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Geography of Pestecide Exposure in the Lower Valley (El Paso County, Texas)

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GEOGRAPHY OF PESTICIDE EXPOSURE

IN THE

LOWER VALLEY (EL PASO COUNTY, TEXAS)

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Dedication

I dedicate this thesis to my loving and supporting husband and my son.
Skeeter and Max

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by

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THESIS

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Abstract

Previous studies using GIS have been used to understand the demographics of particular areas of a city and the risks associated with living there. In the Lower Valley (Socorro, Clint, and San Elizario) area of El Paso County (TX), there has been a rapid growth in population. This increase in growth has led to this project about the types of pesticides used in farms and if they are creating possible health risks for people living in this area and which populations are most at risk. To determine population risk, I use existing GIS information, specifically a USDA aerial photograph taken when crops were at full leaf, US Bureau of the Census data from 2000, and data regarding pesticide usage and crop growth gathered by myself to analyze, compare, and assess possible health risks from living, or attending school, near farm fields. I focus on five pesticides commonly used on local crops (e.g., cotton, pecans, and chiles) and the level of danger that they present to the surrounding population. In regards to the defoliant Defol 750 used on chile, the populations that are mostly at risk are Hispanics and people who are 65 years of age and over. When looking at the insecticides Lorsban 4E and Whirlwind, the populations that are most affected are non Hispanic Whites, renters, and adults 18 to 64 years of age. In regards to Roundup ProMax herbicide and Trimax Pro insecticides, the populations that are most at risk are non Hispanic Whites, renters, and adults 18 to 64 years of age. In terms of schools, nine schools are located within 300 feet of the nearest farm field, putting students and school staff at risk. We can see that there is an overall significant pattern of increased risk in regards to populations that are non Hispanic Whites, adults, and renters, as well as to schools that surround farmlands. In sum, there are a substantial amount of people at risk due to the proximity of farms that use pesticides to homes and schools in the Lower Valley.

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CHAPTER 1: Introduction and Literature

1.1 INTRODUCTION:

In the Lower Valley (Socorro, Clint, and San Elizario) area of El Paso County, there has been rapid growth in population throughout the years. The once outer city limits area, which provided sufficient space for farm lands, is now being surrounded by homes and businesses. This increase in growth has led to this project about the possible health risks for people living in this area, because farms have had to resort to the use of pesticides in order to maintain their crops (Saller et al., 2007). Because pesticides are known to have health effects (Foster, 2002), it is important to understand which populations are most at risk.

1.2 LITERATURE REVIEW:

In this section, I will review the environmental injustice literature in general as well as specific studies related to farms. Then, I will discuss the impacts of pesticides on health. Environmental justice is not only a concern about the actual environment itself, but also a population or specific targeted population segments that are affected unequally by the environmental risks (Roberts et al., 2001). Specific environmental injustices can be seen in relation to air, water, land, and wildlife, among other environmental features (Schlosberg, 1999). "Environmental justice embraces the concept that every individual, regardless of race, ethnicity, or class has the right to be free from ecological destruction and deserves equal protection of his or her environment, health, employment, housing, and transportation" (Roberts et al. 2001, p. 10). Having rights and equalities involves everyone including minorities and those who are less able to fight for those rights themselves, like children. It is as a society that we must provide environmental justice to all equally. Environmental racism, a related term to environmental injustice, refers to:

A conscious or unconscious act of racial injustice towards people of nonwhite race which includes either the placement of waste facilities, pollution industries, or anything that has a negative environmental effect. It can also mean the difference of law making, passing, or reinforcement between white communities and that of non white communities (Roberts et al., 2001, p.9).

Within the population, there is a division of different types of groups that are impacted by the struggle for environmental justice. Residents, businesses, and the government play important roles in terms of how environmental issues are addressed and considered. Each of these groups has individual interest and concerns regarding the environment (Roberts et al., 2001). This creates an ongoing struggle between the needs and wants of each party and an even more difficult solution that all could agree upon. Understanding the position of each group and how they affect the environment can become the first step in determining how we can create solutions.

Previous studies using GIS (Geographical Information Systems) have been used to understand the demographics of particular areas of a city and the risks associated with living in those places. Bolin and colleagues (2000) used US Bureau of the Census and Environmental Protection Agency data to create GIS database, then measure, statistically test, and discuss relationships between hazards (such as airborne point-source emitters) and socioeconomic characteristics of proximate areas. Questions asked include "are there significant differences between the socioeconomic characteristics of neighborhoods with polluting industrial facilities and those without facilities? Is there a relationship between the volume of toxicity of industrial emissions and the socioeconomic characteristics of nearby neighborhoods? (Bolin et al., 2000, p.12). As used by Bolin et al. (2000), these questions will be used as guidelines to my research regarding farms and pesticides, and the proximity of residential and school areas of the Lower Valley to the fields.

In research on environmental justice, air pollution is often studied related to social disparities and targeted populations. Jerrett et al. (2001) focus on three reasons why environmental injustices are found in air pollution distribution: market failures, political inequalities, and institutional structures and land use. Their research combines GIS with the pollution exposure, level of danger of pollutant, and the socioeconomics of the surrounding population. The results of the research showed that lower socioeconomic status groups were the most exposed to air pollution (Jerrett et al., 2001). This article serves as an example of how GIS can be utilized with other research methods to create understanding of distributional injustices. GIS provides a framework for integrating socioeconomic data and information about farm pesticide exposure to examine an understudied dimension of environmental justice in the agriculture-based Lower Valley of El Paso County, Texas.

Farms, pesticides, and health:

Pesticides have been found in soil, water, humans, and animal tissue in samples from all over the world (Anwar, 1997). There are different sampling methods that are used in assessing the exposure of humans to pesticides. One way is by hand wipe sampling, which is a surface dust measure of exposure. Air sampling methods measure outdoor and indoor air in both gas and particulate phases. Food and water sampling of the exposure can also be used (Hoppin et al., 2006). Drift can also be used in order to understand how far pesticides can move from farms to surrounding neighborhoods and homes (Ward et al., 2006).

Pesticides are defined as:

> substances intended for preventing, distorting, or controlling any pest, including vectors, of human or animal diseases, unwanted species of plants or animals that cause harm during the production, transport, or marketing of food, agricultural commodities, wood and wood products, or animal feedstuffs, which may be administrated to animals for the control of insects, arachnids, or other pests in or on their bodies (Anwar, 1997, p.801).

Pesticides themselves are measured individually by the U.S. EPA Toxicity Categories. Category I is the most toxic and an example of this is Methyl Parathion, which is often applied to cotton (Rubin, 2002), a crop commonly grown in the Lower Valley. The EPA requires all pesticides to be assigned a toxicity level (see Table 1). Then each of these levels is assigned a Signal Word, which represents the different toxicity categories (see Table 1). The table shows us the different levels of toxicity (Category I-Category IV), the quantity of exposure at which pesticides in each category are harmful in different exposure pathways (e.g., oral, dermal, inhalation), and the type/duration of irritation caused.

Table 1: Toxicity Categories

	Category I	Category II	Category III	Category IV
Acute Oral	Up to and including 50 mg/kg	> 50 thru 500 mg/kg	> 500 thru 5000 mg/kg	> 5000 mg/kg
Acute Dermal	Up to and including 200 mg/kg	> 200 thru 2000 mg/kg	> 2000 thru 5000 mg/kg	> 5000 mg/kg
Acute Inhalation[1]	Up to and including 0.05 mg/liter	> 0.05 thru 0.5 mg/liter	> 0.5 thru 2 mg/liter	> 2 mg/liter
Primary Eye Irritation	Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days	Corneal involvement or other eye irritation clearing in 8-21 days	Corneal involvement or other eye irritation clearing in 7 days or less	Minimal effects clearing in less than 24 hours
Primary Skin Irritation	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 hours (severe erythema or edema)	Moderate irritation at 72 hours (moderate erythema)	Mild or slight irritation at 72 hours (no irritation or slight erythema)
Signal Word	Danger	Warning	Caution	Not Required

[1] 4 hr exposure

Source: U.S EPA, 2008
Note: mg/liter refers to the amount of pesticide in milligram per liter.

To determine the exposure of humans to pesticides, biomarkers are used. More specifically, biomarkers are: "detections of environmental substance in a person's blood, change in genetic material, and cell death. The biological events detected can represent variation in the number, structure, or function of cellular or biochemical components" (Anwar, 1997, p.802). There are many different reactions that occur in the human body when it is exposed to pesticides, including effects to DNA composition (Anwar, 1997). Acute health effects that have been linked with exposure to pesticides are nausea, dizziness, vomiting, headaches, abdominal pain, and skin and eye problems. Chronic health problems include respiratory problems, memory disorders, dermatologic conditions, cancer, depression, neurological defects, miscarriages, and birth defects (McCauley et al., 2006).

Who is most at risk for pesticide exposure?:

Those who work in the fields and those who live near the fields face high health risks from pesticides. Children in these two groups are especially at risk (Rayner et al, 1999, Ward et al., 2006). There are about 4.2 million farm workers in the United States that are exposed to the pesticide dangers (Arcury et al., 2002). In this case, their risk of pesticide exposure has been linked to their economic level and also their ethnic background. While most of the of U.S. farm workers were once African Americans, today the burden has shifted to Latinos. This low income group is the main population that works on farms and is exposed to pesticides used in them. Not only are they working in unsafe environments, but they are also not given the proper training on how to handle pesticides (Arcury et al., 2002). In a study of the North Carolina hog industries, they found that farm workers were not fully aware of the dangers and lacked knowledge of how to mitigate their exposure to pesticides (Arcury et al., 2002).

However, farm workers are not the focus of this study. Instead, I am going to examine residential and school-based risk associated with living and learning near farm fields. Whereas it is well-documented that farm workers are generally a low-income, minority group, we do not know the demographic makeup of those that live and learn proximate to fields. In her book, Steingraber (1998) talks about the different health effects of pesticides, in particular cancer, and how it has been linked to pesticide usage around her hometown in Illinois. Her work and research provides evidence that the proximity of pesticide usage in farms can affect not only the farm workers themselves but the surrounding populations within a farm as well. Residential pesticide exposure has been examined in the research conducted by Ward et al. (2006). They used GIS to create historical crop maps in the Midwestern United States. Residences were mapped, and the extent of agricultural fields proximate to the homes was used as a way of identifying homes with potential exposure to agricultural pesticides. In the study conducted by Ward et al. (2006), carpet dust from homes surrounding the farms was tested for pesticide residue. The results of this research showed that a large number of homes which had crops at less than 100 m, 101–250 m, 251–500 m, and 501–750 m of their home had some level of pesticide currently found inside their homes.

Children are especially at risk when it comes to exposure to pesticides. Research conducted by the U.S. Environmental Protection Agency showed that children are up to 2 times more vulnerable to certain pesticides like Chlorpyrifos (i.e., an insecticide and one of the ingredients of Lorsban) than adults. The report also showed how children from 0-3 years of age have higher risks than children of 4-12 years of age (Rayner et al., 1999). "Children near agricultural areas have five times the concentration of pesticides in their urine than children in urban areas" (Ward et al., 2006, p.893). Roberts et al. (2007), note that Autism "risk increased with the poundage of organochlorine applied and decreased with distance from field sites" (p.1482). Alarcon et al. (2009) also mentions the risk regarding schools and "acute illnesses associated with exposure to pesticide drift from neighboring farmland" not only to children, but to school employees as well (p. 463).

Studies of farms and environmental injustice:

While air pollution has been the focus of most spatial environmental justice research, others have used these frameworks and methods to examine agricultural pollution. Hog industries in North Carolina are causing an environmental injustice due to their large numbers and high levels of waste containing ammonia, dusts, and endotoxins, among others, which create health problems for humans (Wing et al., 2000). The large hog corporations that are located in North Carolina have concentrated in areas of low-income people, who are most exposed to the contamination (Wing et al., 2000). Like hog farms, agricultural fields also present a risk to the environment and human health. Fields present a risk because of the hazardous chemicals used in the agricultural production process. "Out of 600 chemicals, 34,000 different pesticides are created and registered in the U.S. Environmental Protection Agency. Agriculture itself uses 20,000 of these pesticides. There are about 900,000 farms in the U.S. where 75% are cropland and 70% are livestock" (Lang, 1993, p.578).

In sum, environmental justice studies have shown that poor and minority people tend to be at increased risk for exposure to environmental hazards. This study will test to see if these and other socially disadvantaged groups experience disproportionate exposure to pesticides while at home in the Lower Valley. In addition, the proximity of schools to fields will be investigated. Previous methods introduced in the literature review will be incorporated into this study.

CHAPTER 2: Context and Methods

2.1 RESEARCH QUESTIONS AND STUDY COMMUNITY:

Specifically, I will answer the following questions: what are the social characteristics of the neighborhoods (census blocks) most at-risk to pesticide exposure from the five most commonly used pesticides in the Lower Valley in El Paso County, Texas? How many schools are at-risk from these five pesticides? The Lower Valley study area includes the towns of Clint, San Elizario and Socorro as well as the surrounding rural area, and is located in the eastern part of El Paso County (as shown in Figure 1).

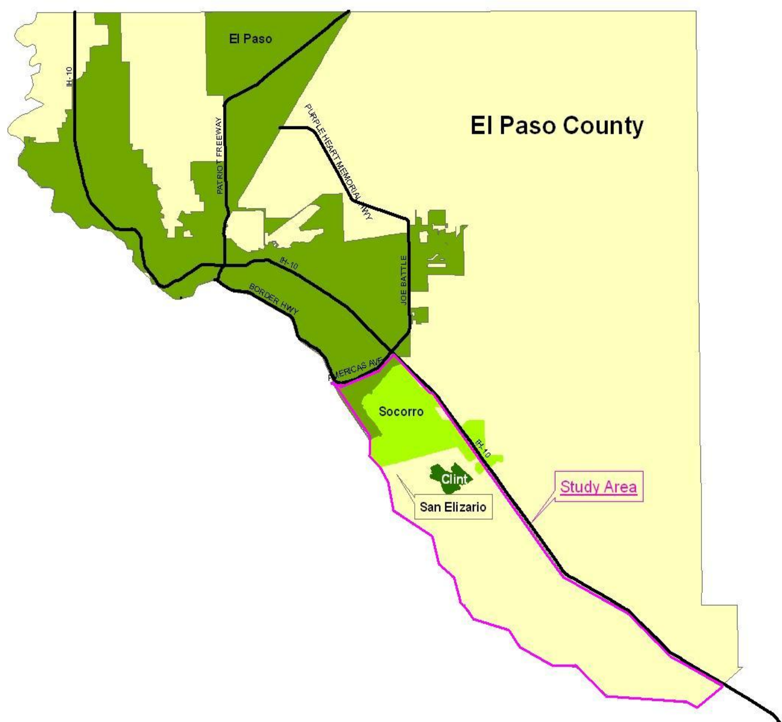

Figure 1: Study Area Boundaries

Census data for these communities, as compared with El Paso County, is presented in Table 2. The data show the demographics that characterize each of communities in the study area. According to the U.S. Census, Socorro is a city, Clint a town, and San Elizario a census designated place (CDP). A CDP is a place that lacks a municipal government, but is still separated statistically by the Census. The poverty level percent of Socorro and San Elizario exceed that of El Paso County. There also is a larger percentage of Hispanic/Latino residents living in the Lower Valley compared to that of El Paso County. With information gathered by the US Census, I compare relevant variables for El Paso County with those of the three main cities in the study area (see Table 2). These variables are important because they provide information regarding the socioeconomics and demographics of the population of each individual place in the Lower Valley in comparison to that of El Paso County.

Table 2: Socio-demographic characteristics of Lower Valley and El Paso County

	Population	Children under 5 yrs (%)	Hispanic or Latino (%)	Rent (%)	Own (%)	Education: high school or higher (%)	Below poverty level (%)	Income: Median house-hold (1999 U.S. $)
El Paso County	679,622	8.68	78.22	36.4	63.6	65.8	20.5	33,684
Clint	980	5.51	83.98	21.1	78.9	72.8	16.6	34,000
Socorro	27,152	9.23	96.43	18.9	81.1	44.5	30.9	24,087
San Elizario	11,046	10.39	97.88	14.2	85.8	31.6	40.2	20,145

Source: U.S. Census Bureau, 2000

2.2 METHODS:

Preparing the field data:

The initial part of my research involved using a rectified aerial photograph from the USDA (shown in Figure 2) to identify farm fields in my study area. I used the municipal boundaries of Socorro, San Elizario, and Clint, as well as the surrounding rural areas within El Paso County to separate the area of interest from the rest of the El Paso County (Figure 1). Then I manually digitized all farm fields by creating polygons within my study area to represent the exact location of each farm (shown in Figure 3) using the ArcMap program. I digitized a total of 2,408 fields in my study area. The next step was to record the type of crop grown and the pesticide(s) most commonly used for each field in that area. To do this, I ground truthed the farms by driving around the area with a copy of a printed GIS map. I took digital pictures in order to identify the crops properly (see Figure 4 for an example). Once the farms had been properly identified, this information was added to the attribute table of each polygon in GIS under the field "Crop." Each crop was individually coded such as shown in Table 3. In addition, Table 3 provides the count for each crop type. Cotton and pecans are grown in the greatest numbers of fields in the Lower Valley. Although giant grass is used as feed like alfalfa, I did not combine them together because of differences in the process by which they are grown.

Table 3: Code for Crop

Code	Crop	Fields
0	No Data	54
1	Pecan	489
2	Cotton	1730
3	Alfalfa	104
4	Corn	20
5	Chile	4
6	Giant Grass	7

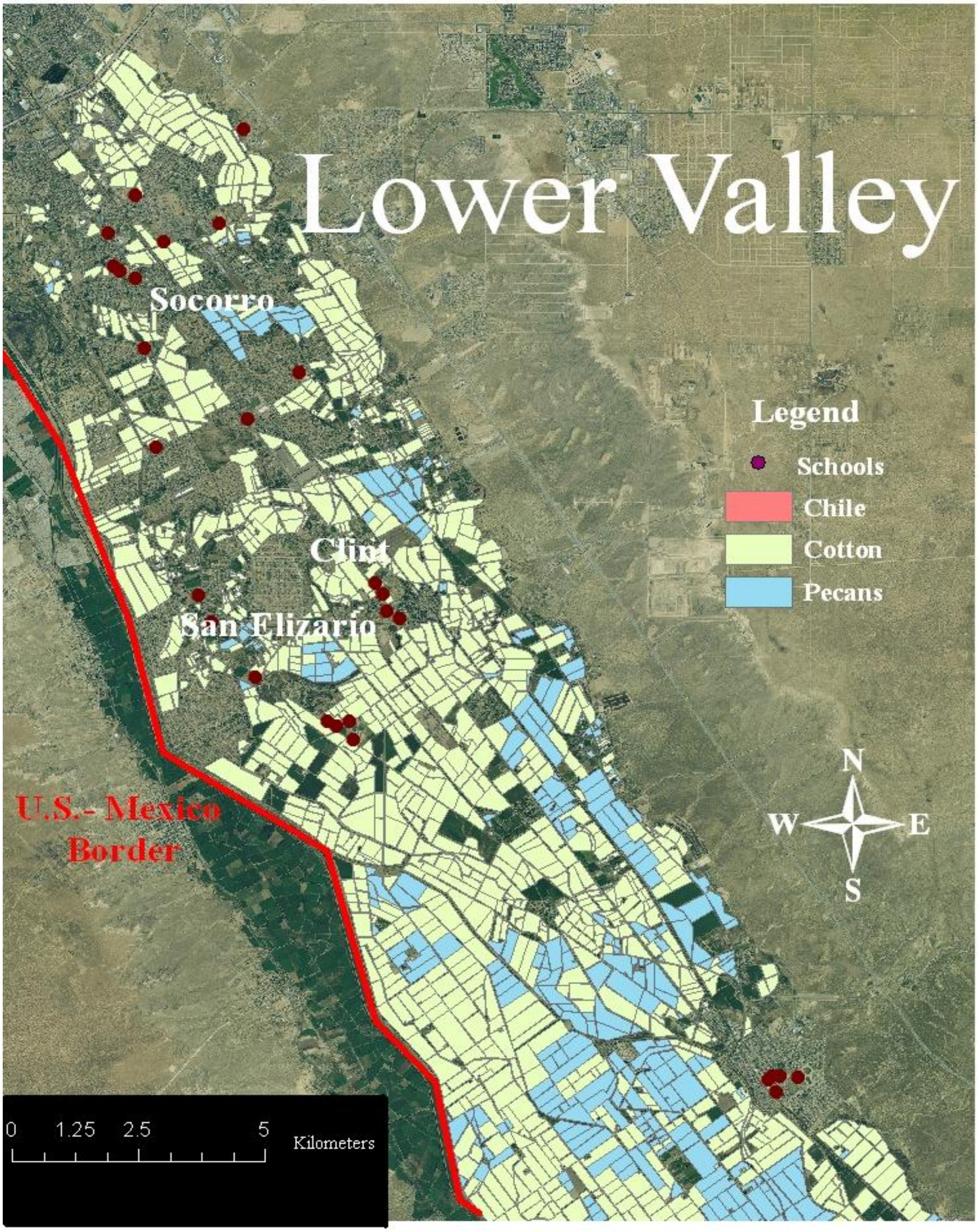

Figure 2: Lower Valley (El Paso County) and USDA aerial photo

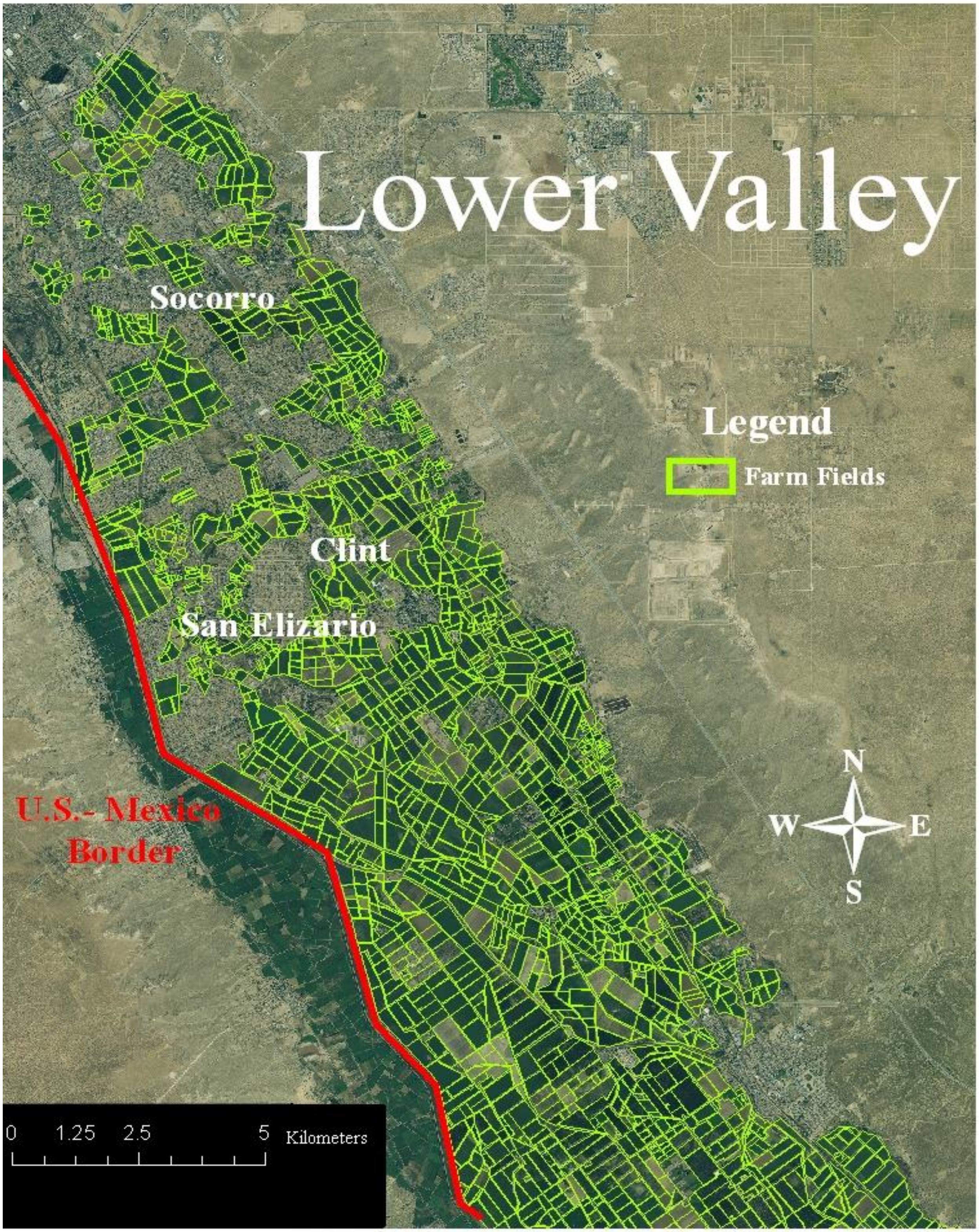

Figure 3: Farm Fields

Cotton Alfalfa

Corn Pecans

Figure 4: Photo of farm fields taken during ground truthing.

Creating risk scores for each field:

I researched the most common pesticides used for each specific crop in this region and checked their toxicity category level as provided by the United States Environmental Protection Agency (EPA), (see Table 1) in order to be able to assign a toxicity level to each of the farms. My method for identifying which pesticides are used on which crops was by starting with information provided by previous articles, such as Ward et al. (2006) and Saller et al. (2007), as well as informal information given by the Texas A&M Research Center in the Lower Valley. Then, I went to the pesticide store of Helena Chemical Company, located in 390 O T Smith Road, Tornillo, TX 79853, in order to identify the actual products used locally. Data acquired through Helena Chemical Company are located in Table 4. Because my interest is in regards to identifying the pesticides commonly used in the Lower Valley, I decided to use the information provided by the Helena Chemical Company. Kevin Giraud, who works at the Helena Chemical Company, provided me with a list of common pesticides used in various crops and the non diluted quantities sold from 2008. From this list I chose the top five according to the quantities sold. I then looked at each of the individual labels of the five chemicals in order to check their toxicity. Once this information was gathered I proceeded with adding it to the attribute table in the GIS shape files. The level of toxicity along with the signal word helped me decide which type of buffer size I used as well as how dangerous each pesticide is.

Table 4: Pesticide Information

Pesticide:	EPA Toxicity Level:	EPA Signal Word:	Crop:	Chemical Type:	Active Ingredient	Count of Units
Defol 750	2	Warning	chile	defoliant	Sodium Chlorate	920,000
Lorsban4E	2	Warning	pecan	insecticide	Chlorpyrifos	452,500
RoundupPower Max	3	Caution	cotton, pecan	herbicide	Glyphosate	1235,000
Trimax Pro	3	Caution	cotton, pecan	insecticide	Imidacloprid	5760,000
Whirlwind	2	Warning	pecan	insecticide	Chlorpyrifos	887,500

To determine which areas are at risk, I used the method of measuring drift, which is how far a pesticide is actually spread through the area when applied aerially. I implemented a measure of aerial drift because previous research has identified this as something that happens on the farms when pesticides are used (Saller et al., 2007). One way in which I identified drift was by the information provided in the article by Roberts et al. (2007). The drift measurement used was 250 meters because this measurement has shown significant impact in health effects regarding autism spectrum disorders (ASD) in children (Roberts et al., 2007). This buffer I applied to those pesticides which contained a level II toxicity due to a higher risk effect if applied. I then chose a second, smaller buffer size of 100 meters for those pesticides that were level III, due to their lower risk. In order to represent how far the pesticides reach from the boundaries of the actual farm, I created buffers in GIS, which are circles around the farms, to represent the extent of the risk, based on the drift of the pesticides.

I also conducted research in regards to specific health and environmental risks posed by each pesticide. In order to get more specific information on each pesticide, I looked into the active ingredient that each pesticide has (shown in Table 4). Defol 750's active ingredient is Sodium Chlorate, which is hazardous to humans and domestic animals. If inhaled, it may cause respiratory problems as well as damage to the liver (EPA, 1999). Both Lorsband 4E and Whirlwind have the active ingredient of Chlorpyrifos, which can alter brain RNA and inhabit DNA synthesis (Eseenzi et al., 1999). Chlorpyrifos also causes damage in the nervous system and can cause respiratory paralysis and death in humans, as well as risks to wildlife (EPA 2002). Roundup PowerMax contains the active ingredient of glyphosate, which can cause damage in human embryonic and placental cells (Benachour et al., 2006). Trimax Pro contains the active ingredient of Imidaclorid, which causes potential damage to non-targeted organisms (Karabay et al., 2005). Thus, there is substantial research that provides evidence that the active ingredients in the five pesticides cause health and environmental problems and should be taken into close consideration.

Population data:

Two sources representing populations at risk were used: census data for census blocks and location of schools in the Lower Valley. First, I identified populations at risk using census data with census blocks as my unit of analysis. The reason why census blocks were chosen was because they are the smallest census unit available, which is important given the study area is rather small, and these would provide enough comparison data in regards of demographic information (see Figure 5). The census variables that I used were: Hispanic percent, non Hispanic White percent, non Hispanic Black percent, non Hispanic Native percent, Asian percent, female percent, female headed households with children percent, average household size, household occupied renting percent, population total under 5 percent, population total 5 to 17 percent, population total 18 to 64 percent, population total 64 and over percent, population total 85 and over percent. I created an Excel data sheet showing not only the percentage of each variable, but also abbreviated names. The names had to be abbreviated in order for the programs to accept the data. Once the Excel data sheet was completed I saved it as a data base file (.dbf) in order to import it as an ArcMap attribute table for each census block. Once all of this information had been imported I was finally able to identify which areas were likely directly impacted by the pesticides being used in the farms and which areas face higher health risks due to the type of pesticide applied. I created the buffers (100 meters or 250 meters) depending on the pesticide, toxicity, and crop (Figure 6). To construct the blocks at risk, I selected the blocks having centroids within crop buffers of 250 meters or 100 meters depending on the toxicity risk. These blocks were labeled and merged into a SPSS file of census data at the block level. Descriptive statistics for the variables that I used are presented in Table 5.

Table 5: Descriptive Statistics for Variables

	N	Minimum	Maximum	Mean	Mode
Total Population	1033	1.00	768.00	57.78	100.00
Hispanic %	1033	0.00	100.00	91.95	0.00
Non Hispanic White %	1033	0.00	100.00	7.23	0.00
Non Hispanic Black %	1033	0.00	50.00	0.21	0.00
Non Hispanic Native %	1033	0.00	84.62	0.31	0.00
Asian %	1033	0.00	16.67	0.03	0.00
Female %	1033	0.00	100.00	51.23	50.00
Female Households with Children %	1033	0.00	100.00	12.42	0.00
Average Household Size	1033	0.00	10.00	3.98	4.00
Housing Units Occupied Renters %	1033	0.00	100.00	21.32	0.00
Under 5 %	1033	0.00	0.50	0.09	0.00
5 to 17 %	1033	0.00	1.00	0.25	0.00
18 to 64 %	1033	0.00	1.00	0.56	0.50
65 and Over %	1033	0.00	1.00	0.10	0.00
85 and Over %	1033	0.00	100.00	0.81	0.00

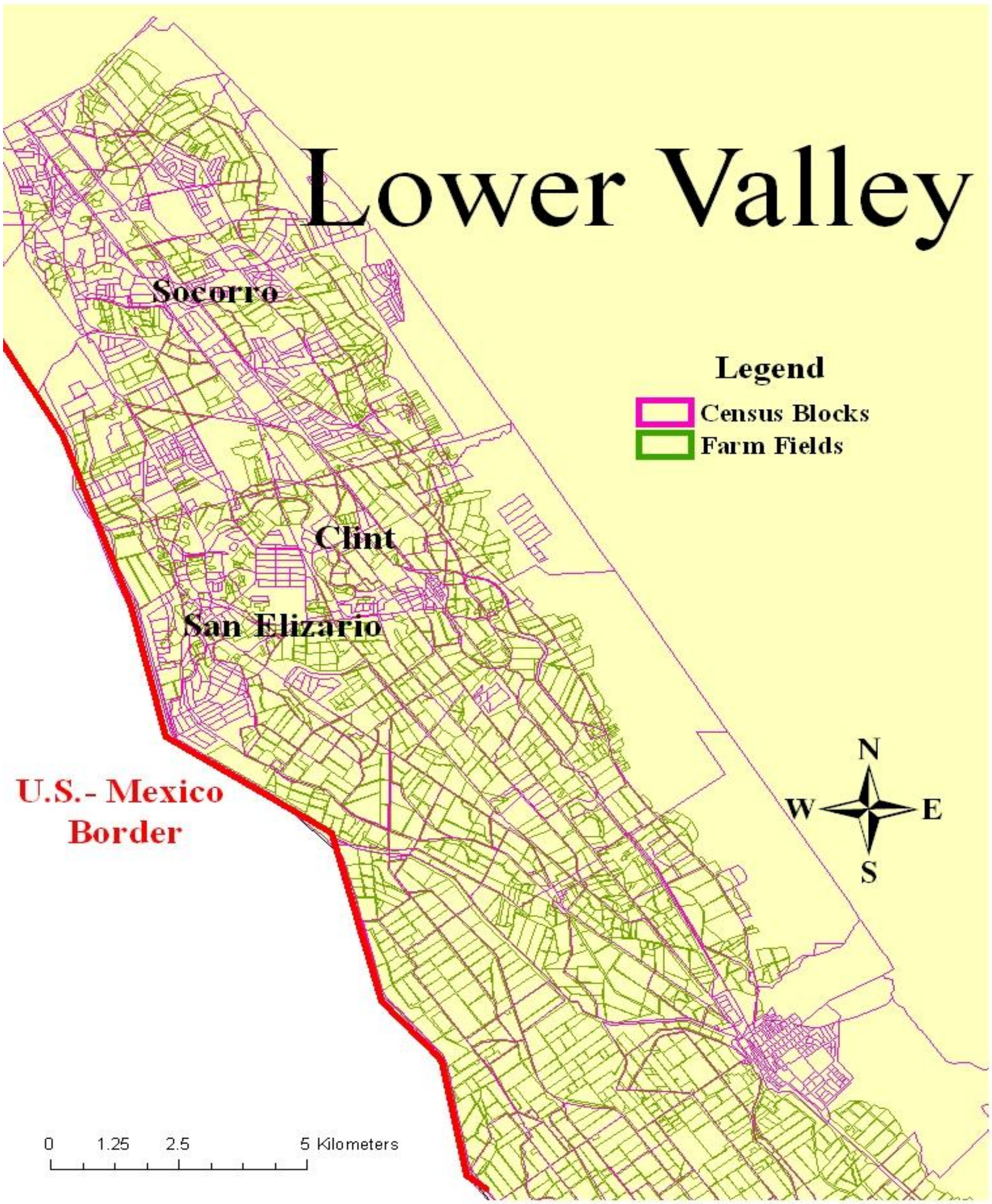

Figure 5: Census Blocks and Farm Fields

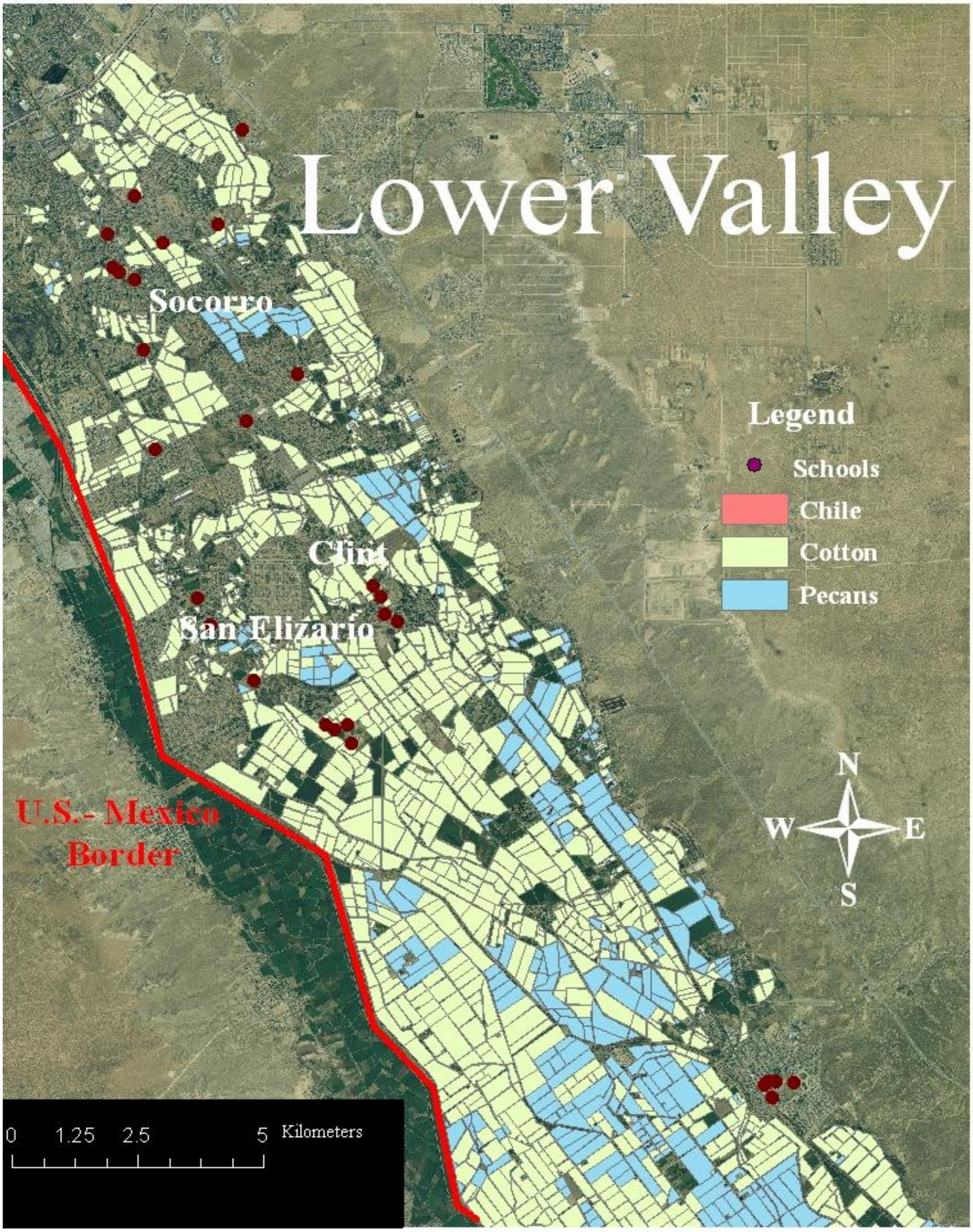

Figure 6: Farm Fields with Crops

Second, I added the schools to my map to see which schools of the Lower Valley are likely at risk. The shape files (GIS-based data file) for the schools were downloaded from the Paso del Norte Mapa webpage (www.pdnmapa.org) for El Paso City and County. I selected all of the schools (n=33) that were located within my study area in the Lower Valley of El Paso County. All of the 33 schools were public and included: 2 pre-kindergarten, 3 Head Starts, 14 elementary, 6 middle, 6 high, and 1 alternative school. This data was acquired from PND mapa, a publicly available source of GIS data. For this, I began by selecting all schools that were within 300 feet of a field boundary. 300 feet was used by Alarcon et al. (2005), as a conservative estimate of at-risk schools, (Figure 7). Then, I incorporated the schools at risk from each pesticide used in this analysis. For each pesticide, I determined how many schools were at risk at 300 feet, 100 meters, 250 meters, and 500 meters from farm field boundaries.

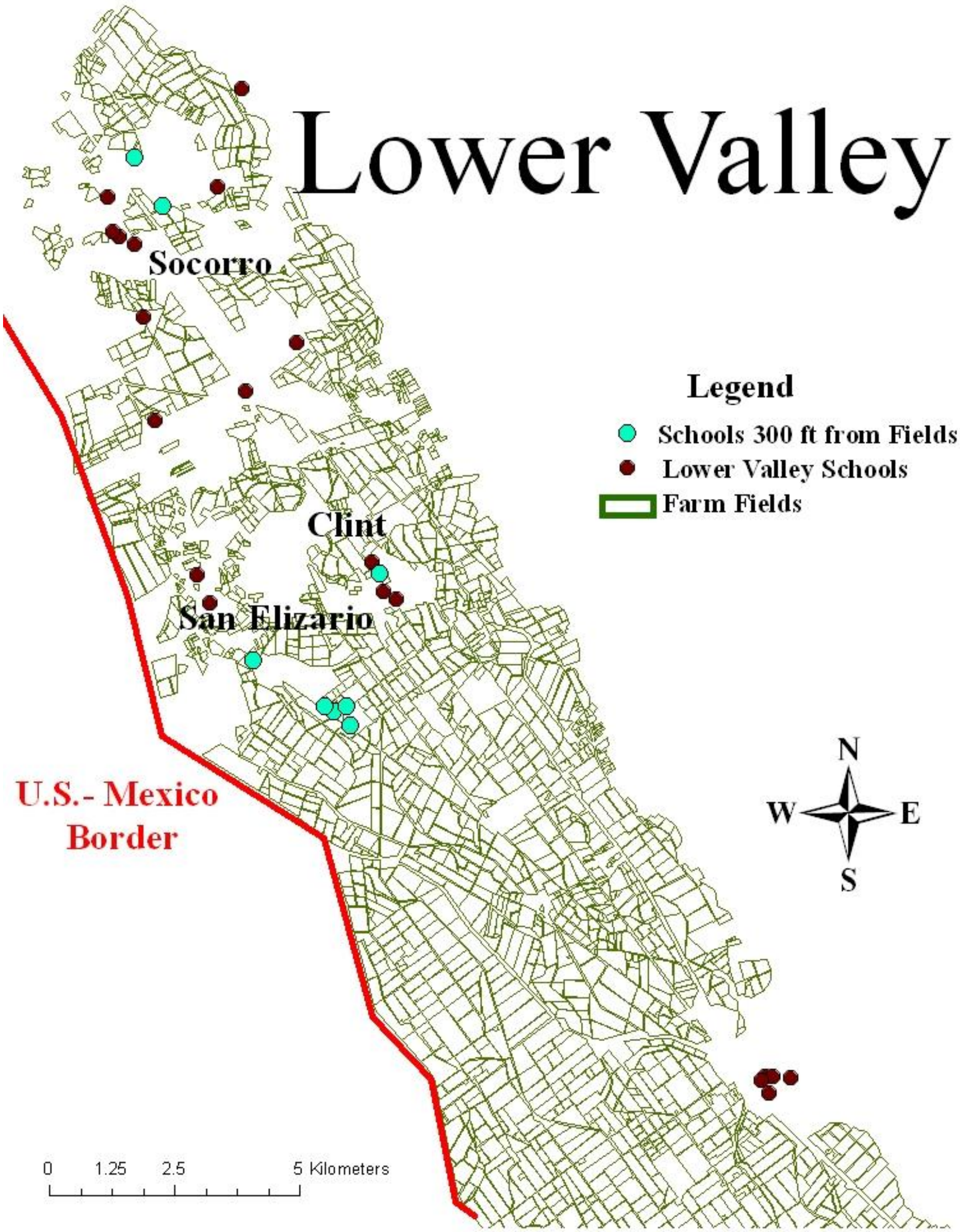

Figure 7: Schools Proximate to Farm Fields

Statistical methods:

For the census block analysis, once each buffer had been created around the fields, I exported all of the information to Statistical Program for the Social Sciences (SPSS), in order to start analyzing the data. I compared the means of all of the census variables to each individual pesticide by using an independent sample t-test and a level of $p<.05$ to see if there were significant differences between the means for at-risk blocks (located within the risk buffer) and compared to not-at-risk blocks (located outside of the risk buffer) for each variable in my analysis (Tables 5-7). Statistical methods were not used for the school analysis; it was purely descriptive in terms of how many schools were near the fields.

CHAPTER 3: Results

3.1 RESULTS:

Defol 750 results:

Defol 750 is used as a defoliant on chiles. The Defol 750 results must be interpreted with caution because only 3 census blocks are at risk from this pesticide. Defol 750 has an EPA risk rating of II, which is the second most dangerous of the EPA's risk categories. In blocks that are within 250 meters of fields that use Defol 750, 100% of the population is Hispanic. In blocks that are farther away from fields that use Defol 750, 91.93% of the population is Hispanic. The difference is significant at $p<.05$, which means there is a larger percent of people who are Hispanic living in blocks near fields that use Defol 750 (Table 6). In blocks that are within 250 meters of fields that use Defol 750, 0.0% of the population is non Hispanic White. In blocks that are farther away from fields that use Defol 750, 8.07% of the population is non Hispanic White. The difference is significant at $p<.05$, which means there is a smaller percent of people who are non Hispanic White living in blocks near fields that use Defol 750 (Table 6). In blocks that are within 250 meters of fields that use Defol 750, 0.0% of the population is non Hispanic Black. In blocks that are farther away from fields that use Defol 750, .21% of the population is non Hispanic Black. The difference is significant at $p<.05$, which means there is a smaller percent of people who are non Hispanic Black living in blocks near fields that use Defol 750 (Table 6). In blocks that are within 250 meters of fields that use Defol 750, 0% of the population is non Hispanic Native. In blocks that are farther away from fields that use Defol 750, .31% of the population is non Hispanic Native. The difference is significant at $p<.05$, which means there is a smaller percent of people who are non Hispanic Native living in blocks near fields that use Defol 750 (Table 6).

In blocks that are within 250 meters of fields that use Defol 750, 34.28% of the population is female. In blocks that are farther away from fields that use Defol 750, 51.28% of the population is females. The difference is significant at p<.05, which means there is a smaller percent of females living in blocks near fields that use Defol 750 (Table 6). In blocks that are within 250 meters of fields that use Defol 0.0% of the population is female headed households with children. In blocks that are farther away from fields that use Defol 750, 12.46% of the population is female headed households with children. The difference is significant at p<.05, which means there is a smaller percent of people who are female households with children living in blocks near fields that use Defol 750 (Table 6). In blocks that are within 250 meters of fields that use Defol 750, 36% of the population is 64 and over years of age. In blocks that are farther away from fields that use Defol 750, 10% of the population is 64 and over years of age. The difference is significant at p<.05, which means there is a larger percent of people who are 64 and over years of age living in blocks near fields that use Defol 750 (Table 6). In blocks that are within 250 meters of fields that use Defol 750, 17.30% of the population is 85 and over years of age. In blocks that are farther away from fields that use Defol 750, .76% of the population is 85 and over years of age. The difference is significant at p<.05, this means there is a larger percent of people who are 85 and over years of age living in blocks near fields that use Defol 750 (Table 6).

Table 6: Group Statistics for Defol 750

Census Variables:		N	Mean	Std. Deviation	Std. Error Mean	p
Hispanic %	No Risk	1030	91.93	17.95	0.56	
	At Risk	3	100.00	0.00	0.00	0.00
Non Hispanic White%	No Risk	1030	8.07	17.95	0.56	
	At Risk	3	0.00	0.00	0.00	0.00
Non Hispanic Black %	No Risk	1030	0.21	2.35	0.07	
	At Risk	3	0.00	0.00	0.00	0.00
Non Hispanic Native %	No Risk	1030	0.31	3.11	0.1	
	At Risk	3	0.00	0.00	0.00	0.00
Asian %	No Risk	1030	0.03	0.59	0.02	
	At Risk	3	0.00	0.00	0.00	0.07
Female %	No Risk	1030	51.28	11.77	0.37	
	At Risk	3	34.28	29.72	17.16	0.01
Female Households with Children %	No Risk	1030	12.46	15.78	0.49	
	At Risk	3	0.00	0.00	0.00	0.00
Average Household Size	No Risk	1030	3.98	1.09	0.03	
	At Risk	3	2.08	2.13	1.23	0.26
Housing Units Occupied by Renters %	No Risk	1030	21.27	24.63	0.77	
	At Risk	3	35.90	55.65	32.13	0.31
Under 5 %	No Risk	1030	9.00	7.00	0.00	
	At Risk	3	2.00	3.00	0.02	0.06
5 to 17 %	No Risk	1030	25.00	12.00	0.00	
	At Risk	3	9.00	16.00	0.09	0.23
18 to 64 %	No Risk	1030	56.00	15.00	0.00	
	At Risk	3	52.00	5.00	0.29	0.67
65 and Over %	No Risk	1030	1.00	16.00	0.01	
	At Risk	3	36.00	55.00	0.32	0.01
85 and Over %	No Risk	1030	0.76	4.37	0.14	
	At Risk	3	17.30	28.34	16.36	0.00

*Findings in bold are significant at p<.05

Lorsban 4E and Whirlwind results:

Lorsban 4E and Whirlwind are used as insecticides for pecans and, 142 census blocks are at risk from these two pesticides. Lorsban 4E and Whirlwind have an EPA risk rating of II, which is the second most dangerous of the EPA's risk categories. Because both of the chemicals have the same toxicity category (i.e., II) and target crop (i.e., pecans), I present only one analysis for these 2 pesticides. In blocks that are within 250 meters of fields that use Lorsban 4E and Whirlwind, 82.91% of the population is Hispanic. In blocks that are farther away from fields that use Lorsban 4E and Whirlwind, 93.39% of the population is Hispanic. The difference is significant at $p<.05$, which means there is a smaller percent of people who are Hispanic living in blocks near fields that use Lorsban 4E and Whirlwind (Table 7). In blocks that are within 250 meters of fields that use Lorsban 4E and Whirlwind, 17.09% of the population is non Hispanic White. In blocks that are farther away from fields that use Lorsban 4E and Whirlwind, 6.61% of the population is non Hispanic White. The difference is significant at $p<.05$, which means there is a larger percent of people who are non Hispanic White living in blocks near fields that use Lorsban 4E and Whirlwind (Table 7). In blocks that are within 250 meters of fields that use Lorsban 4E and Whirlwind, 49.33% of the population is female. In blocks that are farther away from fields that use Lorsban 4E and Whirlwind, 51.54% of the population is female. The difference is significant at $p<.05$, which means there is a smaller percentage of people who are females living in blocks near fields that use Lorsban 4E and Whirlwind (Table 7). In blocks that are within 250 meters of fields that use Lorsban 4E and Whirlwind, 9.42% of the population is female headed households with children. In blocks that are farther away from fields that use Lorsban 4E and Whirlwind, 12.9% of the population is female headed households with children. The difference is significant at $p<.05$, which means there is a smaller percent of people who are female households with children living in blocks near fields that use Lorsban 4E and Whirlwind (Table 7). In blocks that are within 250 meters of fields that use Lorsban 4E and Whirlwind, average household size is 3.51 people. In blocks that are farther away from fields that use Lorsban 4E and Whirlwind, average household size is 4.05 people. The difference is significant at $p<.05$, which means that average household size is smaller in blocks near fields that use Lorsban 4E and Whirlwind (Table 7). In blocks that are within 250 meters of fields that use Lorsban 4E and Whirlwind, 26.79% of housing units are occupied by renters. In blocks that are farther away from fields that use Lorsban 4E and Whirlwind, 20.44% of housing units are occupied by renters. The difference is significant at $p<.05$, which means there is a larger percent of housing units occupied by renters in blocks near fields that use Lorsban 4E and Whirlwind (Table 7). In blocks that are within 250 meters of fields that use Lorsban 4E and Whirlwind, 60% of the population is 18 to 64 years of age. In blocks that are farther away from fields that use Lorsban 4E and Whirlwind, 55% of the population is 18 to 64 years of age. The difference is significant at $p<.05$, which means there is a larger percent of people who are 18 to 64 years of age living in blocks near fields that use Lorsban 4E and Whirlwind (Table 7).

Table 7: Group Statistics for Lorsban 4E and Whirlwind

Census Variables:		N	Mean	Std. Deviation	Std. Error Mean	p*
Hispanic %	No Risk	891	93.39	15.63	0.52	0.00
	At Risk	142	82.91	26.72	2.24	
Non Hispanic White%	No Risk	891	6.61	15.63	0.52	0.00
	At Risk	142	17.09	26.72	2.24	
Non Hispanic Black %	No Risk	891	0.17	1.87	0.06	
	At Risk	142	0.44	4.24	0.36	0.20
Non Hispanic Native %	No Risk	891	0.35	3.34	0.11	
	At Risk	142	0.07	0.49	0.04	0.33
Asian %	No Risk	891	0.03	0.62	0.02	
	At Risk	142	0.03	0.24	0.02	0.83
Female %	No Risk	891	51.54	10.85	0.36	
	At Risk	142	49.33	16.81	1.41	0.04
Female Households with Children %	No Risk	891	12.90	15.59	0.52	
	At Risk	142	9.42	16.62	1.39	0.02
Average Household Size	No Risk	891	4.05	1.03	0.03	
	At Risk	142	3.51	1.40	0.12	0.00
Housing Units Occupied Renters %	No Risk	891	20.44	23.72	0.79	
	At Risk	142	26.79	29.78	2.5	0.00
Under 5 %	No Risk	891	9.00	7.00	0.00	
	At Risk	142	8.00	8.00	0.01	0.07
5 to 17 %	No Risk	891	26.00	12.00	0.00	
	At Risk	142	22.00	15.00	0.01	0.00
18 to 64 %	No Risk	891	55.00	14.00	0.00	
	At Risk	142	6.00	19.00	0.02	0.00
65 and Over %	No Risk	891	1.00	17.00	0.01	
	At Risk	142	1.00	17.00	0.01	0.89
85 and Over %	No Risk	891	0.88	4.94	0.17	
	At Risk	142	0.37	1.57	0.13	0.22

*Findings in bold are significant at p<.05

Roundup PowerMax and Trimax Pro results:

Roundup PowerMax is used as a herbicide and Trimax Pro is used as an insecticide for cotton and pecans, 347 census blocks are at risk from this pesticide. Roundup PowerMax and Trimax Pro have an EPA risk rating of III, which is the third most dangerous of the EPA's risk categories. Because both of the chemicals have the same toxicity category (i.e., III) and target crops (i.e., cotton and pecans), I present only one analysis for these 2 pesticides. In blocks that are within 100 meters of fields that use Roundup PowerMax and Trimax Pro, 85.57% of the population is Hispanic. In blocks that are farther away from fields that use Roundup PowerMax and Trimax Pro, 95.18% of the population is Hispanic. The difference is significant at $p<.05$, which means there is a smaller percent of people who are Hispanic living in blocks near fields that use Roundup PowerMax and Trimax Pro (Table 8). In blocks that are within 100 meters of fields that use Roundup PowerMax and Trimax Pro, 14.43% of the population is non Hispanic White. In blocks that are farther away from fields that use Roundup PowerMax and Trimax Pro, 4.82% of the population is non Hispanic white. The difference is significant at $p<.05$, which means there is a larger percent of people who are non Hispanic White living in blocks near fields that use Roundup PowerMax and Trimax Pro (Table 8).

In blocks that are within 100 meters of fields that use Roundup PowerMax and Trimax Pro, 10.69% of the population is female headed households with children. In blocks that are farther away from fields that use Roundup PowerMax and Trimax Pro, 13.30% of the population is female headed households with children. The difference is significant at $p<.05$, which means there is a smaller percent of people who are female households with children living in blocks near fields that use Roundup PowerMax and Trimax Pro (Table 8). In blocks that are within 100 meters of fields that use Roundup PowerMax and Trimax Pro, 3.70 people is the average household size. In blocks that are farther away from fields that use Roundup PowerMax and Trimax Pro, 4.12 is the average household size. The difference is significant at $p<.05$, which means that the average household size is smaller in blocks near fields that use Roundup PowerMax and Trimax Pro (Table 8). In blocks that are within 100 meters of fields that use Roundup PowerMax and Trimax Pro, 25.92% of housing units are occupied by renters. In blocks that are farther away from fields that use Roundup PowerMax and Trimax Pro, 18.99% of housing units are occupied by renters. The difference is significant at $p<.05$, which means there is a larger percent of housing units occupied by renters in blocks near fields that use Roundup PowerMax and Trimax Pro (Table 8).

In blocks that are within 100 meters of fields that use Roundup PowerMax and Trimax Pro, 8% of the population is under 5 years of age. In blocks that are farther away from fields that use Roundup PowerMax and Trimax Pro, 9% of the population is under 5 years of age. The difference is significant at $p<.05$, which means there is a smaller percent of people who are under 5 years of age living in blocks near fields that use Roundup PowerMax and Trimax Pro (Table 8). In blocks that are within 100 meters of fields that use Roundup PowerMax and Trimax Pro, 23% of the population is 5 to 17 years of age. In blocks that are farther away from fields that use Roundup PowerMax and Trimax Pro, 27% of the population is 5 to 17 years of age. The difference is significant at $p<.05$, which means there is a smaller percent of people who are 5 to 17 years of age living in blocks near fields that use Roundup PowerMax and Trimax Pro (Table 8). In blocks that are within 100 meters of fields that use Roundup PowerMax and Trimax Pro, 58% of the population is 18 to 64 years of age. In blocks that are farther away from fields that use Roundup PowerMax and Trimax Pro, 55% of the population is 18 to 64 years of age. The difference is significant at $p<.05$, which means there is a larger percent of people who are 18 to 64 years of age living in blocks near fields that use Roundup PowerMax and Trimax Pro (Table 8).

Table 8: Group Statistics for Roundup PowerMax and Trimax Pro

Census Variables:		N	Mean	Std. Deviation	Std. Error Mean	p*
Hispanic %	No Risk	686	95.18	11.81	0.45	
	At Risk	347	85.57	24.92	1.34	0.00
Non Hispanic White%	No Risk	686	4.82	11.81	0.45	
	At Risk	347	14.43	24.92	1.34	0.00
Non Hispanic Black %	No Risk	686	0.17	2.02	0.08	
	At Risk	347	0.28	2.87	0.15	0.51
Non Hispanic Native %	No Risk	686	0.35	3.65	0.14	
	At Risk	347	0.22	1.58	0.08	0.40
Asian %	No Risk	686	0.01	0.15	0.01	
	At Risk	347	0.08	0.99	0.05	0.09
Female %	No Risk	686	51.28	10.12	0.39	
	At Risk	347	51.13	14.74	0.79	0.85
Female Households with Children %	No Risk	686	13.30	14.72	0.56	
	At Risk	347	10.69	17.56	0.94	0.02
Average Household Size	No Risk	686	4.12	0.94	0.04	
	At Risk	347	3.70	1.32	0.07	0.00
Housing Units Occupied Renters %	No Risk	686	18.99	21.51	0.82	
	At Risk	347	25.92	29.58	1.59	0.00
Under 5 %	No Risk	686	9.00	6.00	0.00	
	At Risk	347	8.00	8.00	0.00	0.03
5 to 17 %	No Risk	686	27.00	11.00	0.00	
	At Risk	347	23.00	15.00	0.01	0.00
18 to 64 %	No Risk	686	55.00	12.00	0.00	
	At Risk	347	58.00	19.00	0.01	0.00
64 and Over %	No Risk	686	9.00	15.00	0.01	
	At Risk	347	11.00	19.00	0.01	0.13
85 and Over %	No Risk	686	0.86	5.04	0.19	
	At Risk	347	0.71	3.70	0.20	0.60

*Findings in bold are significant at p<.05

School analysis:

Considering all fields together (no risk differentiation), there were eight Lower Valley schools within 300feet the farms (Figure 7, Table 9). This means that there is likely a significant amount of risk for schools (and the children inside them) in the Lower Valley area. Information regarding each of these eight schools can be seen in Table 9. Five of these schools are likely at a great risk due to the fact that they serve pre-school and elementary aged children and we already know that it is dangerous for children to be exposed to pesticides. Rayner et al. (1999) and Ward et al. (2006) have shown evidence that younger children are more vulnerable to health risk from pesticides than are older children and adults.

Table 9: Schools Selected within 300ft of Fields

Address	District	Type	Name	Public
13705 Socorro Rd.	San Elizario	Pre-Kinder	Lorenzo Loya Primary	Yes
200 Herring Rd.	San Elizario	Elementary	Sambrano	Yes
13981 Socorro Rd.	San Elizario	High	San Elizario	Yes
12675 Alameda Ave.	Clint	Elementary	William David Surrat	Yes
13300 Chicken Ranch Rd.	San Elizario	Elementary	Borregon	Yes
13725 Socorro	San Elizario	Alternative	Excel Academy	Yes
321 N. Rio Vista Rd.	Socorro	Middle	Salvador H Sanchez (6-8)	Yes
300 Old Hueco Tanks Rd.	Socorro	Elementary	Hueco (PK-5)	Yes

Then, I selected schools at-risk to the different pesticides using a series of buffers. For fields that likely use Defol 750, there were no schools at risk until 500 meters, at 500 meters, there were 3 schools at risk. For fields likely to use the pesticides Roundup PowerMax and Trimax Pro, there were eight schools at risk at 300 feet, eight schools at risk at 100 meters, 21 schools at risk at 250 meters, and 25 schools at risk at 500 meters. For the fields that likely use Lorsban 4E and Whirlwind, there were no schools at risk at 300 feet or 100 meters. At 250 meters, there is one school at risk, and at 500 meters there are 3 schools at risk (Table 10).

Table 10: Affected Schools by Pesticides

	Defol 759	Lorsban 4E & Whirlwind	Roundup PowerMax & Trimax Pro
300 feet	0	0	8
100 meters	0	0	8
250 meters	0	1	21
500 meters	3	3	25

CHAPTER 4: Discussion

The t-test findings for the 5 pesticides contribute to the literature on environmental justice. The environmental justice literature has generally found that poor and minority residents are most at risk from environmental toxins (Bolin et al., 2000, Jerrett et al., 2001). On the contrary, I generally found that traditionally less vulnerable groups (non-Hispanic whites, adults) were more at-risk from residential pesticide exposure. For example, when looking at the insecticides Lorsban 4E and Whirlwind, there is a significantly larger percent of people who are non Hispanic White, of housing units occupied by renters, and of people who are 18 to 64 years of age living in surrounding blocks. There is also a significantly smaller percent of Hispanics, females, and female households with children, and the average household size is significantly smaller, in blocks near fields that use Lorsban 4E and Whirlwind. In regards to Roundup ProMax herbicide and Trimax Pro insecticide, there is a significantly larger percent of non Hispanic Whites, housing units occupied by renters, and persons 18 to 64 year of age in surrounding blocks. There is also a significant smaller percentage of Hispanics, female households with children, children under 5, and children 5 to 17, and average household size is significantly smaller in blocks near fields that use Roundup PowerMax and Trimax Pro.

There do not seem to be key differences in terms of which residential groups are at-risk between the most dangerous pesticides (Defol 750, Lorsban 4E and Whirlwind, which are of toxicity category III) and the less dangerous ones (Roundup ProMax and Trimax Pro that are of toxicity category II). Across these two risk groups, similar variables were significant: non Hispanic Whites, housing units occupied by renters, and adults. Defol 750 exposure had different risk groups (Hispanics and the elderly), but this could be due to the small number of chile farms located in the Lower Valley and the small number of populated blocks at risk (n=3). Although we do not find a significant number of children living around farms, the schools that surround the farms can be seen as a major source of exposure for children. This should be taken into careful consideration due to the fact that children spend a considerably large amount of time at school.

Related to exposure to pesticides schools, children are in great danger due to being vulnerable to pesticides the younger they are, as shown in research by Rayner et al. (1999). We can see this at only 300 feet: eight out of thirty three schools are already at risk in regards to their proximity to all fields. When using the toxicity levels employed in the residential census block analysis, the following findings emerged. At 250 meters, there was 1 school out of 33 schools located near farms that likely use the pesticides Roundup PoweMax and Trimax Pro. At 100 meters, there were 8 schools out of 33 schools located near farms that use pesticides Lorsband 4E and Whirlwind.

The literature suggests that the use of pesticides endangers and causes health impacts toward surrounding populations. The usage of the five pesticides in the Lower Valley provides sufficient significant evidence that all groups are not impacted the same. In this case, however, in terms of more traditional environmental injustice patterns, we find only renters (generally of lower-income that home owners) and children attending schools to be at-risk. Adults and non-Hispanic whites were also shown to be at-risk in the residential analysis, but this does not match the majority of environmental justice studies.

Limitations:

First, one limitation of the study was due to the time that the study was conducted. Because the study was conducted between the months of July through December, I was only able to use the crops that were currently in season during this time. One of the major crops that were not looked at was onions, because none were being grown during that time. Second, because I was only able to find 3 fields in the Lower Valley that grew chiles, there are a small number of population representations in my analysis for Defol 750. Initially, there were 7 blocks likely affected by the Defol 750 used on chiles, but because 4 of the blocks had no population, these were not used in the analysis. Follow-up research could look into the specific growth of chile to see if there is a reason why the Lower Valley does not have more fields growing it. Third, the study was limited by the source that the pesticide information was provided from, because I was only looking at the quantities sold by the closest chemical store found in the Lower Valley (inTornillo, TX). I might have missed quantities provided by other locations such as the Helena Chemical Company located in Mesquite, New Mexico and Tornillo, Texas. There are also purchases of pesticides done in Juarez, Mexico that are not taken account in this study because they are not monitored like in the United States. In order to get information regarding the quantities imported from Juarez, the Customs and Border Patrol agencies may have been able to provide me with some information, but this would miss those pesticides imported legally through informal channels. A follow-up study could be to do research (using similar methods) regarding the pesticides used in the border city of Juarez, Mexico because of their proximity to El Paso County and its residences.

Fourth, this study focused only on the Lower Valley. Future research could conduct a comparison between the Lower Valley farms and the West side (or Upper Valley) farms. This would have been able to give me not only a different variety of crops and pesticides used, but also a larger population to compare with. It also may have changed the findings and, as the literature on industrial facilities suggests, people with low income and minorities may have been the ones who are most at risk from surrounding farms, and not non Hispanics White as shown in my research. This would likely have especially been the case if the entire population of El Paso County (all blocks) was included, given that the Lower Valley is a poor and Hispanic area, within the County. Fifth, farm workers, a clear risk group, were not accounted for. Had they been, it may have changed the results especially if I had considered those that live near the fields in temporary housing not captured by the census. Sixth, there was no income measures included in my study. I would have liked to have considered the income and housing values of the population living in the Lower Valley in order to compare the income and housing values of non Hispanic Whites to the rest of the population. This was not possible due to the fact that it was not available at the census block level. By doing this, I would have been able to see if non Hispanic Whites were at-risk due to the fact that they own the farms or for any other economical reason.

Seventh, in my research I only considered aerial spray as a form of application of the pesticides. There are different methods in which pesticides are used in farms, they include concentrations of chemicals in water which are used to irrigate the farm fields, chemicals already premixed in fertilizers, and pesticides sprayed by farmers and farm worker by hand. To these ends, pesticide exposure from the water supplies, such as canals and wells, nor land itself was, taken into account in this research. Environmental justice does not only focus on the safety of people but also wildlife and land, and so researching how each of the five pesticides is a threat to any of these categories would help create a larger knowledge on the affects of pesticides used in the Lower Valley.

Eighth, I did not take into account the way that drift is measured. Drift is measured with a combination of wind, weight of the pesticide, how high the pesticides is being sprayed, and spray method (Ward et al., 2006). I used the drift information provided by previous articles (100 meters and 250 meters). I was not able to confirm the specific drift of individual pesticides used in the Lower Valley. However, this method of generalizing risk is common in environmental justice literature, whereby researcher draw 1 kilometer buffers around industrial facilities to represent risk (Bolin et al., 2000).

One last limitation was the actual count of how many and which specific farms were using each of the top five pesticides used in my research. Because of confidentiality concerns, I did not ask each individual farmer about the types of pesticides he/she used or the method in which he/she applied the pesticides. Instead, I replied on sales records from the local pesticide retailer. Also, I was not able to find out more regarding regulation and regulation enforcement of the farmers and pesticides in El Paso County. Knowing this information would have allowed me to create a different type of analysis which could have been included in my research.

CHAPTER 5: Conclusion

The conclusion focuses on policy recommendations, based on my findings. These recommendations focus on the schools, given that children are more at-risk from pesticide exposure than are adults (Rayner et al, 1999). Given the risks of pesticides, I would recommend that the Lower Valley create a stricter regulatory distance that schools, homes, and other public buildings, can be located in relation to the location of farms using pesticides. For this, the county would likely have the power to make a change as well as school districts. The actual public could also influence these policies. Looking at toxicity levels and the approximated aerial drift around the Lower Valley, it is surprising that there are no regulations that require farms to be at a certain distance from schools. This could be because of the lack of building regulations and also because the farms were there before the schools were built due to more recent population growth. Due to the fact that pesticides are being utilized in the area, close inspections and monitoring related to how, when, and where the pesticides are being used should take place. This would include preventing pesticides from being sprayed while schools are in session. Notifying the schools surrounding fields when the fields have been (or will be) sprayed would also diminish the exposure to the public. Although there is currently monitoring and guidance from the Texas Agriculture Center as well as other agencies, I would like to ensure that all farms in the El Paso County are constantly inspected and supervised in regards to their licensing, equipment, worker safety, and pesticide usage and disposal. As shown by previous research, the importance of how pesticides affect the environment is vital not only to create environmental justice but to understand how farmlands and growing communities such as those in the Lower Valley of El Paso can grow side by side. As important as it is for farms to produce, it is equally important to incorporate the knowledge of safety for those around them.

Bibliography

Alarcon, W. A.,Calvert, G. M., Blondell, J.M.,Mehler, L. N. , Sievert, J., Propeck, M., Tibbetts, D. S., Becker, A., Lackovic, M., Soileau, S. B., Das, R., Beckman, J., Male, D. P., Thomsen, C. L., Stanbury, M. (2009). Acute illnesses associated with pesticide exposure at schools. JAMA.294(4),455-465.American FactFinder. In U.S. Census Bureau. Retrieved April 2, 2007, from http://www.census.gov/.Anwar, W. A. (1997). Biomarkers of human exposure to pesticides. Environmental Health Perspectives. 105, 801-806.

Arcury, T. A., Quandt, S. A., Russell, G. B. (2002). Pesticide safety among farmworkers: Perceived risk and perceived control as factors reflecting environmental justice. Environmental Health Perspectives.110, 233-240.

Bolin, B., Matranga, E., Hackett, E. J., Sadalla, E. K., Pijawka, K. D., Brewer, D., Sicotte, D. (2000). Environmental equity in a sunbelt city: the spatial distribution of toxic hazards in Phoenix, Arizona. Environmental Hazards. 2, 11-24.

Chlorpyrifos Facts. (2002). In U.S. Enironmental Protection Agency. Retreved December 16, 2009 from http://www.epa.gov/pesticides/reregistration/REDs/factsheets/chlorpyrifos_fs.htm

Eskenazi, B., Bradman, A., Castorina, R. (1999). Exposures of Children to Organophosphate Pesticides and Their Potential Adverse Health Effects. Environ Health Perspect. 107(3), 409–419.

Foster, J. B. (2002). Ecology Against Capitalism. New York: Monthly Review Press.

Hoppon, J. A., Adgate, J. L., Eberhart, M., Nishioka, M., Rayan, P. B. (2006). Environmental exposure assessment of pesticides in farmworker homes. Environmental Health Perspectives. 114, 929-935.

Jerrett, M., Burnett, R. T., Kanaroglous, P., Eyles, J., Finkelstein, N., Giovis, C., Brook, J. R. (2001). A GIS- environmental justice analysis of particulate air pollution in Hamilton, Canada. Environment and Planning. 33, 955-973.

Karabay, N.U., Oguz,M.G. (2005). Cytogenetic and genotoxic effects of the inidacloprid and methamidophos. Genetics and Molecular Research, 4(4), 6563-62.

Label review manual chapter 7: Precautionary statements. (2008). In U.S Environmental Protection Agency. Retrieved October 15, 2008, from http://www.epa.gov/oppfead1/labeling/lrm/chap-07.htm.

Lang, L. (1993). Are Pesticides a Problem?.Environmental Health Perspectives. 101, (7), 578-583.

McCauly, L. A., Anger, W. K., Keifer, M., Langley, R., Robson, M. G., Rohlman, D. (2006). Studying health outcomes in farm worker populations exposed to pesticides. Environmental Health Perspectives. 114, 953-960.

Rayner, J. H., Akland, G. G., Clayton, C. A., Marrero, T., Pellizzari, E. D. (1999). Final report: Study of exposure and body burden of children of different ages to pesticides in the environment. Environmental Protection Agency. Retrieved from http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/980.

Roberts, E. M., English, P. B., Grether , J. K., Windham , G. C., Somberg, L., Wolff, C. (2007). Maternal residence near agricultural pesticide applications and autism spectrum disorders among children in the California Central Valley. Environmental Health Perspectives. 115, 1482-1489.

Roberts, J. T., Toffolon- Weiss, M. M. (2001). Chronicles from the environmental justice frontline. Cambridge UK: Cambridge University Press.

Rubin, C., Esteban, E., Hill, R. H., Pearce, Jr. K. (2002). Introduction: The methyl parathion story: A chronicle of misuse and preventable human exposure. Environmental Health Perspectives. 1037-1040.

Saller, J, Reyes, P, Maldonado, P. A., Gibbs, S. G., Byrd, T. L. (2007). Children's exposure to pesticides used in homes and farms. Journal of Environmental Health. 110, 27-31.

Schlosberg, D. (1999). Environmental justice and the new pluralism: The challenges of difference for environment. Oxford: Oxford University Press.

Steingraber, S. (1998). Living downstream: A scientist's personal investigation of cancer and the environment. New York: First Vintage Books.

Symptoms of Agricultural Pesticides Exposure. (1999) In U.S. Environmental Protection Agency. Retrieved December 26, 2009 from http://www.epa.gov/region8/toxics/pdf/pestsymptoms.pdf

Ward, M. H., Lubin, J., Giglierano, J., Colt, J. S., Wolter, C., Bekiroglu, N., Camann, D., Hartage, P., Nuckols, J. R. (2006). Proximity to crops and residential exposure to agricultural herbicides in Iowa. Environmental Health Perspectives. 114, 893-897.

Wing, S., Cole, D., Grant, G. (2000).Environmental injustice in North Carolina's hog industry. Environmental Health Perspectives. 108, 225-231.

Vita

Cristina Solis Sanchez was born in El Paso, Texas on January 28, 1985. The younger of two children of Maria Eugenia Solis Gonzalez and Gustavo Solis, she graduated after three years from Del Valle High School, El Paso, Texas, in the spring of 2002. She entered El Paso Community College at the Valle Verde campus. There she received her Associate of Art Degree majoring in psychology in 2005; she then transferred to The University of Texas at El Paso where she received, in 2007, her Bachelor of Arts degree with a major in Psychology and minor in Sociology. During her undergraduate academic tenure, she participated and won 3rd place in The UTEP Student Research Expo by researching Hispanics who don't speak Spanish. Once she received her Bachelor's degree she entered the Graduate School at The University of Texas at El Paso in Sociology. While attending graduate school, Cristina worked as a Teacher Assistant in the Department of Anthropology and Sociology for two anthropology professors. She participated in the Anthropological Association during the school year. She was also awarded the Hispanic Health Disparities Research Center grant, which will allow her to present her research at the Southwestern Sociological Association (SSA) conference in 2010. Cristina plans to graduate with a Master of Arts degree in Sociology in the Fall 2009.

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