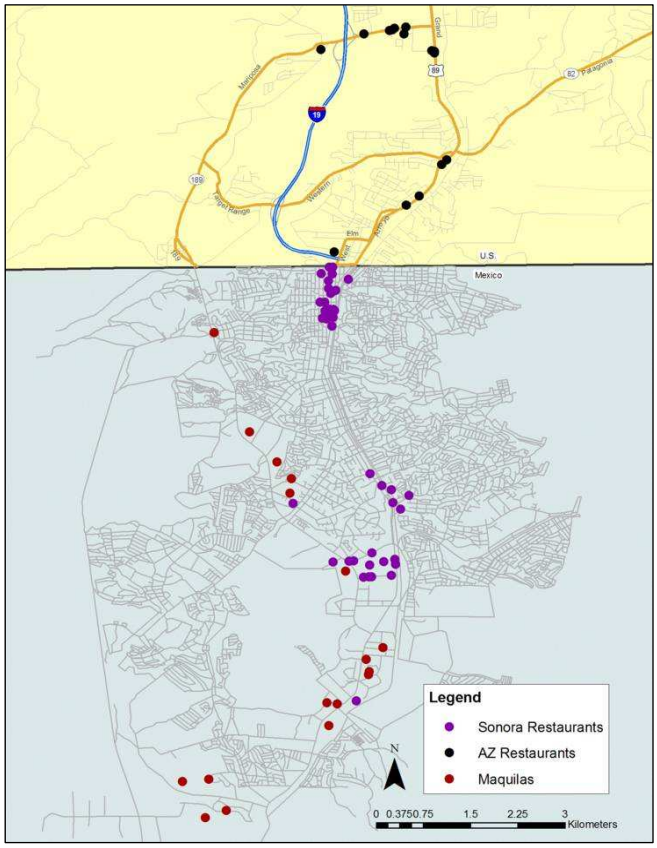
The Biodiesel Capacity Building and Demonstration Project in Ambos Nogales: An Assessment of the Potential for Biodiesel Production to Alter Present Use and Disposition of Waste Vegetable Oil and Grease



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May 2008

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May 2008

Table of Contents

List of Tables

List of Figures

Acknowledgements

This phase of the Biodiesel Project would not have been possible without the financial support of the U.S. Environmental Protection Agency and the cooperation and help of many individuals, groups, organizations, and institutions in the states of Sonora, Mexico and Arizona, United States. More specifically, each aspect of this project required the collaboration—one that was often bilingual, binational, intergenerational, and multicultural—of numerous people in Ambos Nogales and the surrounding areas. Our sincere thanks go to each and every individual who contributed to this project and particularly to: Irma Veronica Gil Delgado, student and survey coordinator from the Instituto Tecnológico de Nogales (ITN); Irma Fragoso and students from her Sustainable Development course at ITN who helped design and conduct interviews at maquiladoras in Nogales, Sonora; Estela-Maria Diaz and students from the Southeast Arizona Area Health Education Center (SEAHEC) Health Career Club of Nogales High School who helped design and conduct interviews at cafeterias and restaurants in Nogales, Arizona; and student researchers from the Bureau of Applied Research in Anthropology (BARA) at the University of Arizona who were conducting the Evaluation of Small Scale Burning in Nogales, Sonora and helped design and conduct interviews at restaurants in Nogales, Sonora. Thanks also to Catherine Varley, graduate student at the University of Arizona, for her outstanding contributions during the early phases of the development of this project and for helping ensure this project moved forward. We also appreciate the invaluable assistance and patience provided by the administrative staff at the University of Arizona's Bureau of Applied Research in Anthropology, especially Armando Vargas and Maria Rodriguez.

Thanks to the Biodiesel Project participants who reviewed drafts of the surveys and offered valuable suggestions, especially Chief Mike Foster and Mark Gerbert of the Rio Rico Fire District (RRFD); Eduardo Rivas B., Eduardo Canizales, and Enrique Velez, of the Firefighters of Nogales (BN for its acronym in Spanish, Bomberos de Nogales); Hans Huth and José Rodriguez of the Arizona Department of Environmental Quality (ADEQ); Abril Quiroz and Dr. Alberto Ramirez of the Border Environmental Cooperation Commission (BECC); Karen Halverson and Suzanne David of the Southeast Arizona Area Health Education Center (SEAHEC); and Joel Gastelum and Alejandro Almaguer of the Association of Environmental Health and Safety Professionals (APSA for its acronym in Spanish, Asociación de Profesionales en Seguridad y Ambiente).

Finally, special recognition goes to the owners, managers, and staffs of the restaurants, cafeterias, and maquiladora kitchens who so graciously donated their time to answer questions and complete surveys. We hope that you all see the results of your hard work conveyed through this report.

1. Introduction

The Biodiesel Capacity Building and Demonstration Project in Ambos Nogales (Biodiesel Project) was designed and implemented to address significant environmental and health concerns in Ambos Nogales (Nogales, Sonora and Nogales and Rio Rico, Arizona) by developing the capacity for the production and use of biodiesel in these border communities. The project was initially funded as part of the Border 2012 program, a collaboration between the United States and Mexico to improve the environment and protect the health of border residents. Additional financial and material support was provided by Friends of the Santa Cruz River, a non-governmental organization of southern Arizona, Turner Labs, and Alcoa.

The binational program focuses on improving air quality, providing safe drinking water, reducing risks from exposure to hazardous waste, and ensuring emergency preparedness along the U.S.-Mexico border (see USEPA nd). The specific goals of the Biodiesel Project were to reduce water and air contamination by reclaiming waste vegetable oil and grease, converting it into biodiesel, and demonstrating the use of the fuel in school and public sector safety vehicles in Nogales, Sonora and Rio Rico, Arizona.

The Biodiesel Project was conceived as a binational, collaborative effort of public and private-sector institutions in northern Sonora (municipality of Nogales) and southern Arizona (Santa Cruz and Pima counties). Project Partners include the Rio Rico Fire District (RRFD), Firefighters of Nogales (BN), Privados Portatiles S.A. de C.V. (PP), Rio Rico Rentals (RRRI), the Southeast Arizona Area Health Education Center (SEAHEC), Instituto Tecnológico de Nogales (ITN), and the University of Arizona (UA), with support from the Arizona Department of Environmental Quality (ADEQ), the Public Safety Association of Santa Cruz County (PSA-SCC), Pima County Association of Government Clean Cities Coalition (PAG-CCC), and the Association of Environmental Health and Safety Professionals (APSA).

The Biodiesel Project was designed to be carried out through nine specific tasks, as shown in Table 1. This report begins with background information on biodiesel production and use and summarizes the findings for Tasks 2, 3, and 4.

Table 1.1. Biodiesel Project Tasks and Partners Responsible for Carrying them Out

#	Task	Responsible Partner(s)
1	Establish and operate facilities for small-scale biodiesel production and testing on each side of the Arizona-Sonora border	Privados Portatiles S.A. de C.V, Rio Rico Rentals*
2	Gather and map data on local producers of waste cooking oil and grease	Southeast Arizona Area Health Education Center (SEAHEC), Instituto Tecnológico de Nogales (ITN), and the University of Arizona (UA), with support from the Asociación de Profesionales en Seguridad y Ambiente (APSA)
3	Estimate the amount of waste vegetable oil entering the waste stream that can be offset through recycling	SEAHEC, ITN, and UA, with support from APSA

4	Identify local users of biodiesel, waste vegetable oil, and glycerin	SEAHEC, ITN, and UA, with support from APSA
5	Submit samples of locally produced biodiesel for ASTM testing	Privados Portatiles S.A. de C.V, Rio Rico Rentals, ITN
6	Use locally produced biodiesel in diesel engines operated by public entities	Rio Rico Fire District, Bomberos de Nogales, ITN
7	Conduct baseline and post-biodiesel use performance assessments and emissions tests of vehicles	Arizona Department of Environmental Quality
8	Conduct education and outreach to waste cooking oil and grease producers about biodiesel and its potential for use in the Ambos Nogales	SEAHEC, ITN, and UA, with support from the Arizona Department of Environmental Quality, the Public Safety Association of Santa Cruz County, Pima County Associations of Government Clean Cities Coalition, and APSA
9	Develop a strategy for expanding production and use of biodiesel within Ambos Nogales	All project partners

*Note that during the project period the Rio Rico Fire District and Bomberos de Nogales took on some of the responsibility for establishing and operating facilities to produce biodiesel.

2. Biodiesel Production and Use: Background for the Ambos Nogales Biodiesel Project

Amid growing concerns about dwindling supplies of petroleum-based fuels and the environmental and social costs associated with global extraction and use of petroleum, attention to biodiesel and other biofuels has grown significantly in recent years. In short, biofuels are any fuels derived from biomass generated by recently living organisms or their metabolic byproducts. Of course, the production and use of biofuels are not without costs, and those costs vary depending on the source of biomass and the method of use of the final product. This section is included to provide information that will help a reader understand the Ambos Nogales Biodiesel Project in that context.

2.1. Biodiesel as a Potential Solution to Locally-Specific Problems

At the local level in Ambos Nogales, the production of biodiesel from waste oil and grease could address two environmental problems: improper disposal of waste oil and grease (especially in wastewater systems where it clogs pipes and causes system malfunction) and poor air quality (biodiesel produces almost no sulfur dioxides and significantly less particulate matter, carbon monoxide, and unburned hydrocarbons than petroleum diesel).

2.1.1. Environmental Concerns and the Potential for Biodiesel to Reduce Them

The municipality of Nogales, Sonora, is served by a binational wastewater conveyance system that forwards waste to the Nogales International Wastewater Treatment Plant in Rio Rico, Arizona. Water quality sampling at both the primary binational outfall as well as within the Nogales, Sonora, collection system indicates waste vegetable oil and grease is a problem for plant maintenance and leads to sewer clogs and overflows. At times, the overflows have contributed to untreated wastewater flows within Nogales Wash - a perennial surface water feature running through both communities and easily accessible by the public – and to the listing (303-d) of the Wash as impaired for *Escherichia coli* (E coli). Past investigations conducted at Instituto Tecnológico de Nogales (ITN) and the Arizona Department of Environmental Quality (ADEQ) suggest that improper disposal of waste vegetable oil and grease by commercial users of the conveyance contributes to the problem within the municipality. Through the Biodiesel Capacity Building and Demonstration Project in Ambos Nogales (Biodiesel Project), the collection of waste oil and grease from those who use it could provide an attractive alternative to the disposal of waste oil into the sewage system, thus reducing the problems noted above.

Particulate matter in Ambos Nogales has caused both Nogales, Arizona and Nogales, Sonora to violate the national ambient air quality standards of their respective countries. For this reason, Nogales, Arizona, and portions of Santa Cruz County – primarily Rio Rico – have been designated as a “Nonattainment Area” for particulate matter (Border 2012 ANAQTF and BLM-ESDS 2005). Particulate matter levels vary due to actions on the ground and also wind patterns; the highest concentration of small airborne particles have been found to occur in Nogales, Arizona in the morning and evening, when the winds are coming from the southeast (Anderson 2007). In Nogales, Arizona, PM_{10} (particulate matter 10 microns or less) levels rose consistently between 1995 and 2001, and despite a temporary decline, are on the rise again. The $150\mu/m^3$

standard for PM_{10} maximum 24-hour concentration has been violated consistently since 1998. In Nogales, Sonora, maximum 24-hour PM_{10} concentrations have exceeded the standard every year but one since 1997. In Nogales, Sonora, dangerous $PM_{2.5}$ (particulate matter 2.5 microns or less) levels have contributed to violations of the U.S. standard, though the 24-hour $PM_{2.5}$ levels have generally been within standard limits (ADEQ 1999). Diesel exhaust typically includes high levels of PM, especially $PM_{2.5}$, along with a variety of harmful gases and over 40 other known cancer-causing substances (CEPA nd).

In 2002, using publicly available data, the U.S. Environmental Protection Agency (USEPA) conducted a comprehensive analysis of the emission impacts of biodiesel and reported that, for heavy-duty highway engines, the addition of biodiesel to conventional petroleum diesel resulted in significant reductions of particulate matter, hydrocarbon, and carbon monoxide emissions, and that greater reductions were associated with increased percentages of biodiesel in the blend (USEPA 2002a). A 20 percent blend (referred to as B20) was shown to reduce particulate matter by 10.1 percent, hydrocarbons by 21.1 percent, and carbon monoxide by 11.0 percent. The USEPA also reported that the use of biodiesel reduced sulfates, polycyclic aromatic hydrocarbons (PAHs), and nitrated PAHs. Of the pollutants examined, the USEPA reported a 2 percent increase in nitrous oxides in a B20 blend, with an increase of up to 10 percent in B100 (100 percent biodiesel blend), though a number of studies have found that adjustment of injection timing and engine operating temperature reduces the levels of nitrogen oxides below petroleum diesel levels (e.g., Walker 1994, Marshall, Schumacher, and Howell 1995; see Keith Addison and Hiraga nd:a, for a summary). The Ambos Nogales Biodiesel Project aims to demonstrate the emissions reductions associated with the use of biodiesel blends in school and public sector safety vehicles on both sides of the Arizona-Sonora border.

2.1.2. Health Concerns and the Potential for Biodiesel to Reduce Them

Increasing attention has also been devoted to the negative effects of diesel emissions on human health. Particulate matter, for example, is a key factor in respiratory illness and an asthma trigger in both communities (ADHS 2004).

Substances within diesel exhaust, such as nitrous oxide, nitrogen dioxide, formaldehyde, benzene, sulfur dioxide, hydrogen sulfide, carbon dioxide, and carbon monoxide, have been directly linked to pulmonary, cardiovascular, and neurobehavioral disorders and diseases. For example, exposure to harmful diesel exhaust has been linked to retardation of pulmonary growth in children. Diesel fumes can also cause nausea and vomiting; wheezing; tightness in the chest; loss of balance; irritation of the eyes, throat and nose; and if exposure is long-term, impaired memory and cancer (ALA-C nd).

In Ambos Nogales, particular concern has been expressed about diesel emissions from commercial trucks and the health risks these emissions present to people who work at the border as well as to the larger community. Approximately 70 percent of all fresh produce consumed in the United States and Canada during winter months is grown in Mexico and imported through Ambos Nogales. Commercial truck traffic peaks seasonally in relation to the produce season, which generally runs from November through March, with the heaviest months being January and February. During these months, approximately 1,100 produce trucks enter the United States

daily, on average; peaks can be as high as 1,300 produce trucks per day (Border 2012 ANAQTF and BLM-ESDS 2005).

Attention has also been paid to diesel school buses. Children are particularly susceptible to the negative effects of diesel emissions because per pound of body weight they take in twice the amount of air as adults, increasing their exposure to these harmful emissions (USEPA 2002b). Children who ride diesel-powered buses are at risk from long-term repeated exposure to the substances in the diesel exhaust. Recently the Santa Cruz Valley Unified School District undertook a project to retrofit its school bus fleet with the ultimate goal of reducing diesel emissions (Gaines, Herr, and Austin 2008).

The reductions in emissions of pollutants such as particulate matter, carbon monoxide, and hydrocarbons which accompany the use of even a 20 percent biodiesel blend (B20) will also reduce the health risks associated with those pollutants. The Ambos Nogales Biodiesel Project aims to demonstrate the feasibility of using biodiesel blends in school and public safety sector vehicles with the goal of reducing the health risks to those who operate and use those vehicles, as well as to those in the communities within which they are driven.

2.2. Biodiesel and Biofuels: A Broader Context for the Ambos Nogales Project

The two principal biofuels that are presently receiving significant attention in the United States are ethanol and biodiesel. Both promise potential environmental benefits, but those benefits are directly related to the source of biomass used to produce the fuels. Some unforeseen, or overlooked, environmental and economic costs such as increases in global prices for staple food crops associated with the conversion of agricultural land for the production of crops for fuel, have caused negative public response to biofuels. The Ambos Nogales Biodiesel Project will use only waste oil and grease for the production of biodiesel, but it may lead to greater interest in and questions about this fuel, so this section provides some of the background needed to understand this project in relation to other efforts to produce biofuels.

2.2.1. Ethanol

Probably the most well known alternative biofuel available is ethanol. As opposed to biodiesel, which replaces petroleum diesel, ethanol is used as a replacement for gasoline. Ethanol burns more cleanly and completely than gasoline or diesel fuel. It can be produced from any material rich in cellulose or sugar, which is ground down and essentially boiled and evaporated like regular alcohol, except with the addition of special enzymes.

Ethanol works in most standard gasoline combustion engines at low concentrations, and a 10 percent ethanol blend with gasoline has become standard throughout the United States. Ethanol is touted as carbon neutral because the carbon dioxide released by burning it has been captured during photosynthesis within months or years of its combustion, as opposed to the long delay associated with the carbon capture/release of fossil fuels such as gasoline. Still, calculations of the benefits of ethanol must also take into account the fertilizer and pesticide use (often supplied by petroleum-based chemicals) involved in the production of the crops used to produce ethanol and the transportation of those supplements as well as the fuel itself. Corn and sugar cane are the

most common crops that are used for making ethanol, and the economic, environmental, and sometimes social costs of producing these crops must be taken into any evaluation of ethanol as an alternative fuel. Recent studies have calculated that ethanol from corn produces roughly 25 percent more energy than is consumed in growing the corn and producing and delivering the fuel (Hill et al. 2006).

2.2.2. Biodiesel

Biodiesel is made from vegetable oils, animal fats, and algae; is a replacement for diesel; and has a greater net efficiency than ethanol. As a fuel, biodiesel can be used directly in diesel engines as B100 (100 percent biodiesel), or in distillate blends with petroleum-based diesels, resulting in blends of B20, B05, etc. In the United States, biodiesel has been approved by the USEPA and carries an ASTM standard (see EMA 2006 for details); in Mexico, is it considered an additive to petroleum diesel. Two venders in Tucson are already offering B100, and the city also hosts a couple of biodiesel cooperatives, in which members make and use their own biodiesel, using waste oil collected from restaurants. Similar projects are springing up elsewhere in the United States and Mexico and around the world.

Biodiesel can be used in any diesel engine with little to moderate retrofitting. Some older engines may need to be retrofitted with viton tubing because the older form of rubber tubing can be corroded by biodiesel. Newer diesel vehicles, however, do not require any modifications in order to run on biodiesel. When biodiesel is first used in a car that has been run on petroleum diesel for a long time, the biodiesel cleans out the sticky debris left by the petroleum diesel, so the fuel filter quickly fills up with tar-like deposits and must be replaced.

Biodiesel can be produced from a wide variety of vegetable oils and animal fats, as well as from algae, and its benefits vary according to the raw inputs that are used in its production. For example, when biodiesel is produced from crops and other cultivable plants, the resulting product is known as “agri-biodiesel.” When derived from crops that are harvested from land that is already in production, biodiesel can produce only 59 percent of the greenhouse gases of petroleum diesel. However, as shown in Table 2.1, different plants produce usable oil at different rates, and this significantly affects the ultimate efficiency of biodiesel.

The operating characteristics of biodiesel also vary according to the source of the biomass used in production. Biodiesel fuels are thicker than regular diesel and become too thick to use at low temperatures. In general, for example, a B20 blend can be used down to -13°C (its cloud point) while a B100 blend can only be used to about 0.8°C (DBAE-UI 2005). Biodiesel made from cooking oil can be used at lower temperatures than that produced from soybeans.

Likewise, the USEPA (2002a) found that biodiesel impacts on emissions varied depending on the type of biodiesel used (the study considered only soybean, rapeseed, or animal fats) and on the type of conventional diesel to which the biodiesel was added. Both rapeseed and animal fats generated greater reductions in carbon monoxide and particulate matter, and produced fewer nitrous oxides, than did soybean-based biodiesel.

Table 2.1. Comparative Biodiesel Production Efficiencies of Various Agricultural Products (Source: Addison and Hiraga nd:b; Authors' Note: The data are compiled from a wide variety of sources. The yield figures are most useful as comparative estimates because crop yields vary widely.)

Crop	kg oil/ha	litres oil/ha	lbs oil/acre	US gal/acre
corn (maize)	145	172	129	18
cashew nut	148	176	132	19
oats	183	217	163	23
cotton	273	325	244	35
hemp	305	363	272	39
soybean	375	446	335	48
coffee	386	459	345	49
linseed (flax)	402	478	359	51
hazelnuts	405	482	362	51
pumpkin seed	449	534	401	57
coriander	450	536	402	57
mustard seed	481	572	430	61
sesame	585	696	522	74
safflower	655	779	585	83
rice	696	828	622	88
peanuts	890	1059	795	113
rapeseed	1000	1190	893	127
olives	1019	1212	910	129
jojoba	1528	1818	1365	194
jatropha	1590	1892	1420	202
avocado	2217	2638	1980	282
coconut	2260	2689	2018	287
oil palm	5000	5950	4465	635

Several potential sources of biodiesel are discussed in greater detail in the following sections to provide a glimpse at the issues that have emerged in the search for economically feasible and efficient sources of biodiesel. With the current interest in biodiesel, it can be expected that new sources, and especially new blends, will continue to be discovered and developed over the next several years.

Soybeans as a Source

U.S. soybean growers have been influential in urging the USPEA to officially approve biodiesel as a non-toxic alternative fuel (Estill 2005). Unfortunately, as shown in Table 2.1, soy has little oil content in comparison to other crops that are used elsewhere in the world and, on a smaller scale in the United States, for biodiesel production. Nevertheless, researchers estimate soybean biodiesel nets 93 per cent more energy than the amount required to produce the fuel (Hill et al. 2006). Also, because soybeans are already widely grown and subsidized in the United States, and because of the strength of the soy industry lobby, soybeans are currently the source for much U.S.-produced biodiesel.

Palm as a Source

Oil palms have particularly high oil content and are grown in the tropical regions of the world where labor is often relatively cheap, so palm oil is cheaper to produce than most other raw oils that can be converted to biodiesel. Biodiesel producers who are primarily concerned with economic efficiency and profit are thus attracted to palm oil as a raw input, even though it has to be shipped to the United States from overseas. Unfortunately, a serious negative consequence of palm production is the deforestation of tropical Southeast Asia, as forests are cleared to establish the palm plantations (UNDP 2007). In addition, due to substantial amount of saturated fats in palm, the palm biodiesel has poor low temperature properties (Sarin et al. 2007).

Jatropha as a Source

Many crops that can be used in biodiesel production require irrigation, and that, combined with the energy required for harvesting them, transporting them, and crushing them to extract the oil, threatens to make biodiesel production inefficient. Some new projects being developed in India and arid parts of Africa and Latin America are popularizing arid-land crops, such as jatropha, that can be used for making biofuels and also provide economic development opportunities. However, Jatropha biodiesel has poor oxidation stability, though it shows good low temperature properties. Researchers have tried combining Palm biodiesel, which has good oxidative stability but poor low temperature properties with jatropha for use in South and Southeast Asia and have found that the combined fuel achieves both better low temperature properties and improved oxidation stability (Sarin et al. 2007).

Algae as a Source

Algae can be used to produce both ethanol and biodiesel, though commercial production is in its infancy. Growing algae for biodiesel has particular potential at power plants that emit a lot of carbon dioxide. Some of the carbon dioxide can be consumed by algae, if directed through an algae filter, drastically reducing the carbon dioxide emissions from the power plant while producing a source for biofuel production. The algae is then separated from the water, leaving a biomass which can be converted to biodiesel with a yield of 5,000 to 10,000 gallons per acre (roughly 7,654 to 15,309 liters per hectare). Similar results have been achieved for ethanol as well.

A New Zealand-based company, Aquaflow Bionomic Corporation, has been a leader in the commercial production of biofuels from algae (see ABC nd). In the United States, the Arizona Public Service Company (APS) and GreenFuel Technologies Corporation announced in December 2006 that they had successfully recycled the carbon dioxide emitted through the stack gases at the Arlington, Arizona power plant into transportation grade biofuels (see Arizona Venture Capital 2006).

Recycled Oil and Grease

The production of biodiesel from waste oil and grease can be distinguished from the above alternatives because it is a process of recycling the waste oil and grease rather than producing

new oil from plants or algae. It is important to note that only yellow grease, which is most commonly derived from vegetable oil, can be used in the production of biodiesel. Brown grease, which is derived from sewage traps in restaurants and also known as “trap grease,” has approximately five times the free fatty acids as yellow grease and therefore is not acceptable for biodiesel production as a stand alone feedstock (Geise 2003).

With significant retrofitting, some vehicles can be made to run directly on certain types of waste vegetable oils (see Addison and Hiraga nd:b). Converting the waste oil to biodiesel makes it possible for the fuel to be used in any diesel engine and thus allows many more users to take advantage of waste oil as a resource. Using recycled oils also offers environmental benefits over using raw crops for biodiesel, since it does not involve clearing of forests, use of pesticides, irrigation, or long-distance shipping.

The amount of waste vegetable oil and grease available for the production of biodiesel is determined by both the amount of waste produced and the amount used for other purposes. Rick Geise (2003), of Griffin Industries, Inc., a rendering company in Kentucky that has been producing biodiesel since 1998, has estimated the total inedible tallow and grease produced in the United States to be 10 billion pounds. Of this, 1.5 to 2 billion pounds are not currently being consumed domestically or exported for consumption outside the country and are therefore available for conversion to biodiesel even if no changes are made in existing supply and demand. If converted, 1.5 billion pounds of yellow grease would result in 200 million gallons of B100 or 1 billion gallons of B20 (Geise 2003).

3. The Ambos Nogales Project

As noted above, the Ambos Nogales Biodiesel Capacity Building and Demonstration Project (Biodiesel Project) was designed to establish facilities for small-scale biodiesel production on both sides of the Arizona-Sonora border. Faculty and student researchers from the University of Arizona (UA), Instituto Tecnológico de Nogales (ITN), and the Southeast Arizona Area Health Education Center's Health Career Club at Nogales High School (SEAHEC/NHS) contributed to the project by gathering and mapping data on local producers of waste cooking oil and grease; identifying local users of biodiesel, waste vegetable oil, and glycerin; and then estimating the amount of waste vegetable oil entering the waste stream that could be offset through recycling.

3.1. Locating Sources of Waste Oil

To begin, researchers from the UA, ITN, and SEAHEC/NHS identified potential sources of waste oil and grease in Ambos Nogales. Nogales, Sonora, with a population of at least 300,000, is much larger than Nogales, Arizona, with 21,000 residents, or even all of Santa Cruz County, with an estimated 2006 population of 43,000. The vast difference in population, as well as the markedly different socioeconomic organization of the two communities, required a different approach to gathering data on each side of the border. On the Mexican side, restaurants and the cafeterias serving maquiladoras were identified as the most significant sources because, cumulatively, they serve thousands of visitors and workers each day. In addition, in contrast to Arizona, where most schools have cafeterias that prepare food onsite, few schools in Nogales, Sonora cook food for the students. On the U.S. side of the border, the potential sources of waste vegetable oil and grease were determined to be restaurants and the cafeterias serving schools, the local hospital, and the Santa Cruz Council on Aging's Meals-on-Wheels program.

As of December 2006, there were 95 maquiladoras operating in the Nogales, Sonora, employing 32,535 people (INEGI 2006). In addition, Nogales has hundreds of restaurants, ranging in size from small taco stands to large establishments serving hundreds of people per day. During the study period, research team members were able to identify 64 restaurants in Nogales, Arizona.

3.2. Getting Information about Practices Associated with Waste Vegetable Oil and Grease

In order to gather and map data on local producers of waste cooking oil and grease and then estimate the amount of waste vegetable oil and grease entering the waste stream that could be offset through diversion for the production of biodiesel, research team members, with assistance from the other partners on this project and members of the BARA research team investigating small scale burning in Nogales, Sonora (Austin et al. 2007), developed a strategy that would both be efficient and meet the project goals. The researchers determined that surveys, conducted by students from ITN, SEAHEC/NHS, and the UA, would be the most effective means of gathering data from as many establishments as possible. The researchers supplemented the surveys with observation and interviews, as necessary, to clarify information that was learned during the surveys.

The primary purpose of this effort was to inform the other project partners about the whether and how they might collect sufficient waste vegetable oil and grease in Ambos Nogales for the

production of biodiesel, and a secondary purpose was to begin the process of community outreach. The wide variation in restaurants and maquiladoras, and the absence of any definitive list of restaurants, precluded categorizing these establishments according to any criteria that would assist in developing a sampling design that would allow for drawing inferences about all restaurants and maquiladoras in Ambos Nogales. Instead, the researchers focused on getting to as many establishments as possible to learn about their current practices related to the use and disposal of waste vegetable oil and grease.

In Sonora, this meant the use of opportunistic sampling of the maquiladoras, working from contacts provided by the Asociación de Profesionales en Seguridad y Ambiente (APSA) and the Environment Committee of the Maquiladora Association, and cluster sampling restaurants in two areas – near the downtown border crossing and near the center of town where many restaurants and fast food establishments are concentrated. In Arizona, because of the absence of any major producer of waste vegetable oil and grease, researchers anticipated high restaurant participation may be needed to yield sufficient quantities for conversion at the Rio Rico facility. Therefore, the researchers set out to survey all of the restaurants in Nogales, Arizona. Two attempts were made to recruit student participants from Rio Rico High School to survey the restaurants in Rio Rico, a U.S. census-designated place with fewer than 3,000 residents, but neither was successful, so no data were collected about the Rio Rico restaurants.

3.2.1. Developing the Survey Instruments

During the fall of 2006, UA faculty and graduate students met with project participants at ITN and SEAHEC/NHS to collaboratively design and pilot test surveys for use with cafeteria and restaurant managers (see Appendix B). The ITN and SEAHEC/NHS students who participated in the project during the 2006-07 academic year helped develop the surveys. After initial development, the surveys were shared with other project participants at quarterly project meetings and by e-mail, and the final versions incorporated the suggested changes.

Because of the differences in how maquiladora cafeterias and the restaurants on each side of the border are operated, and a decision to link the restaurant surveys in Sonora to another survey taking place at the same time for the Small Scale Burning Study (Austin 2007), the surveys for maquilas, Mexican restaurants, and U.S. restaurants were somewhat different; the survey developed for U.S. restaurants was also used with the U.S. cafeterias. Nevertheless, all of the surveys enabled researchers to find out how much waste oil was being produced per week, what was being done with the waste oil and grease at the time of the survey, whether or not the restaurants or maquiladoras were interested in participating in the project, and how the collection of waste oil could best be accomplished.

As shown in Appendix B, the final survey instruments included information about practices related to the use and disposal of cooking oil and grease, changes over time, and the willingness and ability of waste oil and grease producers to donate their oil and grease for conversion to biodiesel. In addition to finding out about the volume and storage of waste oil and grease at the surveyed establishments, the research team gathered information about the ultimate disposition of the material. Waste vegetable oil and grease can be used in a variety of products, including animal feed, cosmetics, as carriers for agricultural chemicals, as fuel in boilers, and in products

such as rubber and plastics. The research team was concerned not only to find out whether waste vegetable oil and grease were being deposited into the sewage system but also to determine if there was already a market for the waste oil and grease on either side of the border, and whether and how local production of biodiesel might impact that market. Thus, surveyors asked what the restaurants, maquiladoras, and cafeterias were currently doing with their waste oil.

Because this was the first such survey on this topic ever attempted in Ambos Nogales, the researchers decided to use several open-ended questions to elicit as many responses as possible and determine the range of these responses. Consequently, for these questions, the surveyors received a variety of answers, ranging from very specific and clear to general and vague. As the biodiesel project moves forward, if a follow-up survey is conducted, researchers can use the data from the initial surveys to construct multiple-choice questions that would result in data that are more easily quantified.

3.2.2. Conducting the Surveys

Students from ITN, UA, and SEAHEC/NHS participated in surveying. At ITN, the surveying was led by Professor Irma Fragoso and student Veronica Gil, with guidance from personnel from the UA and ADEQ. ITN students surveyed maquilas and Nogales, Sonora restaurants. UA graduate students also surveyed restaurants in Nogales, Sonora. At SEAHEC/NHS, surveying was led by Program Coordinator Estela Maria Díaz. SEAHEC/NHS students, accompanied by UA graduate students, surveyed Nogales, Arizona restaurants. The students, along with Ms. Díaz, also surveyed the cafeteria at the local hospital, the Meals on Wheels program, and a school cafeteria within the Nogales Unified School District. The students provided both verbal and written descriptions of the project before beginning their surveys.

Prior to conducting the surveys, the students at each institution received training in surveying, practiced the surveys, and talked about how to respond to various situations that might occur during their visits to the restaurants and/or maquiladoras. A numeric coding and tracking system was developed and used on both sides of the border to ensure anonymity to the respondents.

Information about the the maquiladoras and their practices was gathered from APSA; a Nogales, Sonora company that collects waste oil and grease from maquiladoras; and the Nogales municipal government. Based on this information, the maquiladoras were divided into three groups: those known to transport their waste vegetable oil and grease to Hermosillo for disposal; those without kitchens; and others. The year 2007 was a tumultuous one in the Nogales maquiladora sector, and several maquiladoras closed or significantly reduced their workforces. During the spring of 2007, ITN students conducted pilot surveys in several maquiladoras, and in the fall semester the students from Professor Fragoso's Sustainable Development course completed the maquiladora surveys. Of the maquiladoras in operation at the time, the students surveyed 17 maquiladoras, along with 4 kitchens which served a total of 33 additional maquiladoras. In general, the students reported that the maquiladora cafeteria managers and kitchen operators were enthusiastic about the project.

UA students created maps of all the restaurants in downtown Nogales, Sonora and the central city (see Figure 3.1). They visited each restaurant in these areas at least once, returning when

possible if the manager was busy at the time they arrived. In addition, ITN students in Professor Fragoso's spring 2007 Sustainable Development course conducted interviews at restaurants in the central city. A total of 48 restaurants were surveyed. The students reported that many restaurant managers were supportive of the project. Nevertheless, others appeared suspicious or confused about the nature of the project, despite the verbal and written summaries they received.

Figure 3.1. Locations of Restaurants in Nogales, Sonora

For the Arizona restaurants, SEAHEC/NHS students conducted the surveys under the direct guidance of the SEAHEC Program Coordinator and UA faculty and graduate students. Because surveying took place during two consecutive school years, there was a transition in which some participants left the project and new students joined. Thanks to veteran students who were involved both years, the new students were quickly oriented regarding the purpose and methods

of the project, and they participated in the surveying as well as in community outreach activities. UA students assisted in the surveying by advising, occasionally providing transportation for NHS students to visit restaurants, and helping to keep inventory of the restaurants surveyed.

Of the 64 restaurants identified during the course of the research, SEAHEC/NHS students surveyed 40, and these were located across the community (see Figure 3.2). In general, at the remaining restaurants, the students were unable to meet with a manager or other individual at the restaurant who had the authority to respond to the survey questions. Students called or stopped by these restaurants and were told either that they needed to come at a less busy time or that they needed to come at a time when the manager was in. If they were unable to reach anyone after a couple of tries, they crossed the restaurant off their list.

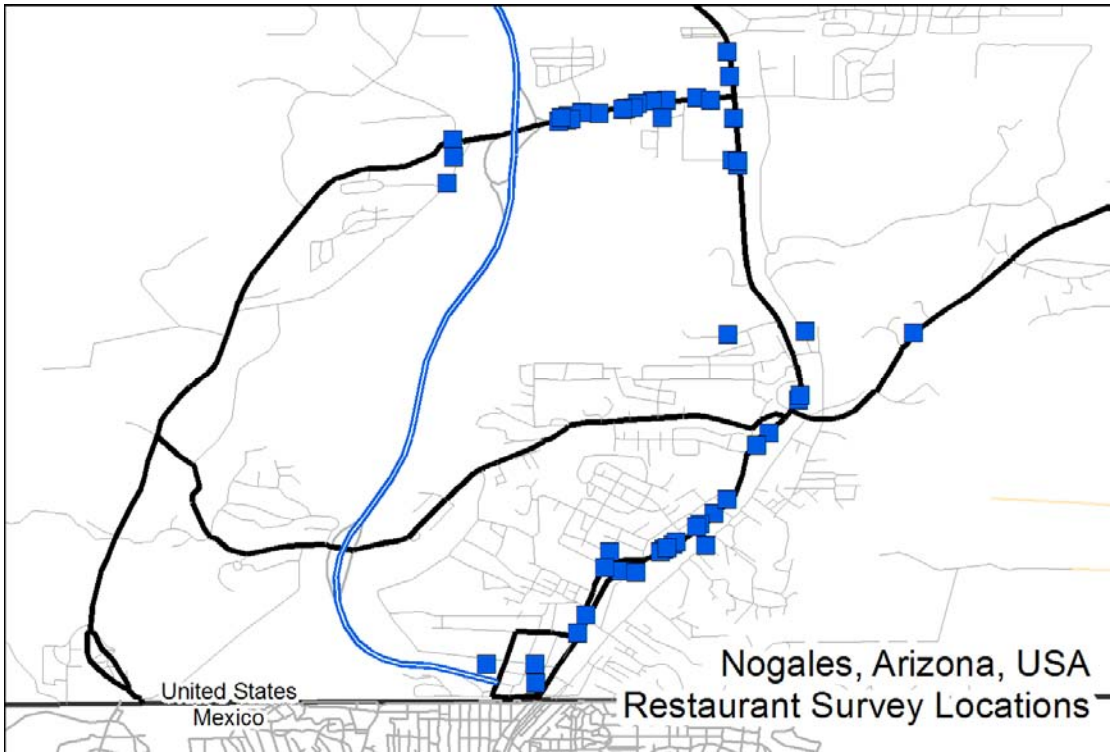

Figure 3.2. Locations of Restaurants in Nogales, Arizona

3.2.3. Analyzing the Data and Preparing Results

After the data were collected, UA faculty and students helped the SEAHEC/NHS and ITN students create databases into which to enter their data. The students from all three institutions entered the data; data from Arizona and the Nogales, Sonora restaurants were cleaned and processed at the UA and are stored in a secure location there. Data from the maquiladoras were cleaned and processed at ITN and are stored in a secure location there.

To enable spatial analysis, a UA graduate student, Ben McMahan, developed a Geographic Information Systems (GIS) database. He and other UA faculty and students gave presentations to the SEAHEC/NHS and the ITN students about GIS and spatial analysis. They worked with the students from both schools to incorporate the survey data into the GIS database while ensuring

that no individual establishments could be identified. Ben then helped the SEAHEC/NHS students generate maps of potential collection routes.

3.3. The Results

The first question on each survey asked, “Do you fry anything?”, and any respondents who reported they did not fry were not asked any further questions. Their surveys were therefore excluded from further analysis.

3.3.1. Nogales, Sonora Maquiladoras

All of the 17 maquiladoras and 4 cafeterias serving maquiladoras responded that they fry food, so the data from all surveys were analyzed.

Typical Oil Use

All 17 maquiladoras and the 4 cafeterias reported using vegetable oil. Five maquiladoras (29%) and 1 cafeteria (25%) reported that they change their oil daily, 8 maquiladoras (47%) change it more than twice a week but less than daily, 1 maquiladora (6%) and 2 cafeterias (50%) changed it twice a week, and the remaining 4 maquiladoras (24%) and 1 cafeteria (25%) changed it once a week or less.

The amount of waste oil disposed of per week was reported to range from 1 to 400 liters for the individual maquiladoras, with the average being 54 liters (14 gallons) and from 100 to 200 liters for the cafeterias, with the average being 130 liters (34 gallons). Of the 5 maquilas reporting the use of 38 or more liters (10 or more gallons) per week, the average volume of oil used per week is 142 liters (37.5 gallons).

Disposal of Waste Oil

All 17 maquiladoras and 4 cafeterias responded to the question about what they did with their waste oil and grease. Of these, the vast majority 11 of the maquiladoras (65%) and all 4 cafeterias (100%) said they give it to a collector. Only 2 maquiladoras (12%) said they store it and 4 (24%) said they throw it out; 3 throw it in the garbage and 1 throws it down the drain. Those who throw the waste oil and grease in the garbage throw out from 1 to 90 liters a week, in the plastic containers in which it is purchased. The maquiladora that reported throwing the waste oil and grease down the drain throws out 2 liters per week.

Eleven (65%) maquiladoras and 4 (100%) cafeterias reported that their waste oil and grease was being collected; the frequency of collection ranged from 1 to 60 days. Only 1 maquiladora that was not already having its waste oil and grease collected reported that it would be able to store its waste, though for only 3 days.

Thirteen (76%) of the 17 maquiladoras and 3 (75%) of the 4 of the cafeterias reported having grease traps; 2 of the maquiladora respondents said they do not have traps and the others reported they did not know if they had them or not. All but one of the maquiladoras and all of the

cafeterias with traps reported that their traps are serviced by another company, with the service taking place from every 3 to every 30 days.

The vast majority (14 or 82%) of the maquiladoras and 3 (75%) of the cafeterias reported using the same amount of oil as in prior years; only 1 maquiladora reported using more oil than in the past and 3 maquiladoras and 1 cafeteria reported using less than before.

Willingness to Participate in Biodiesel Project

All 17 maquiladoras and 4 cafeterias responded to the question of whether or not they would be willing to donate their waste oil and grease for the conversion to biodiesel, and every one of them (100% in both cases) responded “yes” when asked if they would be willing to donate their waste oil and grease for the project.

Findings Relevant to Collection of Waste Oil

In order to evaluate the feasibility of having the participants drop their oil at a central location rather than picking it up from each maquiladora or cafeteria, the survey participants were asked about their willingness to deliver their waste oil and grease to a drop-off location. Eight (47%) maquiladoras said they would be able to take their oil and grease to a central location, 7 (41%) of the maquiladoras and 3 cafeterias (75%) said they would not, and 2 (12%) maquiladoras and 1 (25%) cafeteria said they did not know.

Glycerin

Glycerin is a by-product of the production of biodiesel from waste vegetable oil and grease, and the identification of users could potentially enhance the feasibility of a project to convert oil and grease to biodiesel. Therefore, the maquiladora and cafeteria survey included questions about whether the facility used glycerin or whether the survey respondent knew of anyone else using glycerin. Of all the maquiladoras and cafeterias, only 1 cafeteria reported knowing of anyone who used glycerin; three maquiladoras reported that they did not know if their plant used glycerin, and the remaining maquiladoras and cafeterias reported they did not use glycerin nor know of anyone else who did.

3.3.2. Nogales, Sonora Restaurants

Of the 48 restaurants surveyed in Nogales, Sonora, 2 responded that they did not fry anything and one withdrew from the survey before it was completed. The data from the 45 remaining surveys were analyzed.

Typical Oil Use

The 45 restaurants surveyed fry a wide variety of foods including potatoes, vegetables, and meat (beef, pork, chicken, and seafood). They prepare foods such as chimichangas, totopos, flautas, tacos, and more. Almost all fry foods on a daily basis. Of the 33 restaurants responding to the question about how often they change their oil, 5 (15%) changed it daily, 6 (18%) changed it

more than twice a week but less than daily, 10 (30%) changed it twice a week, and the remaining 12 (36%) changed it once a week or less.

Only 29 restaurants reported how much oil they used in a week, and of those, the volume used ranged from 1 to 350 liters with the average being 42 liters (11 gallons) per week. Of the 10 restaurants reporting the use of 38 or more liters (10 or more gallons) per week, the average volume of oil used per week is 91 liters (24 gallons). The restaurants were also asked how many kilos of lard they used each month, and 7 responded that they used between 5 and 300 kilos per month, as shown in Table 3.1. Two restaurants noted that they do not buy oil or grease because they obtain the grease from the pork they cook.

Table 3.1. Lard Used Each Month by Nogales, Sonora Restaurants

Amount of Lard (kilos)	Number of Restaurants
5	2
6	1
18	1
25	1
32	1
300	1

The amount of waste oil and grease that restaurants reported they disposed of per month ranges from 5 to 1,400 liters (1 to 370 gallons), with 10 restaurants reporting that they produced 100 or more liters (26 or more gallons) per month. Excluding the one restaurant that produced 1,400 liters (370 gallons; the next largest producer was 560 liters – 148 gallons – per month), the average is 91 liters (24 gallons).

Disposal of Waste Oil

Forty restaurants responded to the question about what they did with their waste oil and grease. Of these, the vast majority (30, or 75%) said they throw it in the garbage, 3 (7.5%) said they put it down the drain, 2 (5%) said they give it to a collector, 2 (5%) said they pay a collector to take it, 2 (5%) said they take it elsewhere to donate it, and 1 (2.5%) said he sells it to a collector. Interestingly, of the two restaurants who said they take their waste oil and grease elsewhere to donate it, one responded that he was taking it to ITN for this project and the other said he took it to the dump where someone there was gathering it and making a profit from it; the latter individual also mentioned that he had already heard of this project from an ITN professor. Two restaurants who reported paying someone to take their waste oil and grease, and they reported paying 438 and 1,600 pesos per month for the service. The former said he would like to donate his waste oil and grease for this project but would need a container while the latter said that someone from the Centro de Recuperación y Rehabilitación para Enfermos de Alcohólismo (CREDA), a drug rehabilitation center in Nogales, picks up the oil and grease on Tuesdays and Thursdays. The latter restaurant reported producing 1,400 liters of waste oil and grease per month.

Twenty-six restaurants that throw their waste oil and grease in the garbage or down the drain responded to the question about how much they dispose of, and their estimates ranged from 5 to 560 liters per month (1 to 148 gallons), with an average of 83 liters (22 gallons) per month.

Willingness to Participate in Biodiesel Project

Forty restaurants responded to the question of whether or not they would be willing to donate their waste oil and grease for the conversion to biodiesel. The relationship between willing to donate and their current waste management practices is shown in Table 3.2. The number of restaurants that do anything other than throw their waste oil and grease into the garbage or drain is so small that their responses must be viewed cautiously. Nevertheless, as shown, those currently giving or selling their waste are the least likely to say they would be willing to donate at this time, though half of them told the researchers that they "might" be willing to donate.

Table 3.2. Current Waste Management Practices of Nogales, Sonora Restaurants

Waste_Management	no	maybe	yes
give to collector	1	1	2
pay collector			2
sell to collector	1	1	
take to donate			2
throw in drain			3
throw in garbage	1	2	26
did not respond			1

Of the 45 restaurants that completed the survey, 36 (80%) reported that they could donate their waste oil to the project (see Figure 3.3). Three (7%) said that they could not participate, 2 (4%) said maybe, and 4 (9%) did not respond to the question. One of the respondents who expressed willingness to donate waste oil and grease nevertheless said he would have to get permission of the owner to do so.

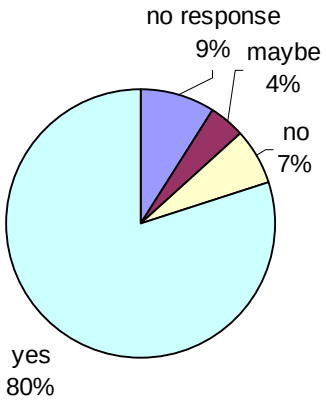

Figure 3.3. Nogales, Sonora restaurants: Responses to the question, "Is there a possibility that you could donate your waste oil and grease to a project that will convert it to biodiesel?"

The 36 restaurants that expressed a willingness to donate waste oil and grease for conversion to biodiesel are currently disposing of their waste in a variety of ways (see Figure 3.4), reflecting the general pattern of all restaurants; the one restaurant currently selling its waste reported it would not be willing to donate it.

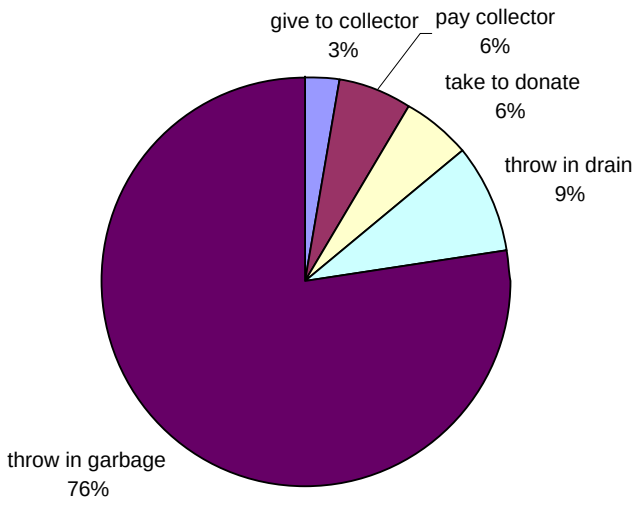

Figure 3.4. Current waste disposal practices of Nogales, Sonora restaurants

Of these 36 restaurants, 28 reported the amount of waste oil and grease they produced per month; the average for those 28 was 134 liters (35 gallons), which is greater than the average for all restaurants. The largest waste generator reported he would be willing to donate oil and grease for conversion to biodiesel. Sixteen of these restaurants generate at least 40 liters (11 gallons) of waste oil and grease per month. If collection were initially limited to the 16 restaurants that reported they would be willing to donate their oil and generated at least 10 gallons (38 liters) a month, those collecting the waste oil and grease could anticipate collecting up to 3,553 liters (939 gallons) per month.

Findings Relevant to Collection of Waste Oil

To further evaluate the feasibility of a project to convert waste oil and grease to biodiesel in Nogales, Sonora, researchers considered both collection and drop-off options. Restaurants were asked about their willingness to deliver their oil. Only 8 of the 45 restaurants expressed willingness to drop off their oil and grease. Clearly, a project will have a greater chance of success if the oil and grease are collected from the participating restaurants.

Another factor in a restaurant's willingness or ability to participate in a biodiesel program is the restaurant's capacity for storing the waste oil and grease. When asked how long they could store

the oil between collection times, 30 restaurants reported times ranging from 0 to 30 days. The average time reported was 6 days. The most frequent response given was one week.

A final factor relevant to the collection of waste oil and grease is the type of container that the material is stored in, and whether or not the container would be picked up along with the oil, or the oil would be emptied into a central container. Most of the restaurants willing to donate their oil put their waste oil into plastic containers; 8 of the respondents noted specifically that they store the waste oil in the container in which the new oil originally was purchased.

3.3.3. Nogales, Arizona Restaurants

Of the 40 restaurants surveyed in Nogales, Arizona, 5 restaurants reported that they did not fry anything and were excluded from any further analysis. Two respondents provided incomplete information (one said he already donated his waste oil for conversion to biodiesel), so the surveys of their restaurants could not be used. In the end, data from the 33 completed surveys were analyzed. To facilitate the analysis, the sample was divided into two categories: nationally-known chain restaurants and 'non-chain' restaurants. A nationally-known chain is any restaurant chain that extends beyond Arizona. This category is made up of restaurants, such as McDonald's, Wendy's, and Denny's, that are found in cities across the United States. The second category, dubbed 'non-chain restaurants' for convenience, is somewhat misleading, as it may include state-wide or local chains. However, it does not include any restaurants that belong to national chains. These categories were created to enable analysis of any differences between nationally-known chain and 'non-chain' restaurants regarding the amount of oil they use, what they do with their oil, and their willingness and ability to donate oil to the project.

Typical Oil Use

The restaurants surveyed fry foods such as French fries, onion rings, chicken, and taco shells. Almost all fry foods on a daily basis. Most of them use a fryer, and on average they change the frying oil about twice a week.

Only 29 restaurants reported how much oil they used in a week, and of those, the volume used ranged from 2 to 85 gallons (8 to 322 liters), with the average being 16 gallons (61 liters) per week. Seventeen restaurants reported using 10 gallons (38 liters) or more per week, and for these, the average volume of oil used per week is 24 gallons (91 liters).

Twenty-six restaurants reported how much oil and grease they disposed of in a month, ranging from 4 to 206 gallons (15 to 780 liters); the average reported is 54 gallons (204 liters).

The data for nationally-recognized chain restaurants were analyzed separately from those of the other restaurants. The two largest users of oil and the largest waste generator are nationally-recognized chains. This group reported using an average of 22 gallons (83 liters) per week (14 restaurants reported data) and, excluding the outlier, generating an average of 41 gallons (155 liters) of waste oil and grease per month (12 restaurants reported data). The non-chain restaurants reported using an average of 11 gallons (42 liters) per week (14 restaurants reported data) and generating an average of 55 gallons (208 liters) per week (12 restaurants reported data).

Disposal of Waste Oil

The surveyors received a wide variety of responses to the question, "What do you do with your waste oil or grease?" These responses were coded, and some categories, such as recycle it, sell it, and a company picks it up, may overlap. Nevertheless, without further investigation, it is not possible to determine where the overlap lies. Further probing of the respondents may have elicited additional information, though several of the respondents volunteered that they were uncertain what happened to the waste oil and grease. Consequently, researchers supplemented data from the survey with information they gathered during phone and in-person interviews with people knowledgeable about waste collection in Santa Cruz County (see below).

Despite the ambiguity associated with them, the survey responses provide a general picture of the oil and grease disposal options available to Nogales, Arizona restaurants (see Figure 3.5). Of the 32 restaurants that responded to the question of what they did with their waste oil and grease, only four restaurants (12.5%) said they throw the waste oil in the trash or down the drain. These four restaurants produce from 2 to 10 gallons (8 to 38 liters) of oil per week, with the average being 6 gallons (23 liters) per week.

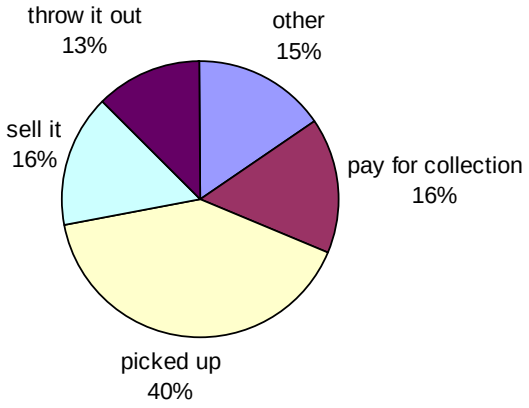

Figure 3.5. Waste oil and grease disposal options of Nogales, Arizona restaurants

The remainder of the restaurants have made some sort of arrangement for disposing of their waste vegetable oil and grease. Some pay to have it collected (5 respondents specifically mentioned paying for the waste, though only one individual reported the amount he paid - $25 per month), others have it collected at no charge, and still others sell the waste oil and grease (5 respondents specifically stated that they sold the waste, at rates ranging from $9 to $35 per gallon). Based on interviews with public officials and private collectors, the waste oil and grease that is collected separately from the regular garbage service appears to be "recycled" in one way or another. Waste oil and grease is collected at the Nogales International Airport through a private arrangement with a rendering company in Tucson. Local entrepreneurs collect the oil and grease from the restaurants and take it to the airport. In addition, the Tucson company also has trucks that pick up oil and grease directly from the restaurants. A private individual in Nogales has converted his pickup truck to run on straight vegetable oil (rather than biodiesel), and he

collects waste from restaurants in Nogales as well as Sierra Vista and other southeast Arizona communities.

To explore whether or not being part of a national chain affects what restaurants do with their oil, several additional analyses were conducted. No major differences in type of disposal were observed between the chain and non-chain restaurants.

Willingness to Participate in Biodiesel Project

Of the 33 restaurants that completed the survey, 20 (61%) reported that they could donate their waste oil to the project (see Figure 3.6). Five (15%) said that they could not participate, 1 (3%) was unsure, and 7 (21%) did not respond to the question. Of those unable to donate, 1 said that his restaurant is already donating to a farm, another said that there was no place to store oil even for a short time, and another was satisfied with its current arrangement in which a company picks up the oil at no charge. Of those who were unsure or did not respond to the question, a common reason was that it would be necessary to seek permission from a higher manager or the restaurant owner first.

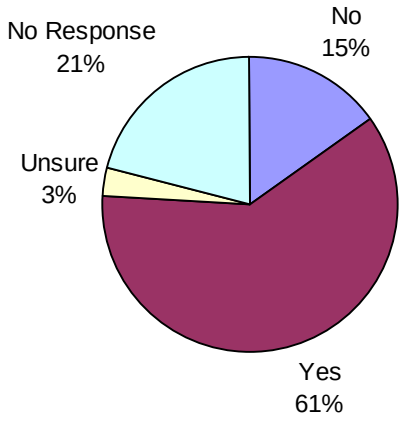

Figure 3.6. Nogales, Arizona restaurants: Responses to the question, “Is there a possibility that you could donate your waste oil and grease to a project that will convert it to biodiesel?”

Again, to explore whether or not being part of a national chain would affect what restaurants would or could do with their oil, several additional analyses were conducted. As shown in Figure 3.7, non-chain restaurants were slightly more likely to express willingness to participate in the project by donating waste oil, as opposed to chain restaurants. This may be because many chain restaurants are already committed to other waste-oil recycling programs, or because the managers at some chain restaurants have limited authority to make this type of commitment. However, since over half of the chain restaurants surveyed expressed a willingness to donate waste oil and grease for conversion to biodiesel, there is no reason to limit collection to non-chain restaurants.

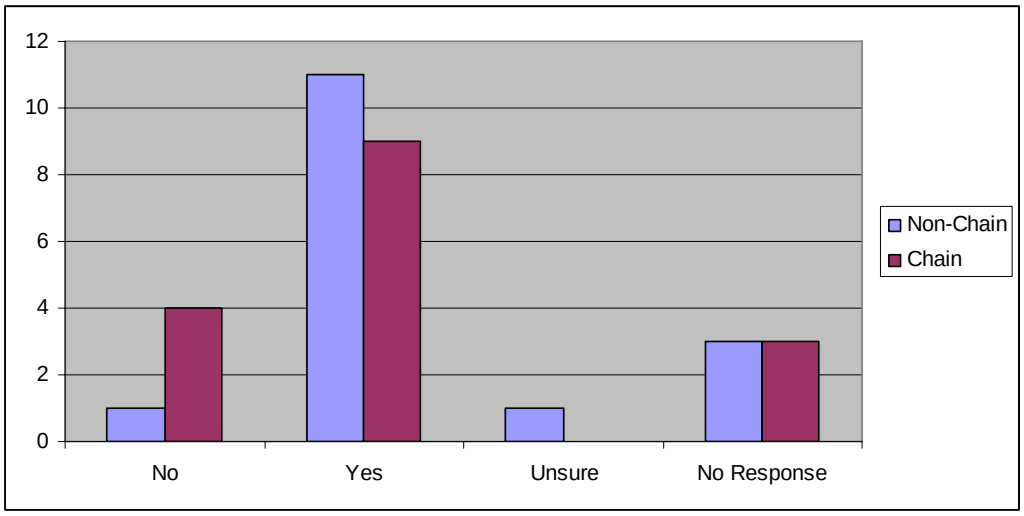

Figure 3.7. Willingness to donate waste oil and grease: Comparison of chain and non-chain restaurants in Nogales, Arizona

The 20 restaurants who expressed a willingness to donate waste oil and grease for conversion to biodiesel are currently disposing of their waste in a variety of ways (see Figure 3.8), reflecting the general pattern of all restaurants; all but one of the restaurants currently selling the waste reported a willingness to contribute to a local biodiesel project.

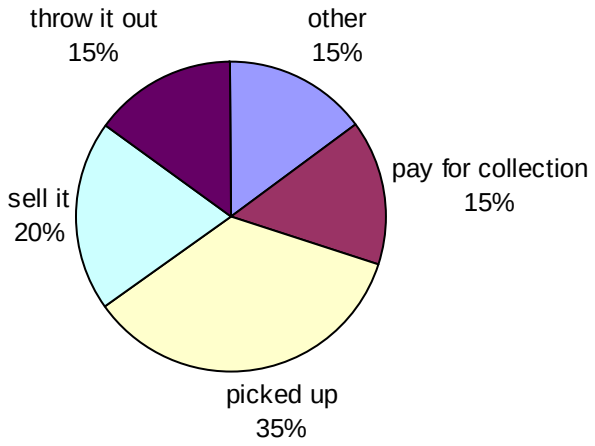

Figure 3.8. Current waste disposal practices of Nogales, Arizona restaurants that expressed a willingness to donate waste oil and grease

Of these 20 restaurants, 17 reported the amount of waste oil and grease they produced per month; the average for those 17 was 40 gallons (151 liters), which is only slightly less than the average for all restaurants. The largest waste generator reported he would not be able/willing to donate oil and grease for conversion to biodiesel. Thirteen of these restaurants generate at least 10 gallons (38 liters) of waste oil and grease per month. If collection were initially limited to the 13 restaurants that reported they would be willing to donate their oil and generated at least 10

gallons (38 liters) a month, those collecting the waste oil and grease could anticipate collecting up to 665 gallons (2,517 liters) per month.

Findings Relevant to Collection of Waste Oil

To further evaluate the feasibility of a project to convert waste oil and grease to biodiesel in Nogales, Arizona, researchers considered both collection and drop-off options. Restaurants were asked about their willingness to deliver their oil. Only 7 expressed willingness to drop off their oil and grease; 11 said they would not be willing to donate unless someone came by to pick up the oil and 2 did not respond to the question. Clearly, a project will have a greater chance of success if the oil and grease are collected from the participating restaurants.

Another factor in a restaurant's willingness or ability to participate in a biodiesel program is the restaurant's capacity for storing the waste oil and grease. When asked how long they could store the oil between collection times, 19 restaurants reported times ranging from 3 days to 5 months. The average time reported was about one month, but that number is skewed by a few restaurants that reported being able to keep it exceptionally long periods of time. The most frequent response given was one week.

A final factor relevant to the collection of waste oil and grease is the type of container that the material is stored in, and whether or not the container would be picked up along with the oil, or the oil would be emptied into a central container. Five of the 20 restaurants willing to donate their oil put their waste oil into plastic bottles. The others put it into cans, plastic tubs, or metal tanks.

3.3.4. Nogales, Arizona School and Hospital Cafeterias

Three cafeterias were surveyed in Nogales, Arizona. These cafeterias provided food for several schools, a hospital, and the region's Meals-on-Wheels program. All three fry daily; they produce 34 liters (9 gallons) per month, 30 liters (8 gallons) per month, and 3,452 liters (120 pounds)[1] per month of waste vegetable oil and grease. Two of them dispose of their waste oil and grease in plastic containers which are placed in the trash, and one pays to have the oil and grease taken away. All.reported that they could donate their waste oil and grease to the project but noted that they would prefer if the oil and grease could be picked up from their site. The two cafeterias that currently dispose of their waste in the trash reported they could store it on site for about two weeks.

3.4. Summary

Waste vegetable oil and grease is produced on both sides of the border. The volume on the Sonoran side greatly exceeds that of the U.S. side for several reasons: (1) Nogales, Sonora has a much larger population than Nogales and Rio Rico, Arizona; (2) Sonora has both maquiladoras and restaurants that generate waste oil and grease; (3) there are more restaurants on the Sonoran side, and many of them generate waste oil and grease; and (4) there is less infrastructure on the

[1] Yellow grease weighs about 7.6 pounds per gallon.

Sonoran side to manage the waste oil and grease that is produced, especially in the restaurants there.

There is sufficient waste oil and grease to produce biodiesel, and that production has the potential to reduce the amount of waste oil and grease that enters the wastewater conveyance system, though if what was reported is accurate, few restaurants and maquilas presently dispose of their waste oil and grease down the drain *as a standard practice*. It is clear that waste oil and grease does make its way into the conveyance system, and there is a strong possibility that a program to provide an alternative method of disposing of the waste oil and grease would reduce that significantly. However, it is impossible to estimate the volume of that waste from the survey data. Of the three Sonoran restaurants who reported putting waste oil and grease down the drain as their standard practice, only two reported the volume of waste they disposed of; together they generate 88 liters (23 gallons) of waste per month.

Decisions about the frequency of collection must take into account the volume that can be collected and costs associated with collection, as well as the length of time that restaurants and maquilas can store their waste oil and grease. If collection takes place less frequently, we need to be prepared for the greater quantities of oil that will accumulate during longer periods of time.

Because not all of the restaurants use easily transportable containers, it would probably be best for them if we either gave them containers to use, which we could pick up and later give back, or else emptied oil from their containers into our own container.

If more restaurant participation is needed, we can revisit the restaurants that have not yet made a commitment. In the meantime, we recommend that our current list of willing participants be used to initiate the project. The fact that the managers of these restaurants have taken the time to meet with our student participants and have expressed their support is an encouraging sign.

Clearly, in Nogales, Sonora, few restaurants are currently participating in any system for collecting and disposing of waste oil and grease, so the potential for those to be disrupted by the collection of waste oil and grease for conversion to waste oil and grease is very low.

4. Summary and Discussion

The purpose of the Biodiesel Capacity Building and Demonstration Project in Ambos Nogales is to address significant environmental and health concerns in Ambos Nogales (Nogales, Sonora and Nogales and Rio Rico, Arizona) by developing the capacity for the production and use of biodiesel in these border communities. This assessment was conducted to gather data to support that project. The researchers designed and conducted interviews and surveys in Nogales, Arizona and Nogales, Sonora to achieve the following: (1) gather data from local producers of waste vegetable oil and grease to determine the amounts produced and the amounts potentially available for conversion to biodiesel; (2) determine how much waste vegetable oil and grease could be taken out of the waste stream if it could be used locally for the production of biodiesel; (3) identify any competing uses for waste vegetable oil and grease; (4) identify potential users for biodiesel and glycerin, a by-product in the production of biodiesel from waste vegetable oil and grease; and (5) identify potential challenges to a project to collect waste vegetable oil and grease for conversion to biodiesel.

Data were collected from restaurants and cafeterias on both sides of the Arizona-Sonora border. On the Arizona side, the cafeterias served various local high schools, a hospital and the region's Meals-on-Wheels program. On the Sonoran side, the cafeterias served the maquiladoras. The data reflect differences based on existing infrastructure, but nevertheless demonstrate that there is sufficient waste vegetable oil and grease on both sides to produce biodiesel.

The total volume of waste oil and grease on the Arizona side is considerably less than that on the Sonoran side, due primarily to the presence of the maquiladora cafeterias on the Sonoran side but also due to the greater number of restaurants on the Sonoran side. In addition, at the time the surveys were conducted, on the Arizona side there were more options for collecting and/or disposing of waste vegetable oil and grease, so the potential for a biodiesel project to play a major role in getting waste oil and grease out of the waste stream was not very high. The primary alternative to disposing of the oil and grease in the trash was collection by a Tucson-based company that would pick up the material and transport it to Tucson for processing. Most respondents reported that they would be willing to donate their waste oil and grease to a local project designed to convert it to biodiesel. Still, a successful program will require a regular and efficient system for collecting the waste; few participants said they would be willing to transport the material themselves.

On the Sonoran side, the maquiladoras and restaurants produce large quantities of waste oil and grease, and they have fewer options for managing it. A few companies collect the waste material and then either dispose of it themselves in the landfill or transport it to places like Hermosillo for use in hog feed, but the participants who were using these options at the time of the study said they would be willing to donate their waste oil and grease to a local project for conversion to biodiesel. Because many restaurants and cafeterias are currently disposing of their waste oil and grease in the garbage, the potential to get large volumes out of the waste stream is great. Most of the respondents will require that the waste oil and grease be picked up and delivered to the location where it will be processed.

There are presently few biodiesel users in Ambos Nogales; the recently installed biodiesel tanks at the Santa Cruz Valley Unified School District will make it possible for that district to run its buses on biodiesel that will be purchased from a distributor based in Phoenix, Arizona. The Biodiesel Capacity Building and Demonstration Project will equip the Rio Rico Fire District and Bomberos de Nogales, Sonora with what they will need to run their non-emergency vehicles on biodiesel. In addition, the students and faculty at the Instituto Tecnológico de Nogales plan to use biodiesel they produce in their buses. Several maquiladoras indicated that they would be interested in using biodiesel in their diesel engines.

Based on data from the maquiladora surveys and interviews with community leaders, the only identified glycerin uses for glycerin were as a hand cleaner (it is especially functional for removing grease and is used by some mechanics). The students and faculty at the Instituto Tecnológico de Nogales have begun a project to utilize glycerin in the production of soap.

This assessment gathered data from a purposive sample of restaurants and cafeterias in Nogales. Some of the cafeteria and restaurant managers who were unable to find the time to complete the survey during the study period may nevertheless be able and willing to donate waste vegetable oil. Therefore, once the Biodiesel Project is operating, it is recommended that all cafeterias and restaurants be included in an outreach effort to solicit participants. The researchers have no information about what types and quantities of food are prepared in the cafeterias and restaurants that were not surveyed, so it is not appropriate to assume that those cafeterias and restaurants will produce waste oil and grease in the same proportion as those that were surveyed.

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6. Appendices

6.1. Appendix A: Project Information Flyers
6.2. Appendix B: Surveys for Maquiladoras and Restaurants

6.1. APPENDIX A
PROJECT INFORMATION FLYERS

Introducing a new community partnership:

Biodiesel Capacity Building and Demonstration Project in Ambos Nogales

We are a group of border community partners who invite you to join us to explore and address significant air, water and environmental health problems in Nogales, Sonora and Nogales and Rio Rico, Arizona.

How will we do this? This project includes several activities that will test and develop local capacity to produce and use biodiesel, an alternative fuel made from waste cooking oil and grease (WCOG), in our border region.

1) We will investigate the potential to collect and reclaim WCOG within in our communities. (Some likely sources: restaurants, schools, hotels, cafeterias.)

2) We will conduct trial collections of WCOG and trial conversion to biodiesel fuel in a binational small-scale pilot project.

3) We will conduct trials and demonstrate this biodiesel fuel in public vehicles in our communities.

Who is working in this project?
Our binational project includes private and public sector partners on both sides of the border: Rio Rico Fire District, Bomberos de Nogales (BN), Privados Portátiles SA de CV (PP), Rio Rico Rentals (RRRI), the Southeast Arizona Area Health Education Center (SEAHEC), Instituto Tecnológico de Nogales (ITN), the University of Arizona (UA), Public Safety Association of Santa Cruz County (PSA-SCC), Asociación de Profesionales en Seguridad y Ambiente (APSA), and Arizona Department of Environmental Quality (ADEQ). Students from the SEAHEC Health Careers Clubs of Nogales and Rio Rico High Schools, and students from ITN and UA, will conduct community surveys and support data collection and analysis.

Does it work? Yes! Communities in many nations are running school buses and public safety vehicles on WCOG biodiesel. Our student partners have participated in demonstrations making biodiesel from used cooking oil. Tucson organizations such as Grecycle already collect and/or sell WCOG. They support our community-driven project.

Why use waste oil and grease to make alternative fuel? Don't farmers grow crops like soybeans for biodiesel production?
The partners in this project are working to identify and test various ways to reduce air and water pollution along the border. This project can offer solutions to both problems. Waste oils and grease that enter our drains can clog sewers. These clogs can cause sanitary sewer overflows and impact the water quality of our watersheds. By collecting and reusing waste oils and grease for the production of biodiesel, we can help maintain the sewer systems and prevent contamination of our watersheds. Diesel vehicle emissions are identified as a major source of high air pollution levels along the border, but biodiesel offers a much cleaner-burning alternative to petroleum diesel.

How can I get more information?
Contact: Michael Foster, Project Coordinator, 520-980-1637, mfoster@rioricofire.org
Irma Fragoso, Instituto Tecnológico de Nogales, 631-311-1870 x 117, ifragoso@prodigy.net.mx
Diane Austin, University of Arizona, 520-626-3879, daustin@u.arizona.edu

Presentando una nueva colaboración comunitaria:

Proyecto de Capacitación y Demostración de Biodiesel en Ambos Nogales

Somos un grupo de miembros de la comunidad fronteriza. Les invitamos a colaborar con nosotros para enfrentar algunos problemas ambientales en Nogales, Sonora y Nogales-Río Rico, Arizona.

¿Cómo lo haremos?

El proyecto comprende varias actividades que se enfocaran en evaluar la capacidad local para producir y utilizar biodiesel como combustible alterno a partir de aceites y grasas residuales en nuestra región fronteriza. Las actividades incluyen:

1) Investigar las posibilidades de recolectar el aceite y las grasas residuales en nuestras comunidades. (Algunas fuentes probables son: restaurantes, escuelas, hoteles y cafeterías).
2) Recoger el aceite y las grasas residuales para convertirlos en biodiesel.
2) Probar y mostrar el uso del biodiesel en vehículos públicos en nuestras propias comunidades.

¿Quiénes trabajan en este proyecto?

Este proyecto binacional incluye colaboradores de los sectores privado y público de ambos lados de la frontera tales como: Río Rico Fire District (RRFD), Bomberos de Nogales (BN), Privados Portátiles SA de CV (PP), Río Rico Rentals (RRRI), Southeast Arizona Area Health Education Center (SEAHEC), Instituto Tecnológico de Nogales (ITN), University of Arizona (UA), Sociedad Pública de Seguridad del Condado de Santa Cruz (PSA-SCC), y Sociedad de Seguridad y del Ambiente de la Asociación de Profesionistas (APSA), y el Departamento Ambiental de Arizona (ADEQ). Los estudiantes del Club de Carreras de la Salud de SEAHEC de las Secundarias y Preparatorias de Río Rico y Nogales (High Schools), y los estudiantes del ITN y de la Universidad de Arizona realizarán encuestas para posteriormente efectuar el análisis de los datos.

¿De verdad funciona?

¡Sí! Algunas comunidades en otros países están usando biodiesel producido a partir de aceites y grasas residuales en autobuses escolares y vehículos públicos. Nuestros estudiantes han participado en demostraciones de cómo hacer biodiesel a partir de aceite de cocina usado. Organizaciones en Tucson, como es el caso de Grecycle, ya recogen aceites y grasas residuales y los transforman en biodiesel que posteriormente venden. Estas organizaciones también están apoyando este proyecto.

¿Por qué utilizar el aceite y las grasas residuales para hacer un combustible alterno? ¿Acaso los granjeros de EE.UU. no cosechan ya plantas tales como la soya para producir biodiesel?

Los colaboradores de este proyecto buscan formas para reducir la contaminación del aire y del agua en esta frontera. Este proyecto puede ayudar a reducir ambos problemas. Aceites y grasas que entran nuestros drenajes pueden resultar en tapones del alcantarillado. Estos tapones pueden resultar en desbordamientos de aguas residuales la cual impactan la calidad de agua de nuestras cuencas. Si recogemos y reciclamos aceites y grasas para la fabricación de biodiesel, podemos mantenar los alcantarillados y prevenir la contaminación de nuestras cuencas. La emisión de diesel vehicular es una de las principales fuentes de contaminación atmosférica que padecemos en esta frontera. El biodiesel es tambien una buena fuente de combustible, sin embargo emite mucho menos contaminantes que el diesel producido a partir del petróleo.

¿Cómo puedo obtener más información?

Usted puede ponerse en contacto con:

Michael Foster, Coordinador del Proyecto, 520-980-1637, mfoster@rioricofire.org
Irma Fragoso, Instituto Tecnológico de Nogales, 631-311-1870 x 117, ifragoso@prodigy.net.mx
Diane Austin, Universidad de Arizona, 520-626-3879, daustin@u.arizona.edu

Using Biodiesel: Some Important Information

Biodiesel (BD) is a renewable source of fuel made from vegetable oils, soy oils, animal fats and algae. It can be used in any diesel engine with little to moderate retro-fitting. As a fuel, biodiesel can be used in its pure form, B100 (*the number represents the percent of biodiesel in the fuel blend*), or in distillate blends with diesel fuels, B20, B05. There are several considerations one must make when choosing to convert to biodiesel:

1) Biodiesel has corrosive properties greater than regular diesel fuel. This means every hose, gasket, and seal (all rubber parts) which will be in contact with BD needs to be retro-fitted with Viton (the best) or Teflon parts, otherwise, the rubber will erode. This is especially true when using B100. However, their have been mixed results when using B20 blends. Some fleets have experienced major problems with rubber components corroding using B20 blends, others have only experienced this problem using B100, but not when they used B20. A common denominator seems to be the use of substandard rubber components (Nitrile and others) in the engine and fuel system. Contact your engine manufacturer and request a parts list for all rubber components in the engine and fuel system.
2) Because of this corrosive nature of BD. Refinery tanks, transportation tanks, storage tanks, and gas tanks should be made from aluminum, steel, fluorinated polyethylene, fluorinated polypropylene or Teflon. It is not recommended to use brass, copper, bronze, lead, tin, zinc or any agglomerate of. Since biodiesel is a solvent, it can corrode those materials causing particulates to enter the fuel system and sedimentation on the tank floor. Furthermore, these oxidizing metals can cause the fuel to degrade at a faster rate. Although, this is especially true for B100, the current literature suggests B20 blends have a higher level of compatibility with the above materials. Make sure your BD refiner and distributor are handling and transporting BD according to the American Society for Testing and Materials (ASTM) standards.
3) The corrosive properties of BD will clean sedimentation in the fuel system deposited from previous diesel use. This will happen when using either B100 or B20. It is recommended for the first three to six moths, to check your fuel filter often during this ‘flush’ stage.
4) At the time of this document, BD (B20 and B100) should not be stored for longer than six months, at which point it begins to degrade.
5) The cold flow properties of BD (B100) are much different than regular diesel. Further complicating this are the different base stocks which biodiesel can be made from also have different properties. For example, soy, being the most common base stock, has a cloud point (begins to gel) of 38º F, inedible tallow has a cloud point of 61º F. When selecting a BD fuel, the cold flow properties will be determined by which base stock the fuel is derived from, the type of diesel fuel used (No. 1 or No.2), the fuel blend percentage, any additives added (some which can lower the fuels cloud point to -20ºf) and the extreme winter temperature of the region. Some distributors now sell pre-

blended winter fuels so the consumers do not have to worry about blending themselves, which had resulted in negative and costly outcomes for some fleets. If your distributor is not already pre-blended winter fuels, see fi they will belnd to you're your fleets specific needs.

6) The build up of algae can occur within the fuel and tanks causing the fuel system to clog. Although these very same algae exist in regular diesel fuel, the conditions of biodiesel allow for its proliferation. The algae feed at the water-fuel interface. The more water in the fuel, the greater algae growth can be expected. Sources of extra water can come from improper fuel refining, and contamination. This can be avoided by ensuring the biodiesel you purchase from your distributor is up to ASTM6751-03 standards (for pure B100), or ASTM975-04c for biodiesel blends. Another measure to be taken is before the new fuel enters the storage tank, ensure there is no diesel fuel remaining in the tank, and it is completely dry on the inside.

Biodiesel Emission Reductions for B100 and B20				
Alternative fuels	**HC**	**CO**	**PM**	**Nox**
B20	13%	10%	15%	+2%
B100	65%	45%	45%	+5%

(http://www.cleanair.org/dieseldifference/fuels/index.html; http://www.nrel.gov/docs/fy06osti /39451.pdf; Meeting notes, 5-22-06 & 6-08-06)

6.2. APPENDIX B
SURVEYS FOR MAQUILADORAS AND RESTAURANTS

Encuesta Aceites y Grasas para Maquiladoras
Programa Frontera 2012
Proyecto Biodiesel

Fecha: _____ **Código de la empresa:** _____

Iniciales del encuestador: _____

Hola, somos estudiantes del Instituto Tecnológico de Nogales y estamos trabajando en conjunto con la Universidad de Arizona en un proyecto de elaboración de biodiesel. Este se produce en base a grasas y aceites residuales. Esta información es confidencial y para uso exclusivo de la investigación. ¿Podría respondernos algunas preguntas?

1. **¿Fríe algún alimento?**

a) Si b) No c) No sabe d) No respondió

Si responde que si:

2. **El aceite que utiliza ¿Es de origen vegetal o animal?**

a) Vegetal b) Animal c) No sabe d) No respondió

3. **¿A qué temperatura utiliza el freidor?**

4. **¿Por cuantos días usa este aceite antes de reemplazarlo?**

5. **¿Qué cantidad de aceite desecha a la semana? (en litros)**

6. **¿Qué hace con el aceite y grasa que desecha?**

a) ¿Lo tiene almacenado?
b) ¿Lo recolecta alguna empresa?
c) ¿Lo tira?
d) Otro (especifique) _____

Si la respuesta es:

a) Pase a 7 y 8 (continúe en pregunta #13)
b) Pase a 9 y 10 (continúe en pregunta #13)
c) Pase a 11 y 12 (continúe en pregunta #13)

Si lo almacenan:

7. ¿Esta el aceite al aire libre?

a) Tapado b) Destapado c) No sabe d) No respondió

8. ¿Por cuántos días pueden guardar el aceite y grasa antes de que el contenedor se llene?

a) No sabe b) No respondió

Si hay alguna empresa que recolecte el aceite:

9. ¿Cuál es el nombre de la empresa?

a) No sabe b) No respondió

10. ¿Que tan frecuente es el servicio? (en días)

a) No sabe b) No respondió

Si el usuario lo tira:

11. Lo tira a:

a) ¿La basura? b) ¿Al drenaje? c) No sabe d) No respondió

Si el usuario lo tira a la basura

12. ¿En que tipo de contenedor tira el aceite?

13. En esta empresa, ¿Tienen trampa de grasa que recolecte las aguas residuales de la cocina?

a) Si b) No c) No sabe d) No respondió

Si tienen trampa de grasa:

14. ¿Hay alguna empresa que le de servicio de limpieza?

a) Si b) No c) No sabe d) No respondió

Si hay servicio:

15. Nombre de la empresa que proporciona el servicio.

a) No sabe b) No respondió

16. ¿Cada cuantos días se le da servicio a la trampa de grasa?

a) No sabe b) No respondió

17. ¿Cómo compara la cantidad de aceite y grasa que están desechando este año con el de años anteriores?

a) Es más b) Menos c) Igual d) No sabe e) No respondió

18. ¿Hay variación entre temporadas?

a) Si b) No c) No sabe d) No respondió

¿Porque?_____

19. ¿Tiene algún equipo o maquinaria que trabaje con diesel?

a) Si b) No c) No sabe d) No respondió

¿Cuál es el equipo?_____

20. ¿Usted utiliza glicerina? O ¿Conoce de alguien que utilice glicerina?

a) Si b) No c) No sabe d) No respondió

21. ¿Es posible que donara el aceite y grasa que desecha, para que sean reciclados?

a) Si b) No c) No sabe d) No respondió

22. ¿Podría llevarlo a un centro de acopio?

a) Si b) No c) No sabe d) No respondió

Comentarios:

_____
_____
_____
_____
_____
_____
_____

Encuesta para Restaurantes en Nogales, Sonora

Numero del Restaurante (vea la lista de contactos):
Nombre de la persona del equipo que hizo esta encuesta:
Fecha:

Hola, me llamo ----------. Soy estudiante de la Universidad de Arizona (o ITN), estoy trabajando en conjunto con el Instituto Tecnologico de Nogales (o la Universidad de Arizona). Estamos haciendo investigaciones para aprender como mejorar la calidad del aire en Nogales. Uno de nuestros proyectos es una investigación para ver la posibilidad de hacer biodiesel, un combustible alternativo, de grasas y aceites deshechas. Otros son relacionados a la quema de leña y el reciclaje. Su participación es opcional, y la información que ud. nos da no será conectado con su nombre o negocio en ningún reporte. ¿Está usted dispuesto(a) a contestar algunas preguntas para ayudarnos con nuestras investigaciones?

1. ¿Por quánto tiempo han tenido ustedes este restaurante? _____

2. ¿Qué tipos de combustible usa ud. para cocinar?

Leña ___sí ___no	Gas ___sí ___no	Estufa electrica ___sí ___no	Otro: _____
(para…) __asador/parrilla __estufa/horno de leña __otro Cantidad? _____	Tamaño de tanque: _____ Frecuencia de cambiarlo: _____	n/a	

3. ¿Fríe ud. algo? ____sí _____no (continua a 22)

4. ¿Qué tipos de comida fríe ud.? _____

5. ¿Tiene ud. un freídor? ___sí ____no (continua a 8)

6. ¿Cuántos días por semana usa ud. el freidor? _____ días

7. ¿Con cuántos litros se llena su freidor? Con _____ litros.

8. ¿Cuántos litros de aceite o kilos de manteca usa ud. por semana?

_____ litros o _____ kilos

9. ¿Con qué frecuencia sustituye ud. el aceite o manteca usada?

____ veces por: __semana __mes __año

10. ¿Con qué frecuencia compra ud. aceite o grasa?

_____ veces por: __ semana __mes

11. ¿Cuántos litros de aceite o grasa desecha produce ud. por mes? _____litros

12. ¿En cuáles meses produce ud. lo más? _____

13. ¿Produce ud. más, menos, o la misma cantidad ahora que en otros años?

___más ___menos ___la misma

14. ¿Usa ud. un contenedor para el aceite y la grasa que desecha?___sí ___no (continua a 16)

15. ¿Qué tipo? _____

16. ¿Qué hace ud. con el aceite y la grasa que desecha?

(check si sí)	¿Qué hace?	¿Dónde?	¿(A) Quién?	Precio por mes
	echarlo el el drenaje	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxx
	echarlo en la basura	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxx
	pagar alguien para recolectarlo	xxxxxxxxxx		
	darlo a alguien que lo recolecta	xxxxxxxxxx		xxxxxxxx
	venderlo a alguien que lo recolecta	xxxxxxxxxx		
	llevarlo a un lugar para venderlo a alguien			
	llevarlo a un lugar para donarlo a alguien			xxxxxxxx
	Otro:			

17. ¿Hay una posibilidad que ud. pueda donar sus aceites y grasas deshechas para un proyecto que los convertiría a biodiesel?

___sí ___tal vez ____no (si no, continua a 22**)**

18. ¿Seria ud. dispuesto(a) a llevarlo a un lugar central? ___sí ___no

19. ¿Seria usted dispuesto(a) donarlo si alguien lo recolectara? ___sí __no (si no, continua a 22)

20. ¿Por cuántos días puede ud. guardar el aceite o grasa en su propiedad? (Puede distinguir entre el verano y invierno, o decir en general.)

___(en el verano) y ___(en el invierno) o ____(en general)

21. ¿Quántos litros acumularía en ese tiempo?

____litros (verano) ____litros (invierno) ___litros (general)

Ya terminan las preguntas sobre el aceite, y la encuesta continua con preguntas sobre la recolección de basura….

22. ¿Usa ud. un servicio de recolección de basura (para el resto de su basura)?

___sí (___GEN ___el servicio publico ___Otro_____)

___no (continua a 33)

23.¿Tiene usted algun problema con la recolección de basura?

(comentarios) : _____
_____

24. ¿Con qué frecuencia pasan los camiones de basura?

____más que una vez por semana ___una vez por semana

____menos que una vez por semana ___todos los días (continua a 27)

25. ¿Hay días específicos cuando deben pasar los camiones? ___sí ___no

¿Cuáles?_____

26. ¿Tiene que estar presente cuándo pasa el camión o deja la basura afuera?
____Si ? tengo que estar presente
____ No ? no tengo que estar presente

27. ¿Hay algunos materiales que ud. separa del resto? ¿Cuáles? Y ¿Qué hace con ellos?

	Separa?	¿Y qué hace?
Comida desecha		
Carton		
Vidrio		
Plástico		
Latas		
Otro _____		

28. ¿Ha tenido que quemar su basura alguna vez? ___sí ___no

Ya han terminado todas las preguntas…

29. ¿Tiene ud. algunos otros comentarios, o tiene preguntas para mi?

Mientras trabajando en los proyectos de biodiesel y el reciclaje, nos gustaría estar en contacto con su restaurante para compartir información.

¿Reciben uds. información de la CONIRAC? (CANIRAC?) (restaurant association) ___sí ___no

¿Está bien escribir su nombre como contacto?

___sí (escribe el nombre y teléfono en la lista de contactos)
___no: ¿Hay otro nombre que debo poner? (si sí, escribe en la lista)

¿Es ud. Proprietario/gerente/empleado del restaurante? _____

Muchas gracias por su tiempo.
¿Quiere ud. recibir una copia de los resultados de la investigación? __sí __no

Interviews for Local Restaurants and Food Services: Arizona

Number of Restaurant: *Interviewer:* *Date:*

*Hello, my name is _____. I am a student at the University of Arizona. This year we are working with a group of government representatives, university and college faculty and students, and community leaders on an exciting binational project. The purpose of the overall project is to develop the capacity for the production and use of biodiesel in Ambos Nogales (Nogales, Sonora and Nogales and Rio Rico, Arizona). Biodiesel is an alternative fuel that can be made from crops such as soybeans or from the conversion of waste vegetable oil and grease. For this project, we are helping to gather and map data on local producers of waste cooking oil and grease in our border communities. Would you be willing to answer a few questions**?[If no, thank the person for his/her time and ask if you can come back another time. Write the name of this restaurant and its location on your contact information sheet. If yes, share information from Subjects Disclaimer Form and then start with question #1.]***

1. Do you fry anything?
[***If no, thank the person for his/her time and ask if he/she is aware of any other restaurant or food service that produces waste vegetable oil. Write the name of this restaurant and its location on your contact information sheet. Write the name of other restaurants here.]***

If **yes**, what do you fry?

2. How often do you fry those foods?

3. How much cooking oil or grease do you use per week?

4. How often do you replace your used oil? What size is your fryer?

5. How often do you buy cooking oil or grease?

6. How much waste cooking oil or grease do you produce in a month?

7.- How does the amount of waste oil and grease that you are disposing of this year compare to previous years? Is it more, less, or equal?

8.- If it is more or less, what is the reason, in your opinion?

9.- How does the amount of waste oil and grease that you are disposing of this month compare to other months? Is it more, less, or equal?

10.If it is more or less than in other months:

a. In which months do you dispose of the most oil and grease?
b. In which months do you dispose of the least oil and grease?

11. What type of container do you use for your waste oil and grease now?

12. What do you do with your waste oil or grease?

13.a. If the response is…**pay someone to collect it…**
How much do you pay for waste oil or grease collection each month?

b. If the response is…**sell it to someone…**
What is the price you receive for waste oil or grease (per gallon or per month)?

c. If the response is…**pour it down the drain or put it in the trash,** just continue to #14.

14. Is there a possibility you could donate your waste oil or grease to a project that would convert it to biodiesel, an alternative fuel for diesel engines?

15.a. If the response is…**no**…
Thank you very much for your time. Would you like to receive a copy of the results of our study?

b. If the response is ....**yes or maybe…**
How long can you store the oil or grease on your property? About how much would you produce in that amount of time?

Would you be willing/able to take it to a central collection place?

Do you have anything else you would like to say?

Can I list your name as a contact person? (**write name on contact sheet**)
If **no**, whose name should I list? (**write name on contact sheet**)
Thank you very much for your time. Would you like to receive a copy of the results of our study?