subsequent work. Any final bill will have sizeable sections on energy policy. The Energy Policy Act of 2005 had a Renewable Fuel Standard (RFS) provision that has considerable impact on ethanol production. It contains a mandate that renewable fuels used in vehicles must increase from 4 billion gallons in 2006 to 7.5 billion gallons in 2012. The law also gives money and other tax credits to experimental and, up until now, marginal fuel sources (think: cellulosic) an opportunity to come to market. Perhaps more important than any bills to date, in December 2007, the 2007 Energy Act was passed and signed by President Bush. Among other things, this piece of legislation mandates that by 36 million gallons of ethanol must be available for consumption by 2022.<sup>128</sup> The sum effect of all these legislative actions has been an increase in corn production for these new markets.<sup>129,130</sup>

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126 Bies, Laura. "The Biofuels Explosion. Is Green Energy Good for Wildlife?" *Wildlife Society Bulletin*. Nov2006, Vol. 34 Issue 4 p. 1203-1205

127 "U.S. House of Representatives Passes Historic Farm Bill."

[http://agriculture.house.gov/list/press/agriculture\\_dem/pr\\_072707\\_FarmBillPassesHouse.html](http://agriculture.house.gov/list/press/agriculture_dem/pr_072707_FarmBillPassesHouse.html),

<http://agriculture.house.gov/inside/2007FarmBill.html>

128 "Fact Sheet: Energy Independence and Security Act of 2007." <http://www.whitehouse.gov/news/releases/2007/12/20071219-1.html>

129 Farrell et al. "Ethanol Can Contribute to Energy and Environmental Goals." *Science* 27 January 2006: Vol. 311. n. 5760., p. 506 – 508.

One other crucial element in ethanol policy is that its support from region to region has varied drastically. Michael Pollan writes that the U.S. Midwest is a “carpet of corn.”<sup>131</sup> If so, then it is easy to see why political support for ethanol mandates, such as the relevant provisions of the 2005 Energy Policy Act or 2007 Energy Independence and Security Act, is highest in the Corn Belt. However, ethanol is needed throughout the country and therefore every state is obligated to get in on the debate about how ethanol is produced and transported from coast to coast.

The place of ethanol policy on the formal agenda in the United States is largely a product of the interaction and priorities of the executive and legislative branches of government. While the Energy Policy Acts, Farm Bills, and Clean Air Act provisions are the domain of the Legislative branch, the U.S. President can influence ethanol policy in a distinct manner as well. “Security” is one of the frequent words or phrases a listener encounters in President George W. Bush’s speeches. With the emphasis on this word, in combination with “energy,” the President declared that America’s course should include ethanol, and particularly corn-derived ethanol.

Finally, besides the President, or Congress there are a number of exogenous influences that put ethanol on the American energy agenda. Notably, September 11<sup>th</sup> and the specter of terrorism have all have made ethanol an issue. Shocks to the smooth

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130 Yacobucci, B. 2006. Fuel Ethanol: Background and Public Policy Issues, Congressional Research Service, Library of Congress, CRS Report for Congress, October 19.

131 Pollan, Michael. *The Omnivore’s Dilemma: A Natural History of Four Meals*. Penguin Books. 2006.

supply of energy supplies can hamper the national economy and security. Farmers have used the issue as a marketing tool and billboards have cropped up in the Midwest, depicting the Iowa or Minnesota farmer as a safer, more reliable source for fuel than a Saudi (dressed in traditional Saudi garments) or an Arab in general. In contrast, the threat of international terrorism does not affect Brazil to nearly the same extent.<sup>132</sup>

### **3.5. Government Agencies, Ethanol Production, and Conservation**

The policy initiatives from the national governments in Brasília and Washington, D.C. mobilized assorted governmental bodies in their respective countries to implement ethanol policy. A multitude of Brazilian federal and state government agencies administer various facets of ethanol production. In the southeastern state of Paraná, there are four main agencies that oversee the environmental management of the agricultural system. The Secretaria da Agricultura e do Abastecimento do Paraná (SEAB) is an inspection service which maintains the health and integrity of agricultural production. It also has a veterinary arm.<sup>133</sup> The Secretaria de Estado do Meio Ambiente e Recursos Hídricos (SEMA) directs the environmental use of lands and natural resources. For example, it assures that the legally mandated “social” role of the land is carried out. SEMA also runs environmental education programs.<sup>134</sup> EMATER

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132 “The Craze for Maize.” *The Economist*. 12 May 2007. Vol. 383 Issue 8528, p29-30

133 “Secretaria.” <http://www.seab.pr.gov.br/modules/conteudo/conteudo.php?conteudo=1>

134 “SEMA.” <http://www.sema.pr.gov.br/>

is the Paranáense equivalent of a rural research and extension service. The Instituto Paranáense de Assistência Técnica e Extensão Rural (IAP) is the state environmental monitoring, enforcement, and licensing agency for Paraná.<sup>135</sup>

There are also agencies that manage the economic and rural development aspects of ethanol production. FAEP, translated as the Federation of Agriculture of the State of Paraná offers the coordination and advocacy of rural economic interests in Brazil. FAEP sides with the sugarcane growers and is their “voice” in government.<sup>136</sup> The Serviço Nacional de Aprendizagem Rural do Estado do Paraná (SENAR Paraná) offers rural workers vocational training. They also advocate for a safe environment for workers by, among other things, working to prevent the misuse of pesticides. Overall the goal of SENAR is social advancement for the workers. The Sindicato Rural, or Rural Worker Unions advocate for the rights of field laborers.

In the United States, the Department of Energy (DOE) has partnered with many ethanol companies to speed the adoption of renewable energy into the national portfolio. Additionally, other land management and natural resource management agencies in the United States administer conservation and land management programs for our nation’s agriculture. The Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA), both of the USDA, work on a number of agriculture related programs and tasks. One responsibility they share is the supervision of the

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<sup>135</sup> “IAP.” <http://www.iap.pr.gov.br/>

<sup>136</sup> “Institucional.” <http://www.faep.com.br/faep/institucional.asp>

Conservation Reserve Program (CRP) lands.

### **3.6. Non-State actors and their stake in ethanol**

#### **3.6.a. Non Governmental Organizations**

In Brazil, the same non-governmental organizations or NGOs that engage in knowledge-making and ethanol policy (MST, Paraná Biodiversity Project, SOS Mata Atlântica, ETC) have an interest to protect the natural heritage of the area and that often means cooperating with other stakeholders. Their influence was seen at the 1992 Rio Earth Summit, the UN Conference on Environment and Development because one of the outcomes of that event was to draw businesses and private companies into global environmental action.<sup>137</sup> Additionally, SOS Mata Atlântica, Paraná Biodiversity Project, and international organizations like Conservation International work to protect the Atlantic Forest, and often interact with land managers and users, including those Brazilians involved in sugarcane ethanol production.<sup>138</sup>

In the United States, two of the most active organizations concerned with the issue of wildlife and biodiversity protection in agricultural lands are the Izaak Walton League and Ducks Unlimited. Both lobby to preserve the amount of land under the Conservation Reserve Program status. They also have been pushing for more funding and efforts for other USDA conservation programs such as the Conservation Security

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<sup>137</sup> "UN Conference on Environment and Development. 1992" <http://www.un.org/geninfo/bp/enviro.html>

<sup>138</sup> "SOS Mata Atlântica." [www.sosmatatlantica.org.br/](http://www.sosmatatlantica.org.br/)

Program (CSP) or the Environmental Quality Incentives Program (EQIP), which are programs associated with the CRP. However, unlike the CRP where farmers retire land from crop production, CSP and EQIP target “working lands,” where farmers are paid to implement certain conservation practices on the land they would use for their agricultural activities.<sup>139</sup> Political pluralism in the United States allows complementary or contradictory legislative and administrative directions. For instance, the National Energy Policy Act and a number of the Farm Bills contain language which work in conjunction to allow these pieces of legislation to promote corn based ethanol. This situation has brought together farmers, ethanol advocates, and corn grower associations. However, it has put this coalition at odds with conservation groups. On the other hand, conservation provisions could just as easily be created if cellulosic ethanol takes flight, which would decrease interest in increased corn production. In this case, farmers would work more closely with conservationists and ethanol advocates, and then theoretically those who support corn production (fertilizer suppliers for corn and corn-specific machinery suppliers for instance), would then take a more adverse position.

### **3.6.b. The Private Sector**

Like any alternative fuel, ethanol has become more prominent with higher oil prices and uncertain and threatened supplies. In response, money has flowed into ethanol and other “clean-tech” companies and products. One of the major sources of

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<sup>139</sup> “Conservation Reserve Program.” <http://www.nrcs.usda.gov/programs/crp/> “Conservation Security Program.” <http://www.nrcs.usda.gov/programs/csp/> “Conservation Security Program.” <http://www.nrcs.usda.gov/programs/csp/> “Environmental Quality Incentives Program.” <http://www.nrcs.usda.gov/PROGRAMS/EQIP/>

financing comes from high profile individuals, such as Bill Gates or venture capitalist Vinod Khosla, who has personally invested in ethanol companies in the United States and Brazil. These enterprises include Pacific Ethanol of Fresno California, and Brazilian Renewable Energy Company (Brenco), which is actually based in Bermuda.<sup>140</sup> Brenco's multinational status reflects the growing international interdependence within the ethanol sector. Other corporations have realized this interdependence as well; especially those based in the ethanol heavyweights of Brazil and the United States. Archers Daniel Midland (ADM), based in Illinois for instance, has sought to enter Brazil's ethanol market either through an acquisition of a Brazilian ethanol company, like Cosan, or just by building from the gRoundup.<sup>141</sup> During the first part of 2007 these investors have put 2.6 billion into clean-tech start-ups, which include ethanol plants. In 2006, the amount totaled 1.8 billion.<sup>142</sup> The alternative energy sector typically requires higher capital costs and risks than many of these financiers are accustomed to assuming. As veterans of Silicon Valley high-tech industry they must adjust to the new markets. By virtue of their enormous financial resources, these wealthy investors can alter how other investors see the potential for new technologies and help attract legislative support to develop biofuels.

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140 Regalado, Antonio. "Big Name US Investors Back Brazilian Ethanol Start-Up." The Wall Street Journal. Section C; Column 1; Pg. 5. March 15 2007.

141 Etter, Lauren and Regalado, Antonio. "ADM plans entry into Sugar-Cane Ethanol in Brazil." The Wall Street Journal. Section A; Column 1; Pg. 3 June 22, 2007.

142 "Venture capitalists delve into risky alternative Energy field." Environment and Energy Publishing, LLC Greenwire. Monday, December 3, 2007.

Besides individual investors, Wall Street has devoted attention to the ethanol production sector in recent years. Over the course of 2007, worry about oversupply has caused investment to slow somewhat. The current, inefficient ethanol distribution system from the Midwest to customers throughout the country coupled with record corn harvests has created an ethanol glut this year.<sup>143</sup> As a result, analysts predict a consolidation in ethanol processing field. One CEO of an ethanol production company, Gordan Ommen, who runs the ethanol firm US BioEnergy, believes this is just part of the maturing process. He explains that, "It's going to be a little bit of a bumpy ride, I think, but in the long run we are bullish on renewable fuels and believe that they are going to be a part of our domestic fuel stream for a long time to come."<sup>144</sup> At the same time as conventional mill and distilleries evolve in the marketplace, both Brazil and the United States are preparing to capitalize on the so-called "ethanol 2.0" or cellulosic ethanol boom. Although it is currently feasible to derive ethanol from cellulose from a number of sources in the laboratory, it remains too expensive for commercial use. Nevertheless, private sources fund cellulosic technology fervently, hoping that this field would take off.

### **3.6 c Private Sector Lobbying**

These private interests also fund lobbying efforts, not only ensure favorable

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143 Krass, Clifford. "Ethanol's Boom Stalling as Glut Depresses Prices." The New York Times. September 30, 2007. Section 1; Column 0; Business/Financial Desk; Pg. 1

144 Karnowski, Steve. "As ethanol production grows, some experts forecast oversupply." The Associated Press. Wednesday June 13, 2007

ethanol policies, but also to guard against unfavorable laws and legislative actions. The fact that the executive and legislative branches determine ethanol policy in the United States means they are targets of lobbying efforts. The influence ethanol policy lobbyists, interest groups, and experts exert are not exclusively on behalf of private entities and businesses. There are many other stakeholders as well. The United States has a conflict-driven, pluralist model of policymaking, and the politics of ethanol is no different. In order to understand how ethanol policy works and is generated, one must grasp the underlying influences. Corn is a cornerstone of America's agricultural sector. It is no wonder that there are plenty of stakeholders who wish to influence legislators and the President in ethanol policymaking. As Michael Pollan points out in *The Omnivore's Dilemma*, corn dominates much of America's cultural, ecological, nutritional, and economic landscape. One way it achieved its supremacy is through the efforts of agricultural lobbying groups.

Archer Daniels Midland is the number one producer of ethanol in the United States<sup>145</sup>. ADM and Cargill, another agribusiness giant, are both are significant political contributors and have lobbied for favorable text in legislation such as the 2005 Energy Policy Act and the various Farm Bills. From a Food First/Institute for Food and Development Policy Report:

“The U.S. agricultural system has been designed to give American grain-trading giants like Archer Daniels Midland (ADM) and Cargill an edge in capturing the

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<sup>145</sup> Kelly, Rob. 16 June 2006. "Ethanol fuelling growth for ADM." [http://money.cnn.com/2006/06/16/markets/spotlight/spotlight\\_adm/index.htm](http://money.cnn.com/2006/06/16/markets/spotlight/spotlight_adm/index.htm)

domestic markets of developing countries. With help from institutions such as the World Trade Organization (WTO), Third World countries are forced to open their markets to American agricultural exports. Now with a farm bill designed to depress farm prices to below the cost of production, they can out-compete local farmers at the marketplace.”<sup>146</sup>

This analysis does not take into account the persistent higher commodity prices common today and a marketplace in which farmers everywhere are flourishing. Lobbying groups that represent the major agribusinesses push for friendly legislation, which often leads to subsidies. These subsidies then create a guaranteed and artificial market for among other things, corn. By becoming cost-competitive and winning the lobbying game, ethanol has gained a place on America’s energy policy agenda.

In Brazil, the ethanol industry has lobbied for an increase in the minimum blending percentage of ethanol in Brazilian automobiles. In 2003, the mandated blending percentage stood at 24 percent but the industry wants the President, who determines the ratio, to increase it to 26 percent.<sup>147</sup>

### **3.7 International Biofuel Cooperation**

Ethanol producing nations, including Brazil and the United States, have many

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146 Parker, Nick. Giving Away the Farm. New Report by Food First Institute for Food and Development Policy. 16 September 2002.  
<http://www.foodfirst.org/archive/media/press/2002/givingawayfarm.html>

147 Schmitz, Troy, G.; Seale, James G. Jr.; and Buzzanell, Peter. J. Brazil’s Domination of the World’s Sugar Market. Morrison School of Agribusiness and Resource Management. Faculty Working Paper Series. Arizona State University. Polytechnic Campus. (no date.)  
<http://agb.poly.asu.edu/workingpapers/0207.pdf>

common interests and face many of the same problems and issues. Climate change, driven by the accumulation of greenhouse gases, like carbon dioxide, is one major concern for the world at large. As a result, international discussion to address climate change has intensified, including how biofuels fit into the picture. Some types of ethanol production have a smaller carbon footprint than oil processing. An increased percentage of ethanol use for fuel may dampen greenhouse gas emissions and therefore curb climate change. Energy security is another major reason given for the promotion of ethanol. Both countries are blessed with large areas of agriculturally productive land and they can, and do, use this resource for biofuels production. These resources can, to some extent, limit a reliance on the oil wealth of other countries.<sup>148</sup>

Considering their similarities, it is no wonder that Brazil and the United States have been developing a new partnership on ethanol policy. President George W. Bush and Brazilian President Lula da Silva met with each other, in the spring of 2007 first in São Paulo, Brazil, then a few weeks later in the United States at Camp David as part of general diplomatic visits. Among their main topics of discussion was ethanol. Biofuels are surely an important item on the international agenda if two leaders of powerful nations reserve time to discuss them. A partnership between these two North and South American heavyweights would not be without precedent. In the 1960s, when the Cold War was at full force, the Kennedy Administration worked with Latin American

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148 "Brazil." Central Intelligence Agency. The World Fact Book. <https://www.cia.gov/library/publications/the-world-factbook/geos/br.html> 10 May 2007.

countries, including Brazil, on a development program, with some likening it to a Marshall Plan for Latin America. The Alliance for Progress program, a name chosen because it easily translated into Spanish and Portuguese, was a multi-tiered policy strategy to lessen inequality in Latin America, and more strategically, to reduce the risk that other countries in the region would follow Cuba into Communism. The lack of land reform was a failure of that program.<sup>149</sup>

The growing importance of biofuels has also reshaped other international relationships worldwide. Biofuels are reshuffling the strategic importance of countries that had not received as much attention in the past. For instance, President Lula da Silva wants to promote ethanol among the Global South and has visited India, South Africa, and China in 2006 in this effort.<sup>150</sup> Additionally, in August of 2007, President Lula da Silva visited Mexico and signed a Memorandum of Understanding for cooperation on technological development of oil and natural gas between those two countries. While there, the President expressed his wish to see Brazil and Mexico integrate their ethanol markets.<sup>151</sup> Over the last few years, the growing importance of its sugarcane-based ethanol sector has given Brazil newfound status as an emerging power. Brazil has

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149 A. F. Lowenthal, ed., *Exporting Democracy: The United States and Latin America*. Baltimore, MD: John Hopkins University Press. (1991)  
Halsall, Paul. "Modern History Sourcebook: President John F. Kennedy: On the Alliance for Progress, 1961." July 1998.

150 <http://www.grain.org/seedling/?id=488>

151 Lombera Martínez, Manuel and Jiménez, Sergio. "Integrarse al sur, pide Lula a México." *El Universal*. Tuesday August, 7, 2007.  
<http://www.eluniversal.com.mx/finanzas/59291.html>

capitalized most visibly on its ethanol resources, but other tropical, lush countries with their agricultural potential can, and are, asserting new powers in the international arena.

Despite reasons for cooperation, differences have prevented agricultural heavyweights like the European Union, Canada, or the United States and these new rising powers from working productively together. For instance, one sticking point between the United States and Brazil is subsidies in domestic agricultural policy. The Doha round of WTO trade talks failed over the debate about the level of support, if any, the United States should give to its farmers. Brazil argues there are negative repercussions for the global economy from these subsidies. An example from the food or fuel debate: If Brazil supplies more of America's energy from ethanol at the expense of food crops, the United States must respond by providing food that can be imported at a reasonable cost. Robert L. Thompson writes that if crops and lands are devoted to biofuels, then "food demand will quickly outstrip their [Brazil's] production capacity, and they will need to import a larger part of their food supply. However, this will happen only if they can export products in which they have a comparative advantage to earn the foreign exchange needed."<sup>152</sup> In order for this conversion to work, Brazil must have a comparative advantage,--an incentive,--to generate a fair foreign exchange balance. As long as the current support for American corn growers remains in place this may not be possible. As mentioned above, Mexico also faces a similar predicament. As a leading agricultural power, the policies that the United States adopts

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<sup>152</sup> Thompson, Robert L. "The US Farm Bill and Doha Negotiations: On Parallel Tracks or On a Collision Course?" IPC Issue Brief. September 2005.

may influence other countries to create similar programs.<sup>153</sup>

The larger agricultural burden might also stress formerly untouched Brazilian ecosystems. As more corn is grown in the United States, fewer soybeans are planted (there is a tradeoff between the two crops). To compensate for reduced American soybean production, Brazil ratchets up its own soybean acreage in addition to its larger sugarcane fields. The result, environmentalists fear, is increased ecosystem destruction.<sup>154</sup> Others insist the increased sugarcane and soybean acreage would come from pasture lands, not pristine native habitat.<sup>155</sup>

How environmental and rural development may change due to the tidal wave of ethanol enthusiasm and increased production of this liquid fuel is not well known.<sup>156</sup>

What policies would developing countries put in place to regulate or manage conservation differently from the United States? It is important to understand how farmers think the recent Brazilian-United States collaboration will bode for their local economy and environment. While ethanol and other biofuels are seen as “green” it is

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153 Sumner, Daniel A., “Implications for the US Farm Bill of 2002 for agricultural trade and trade negotiations.” *The Australian Journal of Agricultural and Resource Economics*. Mar2003, Vol. 47 Issue 1, p99-122

154 Valle, Sabrina. “Losing Forests to Fuel Cars. Ethanol Sugarcane Threatens Brazil’s Wooded Savannah.” *The Washington Post*. Tuesday, 31, July 2007. Page D01 Mattsson B., Cederberg C. & Blix L. 2000. Agricultural land use in life cycle assessment (LCA): case studies of three vegetable oil crops. *Journal of Cleaner Production* 8: 283-292

155 Budny, D. 2007. *The global dynamics of biofuels*. Brazil Institute, Woodrow Wilson International Center for Scholars, Special Report No 3

156 Pimentel, D. 2003. Ethanol Fuels: Energy Balance, Economics, and Environmental Impacts are Negative. *Natural Resources Research*, Vol. 12, No 2, June, 2003.

important to determine the true effects of this new policy on the actual landscape.

### **3.8 Conclusion**

The same basic reasons drive ethanol production and policy in the United States and Brazil. Yet there are also differences in the approaches to ethanol production. The countries have different ethanol legislation tracks: Brazil, under a military dictatorship worked intensely throughout the 1970s on the issue whereas the United States took up an aggressive ethanol policy only in the last half decade. The two countries also have different groups of organizations to promote either the interests of farmers and rural development or conservation. The United States and Brazil have the same goal-- ethanol production for energy--but different playing fields.

## **Chapter 4: Brazilian Sugarcane Agriculture for Ethanol**

### **4.1. Introduction**

In a recent issue of *Science* José Goldemberg, secretary of the environment for the Brazilian state of São Paulo, wrote that the Brazilian sugarcane ethanol production model is "...appropriate for replication in many countries."<sup>157</sup> Goldemberg bases his statement on studies that examine net energy balance and climate change implications for ethanol sugarcane production. However, there have been fewer investigations that survey on-site conservation practices. This chapter documents how individual Brazilian

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<sup>157</sup> Goldemberg, José. "Ethanol for a Sustainable Energy Future. *Science* 9 February 2007: Vol. 315. no. 5813, pp. 808 – 81

sugarcane farms respond to local conservation concerns such as biodiversity preservation, soil erosion, and land tenure considerations in the context of the global ethanol boom. Is Brazilian sugarcane production sustainable with these conservation management strategies in mind and could it be scaled up to a worldwide level? To address these questions and to understand conservation management strategies from the farmers' perspective, I interviewed twelve sugarcane farmers in Brazil who generally were the landowners.\*

## **4.2 Research and Sample Characteristics**

### **4.2.a. Location**

The interviews took place in Paraná, which is a state in Southern Brazil on the southern edge of the main sugarcane belt of Brazil. Sugarcane based ethanol has become more prominent in that rural economy. In fact, the land area devoted to sugarcane cultivation in Paraná increased 23% from 438,858 hectares in 2006-07 to 541,203 hectares in 2007-08.<sup>158</sup> In this study, I interviewed 12 farmers to see how the expansion of sugarcane agriculture influences their thoughts and decision-making process for conservation. All 12 farmers grew sugarcane for ethanol and they lived and worked in the northwest part of the state, located near two main municipalities: Diamante do Norte and Nova Londrina (Figure 4.1). These two jurisdictions reflect

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\* Please note that one farmer gave contradictory numerical data, so his information was not used for the quantitative work.

158 Rapoza, Kenneth. "Ethanol Has Brazil Planting More Sugarcane Than Ever" Dow Jones News Wire. 10/02/2007.  
<http://www.cattlenetwork.com/content.asp?contentid=164900>

the growing overall importance of sugarcane in Paraná. In fact, total production, the percent of farm income derived from sugarcane, and the area devoted to sugarcane have all increased in these municipalities over the past 5-6 years (Table 4.1). The average length of time of the farmers had been planting sugarcane is 16 years.

<b>Year</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
Tonnage (metric tons) Sugarcane	233,997	238,502	269,983	32,908	301,846	380,714
Percent of total farm income	57.8	64.8	42.9	49.7	59.5	76.4
Total sugarcane Area (% total land)	47.0	56.5	49.5	49.9	57.7	63.7
Total area devoted to sugarcane (Hectares)	3,323	3,288	3,715	4,522	4,759	5,292

**Table 4.3** The increased importance of sugarcane in the municipalities of Diamante do Norte and Nova Londrina, Paraná 2001-2006.

(From the *Censo Agropecuário* Instituto Brasileiro de Geografia e Estatística (IBGE) <http://www.sidra.ibge.gov.br/bda/tabela/listabl.asp?c=1612&z=t&o=11>) (For tonnage and total hectares devoted to sugarcane the values from Diamante do Norte and Nova Londrina were added together; for the percent of total farm income and percentage devoted to sugarcane, the values from the two municipalities were added

together.)

Interview requests met a mixed reception; some farmers seemed enthusiastic to discuss ethanol production, and took a generous chunk of time out of their day to carry on a conversation; other farmers had other tasks at hand offered me less time, yet they still answered the questions. Colleagues at the Paraná Biodiversity Project (PBP) selected the farmers for the interviews, so the sample selection was one of opportunity, without any premeditated, systemic approach.

In the research, three main sets of questions were addressed. (Appendix 1) The first set of questions dealt with land tenure, which includes the land size, basic land use activities, and the manner in which the property was acquired. Land size was sought to determine how the total number of hectares of each operation influences activities including conservation behavior. Are there many small farmers or a few larger ones? The area of the holdings is noteworthy since there currently is a land price spike in Brazil's ethanol belt resulting from this alternative energy's explosive growth.<sup>159</sup> The size and dynamic of land ownership can explain where land patterns are moving and whether or not corporate concentration of Brazilian agriculture, is indeed taking place. After the numerical-based land questions, descriptive land use questions probed what crops were grown and why.

The second area of inquiry was the size and conditions of the labor pool. The number of workers each farm employs sheds light on how well the farm runs on manual

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<sup>159</sup> Rumsey, John. "Brazil: Prices in the Clouds Drive Ethanol Growth Organic." Euromoney June 2007.

labor. The third type of data was what sorts of farm equipment were used. Finally, the farmers' narratives were used to explain and support objective data results.

The qualitative data also provides a summary of the farmers' impressions in the changing field of Brazilian sugarcane production, and suggests policies that are effective at addressing their concerns.

#### **4.2.b. Farm Size**

The average total land area for the ethanol sugarcane farms surveyed was 546 hectares. However as Table 4.1 illustrates, there is a large discrepancy in the size of the land holdings between the two largest farms and the smallest nine. After removing the largest two farms, which account for 80% of the total land investigated (all the ethanol sugarcane farm land totaled about 6,010 hectares), leaves the sample of nine smaller farms that are more equally balanced in land size.

<b>Farm Size Ranking</b>	<b>Land Size (in hectares)</b>
1	3870
2	968
3	399
4	218
5	169
6	107
7	85
8	73
9	58
10	56
11	7
Total	6010

**Table 4.2 Comparison land area size of ethanol sugarcane farms** surveyed from the municipalities of Diamante do Norte and Nova Londrina, Paraná July 7-12, 2007

Brazil has a history of land consolidation and retention through generations in a small number of families. Accordingly I sought knowledge of how the land was acquired and how long held and attempted to relate that attribute to conservation management.<sup>160</sup> The owner of the largest slice of land lives in São Paulo, and we (the translator and I) instead talked to the manager, so we could not get any information about the way the land was acquired. The owner for the second largest farm was also

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<sup>160</sup> Metcalf, Alida. *Family and Frontier in Colonial Brazil*. Santana de Parnaíba. 1580-1822. Austin: University of Texas Press. 2005.

absent, but the manager of the property said her boss bought a piece of land of about 100 hectares, and the other parts from some neighbors. The history and socioeconomic profile of these landholders, while perhaps telling in the fact that they were absent, remains tantalizingly unanswered. However, the three farmers that did say that they got their start in farming from inherited land, also all said that they built upon the initial parcel piece by piece through the acquisition of neighbors' property. The high variability and small sample of the land sizes of these landowners-by-inheritance, which are 399, 218, and 56 hectares, precludes any demonstration of connections between the means of land acquisition and land management. Yet, overall, the land tenure data agree with the notion that land distribution is not very equitable and has been controlled by a small handful of wealthy owners in Brazil. In fact, when the last census was taken, in the late 1990's, 1% of owners controlled 45% of farmland.<sup>161</sup>

#### **4.2.c. Where does the crop go?**

In this part of Brazil, the sugarcane product can either be used for sugar or ethanol, depending on the mill.<sup>162</sup> One farmer disapproved of his neighbors selling the sugarcane crop to buyers who were not going to convert into ethanol because he thought ethanol was strategically important for that area.

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161 "This Land is AntiCapitalist Land." *The Economist*. 4/28/2007, Vol. 383 Issue 8526, p41-42

162 Rusk, Kevin. "The Social Costs of Ethanol Production in Brazil: 1878-1987." *Economic Development and Cultural Change*. April. 95.Vol. 43 Issue 3, p627

### **4.3 Environmental Aspects**

#### **4.3.a. Conservation activity**

. Brazil has a forest-reservation law (as part of the Forestry Code) that mandates a certain percentage of land to be dedicated for natural cover. In the Amazonian area of the country, 80% of any rural property must be maintained as forest, but in Paraná the requirement is 20% and also includes “Areas of Permanent Protection” such as 30 meter buffer zones around watersheds.<sup>163</sup> These laws were implemented to preserve whatever forest and natural areas remain in many of the biodiversity-rich ecosystems of Brazil: the savannah-like Cerrado, the Amazon, and in the case of this area, the Atlantic and Semi-deciduous Forests. However, Brazilian agricultural experts conclude that in Paraná boundary-to-boundary cropping has occurred.<sup>164</sup> In general, enforcement of conservation activities is a concern for Brazilian agriculture.<sup>165</sup> Even though Paraná and Southern Brazil have reputations as exemplars of conservation agriculture, even here more needs to be done to uphold land conservation laws.<sup>166</sup> The failure for buffer zones to become widespread preceded the

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163 “Código Florestal Brasileiro” [http://www.controleambiental.com.br/codigo\\_florestal.htm](http://www.controleambiental.com.br/codigo_florestal.htm) Smeets, Edward., Junginger, Martin, Faaiji, André, Walter, Arnaldo, and Dolzan, Paulo. “Sustainability of Brazilian bio-ethanol.” Copernicus Institute. August 2006. <http://www.bioenergytrade.org/downloads/sustainabilityofbrazilianbioethanol.pdf>

164 Interview with Richardson de Souza. Secretaria da Agricultura e do Abastecimento do Paraná SEAB. June 22, 2007.

165 Personal Communication. Maximiano, Gracie. Friday September 21, 2007.

renewable energy revolution, but must be addressed in general before sugarcane agriculture in Paraná would be perfectly ready for replication elsewhere.

How much of the total property farmers devote to crop production is one rough measure of how well farmers were managing their land holistically, which then would allow leaving aside areas for riparian buffers and forest cover. Unfortunately, for this pilot study only total cropland area was measured, more precise and nuanced data was not collected.

This said, of the farms investigated in Paraná, the average percent of productive land relative to total land among all ethanol sugarcane producers is 86%, which this paper terms the farm's productivity ratio. This percentage represents what each interviewed farmer said was the land they have in agricultural production versus the total landholding. If 86% of the land is in use for crops then a maximum of 17% is in a state of conservation, which falls just short of what the Brazilian law mandates. Figure 4.2 illustrates how land size relates to the percentage of land in production.

One caveat: even though the 169 hectare farm seemed to have maximized its cropland area, the interviewed farmer gave answers on lands legally open to use, i.e. outside the forest reservation, so its productivity ratio misrepresents its compliance status. (The 86 % figure takes this into account.) Otherwise, clearly the largest farm left more land unutilized, perhaps because the absentee owner was not operating as close to subsistence level as the small, poorer land owners. More data is needed on the matter is

needed to validate this supposition, however.

The average productivity ratio of the smallest nine farms was 0.9, whereas for the two large ones it was 0.82. This data might mean there is an opportunity for more conservation practices to be taken in the larger farms, and regulators may need to direct their attention to the smaller ones. But if smaller operators cannot afford to idle land then meeting the conservation laws would be difficult. One general recommendation, though, is to do more in-depth work into this area, particularly when determining what lands not in production are expressly met and fulfill the requirements and those unutilized lands which do not, such as merely idled parcels.

#### **4.3.b. Crop diversity**

Growing sugarcane for ethanol production has received much attention and increased profits, but what other crops do these farmers plant and cultivate? What is the relationship between those crops and sugarcane? Brazil is an agricultural powerhouse, and many crops and activities have pushed its economy forward throughout history.<sup>167</sup> Livestock, manioc, and coffee are a few of these agricultural products. Five out of the twelve farmers grew coffee in addition to sugarcane, and another four had grown coffee until they felt that it became uneconomical to do so. All five said that coffee is a traditional crop, but four of the current coffee growers said that they will stop growing it, and one cited a lack of rain for a reason. Five also said they grew manioc. Eight out of the 12 said that they had livestock in addition to sugarcane;

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<sup>167</sup> Metcalf, Alida. *Family and Frontier in Colonial Brazil*. Santana de Parnaíba. 1580-1822. Austin: University of Texas Press. 2005.

one of these specified that the animals were for both dairy and beef. A ninth farmer specified that he had dairy cows. Another farmer had orange trees as well. All together, while sugarcane may currently be a high profile crop, these farmers invest in and live through other agricultural activities as well.

In the course of the interviews, I asked these ethanol producers why they grew sugarcane, and the prevalence of sugarcane monocrops in the region came up. When they explained why they elected to grow a variety of crops, the ethanol sugarcane growers expressed concern about the dangers and downside of a sugarcane monocrops, however the purely sugarcane stands were still extensive. (Sugarcane fields are most expansive in the state of São Paulo.) The large amount of sugarcane also has an effect on birds that might call these fields home. Prior to its harvest, sugarcane requires a burning, which upsets the habitat of bird species that nest in that “ecosystem” otherwise. These animals do not appreciably damage the crops.<sup>168</sup> They believed that diversity, both of ecology and crops, was good for the bottom line.

While the Brazilian law requires at least 20% forest cover, there has been is some flexibility with this law, such as the transferable developments rights programs, which Dr. Kenneth Chomitz from the World Bank has explored in depth.<sup>\*169</sup> This

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168 Personal Communication. Fonet, Lysias. February 7, 2008.

\* Paraná has had a TDR program similar to the one in Minas Gerais, but it has been having trouble getting off the ground.

169 Chomitz, K.M. et al. (2004) ‘Creating Markets for Habitat Conservation When Habitats Are Heterogeneous’, World Bank Policy Research Working Paper 3429, October 2004. Personal Communication. Chomitz, Kenneth 1/30/2008.

program has been most successful in the state of Minas Gerais, and a similar program has been inconsistently applied in Paraná. With a goal to take advantage of the law, one agricultural-economics oriented agency, FAEP, actually pushed for coffee to be considered as a long lived “forest” type to meet Brazilian regulations. Although using coffee for these purposes would allow individual farmers to use the plant for meet their legal and bottom line needs, FAEP’s attempts failed.<sup>170</sup> One farmer echoed this reasoning, stating, “Coffee is also considered replenishment of forest and is almost completely free of erosion due to its implementation.

#### **4.3.c. Soil Conservation**

Although the Center-South sugarcane region of Brazil, which includes Paraná is overall flatter than its Northeastern counterpart, therefore having fewer erosion problems, farmers still take measures to maintain this natural resource. For instance, one ethanol sugarcane farmer said he uses a new technique which consists in performing “curvas gradientes” and “curvas de nível,” which is basically contouring (in areas where each 50 meters of land has a decline of 10 centimeters). He wants the sugarcane growers of that region to use this terracing procedure because that region’s soil sucks too much water). Most farmers did not talk at length about soil conservation. Ten of the 12 ethanol sugarcane farmers said they used composting for soil maintenance and pest control. Two specified using chemical composting and one singled out using granulated composting. When farmers spoke of composting they

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<sup>170</sup> Personal Communication. Jeffrey Kleine Albers and Silvio Krinski. Personal Communication 6/21/2007. Curitiba, Brazil.

meant mixing plant residues into the soil. However, they realized that they should not disturb the soil structure excessively. To this end, one farmer said he added composting mechanically in a way that avoided soil compression. That farmer also said mechanical “rooting” was used to extirpate unwanted grasses. Another farmer said they compost residues into the soil, but they use “soil correction” afterward. In the conversations with the farmers, no differences emerged between small and large scale farms on soil conservation management.

#### **4.4 Social Aspects**

##### **4.4.a. Labor Issues**

Sugarcane fields are very labor intensive places, and there has been both international and domestic criticism of the labor practices of the sugarcane industry. All the interviewed ethanol sugarcane farmers used mechanized planting and manual cutting, with one attempting to mechanize the cutting process. Another farmer said that mechanized cutting is going to improve the soil usage; he also says the workers are doing their job badly and blames the syndicate (of workers) in some part. Another farmer stated Brazilian labor law is “too hard.” He hopes that growing a crop like sugarcane will allow him to use a labor force from the sugarcane cooperative, and not hire employees on his own and deal with the bureaucracy and employer expenses.

What kinds of labor forces do these farms employ? The number of workers at each farm is given in the table below. It is clear that the numbers of workers are estimates, given the round numbers reported. The average number of workers for the sugarcane farms was 577, but this number is not very meaningful since the size and

nature of the farms varied so much. The Productive Hectare/Worker ratio— productive land size was divided by the number of workers – describes how much land each worker theoretically manages. It is a useful measure because it reveals something about farm operations. We assume most workers would concentrate on lands in production. The average ratio is 0.62 hectares/worker, calculated by dividing the total area in production by the total number of workers.

<b>Land in Production</b>	<b>Number of Workers</b>	<b>Amount of productive land/worker</b>
7	100 800	0.06
48	800	.06
48	100	.48
58	300	0.19
85	800	0.11
89	400	0.22
169	800	0.21
174	1050	0.17
334	1000	0.21
484	500	0.97
2,468	500	4.940.97

**Table 4.3.** Productive Hectare/Worker ratio

The data suggests as the size of the farm increases, fewer workers are needed to tend to the land. However, because the two largest farms were essentially in a class of their own it is better to compare the “big two” to the “little nine.” Notice also that the largest farm with nearly two and half thousand hectares, has a land/worker ratio of

about 5 compared to the next largest farm where the ratio was one hectare per worker, and these ratios were considerably larger than those for the yet smaller farms. To put it another way, the average hectare/worker ratio for the two largest farms is about 2, and the rest .22. A worker on the two biggest farms would cover ten times as much area as one on a smaller operation. Although it might be expected that more mechanization accounts for this trend, the two largest farms claimed to have their harvests done manually, the same as on the small farms. There may be some sort of hidden mechanization going on, hidden to the investigator of this study, and perhaps the farm practices and equipment question should have been studied further. Economics of scale that make larger farms more efficient may explain the discrepancy between farms with smaller areas of productive land that support large labor pools when compared with farms with sizeable areas of productive land yet require labor pools that are relatively smaller to the area in production. All this data points to the need to further explore worker experiences along the “big farm-little farm” axis.

#### **4.4.b. MST and Land Occupation**

The Landless Workers Movement (in Portuguese it is known as the Movimento dos Trabalhadores Rurais Sem Terra) is a major presence in rural Brazil. The MST, as it is known, seeks to remedy the highly unequal land distribution and engages in social and labor causes generally.<sup>171</sup> One land manager for the second largest farm stated that the MST invaded her lands and occupied them for 8 months. She says they are very

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171 Brazil's Landless Workers Movement. <http://www.mstbrazil.org/?q=about>

organized because, whenever MST is going to invade some land, they are able to recruit a sizeable group to do so. She says the land owners/producers don't join together when faced with problems that might be solved cooperatively (they think "this is not my problem because it's not my land to be invaded"). They don't have that same sort of solidarity. She made a point that MST killed their cows, even those with baby calves, which then died because they were depending on their mothers' milk to survive. Even though they killed the animals, the farm's owner allowed them to have milk for free for their children.

Besides land tenure, the MST and ethanol producers have a number of other points of contention. One is the use of Roundup, and other herbicides. Farmers need to use Roundup for weed control. However, some in MST feel Roundup harms the workers and alters their physiology and harms the ecosystem.<sup>172</sup> For instance, grass often withers and turns brown after application of this chemical.<sup>173</sup> Many of the farmers themselves say Roundup dries out the soil noticeably. There also have been some experiments with Agent Orange and other toxic chemicals during the beginning of the Green Revolution.<sup>174,175</sup>

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172 Personal Communication. Eduardo Bácaro. Direto de Turismo. July 12, 2007. Diamante do Norte, Brazil.

173 Personal Communication. MST representative. July 2, 2007. Curitiba, Brazil.

174 Ibid.

175 Personal Communication. EMATER representative. July 12, 2007. Diamante do Norte, Brazil.

#### **4.4.c. Economics**

How do the sugarcane farmers consider the economics and financial situation of their business? Ethanol generally is good for these farmers financially, but there was some recent price volatility, with sugar up one year down the next, and up again. There has been a great deal of investment in the sector, but one farmer said the sugarcane cutters have very small wealth. That same farmer opposes purely sugar refineries because he thinks that in that strategic area, the focus must be on ethanol. Another farmer said the region's economy was better with sugarcane production (although the prices were going down during 2007). He thinks ethanol should be 80% of all (transportation) fuel used in the world.

Exportation was also on the minds of these farmers. Many of the farmers stated that they wanted to have their crops and ethanol sent abroad, but there has not been adequate infrastructure to facilitate this activity. Increased international investment can be expected to continue as the ethanol flows to the port of Paranguá.

On the downside, inflation may be a side effect of increased ethanol production, but no farmer directly mentioned increased prices because of the ethanol boom. In particular, there has been a historical parallel to what's occurring now. There was a long, 30 year agricultural boom in Paraná from the 1940's until the 1980's, with land prices rising concurrently.<sup>176</sup> In response many Paranáense farmers moved to Paraguay

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176 Alston, Lee, J., Libecap, Gary, D., Schneider, Robert. "The Determinants and Impact of Property Rights: Land Titles on the Brazilian Frontier."

with its lower costs.<sup>177</sup> Although land prices have increased recently as well, none of the farmers mentioned the land spike and land title changes.

The interviewed farmers did allude to inflation, however, by describing rising machinery costs and the need for the region to focus on ethanol. One farmer said the economy is better but the increasing number of industries might become a bad thing for them (big industries buying the small ones). This was one point in the interviews when potential industry consolidation and corporate concentration was mentioned directly. Some had already given up these and other types of agricultural products.

#### **4.5. Looking to the Future**

One of the major issues that all ethanol sugarcane farmers cited was a lack of an infrastructure to move ethanol to foreign markets. In fact, in the conversations with the farmers, the desire for increased ethanol exports was ubiquitous. The reason may be that prices for exported ethanol are about 20% greater than the domestic contracts, which act as an incentive for overseas sales.<sup>178</sup>

While for the time being Brazilian ethanol producers have been relying on domestic consumption, that situation is changing. The Brazilian oil company Petrobras recently announced that it will open an “Ethanol Export” Corridor from the main ethanol producing states of Paraná and São Paulo to the Atlantic Shore for export.

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177 Nickison, Andrew. “Brazilian Colonization of the Eastern Border Region of Paraguay.” *Journal of Latin American Studies*. 1981.

178 Schneyer, Josh. “API Weekly Summary.” *Platt’s Oilgram News*. Pg. 1 Vol. 84 No. 109 June 8, 2006.

When the new ethanol facilities open at the port of Paranguá in 2009, farmers will not need to rely so heavily on Brazil's internal market.

Despite this optimism, some analysts see barriers to expanded Brazil ethanol exports. Alastair Stewart wrote in the *Wall Street Journal* that Brazil has had trouble expanding its agricultural exports. Stewart writes, "The importance of farm exports to Brazil, however, is increasing pressure on its negotiators to consider greater concessions on issues that the U.S. and European Union want..."<sup>179</sup> These transformation of the international biofuel trade may allow for heightened environmental and conservation goals.

Increased ethanol exportation may result in greater demands for enhanced social or environmental criteria.<sup>180</sup> Europe may work with Brazil on a two way trade-off. They might be willing to sacrifice support for domestic biofuels in favor of those from Brazil, if they are green. European Trade Commissioner Peter Mandelson stated "Europe should be open to accepting that we will import a large part of our biofuel resources," and "We cannot contemplate, in my view, favouring EU production of biofuels with a weak carbon performance if we can import cheaper, cleaner biofuels." EU Energy Commissioner Andris Piebalgs agreed with Mendelson: "For me, there is no need for

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179 Stewart, Alastair. "Barriers Squeeze Brazil's Export Growth." *Wall Street Journal*. (Eastern edition. New York, N.Y.: Feb 8, 2005. pg. A.17

180 "Sustainability of Brazilian bio-ethanol." <http://www.bioenergytrade.org/downloads/sustainabilityofbrazilianbioethanol.pdf> Lagercrantz, Jakob. "Ethanol Production from Sugarcane in Brazil. Review of Potential for Social and Environmental Labelling of ethanol production from sugarcane." *Gröna Bilister*. March 2006. [http://www.gronabilister.se/file.php?REF=39461a19e9eddfb385ea76b26521ea48&art=376&FILE\\_ID=20060511084611.pdf](http://www.gronabilister.se/file.php?REF=39461a19e9eddfb385ea76b26521ea48&art=376&FILE_ID=20060511084611.pdf)

protective tariffs as long as the biofuels are sustainable." However, The European Union has recently announced that it would ban certain biofuels if they do not meet certain environmental and social criteria.<sup>181</sup> In response, Unica, a trade group for the Brazilian sugarcane industry, has become willing to work with the European Union on making biofuels more sustainable. This approach includes both certification and environmental safeguards. Marcos Jank, the President of Unica, said that " we are ready to work with Europe to see the best way to certify biofuels" in addition to the fact that "we are ready to accept restrictions, for example, on the expansion (cane planting) on sensitive areas..."<sup>182</sup> Perhaps one day, an international agreement between the EU and the leadership of Unica will influence the agricultural practices of Paranáense sugarcane farmers. If increased international cooperation occurs, groups such as MST still might be concerned that this outside investment will bring corporate concentration and "delocalize" the benefits of biofuel production and reinforce the existing North-South hegemonic order.<sup>183</sup>

Understanding that these interviews were part of a larger U.S.-Brazil study, a few of the farmers also commented upon the ethanol diplomacy and policy between the

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181 Kanter, James. "Europe may ban imports of some Biofuel Crops." New York Times. January 15, 2008.

[http://www.nytimes.com/2008/01/15/business/worldbusiness/15biofuel.html?pagewanted=1&\\_r=1&sq=ethanol,%20european%20union&st=nyt&scp=1](http://www.nytimes.com/2008/01/15/business/worldbusiness/15biofuel.html?pagewanted=1&_r=1&sq=ethanol,%20european%20union&st=nyt&scp=1)

182 Wiessner, Christian. Editor. "Brazil Challenges EU ethanol logic." Reuters. January 15, 2008.

<http://www.reuters.com/article/GlobalAgricultureandBiofuels08/idUSN1554138420080115?pageNumber=2&virtualBrandChannel=0&sp=true>

183 Personal Communication. MST representative. July 2, 2007. Curitiba, Brazil.

two nations. They were aware that Brazil and the United States are large, regional powers and their agricultural policies and politics influence the other's behavior and marketplace. Of the two farmers who discussed the topic, they expressed dismay that the United States has employed tariffs and domestic subsidies for corn ethanol because they believed those policies prevent their entry into a large market for sugarcane ethanol. One farmer even said ethanol from corn is “anti-economic.”

#### **4.6. A Conservation Baseline?**

Although sugarcane farms that sell their crops for ethanol production are the main focus of this investigation, growers from smaller, more ecologically oriented farms were also visited to offer a view of perhaps a more sustainable alternatives sugarcane production system. These farmers produce sugarcane for consumable items are labeled as “non-ethanol sugarcane” producers. On a subsequent trip to the field, I interviewed 8 non-ethanol sugarcane farms located in the Southwest Paraná, near two main municipalities: Capitão Leônidas Marques and Guaraniaçu (Figure 1).

The Paraná Biodiversity Project gave financial assistance to the non-ethanol sugarcane farms to operate with biodiversity as a goal. Constructing and maintaining “biodiversity corridors,” is one of the main missions of Paraná Biodiversity Project.<sup>184</sup> Both Capitão Leônidas Marques and Guaraniaçu are located near two of PBP's Biodiversity corridors. With the ethanol sugarcane farmers missing the mark to set

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184 “Parana Biodiversity Project.” GEF. From World Bank website

<http://web.worldbank.org/external/projects/main?pagePK=64312881&piPK=64302848&theSitePK=40941&Projectid=P070552>

aside the necessary conservation land and its attendant social issues, how would smaller farms that grow sugarcane compare? First, some background, these growers used their sugarcane crop for cachaça, a distilled spirit, and melado, like honey, and brown sugar production. These farms/units were much more vertically integrated than the ethanol sugarcane farmers. These farms were more recent than the ethanol sugarcane farms, being 5-10 rather than 15-20 years old. The average farm size is much smaller- 13.9 hectares. Concerning land in production, the Average Percent of productive land/total land was 62%, which is dramatically lower than the sugarcane-for-ethanol farms. This last piece of data indicates approximately 38% of the land is not being used currently, and might be dedicated for conservation and meets Brazil's legal requirement.

On labor characteristics, these farms were also very different than the ones in the northwest. The average number of workers for this type of farm is about eight- much smaller than the farm labor forces to the north. The Productive Hectare/ Workers ratio is:  $1.1 \text{ hectares/worker} (13.9 \text{ hectares multiplied by } .63)/8 \text{ average workers}$ . There are fewer workers per hectare for these farms than those that grew sugarcane for ethanol. Only the one very large ethanol farm made do with fewer workers per hectare than these niche farms. The nine smallest ethanol farms averaged between four or five workers per hectare (but with a considerable range) compared to one worker on the niche farms. So the non-ethanol farms are more efficient. These niche farms are not more mechanized and they grow sugar cane just as the ethanol farms do. Why are they more efficient? The niche farms are much smaller, and perhaps the difference lies in how they deal with secondary crops. But the answer requires a more comprehensive study.

The World Bank financed organization, the Paraná Biodiversity Project, assisted these growers with technical knowledge and money. All of these farmers noticed an increase in wildlife over the last 5-10 years and also acknowledged that reduced hunting may play a role. One person said that previously unseen native animals have been showing up from about 4 or 5 years ago.

As people became conscious of the issue, the forest has grown up and the animals came back. With the Brazilian federal disarmament campaign in 2004 (launched from a law in 2003) people gave their guns away (exchanged for money) and now they don't even want to hunt anymore (The law was promulgated to reduce violence, increased biodiversity is a side effect).

All farmers indicated strong economic incentives to produce their brown sugar and cachaça products. One farmer was instructed that cachaça is more profitable for small- and medium-sized producers (like him) and ethanol production requires more land and industrial structure. All the farmers used both manual planting and cutting.

#### **4.7. Chapter Summary**

In the ethanol sugarcane farms analyzed, there was a major difference in the proportion of land in production between the two largest farms (which in fact dwarfed the sample) and the smaller nine. The large farms allow a significantly more land to be unused (in absolute terms), and some farms perhaps meet the 20% mandate from the Forestry Code whereas the small one failed to set aside the required proportion of conserved land. Taken together, it can be said that there has been at least some

noncompliance overall among these twelve farms, with seven of the eleven analyzable farms over 80%. In addition, the larger farms have fewer workers per land unit, although it is not clear that they are more mechanized. In the introduction, José Goldemberg described why Brazilian sugarcane ethanol production model should go global. If this occurs, other countries may want to take into account absolute land size of holdings, because they affect conservation management strategies. However this would bring in the controversial social issues like the nature of ownership, as one sees with the MST.

Back in Brazil, however, the evolution of the worldwide energy market may allow for further promotion of sound conservation strategies because of green mandates from the European Union. In the next five to ten years, Brazil ethanol will be exported not only to Europe, but also to India and China in larger volumes. However, the fact the United States has been passing energy legislation that maintains the status quo and bolsters its own internal corn ethanol producers, it is unlikely that Brazilian ethanol will appear in the US in great quantities in the near future, and accordingly, if there were any changes to the Brazilian ethanol production model, the United States would be on the sidelines.

Why is this important? There was near unanimity among the farmers for more exportation, but at the same time, there was already resistance to the pressures brought upon by the international community for social and environmental reforms. The fact that not many farms I encountered met the 20% legal forest reservation and there was pushback on the social conditions of workers question illuminates a gap between the

way international analysts would like to improve social and environmental conditions and the how these farmers react to market demands. As Brazil continues to grow as an economic power and ethanol continues to emerge as a major transportation fuel, more international scrutiny, arising through media reports and through mechanisms embedded in lasting institutional trade agreements, might well transform Brazilian ethanol into an agricultural product that is more sustainable and socially just.

## **Chapter 5: Iowa Corn Agriculture for Ethanol**

### **5.1. Introduction**

In the last few years, the United States has sought out alternative and renewable energy sources in response to rising oil prices, continuing reliance on imported fuel, and climate change concerns. To spur a transition to new renewable sources of energy, lawmakers at the federal level have pushed through a number of pieces of legislation that mandate minimum goals for domestic ethanol production and use. The 2005 Energy Bill, the 2007 Farm Bill, and the 2007 Energy Independence and Security Act all have provisions to increase the use of ethanol. This last law has the most aggressive ethanol mandate and requires the country to build 36 billion gallons of ethanol into its transportation fuel mix by 2022. While the Energy and Security Act (EISA) puts the spotlight on cellulosic and so called next generation biofuels, with a requirement that 21 out of the 36 billion gallons must come from non-cornstarch sources, that leaves 15

billion left for corn ethanol to pick up the slack.<sup>185,186</sup> An interim Food Agricultural Policy Research Institute report states that one effect of EISA would be increased corn production.<sup>187</sup> Although technological developments are improving yields and also driving down production costs of cellulosic ethanol, its full potential has yet to be realized, and some prominent skeptics doubt that it will happen in the near future. For instance, Collin Peterson, chairman of the House Agriculture Committee believes cellulosic ethanol is a decade off.<sup>188</sup> In any scenario for cellulosic technology, corn ethanol will remain important for the intermediate term. Generally, the increase in ethanol mandates has meant higher crop commodity prices for farmers who grow corn.

Considering these pressures for change in the land use in the Corn Belt of the United States, I interviewed a group of corn growers to elicit their opinions about the effects of the ethanol boom on their farming practices, environmental management practices and evaluations of future trends.

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185 Pitt, David. "US energy bill Mandate for corn-free ethanol presents huge opportunity, challenge for industry." The Associated Press. December, 18, 2007. <http://www.iht.com/articles/ap/2007/12/18/business/NA-FIN-US-Ethanol-Beyond-Corn.php?page=2>

186 The Energy Independence and Security Act of 2007: A summary of Major Provisions. CRS Report for Congress" [http://assets.opencrs.com/rpts/RL34294\\_20071221.pdf](http://assets.opencrs.com/rpts/RL34294_20071221.pdf) Although EISA requires increases in ethanol production solely from advanced sources after 2016, the EPA can waive that right, if market conditions warrant it.

187 "The Energy Independence and Security Act of 2007: Preliminary Evaluation of Selected Provisions." [http://www.fapri.missouri.edu/outreach/publications/2008/FAPRI\\_MU\\_Report\\_01\\_08.pdf](http://www.fapri.missouri.edu/outreach/publications/2008/FAPRI_MU_Report_01_08.pdf)

188 Doggett, Tom. "Lawmaker says cellulosic ethanol a decade away. Reuters. January 15, 2008. <http://www.reuters.com/article/Technology08/idUSN1554889720080115>

## **5.2 Research Site and Sample Characteristics**

### **5.2.a. Location**

All of these interviews took place in Western Iowa, over four counties: Cass (Southwest Iowa), Pocahontas, Clay, and Palo Alto (in the Northwest) (Figure 5.1). These areas are on the edge of the “Prairie Pothole” region of the Midwestern United States, a noted biome for migratory birds in the Central Flyway.<sup>189</sup> I interviewed a total of 11 farmers from November 12<sup>th</sup> to the 16<sup>th</sup>, 2007. I worked with members of Iowa State University and the Iowa State University Extension Service to arrange these interviews. The Cass county interviews were organized as a result of proximity to one of the Iowa State staff member’s home. The Palo Alto, Clay, and Pocahontas county farmers were selected based on their location in the heart of the Southern Prairie Pothole Region (Figure 5.2). In addition, the corn acreage (or hectares) in this Iowa study area has increased by 12 % over the period 2001-2006 (Corn Area Increases in Four Iowa Counties, Table 5.1).

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189 “Iowa Soybean Rust Website.”<http://www.npwrc.usgs.gov/news/press/ducksymp.htm>

Year	Corn Area Planted (Cass, Pocahontas, Palo Alto, and Clay counties ( hectares)
2001	58620
2002	60600
2003	60650
2004	62980
2005	63790
2006	63530

Yearly Increase In Planted Corn Area (National Agricultural Statistical Survey)

([http://www.nass.usda.gov/Statistics\\_by\\_State/Iowa/index.asp#.html](http://www.nass.usda.gov/Statistics_by_State/Iowa/index.asp#.html))

**Table 5.1** Corn Area Increases for four Iowa Counties

I encountered a wide range of responses and levels of enthusiasm for managing environmental and farming matters. A few were interested in the whole idea and details of my thesis in addition to telling me at length about their operations. Others flatly rejected being interviewed. Nine out of the eleven interviews were done in person, and two were done over the phone (those farmers operated in Pocahontas County). I used an interview questionnaire for Iowa corn growers similar to the one that I used for Brazilian sugarcane farmers. (Appendix 2)

### **5.2.b. Farm Size**

The farms of interviewees in Iowa ranged in size from 142 to over a thousand hectares. The average operated farm size was 502 hectares. However, the average

farm size for my set of farmers was significantly larger than the total average farm size for the four counties, which is 182 hectares.<sup>190</sup> The eleven farms are a very small fraction of Iowa corn growers, but they do constitute almost 9% of the corn area in the counties studied.

Farm	Land Size (hectares)
1	1053
2	717
3	689
4	608
5	500
6	425
7	405
8	395
9	348
10	263
11	142
Total	5544

**Table 5.2** Comparison of land sizes of corn producing farms from Cass, Pocahontas, Palo Alto, and Clay Counties Iowa November 12-16, 2007

### **5.2.c. Land ownership**

Almost all the Iowa farmers I interviewed said they operated both owned and

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<sup>190</sup> Iowa State and County Profiles. Census of Agriculture 2002. National Agricultural Statistical Service. United States Department of Agriculture. <http://www.nass.usda.gov/census/census02/profiles/ia/index.htm>

rented land. Of this amount, on average 226 hectares were owned and 276 were rented, which is a more balanced ratio than either the statewide and countywide averages.<sup>191</sup>

Most the farms had their properties in a noncontiguous arrangement.

Rental payments can be cash or crop share. Crop share occurs when farmers do not pay rental with cash, but share some slice of the proceeds from the agricultural production. Seven out of the 11 farmers mentioned they were in some sort of crop share agreement. Two farmers said they had some combination of crop share and cash rental. One farmer stated when he was younger he wanted to move out of his father's household, so they created a father-son partnership. As a result they formed a corporation and, over time, bought shares in the land. He pointed out that the tax laws are set up in such a way that a corporation has "very little liability." Another farmer said the land was "all in the family," and that he rented 56 hectares in a 50-50 crop share from his father. The father lives in Minneapolis.

One of the farmers that I interviewed said his operation was in his family for 105 years. Another said his great grandfather purchased land in Illinois, which was then divided among 4 brothers, each owning 95 acres, before his family eventually headed west into Iowa. Another said the land he owned was assembled from other farmers from the early fifties on, parcel by parcel, when they came up for sale. One other farmer said he bought his farm in 1941.

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<sup>191</sup> Census of Agriculture 2002. National Agricultural Statistical Service. United States Department of Agriculture.  
<http://www.nass.usda.gov/census/census02/>

According to one farmer, land rentals are typically for 1 year. He mentioned that these short term contracts are sometimes at odds with conservation and ecological goals like adding perennial grasses on rented land, a decision with which the leaser might not agree. The ownership in that timeframe is up in the air. However he did not elaborate further. Another farmer said he treats all of it like it owns it himself. One farmer cited taxes as a way for larger owners of larger farms to lease more through economies of scale.

#### **5.2.d. The Corn crop: Where does it go?**

Is it more economical to sell corn to a local ethanol plant or have it? Farmers determine where their corn goes, either to a local ethanol plant, to feed livestock, or shipped down the Mississippi River for export. Ethanol production seems to have changed the equation. For instance, one farmer in Cass County said that with the local plants coming online, his entire corn production goes to ethanol. Others say that they are selling more to ethanol plants.

The “corn basis” is a tool farmers use to make this decision. The “corn basis” is the difference between the futures price and a local cash price.<sup>192</sup> The futures price is determined by the Chicago Board of Trade (CBOT). Iowa cash corn prices are determined locally by grain elevators and ethanol plants. Farmers close enough to ethanol plants to offset the cost of transportation sell the corn nearby, whereas farmers

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<sup>192</sup> Hofstrand, Don. Corn and Soybean Price Basis. Ag Decision Maker Home Page. Iowa State University.  
<http://www.extension.iastate.edu/AGDM/crops/html/a2-40.html>

farther away would sell elsewhere. Within the last few years, as ethanol plants have sprouted up around Iowa, they have changed the pricing landscape between selling locally or out of state. Before the ethanol boom, an Iowa corn basis map -in general- showed the local price much less than CBOT price farther from Illinois, but as one moves farther east the difference, and basis, drops. Now, however, the map is more clumpy and smeared than it once was, when one could discern a relatively smooth transition from west to east.<sup>193</sup> This is in part because the local ethanol plants are able to compete with the higher prices, rather than other buyers like the elevators. The end result of this new arrangement keeps more corn processed locally. However, there will still be movement, regardless. Iowa corn will still be used domestically to feed the nation's appetite and the mandates for ethanol, but also will be exported and shipped out of Iowa, especially in light of China's growing demand for commodities and the weakening dollar.<sup>194</sup>

### **5.3. Environmental aspects**

#### **5.3 a. Conservation Programs**

As mentioned before, Iowa farmers can rely on a number of USDA based programs for technical and financial assistance in maintaining conservation areas. The Conservation Reserve Program (CRP), for instance, sets aside environmentally

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193 "The Daily Corn and Soybean Basis Maps for Iowa and the Midwest." [http://www.card.iastate.edu/ag\\_risk\\_tools/basis\\_maps/](http://www.card.iastate.edu/ag_risk_tools/basis_maps/)

194 Hequet, Marc. "China corn gap looms." Ethanol Producer. March 14, 2008. [http://www.ethanolproducer.com/article.jsp?article\\_id=3871](http://www.ethanolproducer.com/article.jsp?article_id=3871)

sensitive cropland for conservation uses instead of crop production. In return, farmers receive annual rental payments from the federal government. Land is enrolled in the CRP because of the potential for environmental damage if it were farmed. Permitting this acreage or area, to be returned to crop production would result in reduction of biodiversity and environmental quality.<sup>195</sup>

County	CRP
Cass	40 hectares, also CSP (from an acquisition)
Cass	Yes, manmade river and buffer strips
Cass	1.2-1.6 for CRP -16.2 for CSP strips and headlands
Cass	12 acres buffer strips
Cass	16.2 hectares ,previous owner reenrolled
Cass	0
Clay	4 hectares buffer strips
Palo Alto	3.2 acres filter strips
Palo Alto	8
Pocahontas	0
Pocahontas	CRP, 20.2 acres 20.2 CSP

**Table 5.3** Participation in the CRP program by county

Although one cannot draw a correlation between land size and CRP enrollment and any decision to re-enroll or not, the fact that nine out eleven farmers had CRP or CSP land meant that it is pervasive and popular. There are penalties for early CRP and

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<sup>195</sup> "Conservation Reserve Program." <http://www.nrcs.usda.gov/programs/crp/>

CSP withdrawal. It would be interesting to follow up in five years or so when many of these current CRP contracts are set to expire to see what the corn ethanol situation is as well as to see what these farmers decide. As of November, 2007 high corn prices did not seem to affect the conservation program participation of these farmers.

One farmer bought a farm already enrolled in CSP. Another farmer mentioned that landlords prefer CRP lands because they get higher bids. The Conservation Security Program is funded irregularly, and two farmers mentioned it was not funded in 2007. Overall, the CSP has not been put into practice as effectively as the CRP.

When discussing their CRP lands, all the farmers mentioned having installed buffer or filter strips. The buffer (filter) strips are areas where landowners maintain permanent vegetation.<sup>196</sup> Besides offering habitat for wildlife, these features also work to prevent excessive soil erosion and soil, organic matter, and other number pollutants from entering a watershed from the farmland. Five of the 11 farmers specifically said that they had buffer/filter strips enrolled in either CRP or CSP. Four of those five specified the total area of these conservation practices on their land was 16, 12, 8, and 3 hectares.

### **5. 3.b. Crop diversity**

Corn and soybeans are the “cash crops” in this part of the country. A corn-soybean rotation is very common in Iowa because it allows these crops, with different nutritional needs, to be grown on a parcel of land. Each crop pulls specific nutrients out

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196 "Buffer Strips: Common Sense Conservation." USDA-NRCS. <http://www.nrcs.usda.gov/FEATURE/buffers/>

of the soil, while other crop may replenish them. In this case, soybeans are legumes that fix nitrogen and therefore they replenish the soil after corn, which has a high nitrogen requirement, is grown.

The rising price of corn is changing this pattern. One farmer talked about how there has been a bean-corn “see-saw,” where, if prices are high one year in one crop, farmers increase production try to maximize profits. They then alternate to the other crop when prices increase because of decreased supplies from the previous year.

“Corn- on-corn” is a change in this dynamic. “Corn-on-corn” became more common in 2007 as corn became relatively more profitable compared to soybeans. Three farmers gave numbers as to how much “corn-on-corn” they do. One said out of 1050 hectares, 40 were based on “corn-on-corn”. He said that’s the amount that made economic sense for his farm. Another reported that he grew half soybeans and half corn in the past, but now he grows about 30 more hectares of corn than soybeans. The third said that, out of about 400 hectares, he operates 150-200 hectares in a corn-corn rotation.

Increasing “corn-on-corn” farming has several environmental consequences. First, farmers mentioned the cost of the maintaining “corn-on-corn”. One farmer mentioned that there are lower input costs to corn on soybeans (as a result of working with the natural nitrogen cycle, rather than against it). There have been studies that document higher costs required to maintain yields in continuous corn operations.<sup>197</sup> He

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<sup>197</sup> Robertson, Kevin. “Higher Energy Costs Cause Rethinking of Crop Rotation Decisions.” Top Farmer Crop Workshop Newsletter, September 2005 Department of Agricultural Economics. Purdue University. [http://www.agecon.purdue.edu/topfarmer/newsletter/TFCW\\_9\\_05.pdf](http://www.agecon.purdue.edu/topfarmer/newsletter/TFCW_9_05.pdf)

had to replenish the soil with lime and fertilizer after 1 harvest. In general, farmers balance the cost of higher inputs with higher corn prices in making this decision.

Second, the new ““corn-on-corn”” cycle also influences the occurrence of crop pests. One such pest, the corn rootworm, does well in this system because the eggs are laid in the late summer, and hatch the next spring, and the larvae, encountering a new season of corn, thrive in the roots.<sup>198</sup> However, corn and soybeans each have their own pests. Currently, soybean rust has afflicted many soybean types, and one of the farmers I interviewed mentioned soybean rust as an issue.<sup>199, 200</sup> Besides the profit incentive, soybean rust and other associated pests have been other reasons some farmers experiment with continuous corn.<sup>201</sup> There are experiments with other agricultural mixes as well. For instance, two farmers also grow alfalfa and five have pasture. Three grow hay. In these instances, using a variety of crops may allow nutrients in the soil to be replenished and can interrupt to life cycles of some pests.

Many of the farmers I interviewed also had animals. One farmer raises 350 head of cattle a year, with 100 cow-calf pairs in an “environmentally friendly as

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198 Tollefson, Jon, J., Prasifka, Patricia, L., and Kaeb, Benjamin, C., “The monster in Iowa Corn fields.” Integrated Crop Management. Iowa State Extension Service. February 12, 2007. <http://www.ipm.iastate.edu/ipm/icm/2007/2-12/rootworms.html>

199 “Iowa Soybean Rust Webpage.” Iowa State University. <http://www.plantpath.iastate.edu/soybeanrust/>

200 “Soybean Rust Information Site.”<http://www.usda.gov/soybeanrust/>

201 Erickson, Bruce, and Lowenberg-DeBoer, Jess. “Weighing the Returns of Rotated VS. Continuous Corn.” Top Farmer Crop Workshop Newsletter, Purdue University, February 2005. [http://www.agecon.purdue.edu/topfarmer/newsletter/TFCW2\\_05.pdf](http://www.agecon.purdue.edu/topfarmer/newsletter/TFCW2_05.pdf)

possible” way on rented pasture feedlot. One raises sheep. One raises hogs. Animals are typically raised on a different piece of land than where corn or other crops are grown, so these activities would probably not compete for the same piece of land. However, these farmers do use animal manure to help the soil regeneration of the fields of crops.

### **5.3.b. Wildlife/Deer**

White-tail deer are a major presence in the farmlands of Iowa. Nine out of the 11 farmers brought up the deer populations in some manner. Many said the population of deer was out of hand. They cause damage either physically, “Bucks knock corn down” or through consumption of crops. One farmer has kept a strip of corn specifically for deer and pheasants. Another farmer said that he hunted deer (the others might also hunt, however I got no other data on that issue) and three other farmers allowed others onto their land for hunting purposes. One farmer said that there are so many deer that they just assume a 10-20% loss. He added that protective fences are not economical.

One of the major concerns for conservation groups like Ducks Unlimited or Pheasants Forever is the diminishing attractiveness of conservation-devoted land. With the incentives to grow more corn, there might be a commensurate disincentive for land for conservation through various USDA programs, like the CRP. Their worries do have some academic support: an Iowa State Center for Agricultural and Rural Development (CARD) study suggested increased corn commodity prices will reduce the attractiveness of one such conservation land rental program, the Conservation Reserve

CRP lands.<sup>202</sup> For example, increased production might threaten bird populations along the prairie pothole corridor, which is of concern to wildlife groups like Ducks Unlimited and Pheasants Forever.<sup>203</sup> These and other wildlife groups work to support government conservation programs. Studies suggest CRP lands offer habitats for a variety of birds.<sup>204</sup> Do the individual farmers detect this particular value of CRP lands? A few farmers said, in their own experience, they did not see any difference in bird or other wildlife numbers in CRP or non-CRP land. On another hand, a different farmer did notice an increase. Most farmers saw quite a lot of wildlife on their lands in general. In addition to the deer, there were frequent sightings of red tailed hawks and pheasants. Some described seeing coyotes, badgers, opossums, raccoons, and starlings. One said more turkeys were in the fields than 10 years ago. Another believed that in 30-40 years there was an increase in hawks, bald eagles, squirrels, badgers, and opossums but he did not offer a reason. Two farmers saw cougars on their farmland.

### **5.3.c. Soil Conservation**

There were at least three Iowa farmers who used conservation tillage

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202 "Corn as High as An Elephant's Eye Bode Ill for CRP."

[http://www.wildlifemanagementinstitute.org/index.php?option=com\\_content&view=article&id=225:corn-prices&catid=34:ONB%20Articles&Itemid=54](http://www.wildlifemanagementinstitute.org/index.php?option=com_content&view=article&id=225:corn-prices&catid=34:ONB%20Articles&Itemid=54) Secchi, Silvia and Babcock, Bruce. "Impact on High Corn Prices on Conservation Reserve Program Acreage." Center for Agricultural and Rural Development (CARD).Iowa State University. Iowa Ag Review. Spring 2007. Volume 13. Number 2. [http://www.card.iastate.edu/iowa\\_ag\\_review/spring\\_07/article2.aspx](http://www.card.iastate.edu/iowa_ag_review/spring_07/article2.aspx)

203 Personal Communication. Ron Renyolds. Fish and Wildlife Service. October 22, 2007 Personal Email.

204 Best, L. B., H. Campa, III, K. E. Kemp, R. J. Robel, M. R. Ryan, J. A. Savidge, H. P. Weeks, Jr., and S. R. Winterstein. 1997. Bird abundance and nesting in CRP fields and cropland in the Midwest: a regional approach. *Wildlife Society Bulletin* 25:864-877.

techniques. One was committed fully to no-till and stated that to him, “tillage is an addiction.” He also said “Cellulosic crop residue is mother nature’s protection during the winter.” He was against removing corn stover and other residue from the surface for processing into cellulosic ethanol. He said soil takes 3 to 5 years to build back up after switching to no till. He said in this process, organic matter rises slowly with the help of earthworms in a top-bottom accumulation. The no till farmer was also involved in the Iowa Learning Farm.<sup>205</sup> The Iowa Learning Farm is a statewide initiative that reinforces commitments to protect natural resources as a way of preserving farm and agricultural quality of life. He also got paid by the Chicago Climate Exchange for the plant residue sequestration. He thought that was odd because he would have continued no till practices anyway. One other farmer emphasized the importance of understanding the soil morphology. He suggested that the structure and fertility of the loess and glacial till that exists in the region can guide farmers on how to best manage the land. This particular farmer also consults for the American Farmland Trust. The American Farmland Trust (AFT) was founded in 1980 by farmers and conservationists concerned about the loss of farmland to development, and brings together with farmers, political leaders and activists, to preserve America's farm and ranch land. Another farmer said that having a farm cover many different soil types reduces the risk of crop failure. A farmer in Southwest Iowa (with more rolling land and higher erosion potential than Northern Iowa) said he would leave corn residue in the hills to prevent erosion, but sell

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205 “Iowa Learning Farm.” Iowa State University. <https://www.extension.iastate.edu/ilf/>

what was left in the bottom, if it became a commercially viable to sell the corn stover for cellulosic ethanol.

#### **5.4. Social aspects**

##### **5.4.a. Labor Issues**

Three farmers gave a range of answers for their total workers (themselves plus hired help). Some answers were concrete (e.g. 1 other, myself and my dad,...) whereas a total of 4 out of the 11 farmers gave unspecified responses (“I hire a few college kids part time for the harvest....”) The average number of workers was 2.2 persons. The productive hectare/worker ratio for this area is, 229 hectares per worker. One farmer did mention that labor “pays more attention to your land with higher wages”. He elaborated by saying the quality of their effort increased when they received higher pay. He also mentioned larger farms can mechanize more easily. However, no farmer discussed higher corn prices or the emphasis on ethanol production on any differences in these labor issues. More research is needed on this topic as Iowa’s agriculture evolves.

##### **5.4.b. Economics**

In the interviews, many of the farmers talked about the economics of being a corn grower in Iowa in 2007. When it came to the subject of finances, many farmers talked about higher prices for land. According to a recent article in *Barron’s* business news magazine, “The rush for ethanol is easily the biggest factor behind rising farm

prices.”<sup>206</sup> Although the ethanol rush contributes to some fraction of the higher price, it does not account for all of it. For example, many farmers say that out of town hunters (singly or in groups) have caused prices to go up. One farmer said he would run a hunting operation on his marginal land if he could, but farming took up too much of his time.

Farmers voiced some contradictory statements about the effect of these land price run-ups. One farmer held that “Marginal ground has appreciated as quickly as higher-quality ground,” another agreed saying, “Marginal lands have increased in price”. However another, from Pocahontas County, thought that the price of marginal lands has not gone up. The Barron’s article and other literature, however, support the claim that all sorts of Iowa land -- prime farmland or not -- has increased in value. One farmer in Southwest Iowa mentioned that land suitable for crops had been going for \$2500/acre while areas where one would find CRP land only net \$1800/acre. One thing to consider is what the potential productivity of a farm might be. An assessment called the Corn Suitability Rating helps agricultural specialists determine what the value of farmland should be. The soils that exist on a particular farm help determine its price.

Will an increasing emphasis on next generation biofuels cool off the farm real estate market? Michael Duffy, an Iowa State University economist, was quoted in an International Herald Tribune as saying, "In five years, corn-based ethanol will be

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<sup>206</sup> McTague, Jim. “Don’t Bet the Farm” Barrons. December 31, 2007.

around...[but]...Fifteen years? I'm not as convinced. "<sup>207</sup>

Higher land prices make farming an economic activity with high initial capital costs and will keep out new and younger corn growers from the sector, while benefiting those who already have property.

Other issues of economics farmers mentioned included the effect of ethanol plants on the local economy. Some farmers stated that the ethanol production has decimated the local co-ops. A co-operative operates where farmers bring their grain to be stored elevators that allow for shipping grain in bulk. Local ethanol plants can pay a few cents more than the elevator operators. How this out competition may affect the local economy depends whether or not the revenue stays in the area. If the ethanol plant is owned by outsiders, and with this ethanol rush outside investors have been keen to spend money on these operations, then the money that might otherwise stay in that specific area would flow elsewhere.<sup>208</sup> However, to combat the loss of too much income, laws have been changed to promote local ownership of ethanol plants and limit undue external influence.<sup>209</sup> Others say that they are selling more to ethanol plants. One farmer said that he does not sell to Arkansas chicken producers anymore.

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207 Davey, Monica, "Ethanol Production gives new life to Farmland." August 8, 2007.

<http://www.iht.com/articles/2007/08/08/business/ethanol.php?page=1>

208 Barrionuevo, Alexi. "As Investors Covet Ethanol Plant, Farmers Resist." The New York Times. Section A; Column 2; Business/Financial Desk; Pg. 1 November 2, 2006.

209 "Iowa Farmers Find a New Way to Build an Ethanol Plant." The Farm Credit Council.

<http://www.fccouncil.com/uploads/CoBank%20Testimonial.pdf>

There was a split among the interviewed farmers over whether or not higher corn and other commodity prices had yielded inflation overall in those farming areas of Iowa. One said both yes and no, because of higher land prices. Another farmer thought there was not any collusion on input prices that are increasing for farmers. Still another thought farmers get less for crops today than they did before. One other called it a “dog eat dog world.” A farmer said ethanol “changed things,” especially how they market corn.

There are high barriers to entry in the farm business, especially for the younger generation. One younger farmer who was interviewed was just starting out and mentioned how hard his situation can be. He went through many of the economic issues other farmers detailed (increased input and fuel costs, high rents, more competition for land from hunters), but in addition he had to put up capital outlays to begin operations. This particular, youthful farmer faces the situation recounted in a recent International Herald article. Monica Davey writes, “Ethanol is leaving marks everywhere.” She quotes a Kyle Sheaffer, then 28, as saying “...it's just super hard to rent - much less buy – ground...[and]... the initial investment to farm is so much: the tractor, the startup costs, it's crazy. If you want to rent land, you either have to find a landlord who is sympathetic to your cause or who knows you.”<sup>210</sup> The young farmer I talked to also said he has landlords sympathetic to having a new generation engaged in Iowa’s farming culture, which allowed him to get a start.

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210 Davey, Monica, “Ethanol Production gives new life to Farmland.” August 8, 2007.  
<http://www.iht.com/articles/2007/08/08/business/ethanol.php?page=1>

The farmers also made use of ethanol in their vehicles. Almost all the farmers used E10 (a 10% ethanol gasoline blend available in Iowa) and others used various blends of biodiesel in other vehicles (B5, B20, etc.) These responses align with other literature that suggests up to 74% of all gasoline consumed from Iowa service stations is at least an E10 blend.<sup>211</sup> Since the 1980's there has been a 1.7 cents per gallon reduction in excise tax, and retailers have had a 2.5 cents per gallon tax credit on sales above a 70% threshold.<sup>212</sup> One farmer said he would rather see 100% E10 than 10% E85 in the United States. Another farmer said he wanted to get an E85 SUV, but it would have been too expensive, and the closest pump is in Council Bluffs, which is an hour from his farm. Although, the South Carolina NRCS has done some cost sharing with farmers, through the EQIP program, to purchase vehicles to run on E85 and B20 blends, I did not ask these Iowa farmers if they did cost sharing as well.<sup>213</sup> That line of inquiry would allow one to understand how the Natural Resources Conservation Service in Iowa works with farmers to affect agricultural and bioenergy policy-through land use issues alone or influencing more general behaviors like using and supporting biofuels.

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211 Crowe, Brian. "Ethanol." IowaDNR Energy. <http://www.iowadnr.com/energy/renewable/ethanol.html>

212 Crowe, Brian. "State of Iowa" Governor's Ethanol Coalition. August 30, 2007. Omaha, Nebraska. [www.ethanol-gec.org/information/Iowa\\_Report-GEC-Omaha\\_8-07.ppt](http://www.ethanol-gec.org/information/Iowa_Report-GEC-Omaha_8-07.ppt)

213 Durant, Bethel. "Farm Bill Incentives for Use of Alternative Fuels" Palmetto Clean Fuels Coalition. [http://www.palmettocleanfuels.org/Bethel Durant.ppt](http://www.palmettocleanfuels.org/Bethel_Durant.ppt)

One of the questions probed why the farmers grow the crops they do. Two of those interviewed flatly said they farm to be independent, as a farmer is his own boss. Three stated Western Iowa was “well suited for growing corn,” with the right soil and climate. The rest said that corn and soybeans were profitable, cash crops, and that’s “what worked in that system.”

At least three of the farmers tackled the “fuel or food” debate in at least some way. Two mentioned generally higher transportation costs as the reason food may cost more. One made the point that for a box of breakfast cereal the raw crop costs only 1.5 cents. (He used the example of “Wheaties” even though he was a corn grower. He added if ethanol production caused corn prices to double, the cereal should only increase in price by 3 cents.) Another farmer said the reason there are areas of hunger is a distribution issue.

### **5.5. The Future**

Almost all ethanol production in the United States is also consumed in the United States. The Energy Independence and Security Act was written for this purpose. Of those farmers who mentioned the topic, energy security will remain a motivation to grow corn. For instance, one farmer specifically mentioned energy security as a key factor in his growing corn for ethanol. Another said that “...during the Carter Administration, the United States was 40% dependent on foreign oil, and now 60% of our needs are from abroad.” A couple of farmers mentioned the new nearby ethanol plant as an incentive to grow more corn. One farmer said, “To us, Iowa farmers, farming is part of you.” It stands to reason that these inspirations and incentives will

continue to drive farmers to grow corn in the ways that they do.

One farmer in Palo Alto County, who grows his corn near a POET\* ethanol plant in Emmetsburg, was especially interested in selling some amount of his corn cobs, which would otherwise be left in the fields for soil erosion prevention purposes, to that operation for conversion into cellulosic ethanol. The DOE recently awarded POET up to \$80 million to convert one of its mills to utilize cellulosic ethanol from corn cobs and it was from this project that this particular farmer sought to benefit from this new commodity and customer.<sup>214</sup> His experimentation is part of a larger and new attempt to converting extra corn residue and materials (corn stover) after a harvest into cellulosic ethanol. In fact, Robin Graham of Oak Ridge National Lab and others wrote a paper in 2007 explaining that where the POET plant is located in Northern Iowa is one of the three best places (Central Illinois and along the Platte River in Nebraska are the others) to harvest this material for cellulosic ethanol, when ensuring soil erosion is minimized.<sup>215</sup>

The big questions for the future of domestic corn production for ethanol is how quickly can cellulosic and next generation biofuels come online to meet the EISA mandates, and for corn growers how might corn cobs and stover play a role in that

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\* An ethanol and energy company

214 "POET signs cooperative agreement with DOE for first phase of commercial cellulosic ethanol project POET to move forward on design and engineering for Project Liberty" October 4, 2007. <http://www.poetenergy.com/news/showRelease.asp?id=96>

215 Graham RL, Nelson R, Sheehan J, Perlack RD, Wright LL "Current and potential U.S. corn stover supplies." *Agronomy Journal* 99, 1-11 (2007).

transition?

### **5.6. Summary**

Conservation measures through USDA programs are popular among this set of farmers, except for the CSP, which according to some was not adequately funded and also was complicated and confusing to implement. According to the farmers who discussed where wildlife congregated on their land, these land conservation programs seem to improve wildlife and habitat biodiversity to a modest extent. The farmers reflected that increased ethanol production also has changed the way they thought about corn and how to market it. A smaller subset of farms seemed to be especially focused on conservation issues, included three who had some sort of conservation tillage, one who actively promotes no till practices, and another who actively works on integrating and making agricultural policy more holistic. In this research sample farmers are looking forward and are enthusiastic for cellulosic ethanol because it would provide future markets for parts of the corn plant that are not currently commercially valuable such as cobs and stover.

## **Chapter 6 Comparative Analysis and Conclusion**

### **6.1. Introduction**

Brazil and the United States are world leaders in ethanol production. Brazil aims to produce sugarcane ethanol for domestic use-and unlike the United States-for export to other countries to boost revenues. The United States has similar goals: it seeks to boost current corn ethanol production to meet its increasing domestic and

energy security needs. Increases in ethanol biofuel production will have many consequences, but this work concentrates on the environmental management practices of farmers. By using a sample of farms and analyzing the farming methods within the two largest ethanol producing countries, I describe and compare land management strategies implemented by farmers in each place. Visits and interviews with 12 farmers from Northwest Paraná\* and 11 farmers from Western Iowa (the respective “hearts” of ethanol crop production in Brazil and the United States) provide two snapshots to help answer my core question: **What are the consequences of the biofuel boom on farmer land and environmental management practices in Brazil and the United States?**

There are also supporting questions I intend to explore: What are social, economic and political incentives and disincentives for farmers in the United States and Brazil and how do they manage their lands with these economic and conservation pressures? How do the two national systems of conservation laws and regulations differ in this regard? While patterns and contrasts emerged in the data analysis, this research is suggestive-not definitive-and works best to frame and inform future research. This chapter will compare the mindsets and conservation strategies farmers in Northwestern Paraná and Western Iowa in four broad areas: the environmental facet of ethanol production, the social implications, the economic realities farmers face, and what might happen in the future with ethanol crop production. Once these comparisons and contrasts are made on these points, this chapter will summarize the findings and offer a conclusion.

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\* (11 farmers had full data, one had invalid land area data.)

## **6.2. Environmental Issues**

### **6.2.a Conservation Programs:**

How do the interviewed groups of farmers from Brazil and the United States manage their lands with regard to environmental issues?

Seven of the 11 Paraná farmers with valid data failed to meet the government-set percentage goal for preservation of native vegetation (20%). In Iowa, nine of the 11 Iowa farmers in some way participated in the conservation programs the USDA and other governmental entities offered, such as the retired-land Conservation Reserve Program (CRP) or the working lands Environmental Quality Incentives Program (EQIP). Additionally, one of those farmers that did not take part in these programs nevertheless espoused forward thinking and integrated farm techniques. Additionally, in my sample of Iowa farmers, there was no thought of decreasing or opting out of their enrollment of conservation in order to capitalize on high corn prices.

However, it is inappropriate to compare the results from the case studies on conservation head to head because what is required in Brazil is much more stringent than in the system in United States. Instead, how does each set of farmers fare in their respective system? The answer is that they do roughly the same, with qualifications, and more research is needed for a fuller picture to emerge. The farmers in Paraná are at a disadvantage because the transferable development rights program, which might otherwise put conservation in financial terms, has been irregularly maintained there.

On the other hand, institutions for Iowa farmers are relatively robust.<sup>216</sup> However, despite what the government of Paraná does or does not do, the farmers and agricultural agents still should be aware that the law exists because there have been waves of promotional campaigns aimed at the individual farmers and agricultural institutions.<sup>217</sup>

Paraná and Iowa also share certain land constraints in the fact that, since the 1950's, these two political jurisdictions have been almost entirely cleared for human activity. The United States as a whole shares this trait, but Brazil overall is rich in land and can theoretically create more cropland by the clearing of ecosystems. With this in mind, in order for farmers in Paraná who work lands that are completely cropped to comply with the Forestry Code, they would first need to recreate the vegetative systems, and only then would they be ready to undertake the long term maintenance of their legal reserves. All told, this would take a lot of planning and money.

There are a few land management techniques that transcend crop type and field conditions. Buffer or filter strips are an example worth mentioning. The buffer/filter strip is an area of natural vegetation between human land use (cropland) and waterways or naturally growing vegetation. Buffer/filter strips are an important part of the attempt to protect plant and animal wildlife. A typical buffer strip contains three zones of vegetation: trees, shrubs, and grasses, each determined by the distance from the

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216 Personal Communication. Email Communication. Chomitz, Kenneth January 30, 2008.

217 Personal Communication. Email Communication. Maximiano, Gracie. Tuesday May 6, 2008.

watershed.<sup>218</sup> A buffer strip clearly benefits wildlife by providing travel corridors, nesting sites and food sources. As a filter, it protects streams and lakes from cultivated field runoff of sediment and organic matter.

Both Brazilian and American farmers use buffer/filter strips on the sides of their fields, and in fact in addition to the 20% native vegetation threshold, the Brazilian Forestry Code dictates that farmers maintain “areas of permanent protection,” which include 30 meter buffers.<sup>219</sup> However, according to one Brazilian agricultural expert, farmers do not observe the mandate for these buffers adequately.<sup>220</sup> Their disregard for buffer strips was not a function of increased ethanol crop production, but part of a larger divide between agricultural policy and the implementation on the ground conservation practices. On the other hand, the CRP program in Iowa encourages and supports development of buffer and filter strips in the Midwestern farms I assessed.<sup>221</sup>

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218 “Stewards of our Streams.” Buffer Strip Design, Establishment, and Maintenance.” Iowa State University Extension.

<http://www.extension.iastate.edu/Publications/PM1626B.pdf> Correll DL. 2005. Principles of planning and establishment of buffer zones. *Ecological Engineering* 24(5):433-439.

219 Personal Communication with Richardson de Souza. Agricultural Engineer. Secretaria Da Agricultura E Do Abastecimento (SEAB). Tuesday, June 22, 2007. Curitiba, Brazil.

220 Personal Communication. Richardson de Souza. Agricultural Engineer. Secretaria Da Agricultura E Do Abastecimento (SEAB). Tuesday, June 22, 2007. Curitiba, Brazil.

221 “Grassland Bird and Snake Use of Iowa Grassed Waterways is Influenced by Site and Landscape Characteristics.” November 2006. [http://policy.nrcs.usda.gov/media/pdf/tn\\_b\\_60\\_a.pdf](http://policy.nrcs.usda.gov/media/pdf/tn_b_60_a.pdf)

### **6.2.b. Conservation Ethic**

In fact, in my sample, there were farmers who embraced various conservation methods and mindsets, even to the detriment to their bottom line. For instance, one no till farmer in Clay county worked with the Iowa Learning Farm, which promotes a “culture of conservation” and participated in his conservation district to direct county wide conservation efforts. Another farmer from Cass County, being the non CRP participant mentioned above, worked with American Farmland Trust, which seeks to build holistic agriculture policies. Many in this selection of Iowa farmers participated in the Conservation Reserve Program, whereas the Conservation Security Program, another USDA program, was not as attractive. No data was collected on whether farmers in Paraná engaged in any sort of federally- or locally-sponsored agriculture preservation organizations. Still, a few sugarcane farmers stressed that they saw themselves as innovators in soil conservation and other farm management techniques. In that sense, both populations of farmers had more nontraditional farmers in the mix.

### **6.2.c. Land Size and Conservation Participation**

Land size was one of the central factors I wanted to explore in determining how voluntary or required conservation practices might affect land use and biodiversity management. Of the farmers interviewed, the land holdings in the farms of Paraná were distributed much more unevenly than the American farms as they following figures suggest (Figures 6.1 and 6.2). This variability stems from the sample selection, so cannot be used to assert anything about land distribution in Brazil, generally. However in both Paraná and Iowa farmers spoke about increased farm sizes and general

consolidation in the industry. For the largest farms in Northwest Paraná I interviewed managers because the actual owners were absent. On the other hand, in the United States I spoke to all the owners. Keep in mind that, these sample sizes were not random, but reflect which farmers were willing to participate for an interview. Land may be obtained through inheritance, purchase, or even government intervention. Many Brazilians and Iowa farmers have arrived at their landholding position as a result of piece by piece acquisition. Fewer farm properties are gained by outright inheritance. Interestingly one farmer in Southwest Iowa acquired his land as a result of wanting to “move out” from a father-son partnership. This motivation is similar to how the Brazilian frontier was settled in the 16<sup>th</sup> and 17<sup>th</sup> centuries: sons left home to carve out their own homesteads.<sup>222</sup>

In Paraná I interviewed farmers where the smallest farm was about one fifth of one percent of the largest (7 hectares versus 3872). In Iowa, the smallest farm under investigation was 40% as large as the largest. Although the samples are not random, the disparity between Paraná and Iowa over the smallest/largest farm ratios is striking. Brazil is known to have highly skewed land distribution pattern.<sup>223</sup> Additionally, in the discussions, most Iowans said they rented some of the land they farmed, the Brazilians I interviewed not at all. Brazil has one of the most unequal land distribution systems in the world. One result is that less than 5% of Latin America property is rented, because

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222 Metcalf, Alida C. “Family and Frontier in Colonial Brazil.” Santana de Paranaíba, 1580-1822. Austin: The University of Texas Press. 2005.

223 “This Land is AntiCapitalist Land.” The Economist. 4/28/2007, Vol. 383 Issue 8526, p41-42

of the risk of take-over and corruption.<sup>224</sup>

The largest farm (nearly 4000 hectares) did have significantly lower ratio and could conceivably meet the legal requirement. Unfortunately how this non-crop land was used (idle, for natural vegetation, etc.) was not explored in the interviews. The smaller farms (7 of the 9 farms with less than 900 hectares) had more than 80% of their land in production. That left less than the minimum for natural vegetation and wildlife habitat.

In the United States the sample of farms showed no relationship between land size and participation in the CRP and similar conservation programs. However, a report by the Economic Research Service, an arm of the USDA, suggests that even though “the decision to install conservation structures on CRP land is largely unaffected by farm size...once a farm operator decides to participate, a 1-percent increase in farm size is associated with more than a 1-percent increase in the *amount of land* enrolled. The evidence suggests that as farms grow in size, they are likely to install more conservation structures or plant more native grasses, legumes, or trees under the provision of the CRP, even after adjusting for the amount of land they control.”<sup>225</sup> In both places, farmers spoke the language of being “on the margin,” so it seems that in Paraná and Iowa the economics of scale play a role in conservation considerations.

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224 Assunção, Juliano J. Non Agricultural Land use and Land Reform: theory and evidence from Brazil.  
<http://globetrotter.berkeley.edu/macarthur/inequality/papers/AssuncaoNonAgriculturalLandUse.pdf>

225 Lambert, Dayton and Sullivan, Patrick. Land Retirement and Working-Land Conservation Structures:A look at Farmers Choices.” “Amber Waves.” June 2006. <http://www.ers.usda.gov/AmberWaves/June06/Features/LandRetirement.htm>

### **6.2.c. Increased Ethanol Crop Area: At the Expense of Native Vegetation or other Crops?**

The farmers in Iowa I interviewed reflected the established literature that the record area devoted to corn is a result of farmers having displaced soybeans with corn.<sup>226</sup> I also thought that my surveys would show that Brazilian farmers have cleared more native vegetation (rainforests and savannahs) to provide crop land to grow sugarcane rather than replacing other croplands with sugarcane. This was not the case. Farmers in both areas have increased their ethanol crops (sugarcane and corn) at the expense of other food crops. For example a few of the farmers said they aren't growing coffee trees anymore, with sugarcane being partly responsible, while corn acreage does take the place of soybeans in Iowa. However, the general consensus is that Brazil has room to expand agriculture into mostly undisturbed forest and savannah ecosystems. The United States, on the other hand, has much less land that can be newly turned to agriculture. It turns out that that the study area in Paraná is more similar to the United States than say its neighbor, Mato Grosso in this respect, and is heavily farmed with little undeveloped land. This point is important because if farmers want to meet the requirements of the Forestry Code not only do they have to assess where they should position the native vegetation, they need to actively reforest these areas. Reforestation makes meeting the law expensive and on this challenge outside groups (the World Bank

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226 Tokgoz, S., A. Eloheid, J. Fabiosa, D. J. Hayes, B. A. Babcock, T. Yu, F. Dong, C. E. Hart and J.C. Beghin .2007. Emerging Biofuels: Outlook of Effects on U.S. Grain, Oilseed, and Livestock Markets. Center for Agricultural and Rural Development (CARD) Iowa State University Staff Report 07-SR 101 Baker, Allen and Zahniser, Steven. "Ethanol Reshapes the Corn Market." Amber Waves. USDA-ERS. May 2007 Special Edition. <http://www.ers.usda.gov/AmberWaves/May07SpecialIssue/Features/Ethanol.htm>

and associated programs such as the Paraná Biodiversity Project, or European sustainability programs) can assist the regional authorities in an integrated effort to reduce the biodiversity impacts of ethanol production.

#### **6.2.d. Soil Conservation**

Each population has a subset of farmers with elevated awareness of conservation in both Brazil and the U.S, and this was especially true of soil conservation concerns. In Paraná, at least one farmer was proud to say he employed novel soil terracing techniques. In Iowa, three or four farmers talked about using conservation tillage. The no till farmer implemented that technique because he wanted protect the soil. No till farming may also appeal to farmers who see that they will need to use less equipment and manpower. Certain farmers in both Paraná and Iowa have reputations for “doing things differently”—and often these efforts are directed to protect the environment and their land.

#### **6.2.e. Biodiversity**

One of the main assumptions of this project was that conservation program participation translated into increased potential habitat for native flora and fauna, which therefore increases biodiversity. As the Forestry Code threshold was not met by the majority of the interviewed farmers in Paraná, the type of biodiversity management that was within their reach was limited to within the larger sugarcane agricultural system. The picture with corn growers in Iowa was a little brighter; with land consistently set aside in the USDA conservation programs. However, because a minority of farmers thought animal occurrence did not differ from cropland to CRP land, more research

needs to be done to study that attitude and the potential implications for farmers' views on the ecosystem services CRP land may provide, especially if commodity prices remain elevated. However, despite emphasizing linkage between land conservation and biodiversity, that is not the only facet of biodiversity in these croplands. Even though sugarcane and corn fields are not native ecosystems, animals, especially birds occur among these crops. With that mind, the land practices of farmers will affect whatever may frequent the croplands. For instance, in the part of Brazil where I conducted my interviews, the sugarcane requires a burn before harvest to allow more efficient gathering the cane from the field, and that upsets the habitat of bird species that nest in that sugarcane ecosystem. In general, wildlife in the Paranaense fields does not affect the sugarcane crop, on the other hand, Iowa farmers complained about deer damaging their corn fields. Wildlife crop interactions will at best remain at an elevated level or increase as more land is brought into ethanol crop production.

### **6.3 Labor Issues**

One of the major ways ethanol production in Paraná differs from ethanol production in Iowa is through their labor systems. It is true that sugarcane production in Brazil has been mechanizing its ethanol production recently, but it still is very labor intensive and is supported by the findings of this report. That explains why Chapter 4, emphasizing the results from Paraná dealt with labor issues much more than the findings in Iowa in Chapter 5.

The fact that there was such a larger pool of labor in Brazil, orders of magnitude greater than on any Iowa farm, coupled with land rights and class based conflicts within

Brazilian society made social issues between the laborers and owners there more conspicuous. Despite playing a reduced role in Iowa, one or two corn growers did mention labor issues, saying the higher the wage for help, the higher the attention to detail that worker would take to the land.

In particular, one soil and environmental issue arose in the research on Paraná that divided the workers, as represented by the MST, and the owners. That issue is use of pesticide and chemical use. MST was strong its denunciation of the pervasiveness of chemicals developed from the Green Revolution in sugarcane production. Roundup was singled out as the main contemporary culprit, but Agent Orange or similar substances were supposedly used earlier in the region.<sup>227</sup> There was no corroborating evidence found for its use from other sources, however. While both Brazilian and American use Roundup pesticide, its exposure to laborers was a major issue with the MST in Brazil, but does not play such a prominent role in the United States.

#### **6.4. Farmer Motivations**

##### **6.4.a. Economics and Price Signals**

Both farmers in Paraná and Iowa talked in terms of dollars and cents, of the bottom line when discussing the business of farming. On the question of where they send their crops, their decisions are based on what customer offers the highest price. A few Iowa farmers said that that they could see for themselves that new ethanol plants have been outcompeting local elevators, which have suffered as a result. In Paraná, the

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<sup>227</sup> Personal Communication. MST representative. July 2, 2007. Curitiba, Brazil.

farmers talked about how the profitability and rising profile of sugarcane convinced them to grow more sugarcane. In both Paraná and Iowa, one or two farmers expressed concern that increased concentration of farms or of the ethanol industry generally would be detrimental to individual farmers like them. These worries reflect an ongoing shake-out of the ethanol industry in both Brazil and the United States, as the global biofuel sector matures.

How has the support structure for farming responded to increased commodity prices and ethanol production? Although this facet of farming was not investigated among the farmers of Paraná, about a third to a half of the farmers in Iowa mentioned their perceived inflation of input costs, which they theorize has occurred as part of the larger adjustment of the local economy to higher corn prices and the ethanol rush. Iowa farmers also mentioned how land prices were skyrocketing and that effect on their operations. Although land prices generally have gone up in the agricultural regions of Paraná as well, that fact was not explored as in depth. Price signals also shape the farm landscape: a recent “Prospective Plantings” report details how the corn acreage in 2008 is lower than in 2007, and conversely there are more soybeans in 2008 than 2007. Overall, corn covers a larger area than soybeans, just they are more balanced. The report offers evidence that the crop “see-saw” exists.

#### **6.4.b. Energy Security and National Pride**

When it comes to basic economics, sugarcane is a profitable crop in Northwest Paraná and corn in Western Iowa, but that does not preclude the farmers to have other, less tangible reasons to grow these crops. Although the sample size is small, one Iowa

farmer and one in Paraná explicitly promoted their crops as ethanol feedstocks. The Iowa farmer from Palo Alto county said he rather see 100% of cars run on an E10 blend than 10% of cars run on E85. Having a complete and reliable customer base may be his rationale. Also, a farmer from Nova Londrina said he believed ethanol should be 80% of all fuel used in the world. No further elaboration from him on that point was made. On the same subject, I also asked what fuel blends farmers in Iowa used but not in Paraná, because the infrastructure is more advanced in Brazil, where in the United States, ethanol blending is still expanding and critical mass has not yet been achieved. It is also worth noting that a different farmer from Nova Londrina told me that he opposes refineries for refined sugar in that area because he believes it is advantageous to grow sugarcane exclusively for ethanol. Along similar lines, a farmer in Cass County sold his entire corn production to a local ethanol plant, although he didn't talk about it in terms of strategy. Finally, another farmer from Cass County did say energy security was a reason he grew corn. Both sets of farmers know that as a result of the rise of ethanol to meet many of the problems with the current vehicular fuels, they are in a new position as participants on the frontlines of a new energy sector.

## **6.5. Looking to the Future**

### **6.5.a. Different Ethanol Outlooks**

What does the future hold for ethanol crop production and conservation strategies in these two places? If corn will remain a feedstock for ethanol for the foreseeable future, and if Paraná farmers manage to export more ethanol, conservation

issues will remain.<sup>228</sup> How can the conservation efforts of these two places be enhanced? The fact Brazilian sugarcane farmers want to export more of the ethanol means conservation will be subject to the requirements of the European Union and individual European states, whereas in the United States, which protects its domestic production strongly, conservation will remain a domestic issue. In biodiversity terms, the question is how the status quo will affect the fragmented ecosystems. What will the interplay be between conservation and energy policy?<sup>229</sup> European countries especially can put pressure on Brazil to adopt more sustainable methods of sugarcane production. Not only does this include preventing the destruction of pristine parts of the Cerrado or the Amazon, but also reenergize the Forestry Code Mandate. Along these lines, a handful of reports have emphasized how Brazil can meet the standards of the Netherlands, a country with particularly stringent standards. One way is the Transferable Development Rights System for Restoration and Maintenance of the Legal Reserve and the Areas of Permanent Preservation.<sup>230</sup> In the United States, conservation in croplands must include the fate of Conservation Security Program. After it was enacted from the 2002 Farm Bill, it has been inconsistently funded and some say, poorly disseminated. In any situation, how to pitch and interact with the

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228 Hart, Chad E. "The Outlook for Corn and Ethanol." Iowa Ag Review Online. Winter 2008. Volume 14. No.1. Iowa State Center for Agricultural and Rural Development.[http://www.card.iastate.edu/iowa\\_ag\\_review/winter\\_08/article4.aspx](http://www.card.iastate.edu/iowa_ag_review/winter_08/article4.aspx)

229 "Conservation Effects Assessment Project." Soil and Water Conservation Society. [http://www.swcs.org/documents/CEAP\\_Final\\_Report.pdf](http://www.swcs.org/documents/CEAP_Final_Report.pdf)

230 Smeets, Edward., Junginger, Martin, Faaiji, André, Walter, Arnaldo, and Dolzan, Paulo. "Sustainability of Brazilian bio-ethanol." Copernicus Institute. August 2006. <http://www.bioenergytrade.org/downloads/sustainabilityofbrazilianbioethanol.pdf>

farmers must be a central consideration for future conservation programs. Additionally, more political attention can ensure that the Department of Agriculture makes the Conservation Security Program (CSP) more accessible to farmers and consistently funds it.

Another difference between how higher commodity prices affect sugarcane production in Paraná and Iowa is crop rotation selection. Sugarcane grows over the course of 4-5 years whereas corn is grown over the course of one harvest season. In Iowa, high commodity prices across a number of commodities have led to competition among what crops a farmer should grow. In this way, even though demand for corn remains elevated, farmers may still grow more soybeans in 2008 than 2007.<sup>231</sup> In this way, Iowa crops are subject to a commodity see-saw more than Brazilian farmers generally, but perhaps not more than Paranáense ethanol sugarcane growers, specifically, who also have tweaked their crop ratio (sugarcane-coffee). Yet, the fact corn growers were increasing the continuous corn method has allowed new ecological issues like the corn rootworm pest problem to arise in the agricultural policy agenda space in the United States where they would not have done so in Brazil.

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231 Hart, Chad, E. "The Outlook for Corn and Ethanol." Agricultural Situation Spotlight. Iowa Ag Review Online. Winter 2008. Vol 14. No. 1. Iowa State Center for Agricultural and Rural Development. [http://www.card.iastate.edu/iowa\\_ag\\_review/winter\\_08/article4.aspx](http://www.card.iastate.edu/iowa_ag_review/winter_08/article4.aspx) Streitfeld, David. "A Global Need for Grain that Farmers Can't Fill." The New York Times. Business. March 9, 2008 [http://www.nytimes.com/2008/03/09/business/worldbusiness/09crop.html?\\_r=1&scp=3&sq=commodity%2C+farmers&st=nyt&oref=slogin](http://www.nytimes.com/2008/03/09/business/worldbusiness/09crop.html?_r=1&scp=3&sq=commodity%2C+farmers&st=nyt&oref=slogin)

## **6.6 Future Research Directions**

### **6.6.a Ideas from the research**

As a pilot study of a comparative farmer survey project, there are many places to go from here. During the course of the interviews, several other lines of research opportunities became apparent that were worthy of further study, but outside the constraints of this particular project. What follows are some ideas from those that seem most relevant and promising that are interesting, but perhaps less fleshed out.

The first area of inquiry that succeeds this project should also involve conservation and ask: what do these differences/similarities mean for each agricultural system and how “well” it does with conservation management? Further research is needed on the 20% Forestry Code metric in Brazil. If I or some other researcher went back to ask more detailed questions about the noncompliance of the 20 % threshold a clearer picture could be made.

Another relevant research topic would to survey these farmers in Paraná (and other places) to see how they might respond to implementing some of the programs that Kenneth Chomitz suggests with transferable development rights and more delineated property rights especially if the state TDR program is once again in force. This work would contribute to the need for a continued integrated approach to biofuel production.

Secondly, another topic beyond the scope of this project is how mandatory versus voluntary conservation programs influence land use decisions differently. Another point is that Brazilian law mandates landowners to use their property adequately if not it could be reassigned. There has been some literature on the conflict

of “proper use” of land versus conservation. That is to say farmers who might otherwise retire lands for biodiversity or other environmental reasons don’t because the Brazilian authorities might take it away from the landowner for dispersal.

The Cerrado is another area that needs to have this study done. It is under stress from ethanol production but also has tremendous value from biodiversity and other ecosystem services.<sup>232</sup> This pilot project should be extended to other areas of wilderness-cropland interfaces.

An additional possible track would be more detailed work on the relationship between demographic groups and conservation management strategies. For instance, starting out as a farmer is challenging because of high capital and start up costs. This is a major impediment to young farmers in the USA where everyone has expectations of upward mobility. In Brazil the difficulties are as great, but the more rigid class structure and misdistribution of property leads to social movements and disturbances. For this project, I interviewed only one self identified young farmer in Iowa. His conservation concerns did not differ from the others I interviewed there. However, the conservation sensibilities of young farmers in the USA, on the one hand, and new beneficiaries of land reforms in Brazil, on the other, might be worthy of study. A further study should also detail whether Brazilian farmers were perceived to be hurt by rising (if occurring) input prices, which is not evident in this paper. Finally, how does the American ethanol policymaking process promote conservation in conjunction and alongside other issues

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232 Valle, Sabrina. “Losing Forests to Fuel Cars; Ethanol Threatens Brazil’s Wooded Savannah.” The Washington Post. July 31, 2007.

such as energy security and climate change concerns? If farmers make decisions in dollars and cents, how can the USDA and programs like CRP capitalize on their considerations? All together, this project has engendered a number of interesting, research questions.

#### **6.6.b Ideas from limitations of the study**

There were a few clear limitations to this study, and from that a new study that might build on this work could overcome these constraints with the right set of resources. First, the farm samples were not random and particularly in the case of Iowa, were not representative of an “average” farm. Farmer availability for interviews was an issue and was a driving factor in the sample profile. The data set would have been richer, more diverse, and perhaps more representative of the larger farming community had more farmers in both Paraná and Iowa been available. That was a restraint this project needed to address and incorporate. On the point of farmer interviews, not knowing Portuguese limited the level and depth of communication; yet my translator did well on trying to bridge the language gap.

Additionally different slices of the larger demography of farmers may affect the attitudes of conservation; this is especially true for gender. However, this study did not investigate smaller demographic segments in depth. Yet, gender may play an important role environmental management decision-making. A 2002 report a study of farmland ownership and tenure in Iowa showed that women own or co-own nearly half of Iowa’s

farmland and own or co-own 54% of Iowa's leased agricultural land.<sup>233</sup> Findings from the survey showed that the majority of women farmland owners co-own their land with other family members. Other work has shown that women have a desire to keep their land in the family. Women's concerns for the environment ranked slightly higher than the need for income as it relates to their management decision making.<sup>234</sup> The only woman I interviewed in Paraná was a manager of one of the largest two farms. In Iowa, I only interviewed men, but in one case the farmer's wife contributed to the conversation occasionally. In the present day there are large differences in gender equality in farmland holding between Brazil and the United States. Social legislation has typically been quite conservative in Brazil. For example, it wasn't until 2001 that the Brazilian Congress approved a legal code that for the first time in the country's history made women equal to men in the eyes of the law. Currently in Brazil women are becoming increasingly involved in women's agriculture associations and participating in agriculture co-operatives.<sup>235</sup>

Another question this report could not answer based on its timeframe is how the

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233 Duffy, Michael and Darnell Smith. 2004. Farmland Ownership and Tenure in Iowa 1982-2002: A Twenty Year Perspective. Iowa State University Extension PM 1983. Available online at <http://www.extension.iastate.edu/Publications/PM1983.pdf>.

234 Wells, Betty, Diane Phillips, and Emily Neuman. 2004. "Cass County Women Farmland Owners: Survey Report." Women, Land, and Legacy <http://www.womenlandandlegacy.com/WLL-8pager-Nov1-3.pdf>

235 Guivant, Julia. "Agrarian Change, Gender and Land Rights: A Brazilian Case Study." Social Policy and Development. Programme Paper 14. United Nations Research Institute for Social Development. June 2003. [http://www.unrisd.org/unrisd/website/document.nsf/d2a23ad2d50cb2a280256eb300385855/f8ea8ce638eba384c1256d560030a7d7/\\$FILE/guivant2.pdf](http://www.unrisd.org/unrisd/website/document.nsf/d2a23ad2d50cb2a280256eb300385855/f8ea8ce638eba384c1256d560030a7d7/$FILE/guivant2.pdf)

long term agricultural commodities market and ethanol mandates will affect the farmers' land use decision-making. For instance, how well do 10-15 year conservation contracts of those USDA programs intersect the time period in which food crops will be involved in ethanol production? Will corn still be the main feedstock for ethanol when these particular interviewed farmers' conservation contracts come up for expiration in 5-10 years? In Paraná, will sustainability criteria and conservation support from Europe alter the sugarcane ethanol production chain?

Price signals or other considerations for other commodities, such as soybeans, might also affect the acreage devoted to corn. The USDA "prospective planting" report on March 31, 2008 stating that there will be relatively more soybeans and relatively fewer corn planted in 2008 than in 2007 is an example of this mechanism.. Would either biofuel mandates or other economic considerations drastically alter the natural crop "see-saw?" Conservation issues would be still pertinent under these scenarios, as CRP or other conservation programs may fluctuate; the focus is merely on increased commodities in general, and not just on corn for ethanol.<sup>\*236</sup> All together, there are a number of interesting and relevant questions that still exist on the subject of conservation planning or consideration in the face of increased ethanol crops.

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\* For instance, a USDA Agricultural Projections Report predicts, CRP acreage to decline through 2011, then increase later in that decade.

236 "USDA" Agricultural Projections to 2017 Report. Interagency Projections Committee. Office of the Chief Economist. USDA. February 2008. [http://www.usda.gov/oce/commodity/archive\\_projections/USDAAGriculturalProjections2017.pdf](http://www.usda.gov/oce/commodity/archive_projections/USDAAGriculturalProjections2017.pdf)

## **6.7. Conclusion**

The area devoted to ethanol crop production has increased in both Brazil and the United States. With all the data and analysis in this report, this conclusion has four components: conservation programs, land use and alternative crop choices, economics, social issues, and finally the farmer perceptions of the future of ethanol.

What role does conservation (for biodiversity and soil resources particularly) play in the decision-making of sugarcane farmers in Paraná and corn growers in Iowa? The short answer is even though farmers probably think economically and financially first; there is room for a conservation ethic. With the data I have, it is apparent that Iowa farmers engage in the USDA conservation programs more than the farmers in Paraná embrace and meet the legal reserve requirement. I hypothesized that the Paranáense farmers would have a harder time meeting certain thresholds in their conservation programs than their Iowan counterparts, and my work and data bore that conjecture out. It should be noted however in both cases a smaller group of those farmers I interviewed held more unconventional, more conservation based world views. This is an important point. If the situation in Paraná is one of widespread noncompliance for this native landscape mandate, and if Brazil is a model for sugarcane ethanol production that should be replicated in other subtropical and tropical regions, up and coming ethanol producers should look to these two case studies. Are their conservation and biodiversity incentives and mandates more similar to Paraná or Iowa? In general, those who promote increased ethanol production should take these two case studies into account when moving on policy.

Paraná and Iowa has made the most of agriculture, so there is not much native vegetation and ecosystems left in either place, so any increases in area for ethanol feedstocks would come from other crops and not more widespread land clearing.

A handful of farmers in both case studies talked about being close to the margin on operating costs and revenues, and these particular farmers had operations on the smaller side. One farmer in Paraná said he was “a slave to the [ethanol and sugar] market.” One smaller farmer in Iowa described how he farmed in “a dog-eat-dog” world. Inflation may also be a concern. In Iowa, farmers were split over whether the high commodity prices drove general inflation for input and production costs and in their local farming communities. The Iowa farmers were, however, all grappling with higher land prices. One or two farmers in both Paraná and Iowa described how they were apprehensive about increased farm size in their area and accelerated consolidation in the ethanol and agricultural sector and what they mean for their operations.

This project can also conclude that the social and labor issues in Paraná are dramatically different than in Iowa. It is more labor-intensive and greater tensions exist between workers and the farm operators. In Paraná, labor and social questions will linger.

Ethanol production in both Paraná and Iowa has a secure future with high oil prices and legislative mandates supporting those sectors. Farmers of both groups therefore are optimistic, and look forward to new markets, in Paraná this means new overseas customers, and especially in Northern Iowa this means new markets for corn materials previously not commercially valuable.

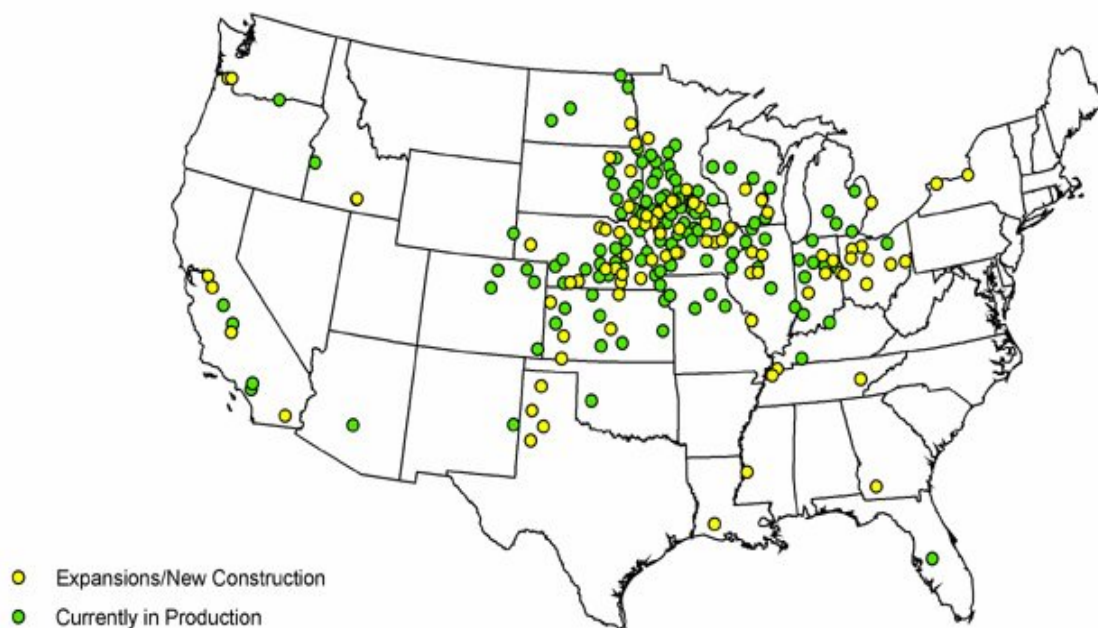
What the recommendations of this project? In Paraná, international collaboration, particularly with Europe, should be developed and maintained in order to resolve conservation and ecological issues. Applying a consistent transferable development right (TDR) program would also improve the noncompliance for the Forestry Code.

In the United States, land tenure issues emerge in Iowa; most corn growers operate a mix of owned and rented farmland. What would the best way to harmonize the time horizons of conservation contracts (CRP) or other environmentally friendly management practices and farmer-farmer rental agreements? As explained earlier, the conservation management strategies can differ on rented than on owned land. Additionally, new legislation should give weight to conservation and not downplayed.

Overall recommendations for both the Paraná ethanol sugarcane and Iowa corn ethanol production systems include continued technological advances and integration and ensuring the health of local economies. Finally, a balance must be struck for the need for sustained conservation practices and a measured biofuels policy; one must target individual farmers and institutions to build a policy from the ground-up.

**Figures**

**Chapter 1 Figures:**



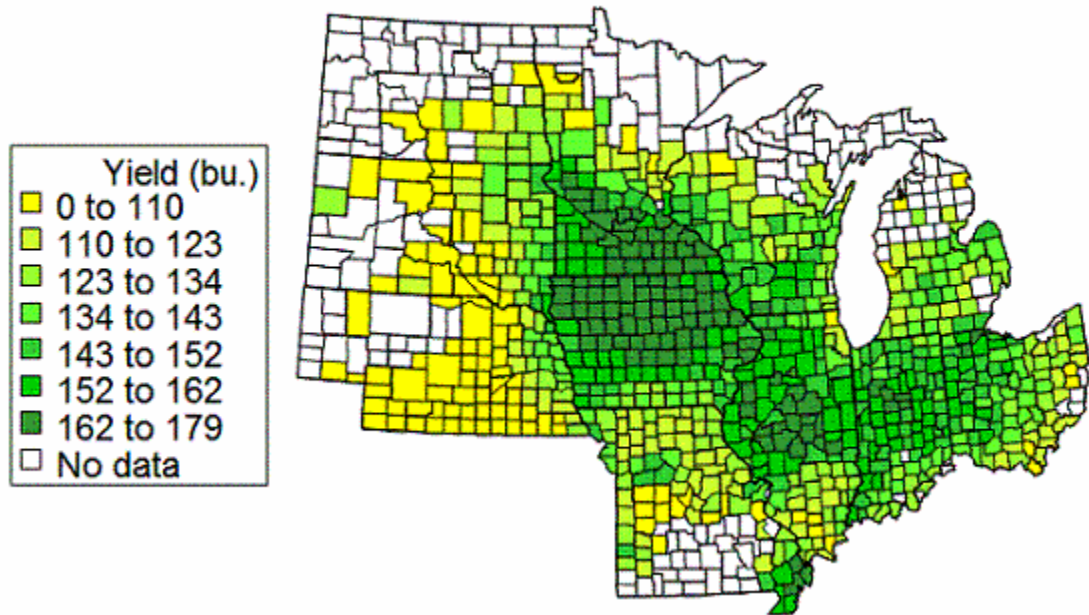
**Figure 1 Map of Existing and Future U.S. Ethanol Plants (as an example of where corn is grown)**

(From Iowa State University's Center for Agricultural and Rural Development<sup>237</sup>)

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<sup>237</sup> "Ethanol Plants." Center for Agricultural and Rural Development. Iowa State University.  
<http://www.card.iastate.edu/research/bio/tools/ethanol.aspx>

**Appendix Figure 1. 2007 Expected Corn Yields.**

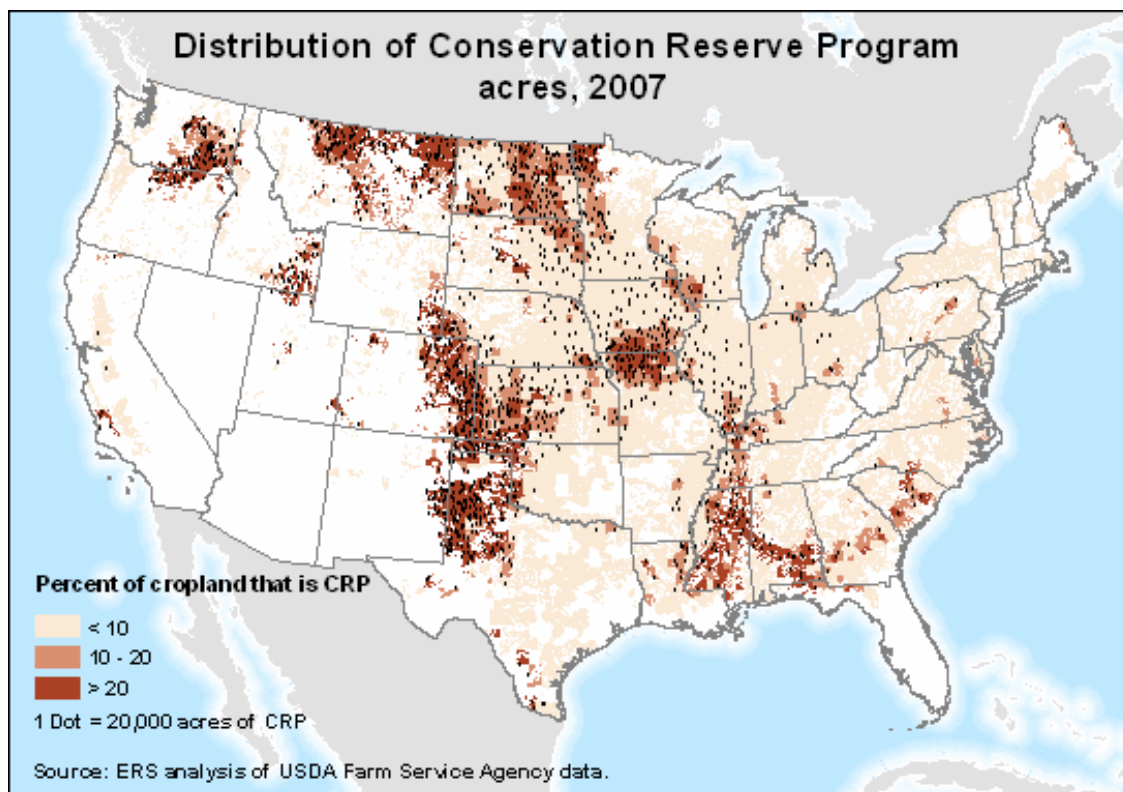


(From Farmer Business Management)<sup>238</sup>

**Figure 2 2007 Corn Yield Upper Midwest (the Corn Belt)**

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238 Schnitkey, Gary. "Future Increase In Corn Acres Will Vary Across the Corn-Belt." Farm Business Management. Farm Economics Facts and Opinion September 15, 2006. University of Illinois. [http://www.farmdoc.uiuc.edu/manage/newsletters/fefo06\\_15/fefo06\\_15.html](http://www.farmdoc.uiuc.edu/manage/newsletters/fefo06_15/fefo06_15.html)

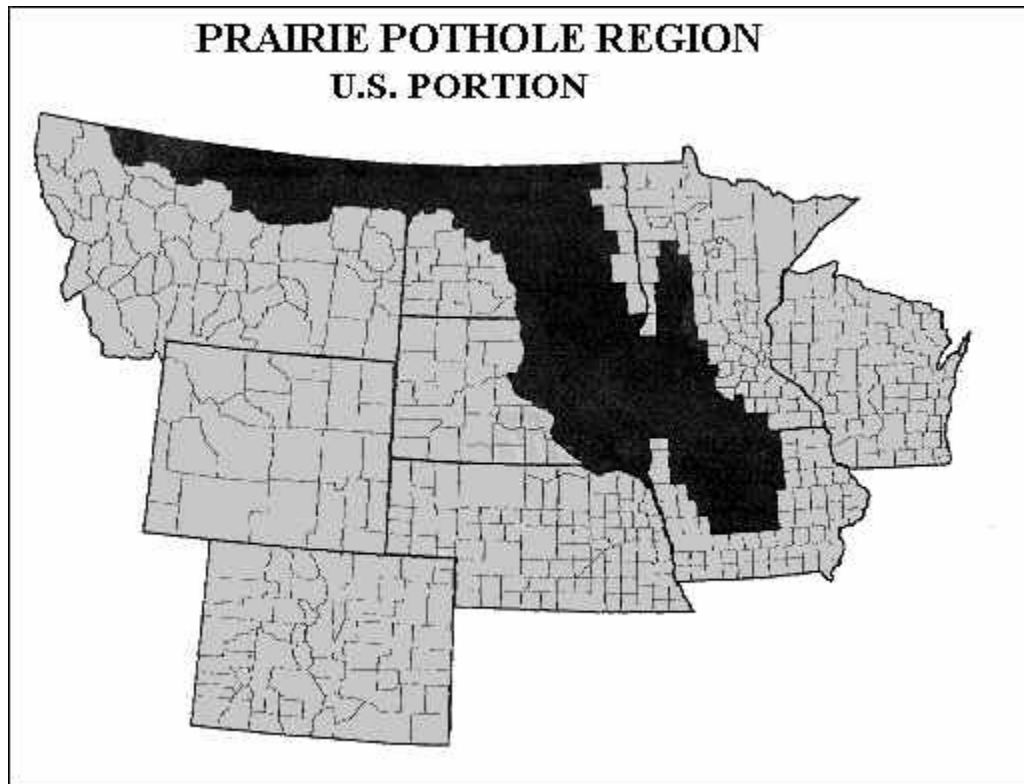


**Figure 3 CRP Lands in the United States**

(From the United States Dept. of Agriculture Economic Research Service)<sup>239</sup>

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239 "Geographic Distribution of Farm Program Characteristics." ERS/USDA Briefing Room. Farm and Commodity Policy.  
<http://www.ers.usda.gov/Briefing/FarmPolicy/maps.htm>



**Figure 4 Prairie Pothole Region of the U.S. Midwest**

(From the Northern Prairie Wildlife Research Center, United States Geological Survey)<sup>240</sup>

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<sup>240</sup> Kraus, Scott. "Researchers will present information at National Conference. First North American Duck Symposium will highlight research, in exchange to get the word out faster." <http://www.npwr.usgs.gov/news/press/ducksymp.htm>



From (Brazilian Cachaça<sup>241</sup>)

**Figure 5 Sugarcane Growing Areas in Brazil**

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241 Morgan, Brian. "Brazilian Cachaça." Trade and Environment Database The Mandala Projects. American University. <http://www.american.edu/TED/cachaca.htm>



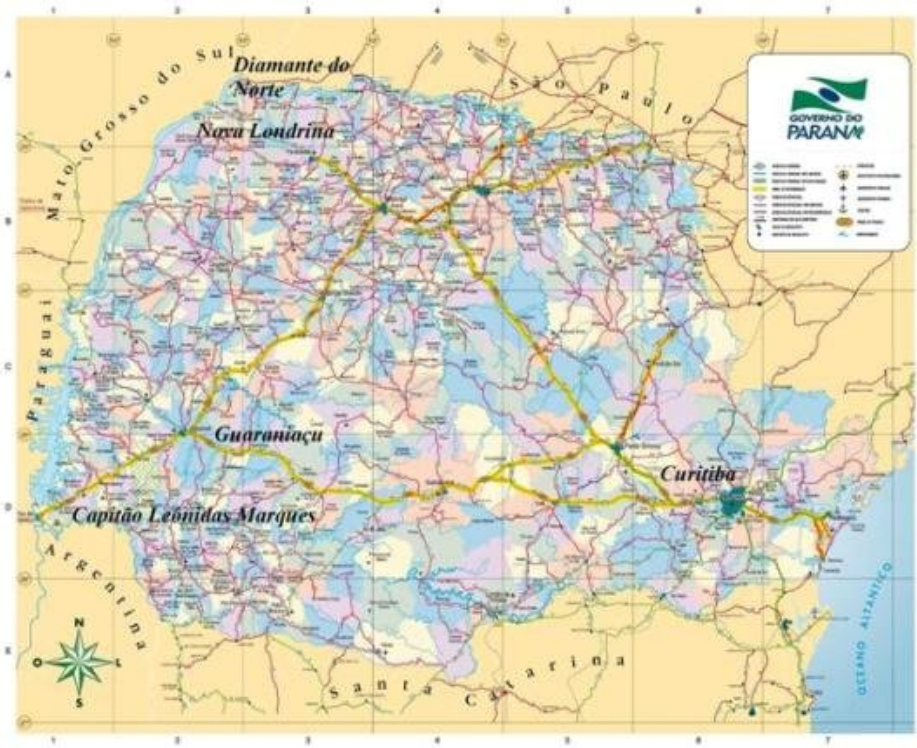
**Figure 6 Former Range of the Atlantic Rainforest**

(From Conservation International)<sup>242</sup>

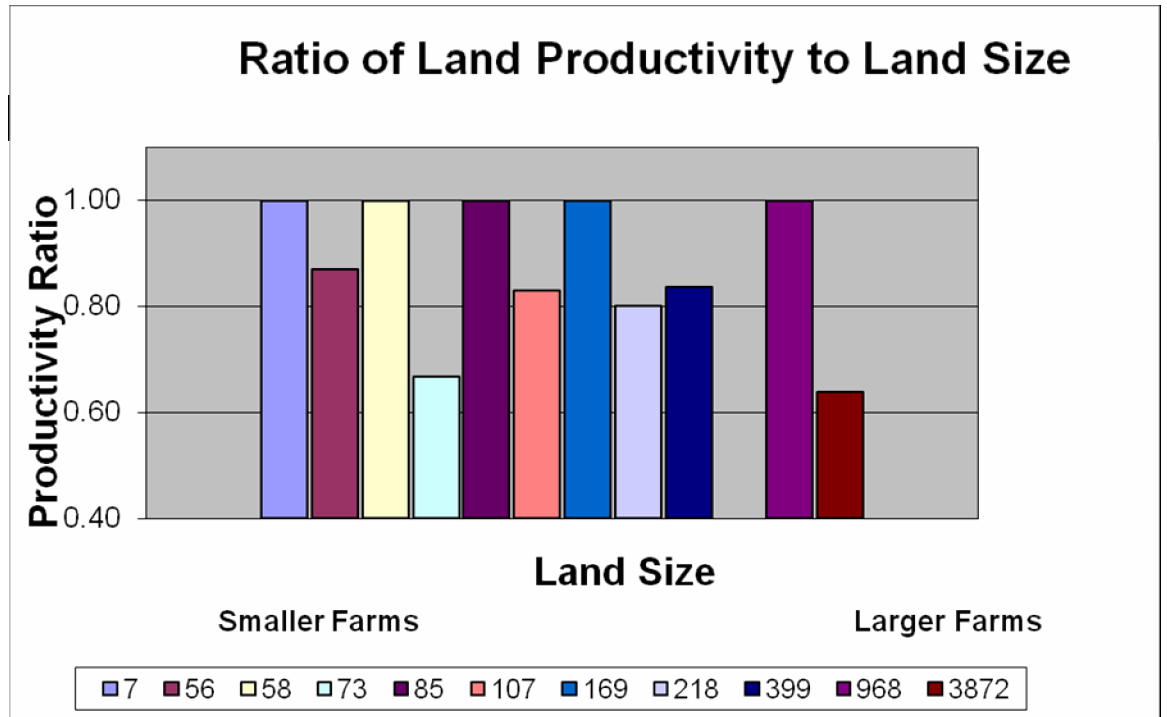
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242 "Atlantic Forest." [http://web.biodiversityhotspots.org/xp/Hotspots/atlantic\\_forest/](http://web.biodiversityhotspots.org/xp/Hotspots/atlantic_forest/)

**Chapter 4 Figures:**



**Figure 4.1** (Modified from State of Paraná Highway Map)



**Figure 4.2.** Ratio of Land Productivity to Land Size

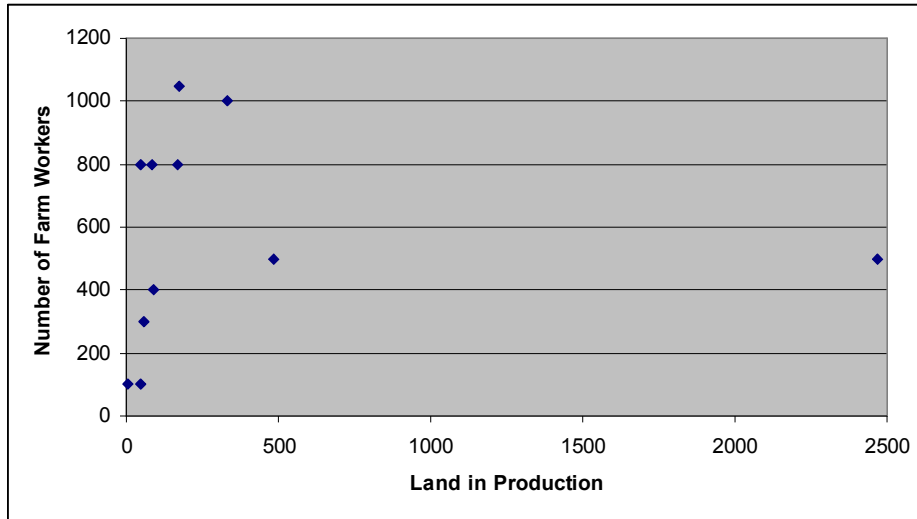


Figure 4.3 Association between productive hectares and number of workers

Chapter 5 Figures:

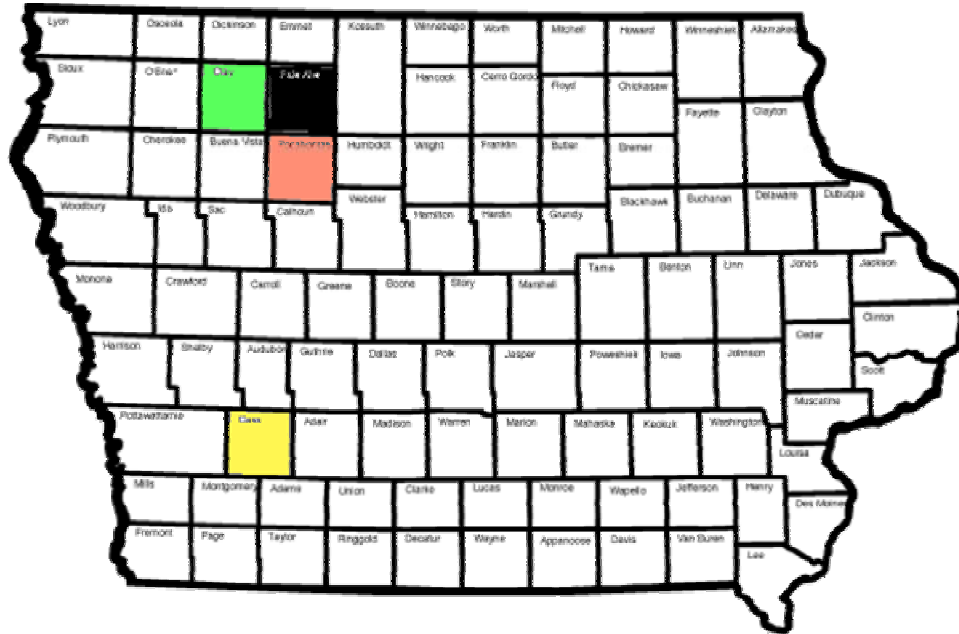
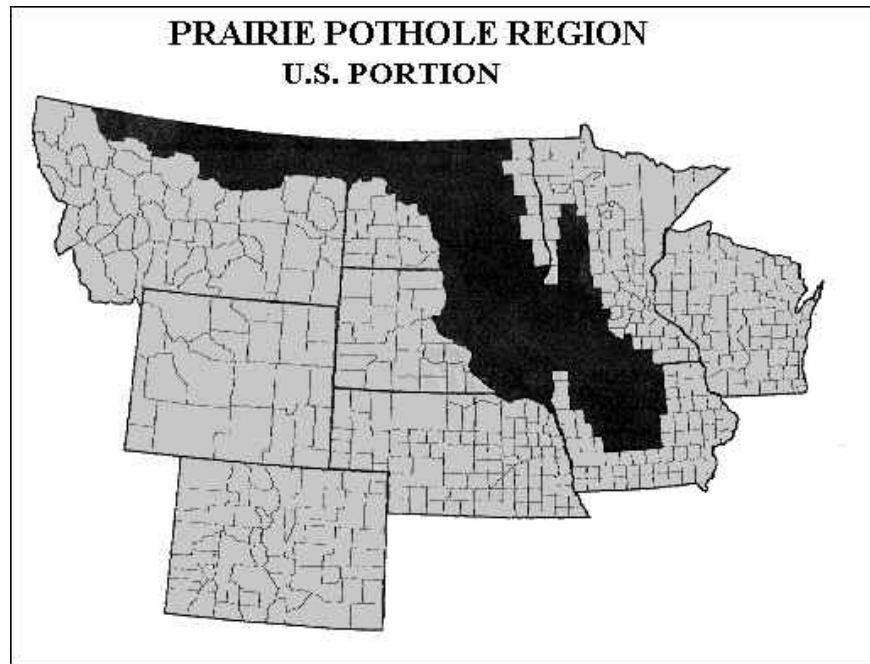


Figure 5.1 County Locations: Clay (Green), Palo Alto (Black), Pocahontas (Light Red) and Cass Counties (Yellow)

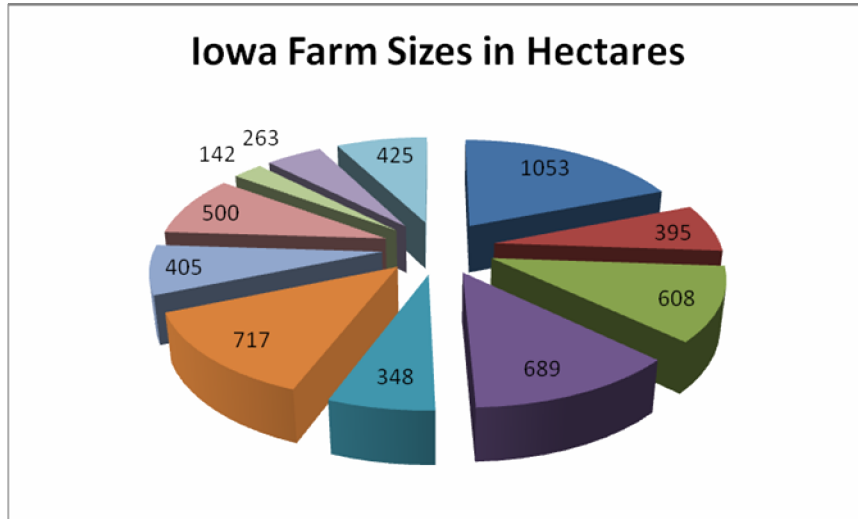


**Figure 5.2** Prairie Pothole Region (From the Northern Prairie Wildlife Research Center, United States Geological Survey)<sup>243</sup>

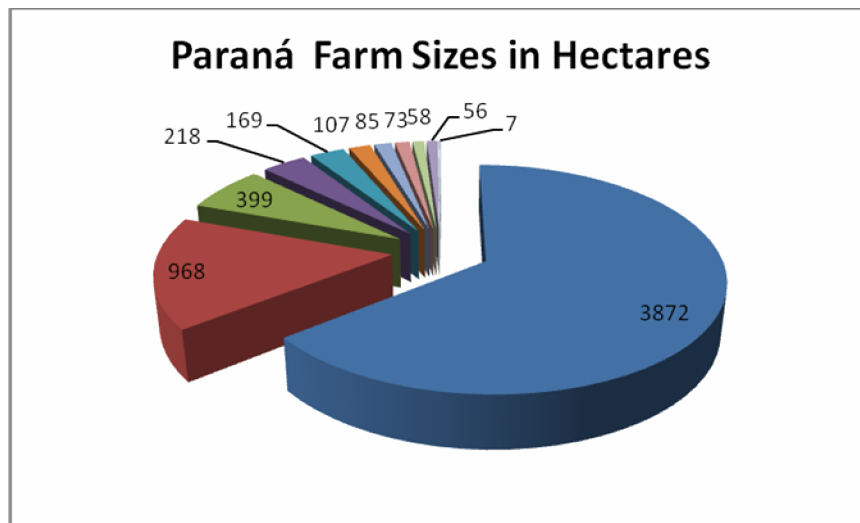
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<sup>243</sup> Kraus, Scott. "Researchers at Northern Prairie Science Center will present information at national conference First North American Duck Symposium will highlight research, in an exchange to get word out faster." The Jamestown Sun, Saturday, February 8, 1997  
<http://www.npwr.usgs.gov/news/press/ducksymp.htm>

**Chapter 6 Figures:**



**Figure 6.1** Comparisons of land area for farms surveyed in Four Counties (Cass, Pocahontas, Palo Alto, and Clay Counties) Iowa November 12-16, 2007



**Figure 6.2** Comparisons of land area for large and small ethanol sugarcane farms surveyed from the municipalities of Diamante do Norte and Nova Londrina, Paraná July 7-12, 2007.

## **Appendix 1 Brazilian Sugarcane Farmer Questionnaire**

First Name

How many people work your land?

How many hectares of land do you have?

How many acres of that land are in agricultural production currently?

What crops do you have (besides sugarcane)?

What farming tools and techniques do you use?

Why did you choose to grow these crops?

Do you own the land you farm?

How did you acquire it?

How do you see the local economics of sugarcane? (How might it help?)

Do you use Round-Up or other types of pesticides?

Often the producer added other comments as well (on the American tariff, etc.) so we documented those thoughts in an “Extra” section below the main questionnaire.

**Appendix 2 Question for Iowa Corn Farmer Questionnaire**

First Name

How many people work your land?

How many hectares of land do you have?

How many acres of that land are in agricultural production currently? Has this amount changed over time?

What crops do you have (besides corn)?

What farming tools and techniques do you use?

Why did you choose to grow these crops?

Do you own the land you farm?

How did you acquire it?

What sort of biodiversity (wildlife, plants) do you see in your fields?

Have the recent economics of corn and ethanol affected this biodiversity?

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