Introduction

"Sin el trabajo,
en el mercado no hay nada."

"Without the work,
there is nothing in the stores."
-migrant farmworker in Oregon

Agriculture has long held a prominent role in the economy, culture, and history of the United States. Despite the growth of industries such as telecommunications and computers, the businesses involved in agriculture- such as corporate-owned farms and agrochemical companies- continue to be strong forces in the national economy. The multitude of economic groups involved in agriculture and the urban consumer's distance from their food production tends to obscure the basic reality: agriculture puts food in every store in the U.S. and on every table in the U.S.

The production of a nation's food- with enormous surplus quantities to export around the world- is, naturally, a big business. It involves companies that own substantial portions of land, agro-chemical companies that produce the chemicals needed to boost production, and companies that process the food to be marketed. There is evidence for the increasing trend of land ownership and food production being concentrated in a few hands. For example, of the 2.1

million farms that existed in 1991, the largest five percent of all farms accounted for 56% of gross cash income. In contrast, the smallest 1.1 million farms accounted for only 5% of gross cash income.[1] Not only is farm production unevenly distributed, but farm production creates enormous wealth. In 1990, U.S. farm exports totaled $40 billion, accounting for 11 percent of the total U.S. exports of $366 billion. Of these exports, $5 billion was in fruits, nuts, and vegetables. Total farm sales (not just exports) of fruits, vegetables, and horticultural specialties amounted to $30 billion in 1990, approximately one-sixth of all agricultural sales.[2] Hired farmworkers, including migrant farmworkers, predominate on large farms that produce fruits, vegetables, and horticulture specialties.[3] Agricultural production, and specifically fruit, vegetable, and horticulture production, is clearly a profitable business for large companies, amounting to literally billions of dollars.

Within the general sphere of agriculture, there is a sub-population of people that is often obscured: the migrant and seasonal farmworkers who through their work in the fields, greenhouses, and nurseries, maintain and harvest the majority of fruit and vegetable crops consumed in the U.S., the same crops that were worth $30 billion in 1990. These crops include, but are not limited to, cucumbers, apples, pears, blueberries, blackberries, strawberries, celery, tomatoes, cherries, peaches, asparagus, and grapes. Migrant farmworkers also help produce non-food crops, such as Christmas trees.

Who, then, are the people who undergird sectors of the agricultural economy and fruit and vegetable production in this country? The vast majority of the migrant and seasonal farmworkers migrate from Mexico and Central America, with others coming from Haiti and Puerto Rico, in addition to Mexican-American, African-American, or white citizens.[4] The exact demographics vary by region, with Mexican migrants predominating on the West Coast.

Migrant workers tend to move in three main “streams”, although there is much diversity to this pattern and some contention about the amount of migration between the states. One of these “streams" is based out of Florida and runs up through New York, another through the central states based out of Texas, and the third through the Western states of California, Oregon, and Washington. The farmworkers who comprise the western stream will be the focus of this thesis, particularly those who work on farms in Oregon.

In the past, single men were the overwhelming majority of migrants. While they continue to predominate, more families and even a few single women are participating in this labor force. In the late 1980’s, women constituted 28% of the migrant labor workforce in California,[5]while a study of Mexican migrants entering the United States for the first time between 1987 and 1992 found that 35% of the migrants were women.[6]

The available estimates of the number of migrant farmworkers in the U.S. attest to the essential support they provide the fruit and vegetable agricultural sector. Population estimates of migrant farmworkers vary dramatically, due to different definitions of migrant farmworkers, as well as the different accounting methods used.[*] One estimate puts the number of migrant farmworkers at 900,000, with an additional 515,000 dependent children.[7] However, a somewhat earlier study estimated the number of migrant workers in California alone at 600,000-1.1 million, including dependents.[8] Other estimates have varied between 2.7 million and 5 million workers.[9] An indication of the uncertainty of these estimates is the unexpectedly large number of aliens who applied for Special Agricultural Worker (SAW) status following the 1986 Immigration Reform and Control Act (IRCA) legislation. At a time when the total estimated hired farm work force was 2.5 million, 1.3 million people applied for SAW status, a number

almost ten times larger than USDA estimates of the population of migrant farmworkers.[10] While the lack of reliable numbers poses various problems (as will be discussed later), there is no question that there are many migrant farmworkers on the West Coast, and that their work is essential to fruit and vegetable production.

A core element of the agricultural economy and the political and economic relationship between Mexico, Central America, and the United States is the disparity between the wealth of the large agricultural companies and that of the migrant farmworkers who perform the essential labor required for fruit and vegetable production. While farm sales of fruit, vegetable, and horticultural products amounted to $30 billion, migrant farmworkers in the U.S. contend with poor housing and sanitation conditions, anti-immigrant and racist prejudice, and a multitude of health problems. Unstable work hours, variable methods of payment (by the hour, the pound, or the box), and low wages all operate together to create an insecure economic situation. Weekly hours of work fluctuate, depending on the quality of the harvest. When harvests are good, work is plentiful, but when harvests are poor farmworkers may only work a few hours a day a few days a week. All these issues, compounded by the fact that many farmworkers are illegal, creates a problematic living situation for migrant farmworkers.

Nestled among these many difficult and complicated issues lies another problem: workers' possible exposure to pesticides and the potential health ramifications of that exposure. This thesis focuses specifically on the problem of pesticide exposure through three central questions. First, how well are the recently-implemented Worker Protection Standards complied with in Oregon? There is a logical corollary to this: Are migrant farmworkers unsafely exposed to pesticides? Second, what is the extent of migrant worker knowledge of pesticides (i.e. what

* Refer to Philip Martin's Harvest of Confusion for a detailed critique and explanation of the agencies that assess the

do they know about the symptoms of exposure, the acute and chronic health effects of exposure, precautions that can be taken to prevent exposure, and how pesticides enter the body)? Finally, is the issue of pesticide exposure salient to migrant farmworkers in Oregon, or do other issues assume prominence?

To fully answer these questions and to provide a foundation for analysis, I begin with an examination of the historical political and economic context that has guided the migratory flow between the United States, Mexico, and Central America. This examination demonstrates how the issue of pesticide exposure, and the broader issue of worker conditions, are intricately woven in with international and national dynamics. With this context established, I then outline in the second chapter the general health issues that act in the lives of migrant workers in order to place pesticide exposure within a broader biological and social reality, as well as to assist with the assessment of the saliency of pesticides. I continue in the third chapter with a discussion of the current research related to the possible acute and chronic health effects of acute and chronic pesticide exposure, in order to demonstrate why the issue of pesticide exposure has potentially serious repercussions on the lives of farmworkers, and exactly how those repercussions may be manifested, or may not be. The fourth chapter explores the regulatory framework that guides pesticide use, with a particular emphasis on the 1992 Worker Protection Standards. Information in this chapter is useful for understanding the purpose of the WPS, its requirements, as well as why my research focuses on these regulations. These chapters lead to the chapters of the thesis pertaining directly to my field research, which was guided by the three central objectives outlined above. They provide a context with which to approach and evaluate my research and results.

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migrant farmworker population, the definitions they use, and the methods they employ.

My thesis is focused on the local level to ensure that the information it offers is applicable to the migrant workers who live in the Hillsboro area outside of Portland, Oregon, as well as to the agencies that serve that area. While remaining linked to the local arena, it places the issue of pesticide exposure within the context of other problems that confront migrant workers, as well as the national and international forces that propel migrants to the West Coast and structure their experiences both here and in Mexico.

Chapter 1: Migratory Movement- the International Political and Economic Context

A brief examination of the context within which farmworkers migrate to the United States is useful both to understand why migrant farmworkers are here and also to provide a location from which to analyze and contextualize the exposure of workers to pesticides. Across the country, but particularly in states such as California, anti-immigrant prejudice runs strong against farmworkers and other Latino and non-Latino immigrants. This prejudice evidences itself in California's Proposition 187, as well as similar legislation proposed by Oregon's House in 1995 (HB2933).[11] The nature of anti-immigrant sentiments is well-summarized by the Oregon Commission on Hispanic Affairs in their statement that "Oregon Latinos collectively have been portrayed as an immigrant, alien, and separatist population that overburdens our institutions and resources, while clinging to a culture and language that many view as a threat to American values".[12]

Migrant farmworkers, as a core labor force of agriculture, constitute an important sector of society and therefore deserve a more detailed and balanced assessment of their participation within the U.S.' economic, political, and social structures. Migrant workers from Latin America and the southwest states have a long history in the U.S. For the last century, different groups of people, usually immigrants, have provided labor in the agricultural economies of California, Oregon, and Washington. Successive stages of laborers have come to the U.S.- including Chinese, Japanese, East Indian, Filipino, and mestizo Mexican immigrants.[13] In 1942, the Bracero program was initiated to facilitate the entry of Mexicans into the U.S. to perform agricultural labor necessary for crop production and harvesting. The war's absorption of human

resources had created a dire shortage of farm labor at a time when enormous production was demanded. Between 1942 and 1947, an estimated 15,136 Mexicans were recruited to work in Oregon alone.[14] This program was administered by both the Mexican and U.S. governments. As part of this program, offices were set up in Mexican states, including Oaxaca, to recruit people to work in the U.S.[15]

Although the government-sponsored program ended in 1965, migration from Latin America has never ceased in its strength and continuity. Prior to the mid-1970's/early 1980's, most of the migrant workers came from northern and central Mexico (e.g. Jalisco, Guanajuato, Zacatecas). The majority of these workers were mestizo. Since the early 1980's, however, people from southern Mexico and Central America have become immersed in this labor migration, and now constitute a sizable percentage of the total migrant farmworker population.[16] This geographic shift is extremely important in terms of the ethnic diversity of farmworkers- the states within Mexico differ ethnically, and the populations of Mexico, Guatemala, and other Central American nations vary among one another. The southern states of Mexico have a much larger indigenous population than the northern states, and in Guatemala indigenous groups comprise the majority of the population. For example, 40% of the population of the southern Mexican state of Oaxaca is indigenous, while the average for the rest of Mexico is only 10%.[17] One result of this ethnic shift among farmworkers is a linguistic shift. While most central and northern mestizo Mexicans speak only Spanish, many indigenous people from southern Mexico and Guatemala speak one of a number of indigenous languages, such as Mixtec, Zapotec, Trique, and Nahuatl. Spanish may or may not be spoken in addition to their first language.

In 1986, the Immigration Reform and Control Act (IRCA) was passed. Its main goal was limiting the entrance of undocumented persons into the U.S., while simultaneously addressing the needs of undocumented people who had a lengthy work history in the U.S. Despite the intent of IRCA to control undocumented immigration, it has not been successful in its aims. In 1990 in California, 40-50% of agricultural workers were undocumented.[18] IRCA had two important sets of provisions. The first prohibited owners from knowingly contracting undocumented workers. However, while IRCA did prohibit owners from knowingly contracting undocumented laborers, it did not require that owners ensure that the documents are authentic. The second set included a few legalization programs. One of these, the Special Agricultural Worker program (SAW), permitted undocumented workers who had worked within the United States previously to receive papers legalizing their presence. Agricultural owners pushed to have the SAW provision included. Specifically, SAW allowed agricultural workers who had worked for 90 days or more in agriculture between 1984 and 1986 to obtain their residence papers. Another program included a guest worker provision that permits the temporary entry of agricultural workers. It, too, was promoted by agricultural owners.[19] Thus, through these special provisions that only applied to agricultural workers, agricultural interests ensured that they could maintain their workforce.

Two important questions must be answered to understand the dynamics of the migration between the U.S., Mexico, and Central America: What explains the continued prominence of circular migration from areas as far away as southern Mexico and Central America? What explains the demographic shift in migration from mestizo Mexicans from northern and central Mexico to a largely indigenous population from southern Mexico and

Guatemala? The answer to the first question is largely economic. In the 1980's Mexico experienced an economic crisis instigated by its enormous debt. The peso was devalued in 1982, and real salaries dropped. High inflation and unemployment were also prominent, as was a general decrease in social services.[20] The current political situation in the southern state of Chiapas, which borders Oaxaca, reflects the extent of this continued economic crisis. The energy for Chiapas' resistance arises in large part from the economic isolation of the people in this state. Like Oaxaca, Chiapas has a large indigenous population, and like Oaxaca, it is under-served by the government. The fact that some communities have felt it necessary to turn to active and organized resistance demonstrates the dire social and economic needs of southern Mexican states. Conversations with migrant workers in Oregon also attest to the desperate economic situation .

The answer to the second question can be found in the history and environment of southern Mexico, as well as its economic situation. Historically, there has been a succession of one group of immigrants replacing another in the agricultural economy, as demonstrated by the shift from Chinese to Japanese to Mexican workers over the last 100 years. Indigenous groups from southern Mexico, Guatemala, and Central America are the most recent wave in this trend. Mixtecs from Oaxaca comprise a large number of these indigenous workers in California, as well as in the camps I researched in Oregon. During the Bracero program, Oaxacans, including Mixtecs, were recruited for labor in the U.S. However, when the Bracero program ended, mestizos continued to migrate to the U.S. to work while Mixtecs did not. At the same time as the Bracero program was terminated, Mexican agribusinesses from northwest Mexico began to recruit workers from southern Mexico, and Mixtecs began to work in the north of Mexico. By the mid-1960's-1970's Mixtec communities were

established in border areas, such as Tijuana and Nogales. This geographic proximity to the U.S. poised Mixtec workers for migration into the U.S.

Mexico's economic crisis with the accompanying devaluation of the peso and drop in real wages, combined with the geographic proximity of Mixtec populations to the U.S., instigated an increase in Mixtec migration to the U.S. (as well as other indigenous groups).[21] This increase in indigenous migration can also be explained by the fact that indigenous communities are often poorer and more politically and socially marginalized and repressed than mestizos. Oaxaca, for example, has the second lowest per capita income in Mexico.[22] As another repercussion of their economic isolation, the southern states of Mexico have not benefited from national "development"- including social services, roads, and other basic infrastructure.[23] Combined with the extreme economic poverty of indigenous communities is the environmental deterioration of the land, which has resulted in soil erosion and extremely low productivity. In fact, as of 1990 "the UN's Food and Agriculture Organization [had classified] the Mixteca [the region spanning part of Oaxaca where Mixtecs and other indigenous groups live] as one of the most severely eroded landscapes on earth, with about 70 percent of the potentially arable land no longer able to grow crops".[24] These two factors- poverty and environmental degradation-are primary forces in the labor migration of indigenous persons to the United States.

The economic situation of communities in Mexico, particularly indigenous communities, not only expresses itself in the mere fact of increased labor migration from southern Mexico, it also expresses itself in the willingness of indigenous migrant laborers to receive exceedingly low wages and accept exceedingly poor working conditions in the U.S.. Thus, indigenous workers do not merely replace mestizo workers, they compete with mestizo

workers for jobs. Evidence of this competition for work has been found in the strawberry crops in Oregon, as well as in crops in California.[25] Historically, the dynamic between a population forced because of economic circumstances to work in poor conditions and agricultural owners in search of the cheapest labor available has undercut the efforts of organizations such as the United Farm Workers (UFW) to improve work conditions and maintain their achievements in the long-term. This remains the situation for agricultural workers on the West Coast today.

Such an analysis of the context of migration is important to bear in mind when examining the work conditions of migrant farmworkers on the West Coast and in Oregon, including potential exposure to pesticides. The economic need of the workers, combined with the endless source of labor for the owners, structures the power relationship between farm owners and migrant workers. The conditions that migrant workers confront are one result of this structure. Therefore, it is impossible to assess farmworker exposure to pesticides without bearing in mind the migration context that brings them to the U.S. and defines their experiences here.

Chapter 2: The Underlying Health Issues

Before focusing specifically on the problem of pesticide exposure and its health ramifications, it is necessary to understand the broader health context that pesticide exposure exists within. With such an understanding, it is possible to begin to comprehend the additional burden pesticide exposure places on migrant farmworkers, as well as the limitations of approaching the dynamics of health solely from the vantage point of pesticides.

Migrant agricultural workers are affected by two sphere of health conditions. They live within the sphere of diseases such as diabetes and AIDS that U.S. citizens are accustomed to, as well as the risks associated with agriculture. Migrant workers also live within another realm: diseases that are found predominantly in Third World conditions, such as tuberculosis and malaria. The poor not only contend with this sphere while they are in Mexico and Central America, but they encounter it in the Third World-like conditions of many of their work and living situations in the United States.

The housing provisions are often extremely poor, ranging from sleeping outside or in makeshift shelters, to trailers and cramped cabins. There are quality differences across camps, but while a few model examples of farmworker housing exist, the majority are overcrowded, poorly constructed, and inadequately ventilated.[26] A quick glance at some camps in Oregon reveals cabins approximately 9 feet by 9 feet, with one small window, two bunk beds, and as many as 8 occupants at the peak season, with a more manageable number of 4 at the end of the harvest. These crowded conditions provide ample opportunity for the spread of communicable diseases such as TB.

Water, sanitation, and bathing facilities are also often rudimentary and inadequate both in the living and work areas.[27] Port-o-toilets are extremely common, with limited shower facilities for large numbers of people. Inadequate water and sanitation facilities promote the spread of diseases such as intestinal parasites and gastrointestinal problems. (For example, one study found the prevalence of parasites in migrant farmworkers to be between 28% and 86% depending on the place of origin. Another study investigating drinking water quality found that 15 of 30 camps (50%) tested positive for total coliform, and 37% for fecal coliform.[28])

While epidemiologic data is limited concerning TB infection rates in migrant farmworkers, it appears that farmworkers also experience excessive rates of TB, a disease closely linked to the crowded living conditions.[29] In a study of 543 migrant farmworkers and their families, 33% of the "Hispanic" workers tested had a positive adjusted PPD, and the prevalence rate among African-American migrant workers was 3.6%, over 300 times the national prevalence. A later longitudinal study, although hampered by a small sample size, found an incidence rate among African-American migrant farmworkers of 5.9% over a three year period, a number 200 times that of the general population.[30]

It is important to recognize that while the migrant farmworker population might experience higher incidence and prevalence rates of diseases such as TB or intestinal parasites than the general population, the same diseases that cause high morbidity and mortality in the general population are also leading causes of morbidity and mortality in the farmworker population. Diabetes, hypertension, dental problems, dermatologic problems, musculo-skeletal injuries, respiratory illnesses, hepatitis, eye conditions, gynecological and pregnancy-related problems, STDs, and injuries have all been identified as leading illnesses

among the migrant farmworker population.[31] HIV and AIDS has also been identified as a potentially large public health problem among migrant farmworkers, although one national study has found HIV-positivity to be concentrated among East Coast migrant workers.[32] Unfortunately, few studies have established the incidence and prevalence of these disease in the migrant farm worker population, much less sub-groups of that diverse population.

It appears that the same illnesses that cause high morbidity and mortality in the general population also affect migrant farmworkers. In addition, migrant workers experience high rates of diseases that are relatively rare in other groups (e.g. TB, pesticide-related illnesses). It is important not to become focused on each individual disease, but instead to focus on the broad living, work, and migration conditions that foster the appropriate biological, social, and psychological conditions for illness to manifest itself. The expressions of these conditions may manifest themselves as TB, or hypertension, or violence, but all have similar roots- the national and international conditions that perpetuate the poverty and inequality of migrant workers.

Chapter 3: Health Effects of Pesticides

General knowledge of the potential health effects of pesticides is essential for evaluating the importance of protecting the people who are exposed to pesticides and the efficacy of the regulations that monitor that exposure. Before initiating a discussion of the research pertaining to the health consequences of pesticide exposure, however, it is necessary to have a basic understanding of what pesticides are.

"Pesticides" encompass insecticides, herbicides, and fungicides, as well as other chemical agents used in pest control. Pesticides are classified by chemical properties, such as organophosphates, N-methyl carbamates, and chlorinated hydrocarbons. Organizations such as the WHO and the EPA also classify pesticides according to the toxicity of the compound and the cancer risk to humans.[33] These chemical and hazard classifications are important to bear in mind for the ensuing discussion, since the classes possess different properties, are often grouped together for regulatory purposes, have different effects on the body, and create different symptoms of exposure. Pesticides may affect the human body through inhalation, dermal exposure, or through ingestion. The most common form of exposure is dermal exposure (accounting for 87% of total human pesticide exposure[34]).

The current familiarity with pesticides made from synthetic chemicals fosters the assumption that pesticide use is a new phenomena. However, pesticides are not a new agricultural tool. Sulfur and arsenic were among the first pesticides, while botanical pesticides were used as far back as the 16th century, when nicotine began to be used.

Metallically-based pesticides containing mercury and lead were used in the U.S. in the later 1800's.[35]

Use of chemical pesticides increased in the 1940's, following the development of chemical compounds used for warfare in World War I and World War II.[36] For example, the insecticide parathion was developed by German scientists during World War II while they were working with nerve gas.[37] Since then, chemical pesticides have become extensively used within the U.S. and across the world. The EPA estimated that in 1987 814 million pounds of pesticides were used in agriculture in the U.S.[38] In 1991, 140 million pounds of pesticide active ingredients (not including the often dangerous inert ingredients) were applied for agricultural purposes in California alone.[39] Numbers such as these dramatically demonstrate the extent of agriculture's reliance on pesticides and the widespread use of pesticides. Very few farms use only organic methods of production, and other methods of production that limit the use of pesticides, such as Integrated Pest Management (IPM), are also not as consistently used as chemical means of pest control.

Given the pervasive use of chemical pesticides, as well as agriculture's current dependence on them, chemical pesticides could pose a substantial risk to the people who apply, mix, and load them, as well as to those who work in the fields, greenhouses, and nurseries where pesticides have been applied. Often, particularly in fruit and vegetable crops, these workers are migrant farmworkers. Migrant farmworkers, as well as others who work in this occupation, could be exposed frequently to a wide array of chemicals at possibly dangerous levels. It then becomes necessary to determine if pesticides are safely used. However, as with all issues, this seemingly straightforward question is actually extremely convoluted. For example, what exact dose through what means of exposure

causes acute effects? Does low-dose exposure cause chronic effects? If so, what dosage is required to cause chronic effects, and how many times must exposure occur? Which pesticides cause which specific acute and chronic effects? These few questions provide a glimpse of the complexity of the issue. While all these questions cannot be fully answered, the general conclusions of current research will be presented to provide a framework that underscores the importance of the central three questions of my thesis.

Effects of Acute Pesticide Exposure

Unlike the debate over the various possible chronic effects of pesticide exposure, there is consensus about the existence of detrimental health effects due to acute exposure.[40] The symptoms of acute poisoning vary according to the class and specific kind of pesticide that the person is exposed to. For example, symptoms of organophosphate poisoning include blurred vision, headaches, diarrhea, dizziness, unexplained sweating, salivation, lacrimation, urination, vomiting, bradycardia, fatigue, chest tightness, peripheral weakness and paralysis.[41] In the case of the pyrethrenoids, symptoms include abnormal skin sensations, vertigo, headaches, fatigue, and nausea.[42]

Various methods are available to assess acute exposure to pesticides. In the case of organophosphates and carbamates, which decrease the activity levels of acetylcholinesterase, the enzyme that regulates the neurotransmitter acetylcholine, exposure can be assessed through measuring the levels of cholinesterase in the blood. Usually, cholinesterase depression precedes physical expression of symptoms. There is some debate about the accuracy of using cholinesterase levels to assess exposure and symptoms, but generally it is

accepted as a method of monitoring acute exposure to pesticides that depress cholinesterase levels, namely organophosphates and carbamates.[43]

Exposure to cholinesterase and non-cholinesterase-depleting pesticides can also be assessed through other methods, such as patch tests, wipings of the skin, tracer techniques, or internal dose markers (measurements of the chemical compound or its metabolites in the body (e.g. urine or blood)).[44]

Other non-technological methods of ascertaining exposure that can be used alone or in combination with technological exams include the normal medical procedure of looking at the constellation of symptoms the patient presents with, as well as determining that a situation existed where exposure was likely to occur (e.g. the person was put in direct contact with pesticides while spraying or was harvesting in recently-sprayed fields, a chemical spill occurred, etc.).

Diagnosis and Reporting of Acute Pesticide Cases

As is evident from the previous discussion of methods for ascertaining exposure, access to a hospital or health clinic is necessary for diagnosis. This may be relatively easy for someone with the resources to access the country's various health services, but in the case of migrant farmworkers many barriers exist to medical care. Migrant workers, by the inherent nature of their work, often live in rural areas where public transportation is limited or nonexistent. This, combined with the fact that many farmworkers do not own cars, makes transportation to health centers difficult. Money is also a barrier, as the costs of paying someone to provide a ride or pay for the appointment and treatment itself are often substantial. The time that must be taken off of work to visit a doctor is also an impediment,

as is the language barrier, and the lack of medical insurance. If a substantial number of migrant farmworkers are unable to use medical services, then not only are many possible cases of exposure never treated, but the exposure statistics that rely on cases reported by doctors cannot accurately reflect the true number of cases.

To compound this dilemma, diagnosis of acute pesticide poisoning is difficult. Many of the symptoms of exposure overlap with a myriad of other health problems that are also common in this occupation, such as intestinal illnesses and heat exhaustion.[45] Exposure may also be difficult to document, as the farmworkers may not know what specific pesticide s/he came into contact with and at what concentration.

Once a pesticide case is diagnosed, it is still often difficult to determine the incidence or prevalence of pesticide-related illnesses since only a few states (California, Oregon, and Washington), require doctors to report cases to a central authority, such as the Department of Health.[46]

Three important goals, therefore, are difficult to achieve: determining that the illness was caused by pesticide exposure, treating migrant farmworkers who have become ill as a result of pesticide exposure, and assessing the incidence and prevalence of pesticide poisonings among migrant farmworkers. While the second is obviously a problem for each individual case, the third makes it difficult to determine the magnitude of the effect of acute exposure on the migrant farmworker community and affects the ability of governmental and non-governmental agencies to prioritize pesticide exposure amidst the other issues that migrant workers confront .

Despite all these problems, there still exists one important difference between the consequences of acute and chronic exposure to pesticides: in the case of acute exposure it is

much easier to determine that pesticides were the cause of the illness. One obvious explanation for this is that in the case of acute exposure, the latency period is much shorter, often within hours of exposure. Secondly, there is often a more clear and even memorable exposure that occurs to demonstrate a causal connection since the latency period is short and the dosage required to display physical and mental effects may be higher. Examples of discrete episodes of acute exposure may include applying pesticides without proper equipment, or working in fields that have recently been treated. Thirdly, it is often possible to use the methods discussed previously (such as cholinesterase testing) to determine that exposure occurred. As will be demonstrated and explored in the next section, the results of chronic exposure to pesticides are much more difficult to describe and quantify.

Chronic Effects of Pesticide Exposure

It is in the arena of chronic effects of pesticide exposure that determining causation becomes an intellectual, methodological, and logistical challenge. There are a number of possible chronic effects of exposure, grouped into the general categories of cancer, reproductive effects, neurological effects, and birth defects.

Despite the challenges inherent in assessing chronic effects, it is imperative to do so for a few reasons. One obvious reason is that low-level chronic exposure occurs more frequently than acute exposure. For example, harvesters may be in daily contact with fields that have been sprayed within the last month, but cases of un-protected entry into fields before the restricted entry interval has expired are more uncommon. Second, chronic effects possess qualities that make them more detrimental to the long-term health and economic stability of individuals and nations. While the acute effects of exposure may pose serious

health, social, and economic costs, their consequences are generally only felt in the short-term. For example, workers are usually able to return to work in a relatively short time, and most of the symptoms fade away once exposure is removed. However, many of the possible chronic effects of exposure- such as cancer, birth defects, and neurological changes- are repercussions that require long-term, intensive economic, social, and/or medical assistance. The burden placed by these problems on the U.S. is daunting, but for developing countries such as Mexico and Guatemala, to which many West Coast migrant workers return to, the burden is even more heavily felt.

The potential for frequent, low-level, chronic exposure to occur, combined with the devastating consequences of some of the health effects, makes it vital to accurately determine what the chronic effects of pesticide exposure are and to evaluate the risks these effects pose. The challenge in this important process is the difficulty of establishing causality between low-level, long term pesticide exposure and chronic effects. There are various methodological and etiologic reasons for this difficulty. First, unlike the acute effects of exposure, there is a long latency period between exposure and the occurrence of the disease that makes a causal connection less apparent. There is also the problem of multiple exposures to multiple pesticides. Since an individual was probably exposed numerous times to various pesticides determining which of the exposures was "responsible" for the disease, or if there was a cumulative or synergistic effect between the multiple exposures and chemicals is a formidable task. Moreover, in the particular case of migrant farmworkers, the worker often does not know what concentration of pesticide s/he was exposed to, or even what kind of pesticide. In a study focusing specifically on migrant workers, these factors would make it even more difficult to establish a correlation between exposure to a particular

pesticide and a health outcome. A final issue that makes determining causality between exposure and chronic effects difficult is the fact that some of the chronic effects occur rarely in the population. Since the prevalence is already low, a large sample size is necessary to show any case of the disease. It is difficult to collect a large number of cases over time, particularly if migrant farmworkers are used as a sample. Thus, methodological issues make it difficult to establish correlations between pesticide exposures and chronic health outcomes.

In addition to these difficulties in determining causality between pesticide exposure and chronic effects, the migrant farmworker population poses unique challenges to research that make it difficult to determine risk in that population. Migrant farmworkers are unique in their transiency both within the U.S. and across national borders. This transiency makes long-term follow-up difficult. Partly as a result of their transiency, as well as their limited access to medical facilities, their medical records are also often incomplete, making reliable ascertainment of the outcome more difficult. As mentioned previously, migrant workers are not likely to know what types and concentrations of chemicals they have been exposed to, thereby making it difficult to assess exposure and risk due to a particular pesticide. Finally, there is a basic unknown value: the number of migrant farmworkers in the U.S. Due to contrasting definitions of what migrant farmworkers are, their transiency, migrant workers' avoidance of government agencies, and weaknesses in counting methods, establishing a reliable estimate of the number of workers is difficult and estimates vary widely.[47] The lack of reliable estimates makes it extremely difficult to determine the prevalence or incidence of a disease in a population and determine the risk of that population.

This discussion of the importance of verifying causal relationships between chronic pesticide exposure and chronic health outcomes and of establishing risk estimates provides a

rationale and framework for evaluating the current status of research pertaining to the effects of chronic pesticide exposure and risk in the migrant worker population.

Neurological Effects

Chronic neurological effects of pesticide exposure have been indicated by substantial research, particularly with regards to organophosphates. Some of the specific effects are more solidly correlated with pesticide exposure than others, but there is an array of neurological outcomes. The neurological effects of exposure affect the core of a person's physical and behavioral functioning and are therefore poignant outcomes of exposure.

Numerous studies have indicated that there are chronic neurological outcomes to acute pesticide exposure. For example, a joint National Institute of Occupational Safety and Health and California study of agricultural workers found evidence of some neurological effects of acute exposure to organophosphates or carbamates. The 90 comparison subjects in this study were friends of the poisoned subjects and had no history of pesticide poisoning.[48] It is possible that this study underestimated the chronic neurological effects of exposure, as the comparison subjects may have experienced poisoning in the past without having had medical records of that poisoning.

Savage, et al also found evidence of selected neurological outcomes in individuals who had been previously diagnosed with acute organophosphate poisoning in Texas or Colorado. Using 100 pairs matched for age, gender, education level, occupational class, socioeconomic status, race, and ethnicity, the researchers found relatively few indications of abnormal neurological outcome. From an excess of 50 scores on the neurological examination, differences were found among the poisoned cases only in measurements of

memory, abstraction, mood, and in one of the motor reflex tests. Tests of neuropsychological functioning, however, did show differences between the cohorts. Differences were found in intellectual functioning, academic skills, abstraction and flexibility of thinking, and simple motor skills. In addition, twice as many cases as controls had scores in the "range characteristic of individuals with cerebral damage or dysfunction" cases exhibited more distress and disability complaints. [49] This study reinforces previous findings of selective neurological effects of acute exposure. Other studies (using controls) have also found chronic neurological outcomes of acute organophosphate poisoning.[50]

There are, however, fewer studies investigating the chronic effects of low-level, chronic exposure. A study based on a sub-set of the joint NIOSH-California study examined chronic neurological effects in 45 pesticide applicators who had had depressed cholinesterase levels but had not had acute poisoning. This study found no statistically significant relationship between a history of cholinesterase depression and neurological factors (motor coordination, mood, postural sway, nerve-conduction velocity and amplitude, vibration, and neurobehavioral elements). While the study found no significant positive correlations, it did find non-significant positive relationships between prior cholinesterase inhibition and a number of the neurological indicators.[51] The lack of statistical significance should be interpreted cautiously, as the sample size was small (45 subjects and 90 controls). Moreover, as with the larger NIOSH-California research, the findings might be underestimates, as the controls (the same control set as in the larger study) could have had a history of prior poisoning without medical records attesting to this.

Another study conducted in New York in 1995 investigated the effects of low-dose, long-term exposure to organophosphates on peripheral nerve function. Using 68 male

pesticide applicators (it makes no mention of whether or not they are migrants) matched with 68 population-based controls on age, sex, and county of residence, the researchers found that there were significant differences between the applicators and controls in their peripheral nerve function.[52] The authors note that two earlier studies, one done in Egypt investigating 229 workers in organophosphate production using 347 controls from textile and fertilizer plants and one done in Nicaragua with 36 people poisoned by organophosphates, found significantly decreased peripheral nerve function as well. These studies support the findings of the New York research. In addition, they indicate that acute exposure can result in long-term decreased peripheral nerve function.[53]

As well as studies such as these, there have been numerous case reports of psychological disturbances and mental illness in pesticide applicators, as well as behavioral changes such as anxiety, concentration problems, memory deficiencies, and other effects.[54] While case reports do not carry the weight of epidemiologic studies, they do point to areas of possible concern.

Research concerning the chronic neurological effects of pesticide exposure is relatively limited, particularly with regards to low-level, chronic exposure. Despite this limitation, a substantial number of studies do indicate that there are neurological effects of exposure. Nevertheless, there remains a severe lack of studies evaluating the incidence or prevalence of neurological outcomes in the migrant farmworker population.

Reproductive and Birth Effects

There is a significant amount of research indicating that pesticide exposure is associated with birth and reproductive effects. The research is not as conclusive as that

concerning neurological effects, and more needs to be done, but it does point to the existence of reproductive effects of exposure.

Laboratory research in animals is one source of evidence of an association between pesticide exposure and reproductive effects. For example, of the 25 most heavily used pesticides in agriculture, ten of them have been determined to cause reproductive problems in laboratory animals.[55]

Limb Defects

Research involving humans also suggests that reproductive defects may be associated with pesticide exposure and agricultural work. A recent review of the pertinent research synthesized much of the findings, both positive and negative.[56] Numerous epidemiologic studies have been done examining the connection between birth defects and exposure. A California study found a correlation between parental agricultural occupation and limb reduction defects (RR 2.3)[57], but a later study by the same researcher found a relationship with limb reduction defects only when additional anomalies were present (OR 1.6).[58] A New York study found no association between potential parental exposure to pesticides and total limb reduction defects, and a slight association with limb defects when they were present with additional malformations (OR 1.4).[59] Neither did a Norwegian study find elevated risk of congenital malformations among the babies of women working in agriculture, forestry, or fishing.[60] A Montreal study found no significant association between exposure to pesticides and birth defects, but this study is inconclusive because the case series only included 9 cases.[61]

Orofacial Clefts

Orofacial clefts have been associated with pesticides in three studies. In the first, exposure was assessed by agricultural work in the first trimester and the non-significant increased risk was 1.9; in the second a more than three-fold risk (OR 3.4) was found in mothers exposed to low levels of insecticides during pregnancy, as determined by residence; and the third found a three-fold risk (OR 2.9).[62] Two non-ecologic studies found no increased risk of orofacial clefts in mothers exposed to pesticides.[63]In one of these, the case series included only 20 cases.

General Birth Defects

Studies have investigated other birth defects as well. A study in China found higher-than-expected number of cases of central nervous system defects in the children of mothers who reported in a retrospective interview being exposed to pesticides in the first trimester (observed to expected ratio of 7.5).[64] A study of children with a liver defect found that fathers who worked in agriculture and were exposed to pesticides were twice as likely to have children with this liver defect.[65] Another Canadian study found no relationship between musculoskeletal defects and maternal work in agriculture during the beginning of pregnancy, but it did find an excess of developmental defects (O/E 4.5).[66]

Spontaneous Abortion

Maternal agricultural occupation or pesticide exposure has also been associated with spontaneous abortion in five studies. [67] Hemminki, et al found a RR of 1.3; Lindbohm, Heidam and Restrepo found odds ratios of 2.8, 2.0, and 2.2, respectively; while Heidam, et al found a relative risk of 1.3. However, only Hemminki, et al and Lindbohm, et al used medical data to determine the outcome, the others determined the outcome, and in some cases the exposure, by retrospective interviews or questionnaires. Of two published studies

finding no positive correlation between spontaneous abortion and pesticide exposure, one assessed exposure by maternal residence, making exposure misclassification a possibility.[68] The second, done in Canada, used work in agriculture as reported by the mother to assess exposure, but no information was solicited specifically addressing pesticides. This same study did find an increased risk of stillbirth (O/E 5.7).[69]

Stillbirths

Additional studies have found evidence concerning stillbirths. These include a later study using the same data as McDonald, et al that found an odds ratio of 3.1 in women exposed through work.[70]Two investigations found a moderate relationship between stillbirth and maternal environmental exposure to pesticides (rate ratio 2.0 and standardized risk ratio 1.5).[71]However, in both of these exposure was determined by the mother's place of residence, which creates the possibility of exposure misclassification. A study of pesticide exposure in floriculture found no evidence of stillbirth.[72]When interpreting this study, as noted previously, it should be kept in mind that the outcome was not determined by medical records and the exposure was partially determined by a retrospective interview with the mother.

The research pertaining to reproductive and birth defects as a result of pesticide exposure indicates that exposure may cause such effects. However, the amount and quality of research available at this point prevents final conclusions. As is evident from the previous assessment of the research, there are methodological issues that make interpretation and comparison across studies difficult. One major problem is the issue of classifying exposure. The studies classified exposure in many different ways- by maternal occupation, maternal residence, and maternal exposure to pesticides. It is difficult to compare the results of the

studies if the exposure group is not similar. Moreover, using factors such as the mother's place of residence to determine exposure makes misclassification of true pesticide exposure likely, thereby diluting the results. A number, if not most, of the studies discussed previously were hampered by this problem. Such loosely-defined categories of exposure explains discrepancies between studies, but more importantly they make it difficult to accurately understand the relationship between the exposure and the disease. The differences in findings regarding stillbirth and abortion exemplify these difficulties. The differences can be explained by the contrasting exposure groups or unspecific definitions of the actual pesticides (thereby making it possible that some of the women were exposed to a pesticide that does increase the risk of abortion and others were exposed to a type of pesticide that does not increase the risk). The differences can also be due to inexact and contrasting definitions of the relevant etiologic period. For example, pesticide exposure may be instrumental in affecting birth outcome only when exposure happens in the first trimester, or it might need to occur in the second and third trimester. If the studies did not capture the relevant etiologic period, there would be no positive findings. This would explain discrepancies with studies that did find positive results, and also limits our understanding of the relationship between exposure and disease. Since methodological issues explain the contrasting results, negative results should not be interpreted to mean that pesticide exposure does not cause reproductive and birth effects. Differing results should instead be interpreted as evidence of the need for further careful research, as well as evidence of a possible link between pesticides and reproductive health effects.

Cancer

The multitude of cancers and pesticides, and the large body of research connecting the two, makes analyzing the possible carcinogenic effects of pesticide exposure a complicated issue to sift through. Some pesticides are known to cause cancer. Given this, the basic issue becomes which pesticides increase the risk of developing which cancers.

Federal and international agencies have intensively investigated the carcinogenicity of pesticides. For example, of the 25 most heavily used agricultural pesticides, the EPA has classified 11 as carcinogenic.[73] In addition, both the EPA and the International Agency for Research on Cancer performed research regarding the carcinogenicity of agricultural chemicals. They found that 2 of the 53 chemicals they investigated definitely cause cancer, 13 of the 53 probably cause cancer, and 16 of the 53 possibly cause cancer.[74]Therefore, thirty-one, or 58% of the chemicals they reviewed, are possible, probable, or definite carcinogens. It is important to note that a chemical's status as a possible or probable carcinogen indicates that the research standards for categorization as a "definite" carcinogen have not yet been met. This could be because the chemical did not meet the criteria necessary to classify it as a definite carcinogen. However, it could also merely reflect the fact that the data needed to classify it as a definite carcinogen is not currently available. As is evident from this discussion, it is accepted that some pesticides are carcinogenic.

The next logical questions then become what types of cancer do pesticides cause and which pesticides pose greater risks for which cancers. Studies in the United States and internationally have indicated that there are excess rates of specific cancers in populations occupied in agriculture and/or exposed to pesticides. Studies of male farmers, farm

owners/operators, pesticide applicators, pest control operators, and pesticide manufacturing workers have found excess risks for leukemia, non-Hodgkin's lymphoma, Hodgkin's Disease, multiple myeloma, glioma, soft tissue sarcoma, and cancers of the lip, stomach, pancreas, bladder, brain, prostate, testis, connective tissue, skin , lung, and lymphatic and hematopoietic systems[75] Among women occupied in agriculture or with agricultural exposures to pesticides, there have been reports of excesses of non-Hodgkin's lymphoma, leukemia, multiple myeloma, soft tissue sarcoma, and cancers of the breast (linked to insecticides), ovary (linked to triazine herbicides), lung, bladder, cervix, and sinonasal cavities.[76] Among the children of parents in agricultural occupations or of parents exposed to pesticides there have been reports of increased risks of cancer, including leukemia and cancers of the brain.[77]

From this multitude of studies, one group important to this discussion is noticeably absent: migrant farmworkers. Most cancer research has focused on farmers and farm operators, and in some cases pesticide applicators; very few studies pertain directly to migrant workers. For example, in a review of 70 investigations of cancer (mostly case-control studies) and 26 cohort or occupational surveys pertaining to agricultural populations, only 5 specifically pertained to migrant farmworkers (subsequently the authors identified 5 more studies).[78] The limited studies that have been done with migrant farmworkers indicate that farmworkers experience similar excesses of multiple myeloma and cancers of the stomach, prostate, testis, while differing from farmers in experiencing excesses of cancers of the buccal cavity, pharynx, lung, and liver.[79]

One interesting study captures the importance of research that pertains directly to migrant farmworkers. In this study the researchers used assessments of occupational

exposure to 41 pesticides and compared these dose estimates with indices of acute toxicity (LD 50) and chronic effects (Reference dose/RfD).[80] Pesticides were deemed to be of relatively high risk if the absorbed daily dose estimate exceeded 1% of the human LD50, the lifetime absorbed daily dose estimate exceeded 100% of the RfD, or if the cancer risk was greater than 1 per million. For mixers, loaders, and applicators of pesticides, the absorbed daily doses ranged from .0001% to 48% of the estimated human LD50. The lifetime absorbed daily dose as a percentage of RfD ranged from .01% to 114,667%, with 58% of the pesticides with available information having maximum estimated doses above the RfD. The added lifetime cancer risks ranged from .02 per million to 2000 per million, with 92% of the pesticides with available information posing cancer risks greater than 1 per million. For harvesters, the numbers were lower, but still serious. The absorbed daily dose estimate exceeded 1% of the LD50 for 4 pesticides, and the lifetime absorbed daily dose estimate exceeded the RfD for 47% of the pesticides with available information. The added lifetime cancer risks ranged from .03 per million to 200 per million. This study indicates that farmworkers- both handlers and harvesters- are assuming high risks. The study's demonstration of the high exposure and cancer risks that migrant workers are confronting underscores the necessity of research that focuses on migrant farmworkers and assesses the incidence and prevalence of cancers.

This discussion provides examples of the occupational groups and types of exposures that have been linked to particular cancers. Some of the cancer excesses are more firmly established than others. While it is impossible to critique each individual study, an examination of a few will highlight general explanations for the differences in results.

A study conducted in Norway followed up 323,292 offspring of people who were identified by the census as owners of agricultural property in order to investigate whether parental agricultural occupation or pesticide exposure were associated with cancer rates in children. The study found that children of farmers who worked 500 hours or more annually had standardized incidence ratios that were elevated for Hodgkin's Disease and cancers of the testes, nervous system, bone, and ovaries. The elevation was only significant for testicular cancer, however. It also found a clear relationship between brain cancers in the offspring of and indicators of parental pesticide exposure. Children who were between the ages of 0-14 had nearly twice the risk of brain tumors than the control, and more than three times the risk for non-astrocytoma neuroepithelial tumors in association with pesticide purchase. The rate ratio for these results increased with increasing pesticide expenditures. Even stronger associations were found for offspring who grew up on the farm or whose parents worked many hours on the farm. These results support the findings of other studies in which indicators of parental or childhood pesticide exposure are linked with brain tumors.[81] The results also indicated that offspring who lived on a farm with orchards or greenhouses and pesticide spraying equipment had a significant 9-fold increase in risk for the rare Wilms' tumor. (This was based on four cases.) These results are in accordance with other studies.[82]

Other findings of the Norway study, however, contradicted the findings of previous studies. For example, the Norway research found no association between acute leukemia and indicators of exposure to pesticides.[83] Nor did the study indicate any relationship between the incidence of soft-tissue sarcoma and lymphoma and exposure to phenoxy acids, in contrast to other findings.[84] Moreover, testicular cancer was not associated with exposure to pesticides. Finally, it does not support other studies that have found relationships between

ovarian cancer and soft tissue sarcoma in women and agricultural occupation/exposures or pesticide exposure.[85]Various factors can explain the discrepancies in these studies. First, in the Norwegian study, classification of the sub-types of leukemias in the Cancer Registry changed during the study period. This makes interpretation of their results difficult (as the authors noted). Second, the Norwegian study focused on the effects of parental occupation and exposure on their offspring, while not all the other studies did so, making the groups difficult to compare. Third, other studies may have relied on retrospective interview data or may not have relied on medical records for ascertaining exposure and outcome, thereby making them susceptible to recall bias, while this study relied on national records for both of these (e.g. Vineis, et al, 1987; Donna, et al, 1984). Finally, and possibly most importantly, was the crude definition of exposure (e.g. of pesticide exposure, or occupation on a farm), making exposure misclassification a potential problem. Other studies with more exact assessments of exposure might therefore find conflicting results. Factors such as these should be kept in mind when attempting to reconcile conflicting findings, as the differences may be due to methodology.

Breast cancer also provides an example of discrepancies in research. It has been associated with exposure to specific types and classes of pesticides.[86] Two studies found higher concentrations of polychlorinated biphenyls (PCB), chlorinated hydrocarbons (e.g. DDT), and beta-hexachlorocyclohexane in the breast and adipose tissue of breast cancer cases than controls.[87] In a prospective cohort study, another researcher found a correlation between serum concentrations of a metabolite of DDT and PCBs and the incidence of breast cancer. Cancer risk increased four-fold with increasing serum levels of the metabolite.[88] However, another study found no such a correlation between DDT metabolites and breast

cancer,[89] and other large population-based studies have found no correlation between breast cancer risk and agriculture.[90] As before, there are various explanations for the discrepancies between the studies. One major explanation is how exposure was defined. Many of the studies found no association between cancer risk and agriculture; those studies did not specifically examine exposure to pesticides in agriculture. Other studies examined the presence of a specific class of chemical; most of these did find a positive association. Another weakness of some of the studies that could explain the discrepancies is small sample size. This is exemplified in the Dewailly study, where there were only 35 research participants. As was demonstrated in the previous discussion, inexact definition of exposure is one of the most important limitations of the research. For example, where exposure was defined as agriculture, the relevant exposure (i.e. chemicals) may not have been captured. These two examples- the Norwegian study and breast cancer- elucidate factors that help explain the contradictions between studies that analyze the association between cancer and pesticide exposure.

There are common missing links across the research pertaining to the neurological, reproductive, and cancerous risks of pesticide exposure. Particularly pertinent to this discussion is the lack of research focused explicitly on migrant farmworkers. The unique context of migrant worker exposure necessitates studies that focus on them. They work in particular crops (fruit, vegetable and horticultural) where different chemicals are used. They also have an entirely different life and historical context that pesticide exposure operates within to manifest itself in disease. As of now, very few studies have evaluated the burden of risk of migrant farmworkers . Research that is based on more exact exposure assessments (e.g. estimates of daily dose), rather than attempts to associate excess risks with general

occupation or residence, is also needed. Finally, much of the current research investigates the acute and chronic effects of acute exposure. Fewer studies investigate the effects of chronic, low-level exposure, which is the more common type of exposure for migrant farmworkers. Further and better focused research will improve the regulation of pesticide use and the protection of migrant farmworkers, as will become evident in the ensuing discussion of regulatory policy.

Chapter 4: Regulatory Policy

The biologically-oriented research pertaining to the effects of pesticides provides a foundation for analyzing the purpose, methods, and success of the policy used to regulate pesticide use and protect farmworkers. The Environmental Protection Agency (EPA) is the main body responsible for regulating pesticide use and the exposure of workers in the workplace to pesticides.

The history of the EPA's current leadership in pesticide regulation is relatively short. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was established in 1947 and was responsible for the regulation of pesticides. In 1970, the authority for enforcement of FIFRA was transferred from the Department of Agriculture to the EPA. In 1972 the Federal Environmental Pesticide Control Act amended various aspects of FIFRA. Among

the amendments was one that authorized the EPA to perform the regulatory actions necessary to carry out FIFRA.[91] In general, the amendments "augmented EPA's authority to protect humans and the environment from unreasonable adverse effects of pesticides". The EPA was to use FIFRA to protect employees who were exposed to pesticides, including farmworkers.[92] FIFRA also authorized the EPA to regulate the sale, distribution, and use of pesticides in the U.S. Under FIFRA, the EPA must authorize through registration the sale and distribution of pesticides.[93] Through a series of court decisions in the 1970's, the authority for regulating pesticide exposure in the workplace was transferred from the Occupational Safety and Health Administration (OSHA) and vested in the EPA. The EPA currently maintains its position as the sole regulator of pesticide sale and distribution and the primary regulator of pesticide exposure in the workplace. While OSHA has established Hazard Communication Standards for chemical exposure in the workplace that apply to agricultural employers, any employees who are covered by the Worker Protection Standards and who are exposed to pesticides subject to labeling under FIFRA are exempted from the OSHA standard.[94] There continues to be overlap of their jurisdictional boundaries.[95]

Thus, through FIFRA, the EPA is responsible for the registration and re-registration of pesticides. Pesticide registration is permitted if the chemical does not pose “unreasonable adverse effects on the environment”, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide.[96] In the EPA's various discussions of its rulings, it refers often to cost-benefit analysis as central to its decision-making.[97] The EPA primarily carries out its mandate to protect agricultural workers exposed to pesticides through the Worker Protection Standards (WPS). Enforcement of the WPS is delegated to the states, however. Within the states the Department of Agriculture or the

Department of Health are usually invested with enforcement. The EPA also conducts research pertaining to pesticides to assist with its decision-making regarding registration of pesticides and the protection of workers.

Worker Protection Standards

The WPS are the main vehicle the EPA uses to protect farmworkers. Their history has been an extremely political one, and until as recently as 1992 offered very little protection to workers. The first WPS were issued in 1974. In 1983 the government decided that the standards were inadequate for worker protection. In 1988 the proposed new WPS were published and comments were solicited concerning the proposal. It was not until 1992, 9 years after the decision that the standards did not offer adequate protection, that there was a final ruling establishing the new WPS. However, due to the efforts of the National Association of State Departments of Agriculture and other agricultural owners, the WPS were not fully implemented until 1995, a full 12 years after the 1983 decision. Throughout these years, substantial input was received from the agriculture industry, departments of agriculture, farmworker unions, pesticide manufacturers, health care providers, and other members of the public.[98]

The new WPS are structured around three main goals: 1) to eliminate or reduce exposure to pesticides, 2)mitigate exposures that occur, and 3) inform employees about the hazards of pesticides.[99] They expand upon the previous standards in numerous ways, with one of the more important changes concerning what category of workers the standards protect. The previous standards applied only to workers performing hand operations in fields treated with pesticides, while the new ones apply as well to workers on farms, forests, nurseries, and greenhouse, as well as handlers who mix, load, and apply pesticides.[100] Other

important changes include the expansion of requirements regarding the use of personal protective equipment and re-entry intervals, as well as the addition of training requirements.[101]

Major provisions of the WPS provide certain protections to all workers. For example, the employer must post information in a central location that includes a poster with WPS information, the location of the nearest medical facility, and information about each pesticide application on the establishment. In addition, in the case of a pesticide poisoning, the employer must make immediate transportation available to the nearest medical facility. Restricted-entry intervals (REI) are established that prohibit most types of entry into a treated area, with the time period that entry is prohibited dependent upon the toxicity of the applied pesticide. Decontamination sites must be provided in areas where a REI is in effect, or where an REI has been in effect or treatment has occurred in the last thirty days. The employee must also be informed when an area has been treated. Protections that apply specifically to harvesters include prohibitions against entering an area where a REI is in effect (unless certain exceptions are met) and requiring that any worker who enters an area under an REI must be trained before entering. Protections that apply specifically to handlers include safety precautions that must be met while applying pesticides, the use of personal protective equipment (PPE), and the provision of training to handlers before they apply pesticides.[102] These are just a few of the provisions but they do demonstrate the methods the WPS use to meet their three goals.

These standards are a great improvement over the 1974 standards. For example, workers applying or handling pesticides were previously only required to wear long pants and a long sleeved shirt. Currently, depending on the toxicity of the pesticide, workers

performing this work must wear chemical resistant suits or coveralls with an apron, gloves, boots, eye protection, and respirators. The 1974 regulations regarding protection against direct exposure to pesticides only contained prohibitions against spraying other workers. The 1992 standards prohibit applying pesticides in a manner that they will contact in any way other people. They also prohibit anyone other than a trained handler from entering an area under treatment.[103]

The EPA has established procedures for addressing requested exceptions to the standards or official changes in the standards. A brief review of Federal Register documents demonstrates the large number of exceptions and changes in regulations that are requested. Changes in the grace period for training and re-training intervals, exceptions for crop advisors, changes in the early-entry restrictions for limited contact and irrigation activities, and reduced REI for certain pesticides are just some of the issues that have been pursued by various groups, usually state departments of agriculture and grower's groups.[104] When deciding on these requested exceptions or changes to the regulations, the EPA solicits comments from the public, including the departments of agriculture, grower's groups, farmworker representatives, chemical businesses, and the general public. When deciding on the requests, the EPA bases their decisions on the expected costs versus the benefits, with the discussion often revolving around worker safety and economic costs to the grower.

Regulation of Pesticide Sale and Distribution

As mentioned previously, the EPA is responsible for regulating the sale and distribution of pesticides. Like decisions regarding changes in the WPS, the acceptance or removal of a pesticide into or from the market is based on a cost-benefit analysis. When a pesticide is introduced, it must pass through the registration process, with studies and

information submitted attesting to the safety of the chemical. Pesticides that were accepted prior to 1984 are allowed to stay on the market, but must pass a reregistration process. The EPA is also authorized by FIFRA to use a "special review" process to evaluate particular risks of pesticides.[105]

The limitations and even absurdity of the reregistration process are evident. The General Accounting Office has determined that the EPA will not meet its 1998 deadline for reregistering all pesticides currently on the market.[106] As a more exact measurement of the lack of progress, the EPA released a progress report stating that only 13% of the pesticides subject to reregistration had reached the final stage of review, of which almost half fell into the lowest risk category. (Pesticides that must be reregistered are grouped into four categories according to the health and environmental risks they pose.)[107]

One study offered oxydemeton-methyl as an example of the weaknesses in the reregistration and special review system. In the mid 1980's this chemical began the re-registration process. During this process, the California Department of Food and Agriculture identified possible male reproductive effects as a concern and limited its use. A special review of the chemical by the EPA was begun in 1987, but the EPA declared the intent to voluntarily cancel the chemical after the manufacturer decided not to try to reregister the product. Another manufacturer then indicated that it wanted to produce the chemical. As of September 1994, the EPA had not suspended use of the pesticide as it is authorized to do since the studies required for re-registration had not been submitted by the second manufacturer. Therefore, a pesticide that entered the re-registration process in the mid-1980's had yet to complete the process and was still on the market as of 1994, with the EPA

in negotiations with the manufacturer.[108] This one example clearly demonstrates the weaknesses of the re-registration and special review processes.

The information presented previously regarding the acute and chronic effects of pesticide exposure highlights important aspects of the regulatory process. For example, it is clear that there are numerous chronic effects of pesticide exposure. Unfortunately, revisions in the WPS were not fully implemented until 1995, a full 12 years after the previous standards were deemed inadequate. The chronic effects of that exposure do not stop with the implementation of the new legislation and will continue into the future. Many people suffered unnecessary risk due to the lethargic rate at which changes were made, as well as the political and economic influence of grower and manufacturer interests.

The issue of acute versus chronic exposure also serves as an example of whether or not current regulations reflect the scientific research. Chronic low-level exposures are believed to pose a larger problem than acute exposures. However, the most of the provisions of the WPS are targeted at protecting workers through reducing acute exposures, not the low-level ones that workers frequently encounter. One exception to this is the extension of the restricted entry interval in the 1992 WPS.[109]

While there are many unanswered questions in research regarding the acute and chronic effects of pesticide exposure, a distinction needs to be made between the level of certainty needed for scientific proof and the level of certainty needed for policy decisions. Scientific certainty relies on a level of proof that required enormous expenditures of resources, and more importantly, time. Policy decisions cannot serve their purpose if they rely on that level of proof, since decisions would be made much later than they were needed. A lower level of proof is functional and feasible for the purposes of policy. The research

does provide enough evidence to indicate that there are acute and chronic effects of pesticide exposure that can be prevented. Policy has been implemented and must continue to be implemented to protect farmworkers. As research continues and clarifies risk, policy decisions can be adjusted to conform to the new information. For example, the EPA recognizes the risk of acute effects of exposure through their WPS, but does it adequately address the risks of chronic, low-levels of exposure? It must ensure that it tailors its regulations to this type of exposure. As one researcher stated, the "uncertainties of our knowledge make it important to have strict rules about workers, because they can be exposed to extremely high doses".[110] It is better to enter with conservative decisions that protect workers, rather than leave workers unprotected, as we did with the delay in revisions of the WPS and current delays in the reregistration process.

Chapter 5: Pesticide Exposure in Migrant Farmworkers in Oregon

Goal of Research:

I organized my research around one main objective, with two subsidiary objectives:

- Main Objective:

(a) To assess the degree of employer compliance with the EPA Worker Protection Standards (WPS) in four migrant camps and

(b) To assess the exposure of migrant farmworkers to pesticides.

- Subsidiary Objectives:

1. To evaluate the extent of knowledge migrant farmworkers have of pesticides (specifically: what pesticides are, what their health effects are, what the symptoms of exposure are, and how exposure can be prevented).

2. To assess the saliency of pesticides to migrant farmworkers.

Methods:

Theoretical Framework

I rely upon a social production of disease model in contextualizing and explaining the roots of pesticide exposure.

Study Population:

Selection of Camps

In consultation with an outreach worker at a local social service agency/cultural center, I chose four camps in the area surrounding Hillsboro, Oregon. These camps were chosen from 27 that currently exist in that area. I established the following guidelines when selecting camps:

- There had to be a large number of people working as harvesters.
- Each camp must include indigenous as well as mestizo populations.
- The camp had to be accessible to me in terms of my entrance into the living area.

The four camps will be referred to as: Clark, Jerry, Barton, and Markov. Clark's camp contains approximately 60 workers and is composed of both families and single men. It is open for the strawberry season. Both mestizo and Mixtec populations are in the camp, as well as a smaller Trique population, making it mixed ethnically. Jerry's camp contains approximately 100 people, all of whom are single men with the exception of 2 women. It has a large Mixtec population, with a smaller mestizo population. The majority of people in this camp come from Oaxaca, Mexico. The crops that are harvested in this camp are: strawberry, blackberry, cucumber, and blueberry. The third camp, Barton's camp, is owned by a company and at the peak of the season can employ and house 250 workers. It is open for the strawberry, cucumber, blueberry, and raspberry harvests. Ethnically, a larger proportion of the population of this camp is mestizo with more Mexican states represented. While single men predominate in this camp, there are a few families. The fourth camp, Markov, has approximately 60 workers. Many of these workers come from the state of Guerrero. There are a large number of families and women, with a number of single men. It is open for the strawberry, blackberry, and raspberry harvests. This camp, too, has a larger indigenous population.

I visited Clark between June 22, 1996 and June 30, 1996. I visited Jerry between June 22 and July 8, Barton between July 10 and July 17, and Markov between July 20 and July 23.

When first visiting each camp, I went with the outreach worker who assisted me in choosing the camps I would work with. At each camp, he organized an informal meeting. During the meeting he explained his role and the work of the agency he worked for. He also explained what I was doing, that my research would assist the agency in their work, and that it could benefit workers who worked in these camps in future years. After his introduction, I introduced myself, and the farmworkers were given the opportunity to ask questions. Following this initial visit, I returned to each camp alone or with volunteer interviewers.

Eligibility Criteria for Participants

A total of 88 people were interviewed, of whom 17 were women and 71 were men. Any person over the age of sixteen who lived in the camp during the time period I visited was eligible to be interviewed. Participants were openly given the option to decline to be interviewed and could stop the interview at any point. People who were clearly intoxicated or who were drinking alcoholic beverages were not interviewed. Participants also had to be conversant in Spanish. Some of the participants were chosen arbitrarily (i.e. I walked up to a person and asked if I could interview them). Others were accessed through a previous person I had interviewed (i.e. the person I had just interviewed would ask a friend or family member if they would agree to be interviewed). Networks of family and friends exist in the camps, and therefore members of the same family and friendship networks were interviewed. To ensure that people of different experiences were interviewed, I intentionally surveyed people who lived in different cabins/trailers. In Clark's camp, the number of single men I interviewed may not be proportional to their numbers in the camp, as I was not initially aware that in one large cabin

only single men lived. Of the 88 people interviewed, two women did not work as farmworkers, and therefore selected questions that did not apply to them were not asked and were excluded from the analysis.

With regards to characteristics of the people who refused to be interviewed, I was able to discern only one pattern. A smaller proportion of women agreed to be interviewed than men. This appeared to be due to three factors. The first and possibly primary factor was language ability. Women were less likely to be conversant in Spanish than men, and therefore could not be interviewed. Secondly, women who were married often declined to be interviewed, saying that I had interviewed their spouse or it would be better if I interviewed their spouse. Women or their husbands often explained that the wife had the same experiences as the husband. Finally, women who had just returned from work were preparing food for their families and were therefore sometimes too busy to be interviewed. I was unable to find any other common characteristics of people who refused to be interviewed.

Survey:

I developed a survey aimed at answering the three questions directing my research. (Refer to Appendix B for the Spanish version and the English translation). The interview covered: demographic information, work history in the United States, experiences of health problems and injuries, and work conditions. I structured the questions pertaining to work conditions in reference to the EPA's Worker Protection Standards in order to answer one of my central questions.

Three professors at Brown University provided input into and critique of the format and methodology of the survey. Three people in Oregon edited the Spanish and provided insight into the appropriateness of the survey in terms of cultural and ethnic factors, work context, and

education level. All three of these people spoke Spanish fluently. One of them was the outreach worker who assisted me, and another had worked previously as a migrant farmworker.

The surveys were administered orally, as many of the farmworkers are illiterate or sub-literate in Spanish. The interviews lasted from approximately 20 minutes to 1 1/4 hours, depending on the degree to which participants strictly answered the questions asked or provided additional information.

Data Analysis:

I analyzed my data using the statistical package SPSS. I obtained frequency distributions as well as crude odds ratios.

Results

Demographic Characteristics of the Study Population

The farmworkers represented a wide range of ages, from as young as 15 to over 61 years; 68% were 30 or younger and 28% were 20 years old or younger. (Table 1.)

A large number of languages were represented as well. Almost 40% of the participants spoke an indigenous language. Other than Spanish, Mixtec was the most common language used; a full quarter of the sample spoke it. (Table 1.) Almost all the workers, 97% (n=85), reported being unable to read English, and 88% (n=77) reported being unable to read, write, or speak English.

There were significant differences between the camps in the languages spoken by the workers. Virtually all the workers in all the camps spoke Spanish. However, 59% and 30% of the people in Jerry's camp and Clark's camp reported speaking Mixtec, respectively, whereas only 4% in Barton spoke Mixtec. (Table 2.)

Reflecting the diverse linguistic pattern found in this sample, there was also an array of ethnicities represented. The majority (35%) identified themselves as Mixtec. "Other" followed "Mixtec" as the most frequently chosen category, with 31% of the sample identifying as "other". (Table 1.)

Ethnicity also varied between camps. Forty percent of Markov's camp identified as mestizo/moreno; in Jerry, only 14% did. In Clark's camp and Jerry's camp, 55% and 64% of the people identified as Mixtec, respectively, while only 12% of the respondents in Barton identified as Mixtec. (Table 2.)

The widespread presence of family networks was a significant characteristic of the farmworkers sampled. The majority of people lived with relatives in the camp. A quarter reported that 1-2 relatives lived with them in the camp, while 30% reported that 5 or more relatives worked in the same camp. (Table 1.) A smaller percentage lived with children; 72% had no children 16 years old or younger living with them. However, a sizable minority, 24%, reported that 1-3 kids accompanied them. (Table 1.)

The farmworkers had variable histories of working in the U.S. Twenty-six percent (n=22) reported working one year or less, 41% (n=35) reported 2-3 years, 13% (n=11) reported 4-5 years, and 21% (n=18) had worked 6 years or more.

For information regarding the gender distribution by camp, refer to Table 2. For information regarding the number of months per year the respondents worked as migrant farmworkers and the number of days per week that they worked, refer to Tables 1 and 3.

Work and Living Conditions

- *Personal Behaviors*

Washing and working practices control exposure that occurs through contact with contaminated clothing and through exposure of the skin while working. Overall, the farmworkers' personal behaviors minimized their risk of exposure, although significant minorities counteracted this trend. Eighty-one percent (81%, n=71) of the respondents washed their work clothes separately from their non-work clothes. Almost twenty percent (19%, n=17) did not wash their work clothes separately.

The majority of the sample, 65%, washed their clothes either in a washing machine in the camp (41%, n=36) or in a washing machine outside of the camp (24%, n=21). 21% washed their clothes by hand. (Table 3.)

The participants were also generally consistent with regards to wearing the appropriate clothing while working as harvesters, with the exception of gloves. Eighty-three percent (n=71) of the workers wore long pants, long-sleeved shirt, hat, socks, and shoes while harvesting. However, the vast majority did not wear gloves (88%, n=86). Only 12% (n=10) consistently wore all the suggested articles of clothing (i.e. gloves as well).

- *Access to Medical Facilities*

Utilization of and access to medical facilities was extremely limited. Almost three quarters of the workers reported that they had not been seen by a doctor or nurse in the last month. When asked how easy it was for them to receive medical attention, over half reported that it was "difficult". Thirty percent reported that is was "easy". (Table 3.)

Indigenous respondents, women, and speakers of indigenous languages were no more or less likely to have not had medical attention in the last month than mestizo workers, men, or non-speakers of indigenous languages (versus having had medical attention) (OR 1.2, 95% CI .4-3.9; OR .8, 95% CI .3-2.6; and OR .8, 95% CI .3-2, respectively).

- *Employer Compliance with Worker Protection Standards*

The majority of workers reported that their employer provided a place to wash in the work area with towels, soap, and water (79%), with 17% reporting that the employer did not provide a place to wash. (Table 3.) When divided by camp, there were variations in these numbers. While Jerry, Barton, and Markov camps had similar percentages of workers who responded "yes" to this question (82-89%), Clark's camp had a lower affirmative response rate (60%).

Respondents in Clark's camp were four times more likely to report that their employer did not provide a place to wash than respondents in the other camps (versus did provide a place to wash) (OR 4.1, 95% CI 1.2-13.4).* Workers in Markov's camp were much less likely to report that there was no place to wash (OR .2, 95% CI .03-1.8). Respondents from Barton and Jerry were not notably less likely to report that there was no place to wash (OR .8, 95% CI .2-2.9; OR .7, 95% CI .2-2.7, respectively).

Most of the participants had worked in an area that had been fumigated within the last month or where a "no entry" sign had been posted within the last month (59%). When divided by camp, two of the camps-Clark and Jerry- had higher percentages of people replying "yes" to this question (70%, 73%, respectively). Barton and Markov had lower affirmative response rates. (Table 4.)

Half of the respondents had received information/training in the last five years about how to protect themselves against pesticides and use them safely. An almost equal percentage (45%) had not received such training. When grouped by camp, the responses varied significantly.

* When a camp is reported to have an increased or decreased risk this is always in comparison with the other camps, whether or not it is stated in the text.

Whereas 73% of the respondents in Jerry's camp had received training, only 36% had in Barton. (Table 4.)

Workers in Barton were two-and-a-half times more likely to report that they did not receive training in the last five years (versus having received training) (OR 2.5, 95% CI .9-6.6). Respondents from Jerry's camp were less likely to report that they had not received training (OR .3, 95% CI .1-1.0). Markov respondents were not notably less likely to have not received training (OR .7, 95% CI .2-2,0). while workers in Clark were only slightly more likely to report that they had not received training (OR 1.6, 95% CI .6-4.3).

The WPS specifically state that persons who have worked five or more days in areas where pesticides have been applied within the last month or where a restricted-entry interval has been in effect in the last month must receive training every five years. Of the workers who reported that they had worked in an area where pesticides had been applied or a restricted entry interval had been in effect, a full 42% (n=21) had not received training about pesticides. Fifty-eight percent (n=29) stated that they had, while one person did not know.

When asked how often they smelled chemicals while working, 44% reported smelling them "sometimes" and 47% reported smelling them "never". Only a small percentage smelled chemicals "usually" or "all the time". (Table 5a.) Workers in Clark were much more likely to report that they "always", "usually", or "sometimes" (versus “never”) smelled chemicals (OR 5.0), while workers in Barton were much less likely (OR .2), as were women (OR .3). Indigenous respondents were as likely as mestizo respondents to report that they smelled chemicals "always", "usually", or "sometimes". (Table 5b.) However, when persons who responded "always" or "usually" to this question were grouped together, indigenous workers

were almost three times more likely to report that they smelled chemicals "always" or "usually" (versus "sometimes" or "never"), while women had risks similar to men. (Table 5b.)

When asked if they had been affected by pesticides while working in the U.S., only 8% (n=7) responded "yes" while the vast majority (91%, n=78) responded "no".* There were no noticeable differences when organized by camp. When those who reported that they had been affected by pesticides were asked if the owner arranged transportation to a hospital, one person (14%) did not respond and the other six (86%) reported "no".

Only a small portion of the respondents reported that they had been put in direct contact with pesticides while working (12%).** (Table 5a.) Of those who responded affirmatively, 60% had been put in direct contact with pesticides once in a while and 30% had direct contact only once. (Table 5a.) Participants from Clark's camp were four times more likely to have been put in direct contact with pesticides (versus no direct contact) (OR 4.0, 95% CI 1.0-15.6). Participants in both Barton and Markov were less likely to have been put in direct contact (OR .2, 95% CI .03-2.0; OR .4, 95% CI .04-3.0, respectively), while respondents from Jerry were just as likely to report direct contact (OR 1.4, 95% CI .3-5.8).

- *Informing Workers of Sprayed Areas*

The WPS have various regulations regarding informing workers of areas that have been sprayed. Compliance with two of the three main provisions was relatively high, while compliance was much lower with regards to the third provision. When asked how often their employer informed them verbally or with a sign when pesticides had been applied or were going

* When interviewing the participants, I did not provide a definition of “affected by pesticides”; they interpreted it as they wished.

** When interviewing the participants, I did not provide a definition of “direct contact”. If the person appeared confused, however, I provided the example of someone harvesting fruit and being touched by the spray of someone applying pesticides in an adjacent field.

to be applied, 69% reported that they were informed all the time, and 19% reported that the employer informed them once in a while or never. (Table 5a.)

Workers in Barton were twice as likely to report that their employers informed them "sometimes" or "never" when pesticides had been applied or were going to be applied (versus "all the time") (OR 2.3). Respondents from Clark's camp were less likely to report this (OR .5). Indigenous persons and speakers of indigenous languages were also slightly less likely to be uninformed (OR .6 and OR .7, respectively). (Table 5b.)

In terms of the second major provision, the majority of participants stated that their employer posted the required "no entry, danger" sign with the picture of a man with his hand raised (87%). Eleven percent of the farmworkers stated that the employer did not post the sign or they did not know if s/he did. (Table 5a.)

Barton workers were six times more likely to state "no" or "I don't know" when asked if their employer placed the required "no entry" sign after an area had been sprayed (versus “yes”). All the other camps were much less likely to report this, while women were somewhat less likely (OR .6) (Table 5b.) When only the respondents who replied "no" are included in the analysis, Barton workers were 4.4 times more likely to report "no" than workers in other camps, and all other camps had approximately equal risk. (Table 5b.)

It is with regards to the third main provision that compliance with the WPS becomes inadequate. When asked if a sign was posted with additional information on it that is required by the WPS (e.g. the number of hours that the restricted-entry interval is in effect), approximately three-quarters of the respondents reported "no" or "no se" to all the required pieces of information (from 63% for the number of hours before the area can be entered to 82% for emergency information). (Table 5c.)

- *Employer Compliance with Worker Protection Standards: for Pesticide Handlers*

Separate provisions are established by the WPS for persons defined as "handlers"- people who apply, mix, or load pesticides. Of the 86 people who were farm laborers, 21% (n=18) reported that they had also worked as handlers (for the most part in the application of pesticides, versus mixing or loading them). A little over three-quarters (79%, n=68) reported that they had not worked as handlers while working in the United States.

The WPS outline what protective equipment handlers are required to use. The compliance with this aspect of the standards was uneven. While 44% never wore protective eyewear and 39% never wore a respirator, smaller percentages never wore protective clothing (22%) or chemical-resistant gloves, shoes, and hats (17%). (Table 6.)

Of those who wore protective equipment, the majority reported that they had received the equipment from their employer. For example, 80% stated that the owner provided protective eyewear. A sizable minority, however, reported that someone other than the owner provided the equipment. (Table 6.)

Over two-thirds of the farmworkers who reported that they used protective equipment stated that their employer cleaned the equipment (69%, n=11). A quarter (25%, n=4) stated that the owner did not clean the equipment, and one person did not know (6%).

A little over three quarters of the handlers stated that the employer provided training about how to use the protective equipment, what equipment was necessary, first aid, and environmental precautions (78%, n=14). Almost a quarter reported that the owner did not provide such training (22%, n=4).

- *Health Conditions*

Health conditions were a prominent occurrence among the migrant workers sampled. Fifty-three percent did experience health problems, while 47% did not. When grouped by camp, the affirmative and negative responses were distributed similarly, with the exception of Clark's camp. Only 35% of Clark respondents had experienced health problems. (Table 7.)

Of those who reported that they had experienced health problems after working in the fields, there were dramatic differences in the frequency with which various health problems were reported. Headaches were the most common problem, with 65% of the workers reporting them as a health problem. Dizziness followed headaches, with 37% of the workers experiencing this. (Table 8.)

When workers had health problems, doing "nothing" to treat it was the most frequently chosen response to skin problems, headaches, dizziness, and nausea. (Table 9.)

Participants who had been affected by pesticides were almost six times more likely to report health problems than participants who had not been affected by pesticides (versus reporting no health problems). However, those who had been affected by pesticides were much less likely to report 4-6 types of health problems (vs. 1-3) (OR .2). Indigenous workers were twice as likely to report health problems as non-indigenous workers (this excludes those who identified as "other"). Farmworkers who stated that they smelled chemicals "always", "usually", or "sometimes" while working were slightly more likely to report health problems than those who “never” smelled chemicals (OR 1.8). Workers in Barton and women were also slightly more likely to report health problems (OR 1.8 and OR 1.9, respectively). (Table 10.)

Knowledge of Pesticides

The information gathered about farmworkers' knowledge of pesticides highlights some worrisome points. When asked if they had heard of pesticides, 72% of the workers stated that they had (n=62). A little over a quarter had not heard of pesticides (28%, n=24). These percentages varied dramatically when grouped by camp. For example, while 100% of the workers sampled in Jerry had heard of pesticides, only 52% of those in Barton had. (Table 11.)

Respondents in Barton and women were almost four times more likely not to have heard of pesticides (versus having had heard of pesticides) (OR 3.8, 95% CI 1.4-10.3 and OR 3.9, 95% CI 1.2-12.5, respectively). Indigenous workers were less likely not to have heard of pesticides than mestizo respondents (OR .3, 95% CI .1-1.1). Workers from Clark and Markov, and speakers of indigenous languages were not significantly more or less likely not to have heard of pesticides (OR 1.1, 95% CI .4-3.4; OR 1.3, 95% CI .4-3.8; OR .7, 95% CI .3-1.9, respectively).

Of those who had heard of pesticides, the vast majority had heard of pesticides from an employer or supervisor (84%). It is important to note that in the list offered to the respondents of possible sources of information, employer/supervisor was the first option on the list. Respondents may therefore have chosen this item more frequently, thus overestimating the number of workers who heard of pesticides from an employer.

When analyzed by camp, the general trend of employers being the most frequently cited source of information about pesticides continues to be evident. Markov had the highest percentage of people reporting employers as a source of information (92%), and Clark the lowest (71%). Interesting differences are evident on alternate sources of information. While no more than 15% of either Barton or Markov named any alternate sources, 36% of Clark identified doctors, family members, and co- workers as sources, for example. (Table 11.)

Workers in Markov were about two-and-a-half times more likely to have heard of pesticides from their employer (versus not having heard of pesticides from the employer) (OR 2.7, 95% CI .3-25.3). Workers in Clark were much less likely to have heard of pesticides from their employer (OR .4, 95% CI .08-1.5). Participants from Jerry and Barton were no more or less likely to have heard of pesticides from their employer (OR 1.3, 95% CI .3-5.8; OR 1.1, 95% CI .2-5.8, respectively).

To more extensively assess farmworkers' knowledge of pesticides, I asked workers what they had heard about pesticides, and how pesticides enter the body. These questions were only asked of those who said they had heard of pesticides. The vast majority of workers had a low knowledge level (76%, n=47), while only a few had high or medium knowledge levels (10%, n=6, 15%, n=9, respectively).* Higher percentages of women, indigenous workers, and workers from Clark's camp had low levels of knowledge than men, mestizo workers, and respondents from other camps. (Table 12.) Speakers of indigenous languages were almost four times more likely to have low knowledge levels (versus medium or high) (OR 3.8, 95% CI 1.0-15.4). Indigenous respondents were approximately three times more likely to have low knowledge than mestizo respondents (OR 2.8, 95% CI .7-11.7), while workers from Clark and women were about twice as likely to have low knowledge (OR 2.2, 95% CI .4-11.3; OR 2, 95% CI .2-18.5, respectively). Farmworkers from Barton, Markov, and Jerry were neither significantly more or less likely to have low knowledge (OR .7, 95% CI .2-2.5; OR .7, 95% CI .2-2.5; OR 1.1, 95% CI .3-3.9, respectively).

* To determine whether or not the knowledge level was low, medium, or high I referred to the textual responses participants gave to two questions asking what they had heard about pesticides and how pesticides enter the body. According to the amount of information the person was able to provide about how pesticides enter the body, what the symptoms and health effects of pesticides are, and how to prevent contact with pesticides, I assigned each of answers to the two questions a value of 1,2, or 3. I then averaged the two numbers. In cases where the average was not a whole number, e.g. 1.5, I would return to the textual responses and evaluate if the responses were closer to, for example, 1 or 2.

Saliency- Who cares?

Two questions were directed towards assessing the saliency of pesticides to migrant farmworkers. When asked to choose from a list of 14 items the problems that concerned them the most, only five workers, or 6%, chose pesticides. When the items were ranked by the number of times each was chosen, pesticides were tied for 11th out of 13th. Health was the most frequently chosen response, with money/wages and the INS tied for second, and work stability ranked third. (Table 13.)

When divided by gender, slight differences arose in this ranking, although pesticides remained extremely low for both genders. Of the women, none chose pesticides. Pesticides were therefore tied for last. Among the men, pesticides were chosen by 7% of the sample, and were in a three-way tie for 10th out of 13th. (Table 13.)

The second question directed at assessing saliency asked if the person was worried about pesticides. The farmworkers were split in their responses to this question, with approximately half responding affirmatively and half negatively. When grouped by gender, there were only subtle differences in responses. (Table 14.)

Discussion

Demographic Characteristics of the Study Population

The demographic information highlights both the importance of employer compliance with the Worker Protection Standards, as well as sub-populations within the sample that are

potentially at higher risk of pesticide exposure. Women, children, and linguistic and ethnic minorities, in particular, constitute these sub-groups.

The huge proportion of young workers in my sample is one sub-group that is at higher risk because of their age. These workers are potentially being exposed to pesticides in their reproductive years. Given the hypothesized connections between pesticide exposure and birth and reproductive effects, this could have serious repercussions for themselves and their offspring. The young age of the workers also has repercussions in terms of diseases with long latency periods such as cancer. The young age of the workers ensures that they will most likely live long enough for the latency period to be completed and the disease to manifest itself, should it occur.

The large number of children living in the camps is another sub-group at higher risk because of their young age. Children are more likely to engage in activities that could expose them to pesticides, such as putting objects in their mouth and not washing their hands before eating or sticking their fingers in their mouths. As with younger adults, if children are exposed their young age allows the latency period of diseases such as cancer to be completed. These serious health implications, as well as the large number of parents with children in the camps, speaks to the need for child labor laws to be strictly enforced, and for efforts to be made to educate parents about how pesticides may affect their children and how they can limit their children's exposure.

Speakers of indigenous languages constitute a sub-group that is less likely to receive the required pesticide information in the appropriate language. Since worker ignorance of labor

regulations, along with the often-times more extreme economic need of indigenous workers*, can allow employers to exploit farmworkers, speakers of indigenous languages are also possibly more likely to be exposed. The large proportion of people who speak indigenous languages underscores the need for information about pesticides to be conveyed both orally and in written form in the various indigenous languages. Because of the concentration of speakers of indigenous languages in particular camps, it is possible to identify which camps most need multilingual materials and translators. The linguistic distribution across camps also creates the potential for there to be knowledge differences between camps. Since this linguistic distribution overlays with ethnic distributions, there is the potential for inadequate knowledge transfer and increased exposure to be organized along ethnic lines, in effect placing indigenous minorities at higher risk.

The demographic information not only outlines sub-populations that are at higher risk of exposure due to personal characteristics, it also reveals work factors that may be increasing the extent of exposure. The people who have worked here for only a few years (particularly those who have been here only a year) may not yet have established connections with agencies (e.g. health clinics) or other workers that can inform them of labor laws and work issues. They are therefore less likely to be aware of the protections that are due them. This underscores the necessity of employers providing frequent training to workers and fully complying with all labor regulations.

The demographic information does not speak directly to work conditions that affect pesticide exposure, but it does include information that forcefully demonstrates the need for all

* Refer to the discussion of migration for information regarding the economic circumstances that are particular to indigenous migrant workers. Refer to Human Rights and Indigenous Workers for a more in-depth discussion of the racism and more extreme poverty that affects the lives of indigenous workers both in Mexico and the U.S. Refer to

groups of people to be adequately protected, and for work conditions to reflect the goals of the WPS.

Work and Living Conditions

- *Personal Behaviors*

In general, workers, intentionally or no, engaged in personal behaviors that minimized their exposure to pesticides. The large proportions of people who separated their work and non-work clothes when washing and who machine-washed their clothes is reassuring in terms of limiting pesticide exposure that occurs through contact with contaminated clothing. The substantial minority of people who do not wash clothes separately or in a machine are cause for concern, however. Machine-washing clothes was at least partially a function of availability; some of the camps had washing machines and others did not. The installation of washing machines in every camp would decrease the numbers of people who wash by hand.

The vast majority of farmworkers wore long pants, long-sleeved shirts, socks, shoes, and hats while working, thereby minimizing their exposure. Very few workers wore gloves, however. It would be optimal if workers did wear gloves, but I do not think increased education is likely to make this happen. Participants wore gloves when working with only one particular summer crop: blackberries. I assume this is to protect their hands. In other crops, they are too inconvenient to wear, particularly if they slow down the picking speed or if they damage fruit that is to be sold as fresh fruit. It is possible that rubber gloves (like hospital gloves) could be a workable compromise if they were impermeable to pesticides.

- *Access to Medical Facilities*

The Death of Ramón González for a more specific discussion of how indigenous communities bear the brunt of

The low utilization of medical facilities and the difficulty in accessing medical facilities has serious implications for the diagnosis, treatment, and reporting of pesticide-related illnesses. It is clear that many workers are experiencing health problems and are not seeking help for those problems. They are therefore not receiving treatment, and those who have pesticide-related illnesses are not being reported into the state system. This is a well-known occurrence, but the number of people who report health conditions and the number who report not getting medical attention detail the enormous extent of this problem. For example, in the entire state of Oregon in 1994, only 9 of the 101 pesticide exposure reports documented by the Pesticide Analytical and Response Center came from "farm, nursery, and related occupations" (15% of the total reports). Of these nine, only four affected Latinos.[111] If only 10% of the 46 people in my sample who reported health problems had pesticide-related illnesses, then there would be more pesticide-related illnesses among Latino agricultural workers in my sample of four camps than in the entire state of Oregon.

- *Employer Compliance with Worker Protection Standards*

Compliance with the WPS varied according to specific regulations within the standards. With regard to the provision of washing facilities in the work areas, it appears that generally there was a high level of compliance. Clark's camp was the exception to this trend, with workers in Clark being four times more likely than workers in other camps to report that facilities were not provided. When interpreting this information, it is important to keep in mind that the WPS require that washing facilities (i.e. decontamination sites) must be provided until 30 days after the application of pesticides or after the end of a restricted-entry interval. They also require that the facilities be within 1/4 mile of the work area. Therefore, some of the people who responded

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pesticide exposure in the fields of Mexico.

negatively may have been working after this 30 day period had expired, or within 1/4 mile of the living quarters where other washing facilities were provided. (The latter possibility is more likely to have occurred in Clark's camp than the others as one of the fields was close to the living quarters.) This would have led to underestimates of the provision of decontamination sites. However, one factor may have led to overestimates. Some of the participants may have reported that washing facilities were provided, when in fact only water (for example) may have been provided, and not soap or towels.

The higher percentage of workers in Clark and Jerry who had worked in an area that had been sprayed within the last month or where a "no entry" had been posted indicates either that Clark and Jerry camps apply pesticides more often than Barton and Markov and their workers are therefore potentially more exposed to pesticides, or that Clark and Jerry camps more thoroughly inform their workers when pesticides have been applied.

The proportion of people who had not received training in the last five years is alarming. The fact that workers in Barton were 2.5 times more likely not to have had received training indicates that Barton is a camp whose training practices should be monitored. Conversely, respondents in Jerry were much less likely to report not having received training. I believe Jerry's use of videos to train their workers is instrumental in Jerry's higher affirmative responses in this area.

The huge percentage of workers who, according to the WPS, were required to receive training but did not is in direct contradiction of federal standards. More importantly, it has potentially serious repercussions for the workers. It indicates that many farmworkers are working in areas where pesticides have recently been applied who have had no formal training about the nature of the chemicals they are working amidst, the health hazards they pose, or how

to recognize symptoms of exposure. I must note that there were a few workers who stated that they had not received training who also reported that their employer had distributed pamphlets about pesticides. This, however, does not refute the potential repercussions of these percentages for two reasons. First, the WPS require that, in addition to using written materials, the training be presented orally or audiovisually. Second, only a few workers reported that they had not received training yet also reported that pamphlets had been distributed to them (a number nowhere near the 21 people who reported this). People who work in areas that have recently been sprayed ought to be fully informed of the hazards of their work, and incomplete compliance with the WPS prevents full disclosure.

The large proportion of people who never smelled chemicals while working (almost half) and the small proportion who smelled them "always" or "usually" is reassuring. However, an almost equal percentage (44%) reported smelling them "sometimes", which indicates that half of the workers may have been intermittently unsafely exposed to pesticides. The much greater likelihood that workers in Clark smelled chemicals "always", "usually", or "sometimes" highlights Clark as a camp where workers may be more exposed, possibly due to uneven compliance with the WPS, and indicates that it should be monitored in this regard.

It is difficult to interpret the information pertaining to indigenous workers, speakers of indigenous languages, and women since the results vary depending on whether those who smelled chemicals "sometimes" were categorized with those answered "always" or "usually". Interesting, however, is indigenous workers' three-fold increased risk of reporting that they smelled chemicals "always" or "usually". They seem to be more likely to smell chemicals more frequently, and thus potentially be exposed more often. While the information regarding people of indigenous ethnicity suggests that in this respect there are ethnic differences to exposure, there

do not seem to be significant language or gender differences. When interpreting this information it is important to bear in mind that not all chemicals can be smelled. This information therefore indicates when workers are able to detect (and may be exposed to) chemicals with smell, but says nothing about exposure to chemicals with no smell.

The information concerning probable cases of pesticide exposure and poisoning is promising. The small numbers of people who had been affected by pesticides or put into direct contact with pesticides indicates that acute cases of poisoning are relatively uncommon. However, since workers in Clark camp were four times more likely to report that they had been put in direct contact with pesticides, it is possible that more acute exposure is happening within this camp and it should be monitored carefully. When interpreting information concerning direct contact with pesticides, a specific point regarding methodology should be kept in mind. If the respondent seemed confused about the question, I would provide as an example a scenario of a worker being touched by spray drifting from an adjacent field. It is possible that these particular respondents interpreted "direct contact" to mean only this, which would underestimate the "true" number of cases.

An important note in this discussion is that among the small group of people that reported being affected by pesticides (n=7), six of them stated that their employer did not arrange transportation to a medical facility. The WPS require that the employer must arrange transportation, and the fact that none of the workers in this sample (albeit small) reported that the owner did so is problematic. Many workers do not have ready access to transportation, and thus it becomes a severe limiting factor in access to medical care. Not only does it appear that employers are not complying with this important section of the regulations, but non-compliance also affects state-wide reporting and surveillance of pesticide-poisoning cases. Thus,

farmworkers do not receive appropriate medical care and the accuracy of prevalence and incidence data is compromised.

- *Informing Workers of Sprayed Areas*

From the farmworkers' responses, it appears that there is relatively high but uneven compliance with the WPS requirements regarding posting warning signs and informing workers of the application of pesticides. A solid majority of the workers stated that their employer informed them "all the time" when pesticides had been or were going to be applied. The remaining percentage of people (19%) who reported that their employer informed them "sometimes" or "never" is disturbing, however, because it suggests that some workers may be entering fumigated areas without warning or at least have reason to believe that they are not being informed all the time.

As outlined in the Results, there was differential compliance across camps. The slightly increased likelihood that respondents from Barton reported that their owners informed them "sometimes" or "never" when pesticides had been applied identifies Barton as a camp that should take precedence over the others in terms of monitoring informing practices. The decreased likelihood that indigenous persons or speakers of indigenous languages reported "sometimes" or "never" is reassuring since it indicates that workers are not being differentially informed based on their ethnic identity or language use. Reasons for this decreased likelihood are unclear, however.

The majority of workers reported that the employer posted "no entry" signs. However, within this high reporting rate, Barton stands out as a camp where workers were much more likely to report "no" or "I don't know" to whether "no entry" signs were placed (OR 5.9). This

significantly higher likelihood indicates that Barton may not be fulfilling its duty of informing workers as well as the other camps. As with the odds ratios regarding the informing of workers, the similar or decreased likelihood that indigenous persons or women reported "no" or "I don't know" indicates that gender and ethnic differences do not seem to be indicative of differences in general knowledge of when areas cannot be entered.

It is with regards to signs with additional information that compliance with the WPS becomes unsatisfactory. Approximately two-thirds of the workers stated "no" or "no se" when asked if there were signs with information concerning: the designation of areas that had been sprayed, the name of the pesticide that had been applied, the number of hours before re-entry could occur, emergency information, and information about how to prevent contact with pesticides. This number is probably an underestimate, as some of the workers responded affirmatively when they appeared unsure. The WPS do not require that these signs be placed in the work area, they just require that they be placed in a central area. I did not see any sign with this information in the living quarters of any of the camps I visited. Therefore, if they were not placed in the fields it is probable that they were not placed in any location where the workers would be likely to see them. The widespread "no" and "no se" answers, as well as the lack of familiarity that workers expressed when asked this question (in contrast to the general familiarity with the "no entry" signs), indicates either that employers are not complying with this specific requirement of the WPS or that workers do not see or read these signs. (As there is no requirement that this information be posted on a “sign” per se (it may be posted, for example, on a bulletin board or clipboard) and as there is no requirement that these particular signs be written in Spanish, the latter option is a realistic possibility.) If employers are posting these signs but

workers are unable to read them, then they are profoundly ineffective in their purpose of imparting information to employees.

The information I received concerning the posting of signs is difficult to interpret for a few reasons. The primary reason is that if an employer has applied pesticides and does not inform the worker, it is unlikely that the worker will know if they were applied and s/he should have been informed. Instead of interpreting the information about informing workers as specifically as the categories of "always", "usually", "sometimes", and "never" suggest, I instead interpret it as an indication of the general level of communication between the employers/supervisors and the farmworkers. For example, workers who report that their employer informs them "all the time" may not really know if they have been informed all the time, but they may know that their employer tells them on a regular basis to avoid the fields/areas that have been sprayed. Similarly, workers may not know if their employer has not posted the "no entry" sign when s/he should have, but the high number of people who report that their employer posts this sign indicates that they have seen it regularly. There also seemed to be a high degree of familiarity with this sign. When the interviewer described the sign and raised her hand as it is pictured in the sign, the respondents as a whole recognized it. In contrast, as noted previously, there appeared to be a much lower recognition of any sign with additional information.

- *Employer Compliance with Worker Protection Standards- Pesticide Handlers*

The information shared by those who had worked as handlers indicates disturbing trends of incomplete compliance, particularly given handlers' increased exposure to pesticides. Large numbers of people reported never wearing the appropriate protective equipment, and significant percentages did not wear protective equipment all the time . Given the nature of handlers' work,

these responses indicate that handlers' are probably being inappropriately exposed to pesticides through non-compliance with the WPS.

Different chemicals and methods of application require different levels of protection, however. It is therefore possible, and even probable, that some of these cases of apparently inadequate protection were within legal guidelines. It is equally possible, however, that some of these cases were not. The small sample size also makes it difficult to attribute this information to a pattern, rather than a chance characteristic of this sample. As before, there is a factor that may have led to overestimates of the provision of protective equipment, particularly gloves, hat, and shoes. The questions in this section were lengthy, and it is possible that workers reported that they did wear, for example, chemical-resistant gloves, hat, and shoes, when in fact they only wore chemical-resistant gloves. While there are clear limitations to the absolute interpretation of this information, it does provide avenues to explore, particularly in terms of increased monitoring of this part of the WPS.

The WPS not only require that handlers wear the appropriate protective equipment, they also require that the employer provide and clean the equipment. The information provided by the respondents represents slightly improved compliance in these areas, although still incomplete. High percentages of people reported that their employer provided respirators, with somewhat lower percentages reporting that their employer provided eyewear and protective clothing, and much lower percentages reporting that their employer provided gloves, shoes, and hat. The workers who provided the protective equipment themselves probably represent people using equipment that is not considered protective according to the WPS. For example, the relatively high percentage of people who reported that they provided their own gloves, shoes,

and hat may indicate that workers provided these items but they were not in fact chemical-resistant.

In addition to providing protective equipment, employers are required to clean or replace the equipment. Most farmworkers reported that their employer did do so, but a full quarter reported that they did not. This implies that many workers are using contaminated clothing or are washing that clothing themselves. The large numbers of people who reported that their employer did not clean the clothing could be interrelated with the fact that many workers provided their own protective equipment.

While three-quarters of the respondents stated that their employer provided training for them, almost a quarter stated that no training was provided. Three-quarters is a high percentage, but given the nature of the work that handlers do, the implications for the other quarter that are not trained are serious. The quarter who reported receiving no training are presumably engaged in activities such as mixing pesticides, applying pesticides, or loading pesticides without adequate knowledge of what to do in the case of a medical emergency, what protective equipment is necessary, and what their employer's responsibilities are. This, in addition to the previous example, indicates that there is incomplete compliance with the WPS, thereby placing workers at greater personal risk.

- *Health Conditions*

As demonstrated by the large proportion of people reporting health conditions after working in the fields, health problems were a prominent issue in the lives of the participants. These illnesses cannot be positively identified as pesticide-related, since no diagnosis was made by a medical professional and individual case histories were not collected. The symptoms that were reported are also symptoms of numerous other illnesses, heat exhaustion being one

common example. However, they are also recognized as symptoms of pesticide poisoning. While it is impossible to assert that all the illnesses reported are pesticide-related, it is possible to say that all of the illnesses could have been pesticide-related. Some specific examples are more certainly linked with pesticide poisoning, and a few are almost definitely examples of pesticide poisoning. (A man who was applying pesticides and not wearing a respirator who immediately began to vomit is one example). If one were to assume that only 25% of the reported illnesses were pesticide-related, that would still leave eleven people out of 86 who experienced pesticide poisoning.

The information regarding the medical treatment respondents received when they were ill supports the previous findings outlining workers' limited access to and utilization of medical assistance. "Doing nothing" and "treating it his/herself" were the most common treatments for almost all health problems. A substantial number of people could therefore be experiencing illness and not receiving any assistance. Moreover, as before, this information underscores the limitations of the system for diagnosis and reporting of pesticide-related illnesses. If any of these health problems were pesticide-related, it is unlikely that the person received medical treatment and that the illness was reported to the state system.

Removing these health problems from the realm of pesticides, the large proportion of people reporting health problems does reveal the extensive impact health issues have on migrant farmworkers. Some of the problems may be relatively minor, such as headaches. Others are more serious. In one poignant example, a woman went to a hospital after miscarrying her baby. Since she was unable to communicate her situation to the doctors, she was sent home with no treatment. She has since been unable to conceive. In addition to the relative severity of health conditions, there is also the issue of frequency of illness. The substantial percentages of people

who experienced each health problem more than four times or daily is noteworthy since it indicates that many of these problems are chronic.

The increased risk in specific sub-populations that health problems will be experienced and reported is interesting to examine. As trends in other studies have established, women were more likely to report health problems than men, although this increased likelihood is moderate. From my information, it cannot be determined whether women actually experienced more health problems, or whether they reported them more. The increased likelihood that indigenous workers experienced health problems could be due to socio-cultural differences in reporting. It could also be due to increased risk of illness for indigenous workers' due to economic, linguistic, racial, and social conditions. The informal testimony of farmworkers concerning indigenous workers' willingness to be paid less and the research of authors such as Wright lends credence to the latter explanation and would fall within the historical experience of indigenous persons both in Mexico and the United States. The fact that those who spoke an indigenous language were no more likely to report health problems than those who did not speak an indigenous languages is potentially illuminating. It suggests that the increased risk indigenous workers experience may not be due to linguistic factors but instead ethnic/racial factors. The substantially increased likelihood that those who had been affected by pesticides reported health problems (OR 5.7) is also noteworthy. It could represent increased self-analysis of health history by those who had been affected by pesticides. It could also indicate that those who had been affected by pesticides experienced increased health problems as a consequence of the exposure. The reasons for why those who had been affected by pesticides were much less likely to report that they had experienced 4-6 types of health problems are unclear. It is also unclear why those who had been put in direct contact with pesticides were not more likely to report health problems, considering

that those who had been affected by pesticides were substantially more likely. The slightly increased likelihood that workers in Barton reported health problems could be indicative of increased exposure to pesticides or general work, housing, and economic conditions that are contributors to illness. However, this camp had some of the best housing and bathroom facilities, which refutes the housing hypothesis. The substantially decreased risk for health problems of workers who handled pesticides is also an interesting phenomena. It could be due to the additional training and protections handlers receive (versus harvesters).

Whether or not these illnesses are pesticide-related, health conditions are a prominent problem. Efforts to address the high rate of illness must not focus solely on farmworkers' difficult access to medical assistance, although this is important. They must also incorporate the housing and work conditions (among others) that sculpt illness.

Knowledge of Pesticides

The information gathered about knowledge of pesticides is worrisome, for it indicates that a significant minority have not heard of pesticides and that those who have heard of pesticides know very little about them. The significant minority of people who had not heard of pesticides and the overwhelming number of people who had low knowledge levels about pesticides indicate either that the requisite training is either not being offered, or that the training is ineffective in its purpose of imparting basic information about pesticides to workers. It is the employer's responsibility to impart the requisite information in a manner that can be understood to all workers. My research indicates that this is not happening to the degree it should.

While workers probably receive information at various times in various camps, the differences in awareness of pesticides indicates that these camps are not equal in their compliance with the WPS. Camp differences in the likelihood of not having heard of pesticides

suggests that Barton is not fully or effectively imparting the necessary information to all its workers, and that Clark and Markov are not doing so as well as Jerry. Part of the success of Camp Jerry in adequately informing farmworkers may be due to the fact that Jerry used a video to transmit the information; all the other camps used pamphlets.

However, while workers in Clark were twice as likely as workers in other camps to have low pesticide knowledge, workers in Barton and Markov were less likely. (Remember that this information was only received from workers who had heard of pesticides; these questions were not asked of other workers.) Thus, while Barton respondents were less likely to have heard of pesticides, those who had heard of pesticides had slightly more knowledge than workers in other camps. Respondents in Clark appear to have less knowledge than workers in other camps, in addition to being somewhat less likely to have heard of pesticides.

The fact that women were four times more likely to report that they had not heard of pesticides and twice as likely to have low knowledge is cause for concern. Considering the large numbers of women who work on the West Coast as farmworkers, their important role in preparing food, taking care of children, and washing clothes (all areas where pesticide exposure can be mediated), and the fact that they are most directly responsible for their health while pregnant, low awareness of pesticides can have serious ramifications for the individual woman, her family, and her children. It is possible that women's apparent lower degree of awareness is partially due to social factors; i.e. that pesticides are a subject that women do not deem important and that their family members and friends do not discuss with the women in their lives. It is also possible that the lower awareness is partially due to the fact that the women I interviewed were

probably less literate in Spanish than men*, and therefore the training materials that are in written Spanish are less effective for them. If this is the case, then the number of women with low levels of knowledge about pesticides is a very conservative underestimate since I was unable to interview many women because they were not able to speak Spanish proficiently. These women probably also had extremely low literacy in Spanish and would therefore be even less likely to have obtained information about pesticides. If the reasons outlined above are some of the reasons that women are less informed, there are potential avenues for addressing the situation. Pesticide training should incorporate information that is transferred both orally and in written form in the indigenous languages, not just Spanish. This would address the language barrier that may be a cause of the discrepancy between men and women. If cultural factors are also an issue, pesticides could be presented in a format that targets women's area of work within the family (e.g. care of children, pregnancy concerns, care of the household) in addition to the general agricultural arena. Regardless of the method chosen to raise women's knowledge of pesticides, it must be recognized that their knowledge of pesticides is much lower than that of men, and that such a discrepancy poses dangers to women's health.

It is unclear why indigenous respondents were less likely to report that they had not heard of pesticides than mestizo respondents. It is reassuring since it indicates that indigenous people are not disproportionately uninformed. However, this decreased likelihood may be due to how the respondents were categorized, as workers who identified as "other" were not included in this analysis and most of those who identified as "other" identified as Mexican or Hispano.

When one includes the information about levels of knowledge, the picture concerning indigenous workers is less reassuring. The fact that indigenous workers were almost three times

* For a variety of reasons, women who speak an indigenous language as a first language are less likely to become

more likely to have low knowledge levels than mestizo workers, and that speakers of indigenous languages were four times more likely than non-speakers to have low knowledge levels is cause for concern. It indicates that while indigenous workers and those who speak indigenous languages are hearing about pesticides as much as other workers, they are not receiving the same detail of information. It is possible that the increased risk of indigenous workers is confounded by languages spoken, and that the valid correlation is between speaking an indigenous language and low knowledge. If this is true, then the source of the increased risk may be inadequate training in indigenous languages. The WPS require that the trainer "present the information in a manner that the trainees can understand, using a translator, if necessary".[112] If workers are not fully comprehending the training provided to them due to language barriers, then the requirements of the WPS are not being met.

The large numbers of people who reported being informed of pesticides from an employer or supervisor underscores the important role employers play in transferring information regarding pesticides. While the number of people who reported hearing about pesticides from employers may be over-estimated, it is clear that without the efforts and compliance of employers, farmworkers would be under-informed. The relatively low numbers of people who reported hearing of pesticides from family members or friends could also be another indication of the low saliency of pesticides to workers.

In terms of the employer's role in transferring information, the differences between Clark and the other camps in the percentage of workers who reported hearing of pesticides from their employer is cause for concern. The lower rate in Clark indicates that the employers and supervisors in Clark are not taking as active a role in training workers as the employers in other

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proficient in spoken and written Spanish than men. Refer to Nagengast's Human Rights and Indigenous Workers for comments about the rates of monolingualism and literacy among Mixtec women and men in Mexico.

camps (particularly Markov) and therefore are possibly not consistently complying with the WPS.

Overall, while most participants had heard of pesticides, the level of knowledge of pesticides was extremely low, despite the fact that one of the main purposes of the WPS is to inform workers. This generally low knowledge level, combined with notable differences in awareness across camps, gender, ethnicity, and language use, conveys a disturbing picture. Not only are many workers uninformed, but the lines of ignorance correspond with lines of ethnicity and gender, thereby reinforcing the other ways in which women and linguistic and ethnic minorities are disproportionately burdened in Mexico and the United States.

Saliency- Who Cares?

Pesticides were obviously a low priority for both men and women. This leaves people who work with migrant farmworkers (e.g. doctors, unions) with two choices. They can either accept that pesticides are not as salient as other issues such as wages and instead focus resources on those issues, or they can decide that pesticide exposure must be given priority because of the health risks it poses and attempts should therefore be made to increase the saliency of pesticides to workers. If the second option is pursued, it is possible to link the issue of pesticides with other concerns that appear more prominent. For example, health was one of the top three concerns for both men and women. Action regarding pesticides could therefore be effectively tied in with this issue. The health effects of pesticides could also be approached through a broader framework of work conditions (e.g. wages and work stability) that hold more prominence. The

relatively large number of people who reported that they were worried about pesticides indicates that there is the potential for this issue to become more salient. However, given the multitude of problems confronting migrant farmworkers-housing, the INS, money, transportation- it is difficult to prioritize pesticides over all other issues or dedicate resources to them to the detriment of other issues.

As is evident from this information, pesticides were not the most salient issue in farmworkers' lives. The question is not so much how to make them more salient, but if energy and resources should be directed towards this. The ultimate decision depends on how individuals, agencies, and farmworkers weigh pesticides amongst the multitude of other realities that affect the lives of farmworkers.

Sources of Bias

Differential bias is evident in my research. The most prominent source of bias is confounding. I did not "control for" any confounding factors due to time and resource limitations. My results therefore must be interpreted while taking this into consideration. For example, differences that were found between camps could be totally or partially due to differences between the camps in gender, ethnic, linguistic, and/or age distributions (to name a few possibilities) that are also related to the outcome of interest. These differences could be underestimates of the "true" effect for the same reasons. Similar and other confounding factors probably affected other correlations I found. Information bias is also a possible actor in my results. There may have been recall differentials between workers who were ill and those who were not. For example, respondents who experienced health problems may have been more

likely to carefully reflect on their work history to find an explanation for their illness, including pesticide exposure. They therefore might differentially estimate, for example, whether or not they had been affected by pesticides or put into direct contact with them. However, the lack of a positive correlation between reporting direct contact with pesticides and reporting health problems refutes the latter possibility. Workers with illnesses may also have been more likely to carefully detail all their problems, while less ill workers may have skipped over seemingly inconsequential problems. I do not think recall differentials significantly affected how workers reported their general work conditions (e.g. posting of signs, provision of washing facilities), however.

I was carefully aware of interviewer bias while formulating my survey, interviewing respondents, and analyzing my results. I did enter this work with a political and personal perspective, and purpose. While I acknowledge this, I also attempted to be aware of my biases and to minimize them as much as possible. I sequenced the survey in order to minimize any influences the type of questions I was asking might have on responses. For example, I asked questions pertaining to health issues before questions pertaining to work conditions and pesticides. I asked questions about the saliency of pesticides before entering the series of questions pertaining to pesticides and work conditions. The very small number of people who included pesticides in their list of concerns, in particular, assuages concerns that the saliency of pesticides may be over-estimated due to attempts to answer my survey "correctly". The small number of people who reported being affected by pesticides or put into direct contact with pesticides also minimizes the possibility that respondents over- reported the occurrence of these incidents in response to the focus of my survey.

Record bias probably played a comparatively minimal role in affecting my results. Since the surveys were conducted orally, I and the other interviewers recorded the answers of the respondents. I may therefore have selected responses that were of interest to me. I consciously attempted not to do this, and the structured nature of the survey minimized the latitude I had for biasing responses. Such a tendency would be most evident in my very minimal qualitative analysis.

Selection bias, like recall bias, most likely did not greatly influence my research. Since I asked people I knew nothing about if they would be interviewed, I could not have selected them according to their exposure status. (Moreover, theoretically everyone I interviewed was exposed due to the nature of their work). Selection bias would only operate if there were factors related to why people refused to be interviewed that were also correlated with my outcomes of interest (for example, if younger persons were more likely to decline to be interviewed and young age was related to an outcome). I do not have quantitative demographic information about the overall populations of the four camps I researched. In terms of gender, as noted previously, women may be disproportionately underrepresented in my sample since they more frequently declined to be interviewed and less frequently spoke Spanish. Only in Markov would this trend be different, since I attempted to take the opportunity to interview women as there were large numbers of women in that camp. Therefore, the number of women in my sample from that camp may be slightly disproportionate from their total numbers in that camp. Jerry had only two women, and therefore the gender representation in my sample from that camp is not different from the camp as a whole. In terms of age, I do not have reason to believe that the age distribution in my sample is notably different from the age distribution in the four camps overall, but I have no concrete data concerning this. With regards to ethnicity, monolingual speakers of

indigenous languages could not be interviewed, and therefore the indigenous representation in my sample may be smaller than the camps as a whole. Other than this, I can perceive no reason for differences in ethnic distribution between my sample and the general population, although, as before, I have no concrete data.

Demographic differences between the camps I selected and the larger group of 27 camps in the Hillsboro region could decrease the ability to generalize portions of my results to other camps in the region. Any bias of this type would not affect the internal validity of my results; it would only affect the ability to generalize my results to other camps. I did purposefully include camps in my sample that included populations of women and indigenous minorities. However, these four camps do not appear to be significantly different from the other camps in the Hillsboro/North Plains region in terms of their ethnic and gender demographics, and therefore this kind of bias seems unlikely. I do not have information about the age range in other camps, or quantitative information concerning the ethnic and gender distribution across the camps. I do, however, have a general qualitative assessment of the gender and ethnic distributions of the other camps that was shared with me by a outreach worker in a local social service center who is knowledgeable about the camps. According to this information, the four camps I chose are not notably different from the other camps in region. Of the 27 camps, 8 were occupied by single men, 13 were occupied both by single men and families, and 6 were occupied by families. The four camps I researched, one composed of single men, and three composed of a combination of single men and families, do not vary notably from the overall gender distribution. With regards to ethnic distributions, of the 27 camps, 4 are predominantly mestizo, 18 have both indigenous and mestizo populations, and 5 have predominantly indigenous populations. Of the camps I researched, three had both indigenous and mestizo populations, and one was predominantly

indigenous. Therefore, the sample of four camps is not dramatically different from the general pattern across the 27 camps. Thus, the four camps I researched are comparable to the 27 camps in that region with regards to ethnic and gender distributions.

Chapter 6: Conclusion

This thesis has attempted to assess whether the EPA's Worker Protection Standards are complied with in Oregon, as well as to begin to find patterns to sub-groups that are disproportionately affected by non-compliance. It appears that compliance varies across each individual provision of the WPS, and that some groups are at higher risk than others, specifically women, ethnic and linguistic minorities, and persons in individual camps. I have included information concerning migrant farmworker knowledge of pesticides, as well as the saliency of pesticides for two specific purposes. First, knowledge of pesticides is one method of measuring the efficacy of some of the stated goals of the WPS. Having a solid knowledge base of one's work conditions is also an important first step in organizing to address those conditions. Second, understanding the saliency of pesticides to migrant farmworkers can help individuals and agencies working with farmworkers prioritize their actions, as well as assist them in identifying ways of making pesticides more salient. Ultimately, the extremely low knowledge of pesticides and moderate saliency of pesticides that I found does not empower workers to address the issue of pesticides in their work and living conditions. This reinforces the need for employers and enforcement agencies to ensure that the employers achieve more complete and more effective compliance with the WPS.

While this initial assessment of the employer compliance with the WPS and worker exposure to pesticides contains important information, it is important to not become entangled within this issue. The subject of pesticide exposure should instead be woven with the broader context of general work conditions, the asymmetrical relationship between agricultural owners and migrant workers, the political and economic conditions within Mexico and Central America,

and the international relationship between the United States, Mexico, and Central America. It is only by weaving these elements together, and fully understanding how they structure one another, that the particular issue of pesticides and the broader issue of the exploitation of migrant workers can be understood. Pesticide exposure will not be fully resolved by enhanced enforcement of the WPS. It will only be resolved when people are not forced to become virtual refugees through poverty, when indigenous communities receive the full rights entitled to them as citizens of a nation and human beings, when our nations are willing and able to provide social and economic support to its citizens in need, and when farmworkers and immigrants in the United States are understood to deserve the same living and work rights that other laborers and non-immigrants receive. Until that time, enforcement and organizing will only be temporary solutions to a recurrent problem.

> "I will only be able to worry about pesticides
> when I can be permitted to deal with disease,
> and hunger, and the endless miles of road."[113]
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> - a Mixtec man in Mexico

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