Health effects of pesticides on agricultural farmers in the developing countries of Fiji, Ecuador, the Philippines, and Costa Rica versus the United States

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Executive Summary -
This paper will compare and contrast the reasons and statistics of development of negative health affects experienced by farmers and farm workers exposed to pesticides in both developed and developing countries. Several studies have suggested that a constant and close exposure of pesticides have negative affect on those who work closely with them. In developed countries farmers and farm workers have a lower risk of being affect by pesticides, whereas, in developing countries many workers face several disadvantages that affect the opportunities that they may be afforded. Countries in which one can clearly examine these specific global issues include developing countries such as: Ecuador, Fiji, Philippines and Costa Rica. These countries have the lack of knowledge surrounding pesticides, outdated technology, and the economic value of crops outweighing the value of human health. Whereas, within developed countries, such as the United States that are afforded more technology and that are scientifically aware and knowledgeable about pesticides, farmers and farm laborers experience improved circumstances and statistics that surround the use of pesticides amongst agricultural workers and farmers. Being that farmers and farm workers from both developed and developing countries are individuals who treat and nurture agricultural lands closely, including the application of pesticides; they inhale a high concentration of the chemicals. Another contributing factor to the inhaling of high concentration is the amount of time each worker spends concocting the mixture of insecticides, fungicides, herbicides, nematocides (used to kill nematodes, elongated cylindrical worms), and rodenticides and applying the mixture to the crops. Creation of the mixture, application of pesticides, and disposable of pesticide containers contribute in making the farmers and farm workers high at risk for developing pesticide related illnesses. By researching and further examining the various circumstances that surround the production and application of pesticides, what will be determined are what types of acute or chronic illnesses emerge and why are they more prevalent in developing countries rather than developed countries.

Keywords: pesticides, herbicides, fungicides, insecticides, toxins, agriculture

1. Introduction
Agricultural crops exist in an environment that is shared by various organisms categorized as producers (plants), consumers, and decomposers. Consumers and decomposers are organisms that contribute to the destruction of agricultural crops. Consumers can be categorized as organisms that are eaten by other organisms versus decomposers, which are involved in the break down of organisms by chemical means.

Within the cycle of agriculture, the destruction of crops exists as a significant problem that results in the loss of time and revenue. Forty percent of the sugar cane farmers in Fiji rely on pesticides. This is because, if pesticides are not applied to crops, the production of food would drop, causing the prices of food to increase sharply. This is prevalent within the confines of the United States. Therefore, this re – emphasizes the importance of the application of pesticides, because without these pesticides, crops are destroyed causing loss of revenue. Additionally, this also highlights the ways in which developed countries such as the United States can afford certain advantages, whereas, within developing countries such as Fiji farmers are struggling to sustain their jobs due...
to lack of funds. Also, another contributing factor to loss
of revenue includes, the way in pesticides are necessary in
order to remove unwanted plants which have the ability to
disrupt the growth rate of already existing plants, while
insects and fungus eat away at the leaves and roots of the
plants causing them to die. Crops that are damaged are not
eligible for use among consumers; the less type of crop
there is available that means that prices of crops that can
be used will have to increase. Scarcity and rarity of any
product indicate price increase. Thus, the common
strategy to reduce the loss of crops, revenue and time is
to through the application of pesticides by agricultural
workers. Pesticides partake in the protection of agriculture
from other organisms that occupy the same environment
and area as the intended nurtured agriculture. Within the
United States the use of pesticides exists within 70% of
agriculture lands (Tamim and Weigmann 1988), out of
those 70% of lands that use pesticides, less than 0.1% of
the applied pesticides are estimated to actually reach the
targeted pests (Tamim and Weigmann 1988). The
application of pesticides contaminate the surrounding
environment including the land, air, water, and more
importantly, endangers and causes critical health concerns
to arise for those who administer pesticides- the farmers.

From seeds, to soil, to plates, and gardens, agriculture plays a significant role in the lives of human
and animal sustainability and existence. Agriculture’s
primary contribution is in the production of food for
human consumption. In between the time that agricultural
crops are planted and before they are shipped for retail to
grocery stores and markets worldwide, they are exposed
doused in pesticides. Without the application of
pesticides it poses a problem in the production of food,
with the application of pesticides it poses a problem in the
health of agriculture workers and farmers that surround
themselves with the chemicals contained within
pesticides. Whichever direction is decided upon, pros and
cons will present themselves.

2. The History of Pesticides

Pesticides are defined as products that are
"intended for preventing, destroying, repelling, or
mitigating any pest" (Delaplane 1996). The idea of
killing insects, weeds, and fungus was first introduced
during the times of Ancient Romans. An ancient Roman
by the name of Marcus Terentius Varro, discovered “the
first chemical weed killer” in the first century B.C.
(Holley, Taylor, and Kirk 2007). The mixture, amurca
that he [Varro] introduced contained crushed olives,
which proved detrimental to moles, ants, and weeds,
serving as both an herbicide (killer of plants) and
insecticide (killer of insects). Sumerians as well as
Ancient Egyptians (Africans) also conducted
experiments using pesticides (Holley, Taylor, Kirk,
2007). Written upon the oldest known medial document
to-date, The Ebers’ Papyrus, contains over 800 recipes
that were utilized amongst people as poisons and
pesticides (Holley, Taylor, Kirk, 2007). Other cultures
utilizing pesticides during early time periods included
South Americans, Chinese, and Europeans. As farming
and agriculture became widely known, the idea of crop
protection sprouted. The next time these particular
elements and compounds made an appearance to serve as
a pest killer, agriculturally, occurred in the United States
during the late nineteenth century. In this case, cooper
acetoarsenite, calcium arsenate, nicotine sulfate, and
sulfur served as the pest killer, but because of the
unsuitable and unpractical application method and poor
chemistry of the elements and compounds, the use of
these elements and compounds ceased (Delaplane 1996).
The official production of pesticides began after the
Second World War, with the emergence of DDT, BHC,
aldrin, dieldrin, endrin, and 2,4-D (Delaplane 1996).
These chemicals were categorized as being popular,
inexpensive, and most importantly effective, which is
why some of their use has continued into the 21st
century.

One of the most widely used pesticides appeared in 1885 in France with the emergence of the
herbicide knows as the Bordeaux mixture (Holley,
Taylor, Kirk, 2007). The Bordeaux mixture, which is
composed of copper sulfate and calcium hydroxide
(ams.usda.gov), is responsible for killing off unnecessary
weeds. When the Bordeaux mixture was initially
discovered, it was used to control the mildew appearing
on grapes (Holley, Taylor, Kirk, 2007).

The first widely used and well-known herbicide
preceding Bordeaux was 2,4-dichlorophenoxyacetic acid
(2,4-D). 2,4-D is a pesticide used specifically for the
prevention of broad-leaf weeds (EPA). According to the
National Pesticide Information Center; 2,4-D acts first as
an herbicide and secondarily as “a plant growth
regulator”. Herbicides, like Bordeaux and 2,4-D during
the time of discovery contained extremely toxic
chemicals such as arsenic and sulfur (University of
Minnesota Entomology Department), but over time and
as the science of herbicides became more researched and
developed, the toxicity of the chemicals used to create
herbicides became less harsh and more.

Pesticides, used to control pests, appeared
during and after the Second World War (University of
Minnesota Entomology Department). Pesticides debuted
in this era specifically due to the deadly threat of
diseases such as typhus (carried by fleas) and malaria
(carried by mosquitoes), (living history farm) which
were responsible for the high death tolls of Americans.
In response to reducing the amount of death related to
these devastating diseases, insecticides were created in
hopes of killing the insects responsible for carrying the
deadly diseases. The breakthrough insecticide
The health circumstances that surrounded World War II were a key reason as to why pesticide use became popular and more developed. In addition to pesticides being able to save American lives, obtaining pesticides was easy, the price of these chemicals and production was very inexpensive, and the usage of pesticides was obviously very effective. Though the usage for the pesticides were not heavily centered on agricultural purposes, the war had been responsible for the heavy utilization of 2,4-D (which was introduced earlier), along with 2,4,5-D (introduced in 1944), 2,4,5-T (introduced in 1945), BHC, Aldrin Dieldrin, endrin, and as well as phenoxy (Holley, Taylor, Kirk, 2007).

Today, the pesticides mentioned as well as a number of other pesticides, have been banned from being used within the United States, but despite the restrictions, according to the EPA, “all pesticides sold or distributed in the United States must be registered by EPA, based on scientific studies showing that they can be used without posing unreasonable risks to people or the environment” (EPA). The initiative to ban pesticides is a result of the threat that they [pesticides] pose to human health. There are exceptions however. For example, DDT has the ability to still be manufactured legally in the United States, but the United States has made the exception for the use of DDT only for emergencies with regard to the public health of its citizens (NPIC). Essentially, if another epidemic like what took place during the Second World War were to occur, there would be an exception to utilize DDT or any type of pesticide that had the potential to save the current human population. This demonstrates the belief in quantity over quality. The chemicals that are contained within the pesticides are not beneficial, but detrimental to human health, but if they have the ability to save a drastic number of lives then that is the option that would be best suited for emergency situations.

Though additional research has been done to analyze the type of effects that the chemicals within pesticides have on the human population, the use of pesticides are still prevalent and impact both human as well as animal life, causing many harmful and detrimental affects which will be further discussed in the section “Health Effects of Pesticides”.

2.1. Types of Pesticides and their Uses

According to the Environmental Protection Agency, the active ingredients within pesticides are responsible for “preventing, destroying, repelling, and mitigating pests and within a plant, the active ingredient acts as a regulator, defoliant, desiccant, or nitrogen stabilizer” (EPA). Essentially, pesticides specifically exist within the production of agriculture with the intention to protect crops and prevent pests from causing damage, which as stated before prevents loss of time and
revenue for farmers. When crops are damaged they no longer can be sold for profit, also indicating that time and energy have been wasted on a plant that was not able to produce anything in return for the farmer.

The most common types of pesticides used among farmers and farm laborers for agriculture purposes include fungicides, herbicides, and insecticides. Research conducted at Rutger’s School of Environmental and Biological Sciences stated that fungicides have to modes of action: contact and penetrant. Contact is when the pesticide will remain on the outside of the plant to act, while the penetrant will get into the plant to carry out its act, both have the equal ability to cause damage.

Pesticides not only take part in the protection of crops, but they also play a role in the field of public health. In countries, like India, those are susceptible to diseases such as malaria; pesticides “control the spread of diseases that are communicated by insect, parasites, and larvae.” Pesticides were applied that contained the chemicals DDT, BHC, dieldrin, malathion, pirimiphos methyl, benidicarb, and other varieties of pyrethroids (Bag, 2000). According to Bag, 5% of the use of pesticides in India were public health related and because of the application, it was recorded that in the year of 1958 which the incidence of malaria was at 75 million dropped to 0.1 million in 1965, which was a significant reduction. This proves that the application of pesticides positively plays a role in public health, as far as the reduction of disease. Though it has been discovered that parasites have built immunity to the pesticides and the statistics have not dropped, even with the continuation of pesticide application (Bag 2000). The drop from 75 million to 0.1 million demonstrates that pesticides have aided in the reduction of malaria successfully.

2.2. Fungicides

Fungicides by definition are chemicals that “control fungal diseases by specifically inhibiting or killing the fungus causing the disease” (McGrath 2004). Fungicides are comprised of metallic chemicals, which include copper oxychlorides, and non-metallic agents that include sulphur and limesulphur as well as thio and dithio carbamates (Bag, 2000). These chemicals and agents within the fungicides are used by farmers with the intent to protect their crops and ensure that the value of their crops does not decline (Bag, 2000). Crops that appear to be bruised or unempt are unappealing to consumers as well as farmers; as a result crops that appear like this are not eligible for sale, which is a loss in revenue for the farmer.

Fungicides are used on crops in order to kill or limit the fungal disease to prevent damage done to crops acted out by the fungal diseases. For example in Ecuador, a fungicide used to protect the popular crop, potatoes, against a widely known potato disease, “phytophthora infestans” (Crissman, Cole, and Caprio 1994), (resulting in a major loss of potato crops), is Metalaxyl (Wani, Rewal, Sahoo, Singh, and Bhat, 2012). According to the Environmental Protection Agency, Metalaxyl targets the Oomycetes or water-mold fungi, which are a root cause of plant disease (EPA). To protect this disease from spreading within surrounding crop communities and damaging crops like within Ecuador, the application of fungicides are imperative. “Without fungicides, most farmers, like in the case study of potato farms in Ecuador, would suffer severe yield losses” (Crissman, Cole, and Caprio 1994). Not just specifically fungicides, but all types of pesticides play an important role in ensuring that the value of crops does not decrease due to damage caused by pests.

2.3. Herbicides

Herbicides are “chemicals that are used to manipulate or control undesirable vegetation” (Environmental Protection Agency) i.e. weeds and are also an alternative to boost harvesting (Environmental Protection Agency). Common types of insecticides used in developing countries and the United States include 2,4-D (causing discoloration and deformations in new growth), glyphosate, and atrazine (inhibits photosynthesis) (Environmental Protection Agency). Herbicides usually are applied before the crop has been planted or during the vegetation of the crop, maximizing crop productivity and minimizing unnecessary vegetation. (Environmental Protection Agency) If within an area there is a specific crop focus that cannot be disrupted by any other vegetation, an herbicide is the best-suited pesticide to apply.

2.4. Insecticides

Insecticides are “chemicals used to control insects by killing them or preventing them from engaging in behaviors deemed undesirable or destructive”, Typically insecticides attack the nervous system of the insect, which kills them off before they are able to cause harm to the crop (Environmental Protection Agency). Common types of insecticides that are used include organochlorine (causing tremors and convulsions to the pest), organophosphate (causing paralysis to the pest), and carbamates (causing paralysis to the pest) (Environmental Protection Agency). Insecticides are applied to 12% of crops with cotton and corn being the top two (Environmental Protection Agency). Cotton and corn are two crops that are used for and in majority of the products that humans utilize including food, clothing, and beauty products. The protection of these two crops is extremely important being that they are the most popular.
When pests come into contact with insecticides, fungicides or herbicides, the pesticides pinpoint vital organs and systems within the organism, to ensure that the pest cannot proceed to cause damage to crops. Pesticides have the ability to protect crops, but in most circumstances when frequently applied by farmers and farm workers, they do not protect, but endanger the health of those who apply them. The next section will further examine the detrimental health effects that pesticides have on human life.

3. Health Effects of Pesticides

Though pesticides may be used to aid and reduce the spread of diseases in countries like India, the application of pesticides still have negative health effects on those who come within close contact and inhale pesticide residue. There are four types of exposure routes where pesticides can come into contact with the human body which include oral (swallowing a pesticide), inhalation (inhaling a pesticide), ocular (pesticides getting into the eyes), and dermal (pesticides get on the skin) exposure routes (Koehler 1998). These type of exposures are caused by activities such as breathing toxins for a long period of time, not properly (or at all) washing hands after handling pesticides, accidental spraying of pesticides in the eyes, or rubbing and touching eyes or skin after applying/handling pesticides, contribute to pesticides invading the body and allowing the chemicals contained within them to begin causing harm.

Within the United States the main issues that surround those who work with majority of pesticides negatively affect the same areas of the body, but there are some that do more damage than others. “All pesticides are toxic to humans and other organisms. The degree of harmfulness to humans and other living organisms depends on pesticide characteristics, the amount of dosage of the pesticide, and the duration of expose or contact time” (Younos and Weigmann 1988). An aspect of this is dose-response and with dose-response, what can be observed is the response or effect that the toxin has on the organisms that it affects. What has to be taken into consideration is the amount of chemicals that enter the body and the type of individual that has been affected. Essentially, any type of toxin that enters the body has the potential to cause negative effects, but it is the amount of the toxin that enters the body that will either cause no harm or extreme harm. The higher the amount of toxin build up in the body, the greater the effects of the toxin will begin to take a toll on the human body. This relates to farmers and farm workers who are exposed to pesticides everyday. Their occupation ensures that they are constantly exposed to pesticides, making them more susceptible to experience the negative side effects of pesticides. This occupation proves even worse especially when farmers and farm workers have a lack of proper protective equipment and knowledge makes preventing toxins from entering the body more difficult.

When discussing pesticides and the hazardous health issues that may occur, they may come in the form of either chronic or acute toxicity. According to Bang, “chronic toxicity of pesticides arises due to long-term/continuous exposure to pesticides and probably affects the entire population. Acute toxicity which arises out of short-term/immediate exposure affects only those who are involved in the formulation, manufacture, trade and application of pesticides” (Bag, 2000). Within agricultural use, those who come into contact with pesticides will experience either both acute and chronic toxicity. Either way, “exposure can be direct as when spraying the chemical on the farmland, or indirect through intake of food which contain toxic residues.” (Bag, 2000) An individual’s acute toxicity with pesticides can eventually develop into chronic toxicity if it is not treated or worsens.

Acute effects are described as “illnesses or injuries that may appear immediately after exposure to a pesticide (usually within 24 hours) (Koehler, 1998). Usually within those 24 hours, acute oral effects that can be experienced by an individual are burning of the mouth, throat or stomach (Koehler, 1998). According to Florida Pest Control Association, some pesticides that enter the body may not affect the digestive or respiratory system specifically, but can be absorbed in the blood and cause harm in other ways. Acute inhalation effects include burning experienced by the respiratory system, making it harder for individuals to breathe. Acute dermal effects include external irritants such as itching, blistering, cracking or a change in color. If pesticides get into the eye(s) of an individual is has the potential to cause temporary or permanent blindness or severe irritation (Koehler, 1998). If an individual is experiencing pesticide poisoning the signs and symptoms that may occur include excessive sweating, chills, thirst, chest pains, difficult in breathing, body aches, and cramping in muscles (Koehler, 1998).

Within a study done in Costa Rica, farmers working with pesticides, individuals were at risk for poisoning, neurological damage, cancer, endocrine system disruption, and immune system suppression to workers and farmers in direct contact with pesticides (Galt, 2007). This is because; most farmers neglected to wear appropriate protective gear while applying pesticides. One of the main reasons why pesticides are poisonous is because pesticides leech into the environment and can cause members of the community to suffer chemical-related illnesses. These chemically related illnesses result in hospitalization and emotional distress because of the uncertain source of their health problems; the alarming
realization that farmers do not connect pesticide toxicity with certain adverse physical problems creates a requirement for research, using this public health approach (Galt, 2007). It has been reported that an estimated 1 million to 5 million cases of pesticide poisonings occur every year, resulting in 20,000 fatalities among agricultural workers, and only 25 percent of pesticides are used in developing countries (Galt, 2007).

Additionally, in Ecuador where farmers cultivate potatoes, pesticide contamination was highest on the hands (based on solvent rinses), sleeves (based on cotton patches) and back (patches also) (Crissman, Cole, and Caprio 1994). Two of the eight applicators (one each of carbofuran and methamidophos) that were used for cultivation made workers sick within a short span of two hours (Crissman, Cole, and Caprio 1994). Approximately 56% of farmers and farm workers showed clinical signs of poisoning and their hemoglobin-corrected red blood cell cholinesterase dropped to less than half of initial levels, where it was required for them to be treated at home (Crissman, Cole, and Caprio 1994). In some developing countries, workers believe that home remedies can cure the symptoms experienced as a result of pesticides. If those workers use the home remedies to rid the symptoms for the time being then they will not continue to see pesticides as a serious threat, they will see it as minor and continue to work with them.

As mentioned before, a main pesticide that is applied to potato crops to reduce phytophthora infestans from invading potato crops is Metalaxyl. According to the Environmental Protection Agency, metalaxyl has been categorized as having an acute toxicity level, but placed in the highest position at toxicity category II. Those who work with metalaxyl will begin to experience symptoms of eye irritation, but that is the most severe symptom that will be experienced (Environmental Protection Agency).

The Environmental Protection Agency declared that this pesticide does not have carcinogenic affects on humans. Another common fungicide ingredient that is used within Ecuador for potato application is a type of dithiocarbamate fungicide called mancozeb (Crissman, Cole, and Caprio 1994). Mancozeb is classified as a cholinesterase inhibitor, affects the nervous system (environmental commons). Some symptoms of mancozeb are fatigue, headache, convulsions, slurred speech, skin rash, inflammation of the eyelids, confusion, and slowed heartbeat (environmental commons). This specific type of fungicide is also known as being an endocrine disruptor on the human population (National Center for Biotechnology Information), but within organisms it causes thyroid and carcinogenic effects (Singh and Srivastava 2013). The symptoms that are associated with the pesticide are carcinogenic, meaning that they are linked to cancer (environmental commons), which could possibly lead to death.

As a result of the high level of poverty within Costa Rica, a lot of farmers and farm workers are constantly, pressed to earn economic income for their families. Therefore, farm workers are often exposed to herbicides, weed killers, for more than twenty days per year, are at a high risk for cancer; as well as acute exposure leads to poisoning and death (Gay, 47). The reasons why farm workers still actively use these herbicides is because that is the only way they are guaranteed that their crops will be ready for harvest. However, it is unfortunate that even though farmers are able to provide revenue for their families, neighboring residents are also affected by the herbicide usage. A case study highlights a specific legal case in October 1999 which exposed a Costa Rican property owner who was sentenced to five years in jail and civil fines of $4,570 for “moral damages” associated with using Biofox or Conter (highly toxic when mixed with water, and lethal to humans and animals that ingest it) on his coffee plantation. Additionally, the farm owner also dumped left over residues and cleaning contaminated equipment in a river, which ultimately polluted the water supply of a community in San Rafael de Tarrazu in the province of Cartago. The surrounding neighborhoods suffered diarrhea, vomiting, and gastritis, and the severity of some illnesses resulted in hospital visits and bills and a need for bottled water. The herbicide 2,4-D is considered to have long-term toxic effects and the most popular (Szmedra 2001). 2,4-D has been associated in the “development of certain cancers in agricultural workers in Northern Europe and the USA” (Szmedra 2001). Specifically 2,4-D is associated with toxic effects on the human body that have been associated with his pesticide include heart, liver, and kidney damage, as well as disorders within the central nervous system (Szmedra 2001).

The environmental protection agency’s 2001 statistics indicate that within the United States, the top two insecticides that were used in million of acres were cyfluethrin and tefluthrin. Both of these insecticides are considered to be pyrethroids that affect “both the peripheral and central nervous system, causing a hyper-excitabale state” resulting in tremors, incoordination, hyperactivity, and paralysis (Environmental Protection Agency).

Therefore, it is prevalent that the usage of herbicides is very imperative for farmers in both developing and developed countries, but the important issue is that legal officers manage the way in which they use these pesticides. Farmers should become more educated about the components of the herbicides and pesticides. It is strongly believed that because they lack this knowledge this is why a lot of countries suffer with a vast about of medical issues. This is a very detrimental issue especially within the developing countries. They are always at a disadvantage because they lack the number of funds that are afforded to developing countries such as the
United Stated. Thus, we as a global community to work towards ensuring all farmers are all on an equal playing field and that each farmer and farm worker are taught the necessary skills in order to ensure that both their health and the health of the neighboring environs are safe.

3.1. Production of Pesticides in the United States Makes Lasting Impact

The United States has the ability to ban the complete use of all pesticides produced though there has been restriction on pesticides, not all have been banned. Though if this did occur, the United States would experience major repercussions, including a decrease by 73% in the year-ending supplies of some of the country's most popular crops such as corn, wheat, and soybeans (Delaplane 1996). Various parts of the world is responsible for producing certain crops. Because of the various climates that exist around the world, not every type of vegetation can withstand and flourish in certain climates. Within the agriculture industry, the United States is responsible for important crops such as cotton, peaches, and oranges. If the United States banned the use of pesticides completely then the production of these crops would cease. If the specific type of pesticide, fungicide, was banned that would lead to the reduction of fruit by 32%, vegetables, 21%, 68%, and both corn and wheat by 6% (Delaplane 1996). Fungicides contribute to the maintenance of specifically healthy foods that have the ability to prevent heart disease as well as certain cancers (Delaplane 1996).

The banning of pesticides leads to the decrease of particular foods, which would cause a chain reaction starting with a sharp increase in good prices by 13% followed by the reduction of GNP by $28 billion, reduce personal spending by $22 billion, which would all be the result of a 235,000 job depletion (Delaplane, 1996). Included with those 235,000 jobs, 125,000 are within the agricultural field (Delaplane, 1996). Loss in agricultural jobs would mean depletion in the production of crops, which would result in a certain crops becoming a rarity, which would cause the 13% increase in the prices of food. If food becomes expensive the citizens of the United States would have to cut their personal and leisure spending habits in order to be able to afford essentials, including food.

Most importantly, the United States’ ability to supply food for poor countries would cause an increase in hunger worldwide (Delaplane, 1996). Productions of the United States, agriculturally has the ability to affect all nations because of the power that the United States possesses, economically. Pesticides are necessary and imperative for the economy to stay afloat within the United States as well as surrounding countries.

3.2. Use of Pesticides in the United States and Developing Countries

Main and contributing factors centered on this global issue experienced by developing countries such as Ecuador and Fiji, are the lack of knowledge surrounding pesticides, outdated technology, and the economic value of crops outweighing the value of human health. Within developed countries, such as the United States that are more technology and scientifically aware and knowledgeable about pesticides, farmers and farm laborers experience improved circumstances and statistics that surround the use of pesticides amongst agricultural workers and farmers.

Within developed countries like the United States, there are resources such as “research, education, and government agencies that are constantly reducing the risk of using pesticides by producing “safer” chemicals, pest-specific pesticides, better application methods, and more developed and tougher pesticide laws.” (Delaplane 1996) Because of this “agricultural workers in Australia, Canada, the United States, and several European countries have a lower overall risk for cancer.” (Wiklund, Dich, Eklund 1989) The advanced technology, increased knowledge of pesticides, and effective protection against pesticides within developed countries, like the United States, has given them an advantage over the developing countries. Because of the lack thereof in developing countries, it has evolved into no care at all. The reason why there is a lack of care is because the threat of pesticides on human health is not emphasized or communicated well enough.

Countries and farmers within those countries that are not fully aware about the effects of pesticides on humans or simply just lack care about the effects of pesticides tend to not handle pesticides with care or properly protect themselves from pesticide exposure. According to a study done in 1994 by Crissman, Cole, and Carpio on pesticide use and farm worker health in Ecuadorian potato production, among all of the surveyed farm workers, collectively all of them wear rubber boots as the only form of protective equipment for themselves (Crissman, Donald, Fernando 1994). Among other farmers’ recorded answers in Ecuador, two used rubber pants, one used a rubber jacket, two used a plastic sheet on the back, and one used rubber gloves (Crissman, Donald, Fernando 1994). These were the only other recorded uses of personal protective equipment. It was also stated that 81% of these farmers and farm workers were aware and had read the warning label that came with the pesticides (Crissman, Donald, Fernando 1994). The neglecting of the attached warning labels of the pesticides demonstrates that these individuals not only in Ecuador, but other foreign countries that receive pesticides from the United States do not fully
comprehend the long-term affects of pesticides. Though within this study 81% of these farmworkers claim that they read the warning labels of pesticides, “18/40 unprotected farmworkers often continue to work in fields during applications.” (Crissman, Donald, Fernando 1994) Those involved in this study are aware that illnesses do stem from pesticides, but because of the demand for their crops, they cannot stop the production. The economic values of the crops produced outweigh the value of human life. According to a study completed by Sunding and Zivin in 2000, there are four stages in the sequence of events within the pesticide process. “Stage 1: the farmer observes initial insect population and market parameters. Stage 2: the farmer makes pesticide application decision. Stage 3: Pest population evolves. Stage 4: workers manifest symptoms” (Sunding Zivin 2000). This sequence of events is universal within all continents and their countries which continues in a constant cycle.

Figure 1. Sequence of Events Within the Pesticide Process (Adapted from Sunding and Zivin, 2000.)

Figure 3.2.1. Sequence of Events within the Pesticide Process (Adapted from Sunding and Zivin, 2000)

When a farmer, anywhere within the world whether they exist in a developing country or developed country, first observes a pest problem within their crops, they are required to take action if they do not want to the plant to lose its value and potential revenue for the farmer. This means that if the farmer does not take immediate action, the crop will lose value caused by damage from outside sources. The damage will not allow the crop to grow to its full potential-making the crop useless to sell and will not acquire any money for the farmer to further invest their money and time growing a particular type of crop. When a farmer first identifies a problem within their crops that can be taken care of with pesticides, the farmer will make the decision to apply the pesticides to their crops to prevent damage from taking place. As time goes on, if the pest problem does not alleviate, the farmer will have to continuously apply pesticides to the crops. In some instances farmers and farm workers continuously apply pesticides because pesticides will never completely dissipate. Pests also have the ability build immunity to certain types of pesticides and continue to cause damage crops. When this occurs, farmers and farm workers use this to justify the application of an even heavier application of additional amount of pesticides to crops. The frequent application and human exposure to pesticides are what causes an increase in the chances of farmers developing symptoms.

During the 60s, integrated pest management (IPM) was implemented. “IPM is used to improve the effectiveness or reduce the overall use of pesticides.” (IPM) This was developed and used as a different strategy to control pests. Laws and regulations in the United States such as IPM contributes to the advancement of their technology and keeping the pesticide related illnesses to a minimum. Pesticide laws and initiatives either are rare or cease to exist within developing countries because if they existed then they would not be allowed to use the pesticides that the United States has taken the initiative to ban.

A variety and major part of the food that the human population consumes comes from overseas. These countries offer various climates and soil types that make it possible for other countries to produce certain types of fruits, vegetables, and wheat. Unlike the United States, regulation of pesticides and law enforcement of pesticide use in other countries, specifically developed countries are not enforced. Due to the lack of health care, knowledge about the effects of pesticides, outdated technology, and the economic value outweighing the value of human life, developing countries encounter more issues surrounding the use of pesticides.

In countries like Costa Rica, pesticides come with various color bands, which indicate the threat that it can cause to the consumers. Costa Rican color band symbols include yellow indicating that if it is sprayed today, consumers have to give it two or three days, green which indicates that if it spray today, it can be harvested tomorrow and presents a low regulatory risk, and red, indicating that if sprayed today, 15- 22 days have to pass before harvesting (Galt, 2007). “80% of fungicides sold in the study site have a green band, while insecticides mostly have red and yellow bands. Some farmers interpret the green band to mean that fungicides do not present residue problems and others consider them to be biopesticides” (Galt, 2007). Some developing countries have taken the
initiative to improve the communication of the severity of pesticides to their citizens with color-coding, and it has not been present in the awareness of the types of pesticides and their effects on human health, but there is definitely room for improvement. Being that organophosphate and carbamate insecticides are “highly toxic and tend to dominate insecticide use in developing countries” (Galt, 2007).

18. With this given information it is evident that the products that are high in toxicity and extremely threatening to human health that are sent to non-developed countries, or countries with not as much power as the United States or Europe are less likely to go under thorough inspection. Within developing countries, when political action needs to occur, their voices may not be necessarily heard or the process to make change does not happen at a rapid rate because of their ranking in power or priority to those countries who do have the upper-hand.

19. Research conducted on the following developing countries all experienced similar issues: Ecuador, Philippines, Fiji, and Costa Rica. These countries experienced a lack of education about pesticides and their effects, outdated technology, insufficient protective gear, as well as “the lack of respect for the time required between application and harvest” (Galt, 2007). In combination with these factors as well as being a step behind in healthcare, there is a higher percentage of individuals who suffer from acute and chronic illnesses, that have the potential to be fatal, due to pesticides. Those affected with chronic or acute illness are those who directly work with the chemicals and there are even those who reside in surrounding areas that experience slight pesticide related symptoms as well.

20. A study that was conducted in the United States in the state of North Carolina conducted by Quandt, Chen, Grzywacz, Vallejos, Galvan, and Acury, 2010 revealed that as a result of being exposed to a high concentration of pesticides, farmers and farm workers were linked with cholinesterase depression. According to the study, cholinesterase depression cases often occur in developing countries through the misuse of pesticides, but this particular case focused on the development of this mood disorder within the United States. A particular problem that existed among these workers that contributed to the development of cholinesterase depression was the fact that farmworkers were wearing the same clothes for more than 2 days, which has the potential to cause re-exposure (Quandt, Chen 2010). When farmworkers remove their clothing and wear their shoes into their homes, pesticide residue tracks and increases the potential to infect those who are within close proximity and are surrounded by the residue frequently. Within the study conducted by Quandt and Chen, it states that homes, especially with carpet that have traces of pesticides in them are ones that “have a higher number of pesticides and higher concentration than indoor air or outdoor soil” (Quandt, Chen 2010). Another factor stated by researchers was that “these findings [diagnoses of cholinesterase] may indicate that training of these workers is just inadequate. Indeed, estimates suggest that one-quarter to two-thirds of farmworkers do not receive training” (Quandt, Chen 2010). It is imperative to add that these particular farmworkers in the case in North Carolina were Mexican and could not speak English fluently, which is a flag. Within this paper, all workers who have been associated with misuse, lack of awareness, and lack of caring about pesticides and the handling of pesticides that are referenced have been those who are not able to fluently read or write in English and are categorized as “foreigners” to the United States where pesticides are manufactured and shipped to foreign countries.

21. With pesticides being manufactured in the United States and shipped to various and many foreign countries that the United States is not completely aware of, it is impossible to ensure that countries like Ecuador, Fiji, and the Philippines have the warnings and dangers of those pesticides in the native language of the receiving country. Warning labels on pesticides appear like Figure 1 (Get Set Inc.) in English, without any type of translations. The active ingredients of pesticides are required to be identified by the name they are given on the label as well as its percentage weight (Environmental Protection Agency). The other ingredients that exist within pesticides are called “inert ingredients” and they play the role in the product’s “performance and usability” (Environmental Protection Agency).

22. According to the study, 70% of individuals did receive training, but did not comprehend all parts of it (Quandt, Chen 2010). Facilities that also surround the area of farms that face pesticide application every day are also a contributing factor. “Facilities in a substantial number of farmworker camps have been found not to meet regulations for laundry and bathroom facilities that would allow workers to wash pesticides form clothing and form their skin” (Quandt, Chen 2010). The facilities play a role in continuing to contaminate the farmworkers due to the fact that they are not regularly cleaned properly to reduce or rid the amount of pesticides that do exist.

4. Conclusion

23. Though the United States has many advantages such as a more resources, foreign countries (to the United States) as well as the United States, have begun to take action against the excessive use of pesticides. Within India, “over 20 chemicals have been restricted or withdrawn from agricultural use.” (Bag 2000) Pesticides in particular such as aldrin, BHC, endrin, and many others have been banned in countries such as India. These minor changes that have begun to take place in India need to become common in all developing countries who are utilizing extremely toxic pesticides.
The major change that needs to take place within these developed countries is the development of better technology. If more advanced protective equipment is developed, tighter restrictions on the production and disposal of pesticides, and the education of pesticide knowledge is enforced, it would cut down on the development of pesticide chronic and acute illnesses. Additionally, with the advancement in technology, countries can find more affordable and efficient ways to conduct food production. Also, farmers can explore different ways to expand their yield and create more organic produce. If so, this can attribute to a global improvement. With the improvement in technology they can find ways to decrease their production process and thus decrease the amount of money developing countries spend on import. They can also, sell their merchandise to developing countries so that way in the long run both countries experience a profit.

The most important which should be emphasized from this paper is the severity of pesticides on the health of individuals. The United States has discontinued DDT (Environmental Protection Agency) and has made efforts to enforce acts and laws such as The Federal Insecticide, Fungicide, and Rodenticide Act, which according to the Environmental Protection Agency, “provides the basis for regulation, sale, distribution, and use of pesticides in the U.S.” This act also “authorizes the Environmental Protection Agency to review and register pesticides for specified uses.” Other acts following are The Pesticide Registration Improvement Act, The Federal, Food, Drug and Cosmetic Act, The Food Quality Protection Act of 1996, and The Endangered Species Act (Environmental Protection Agency). If these laws and regulations can be carried to those countries where the United States imports pesticides as well as crops, then the percentage of pesticide related illnesses would decrease. The United States stands as a country with economic and political power, if change needs to take place, the US is going to have to take the first step to help along other countries. If the United States strongly considers this proposal and it is successful, then other developing countries can follow suit and this can attribute to a global higher life expectancy. As well as, this can contribute to a decrease in healthcare since many individuals at this time cannot afford health insurance. This would be one less concern for both farm workers and the people who live within their communities.

Therefore, it is important that researchers continue to re-iterate this issue and take a global stance. Society often times forgets the lives of humans, which is ironic because in many cases the infrastructures and policies which government are striving to enforce are harming civilization rather than improving it.

5. References
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Environmental sustainability of supply chain systems.

The scale of environmental and social impact from global production and consumption of pesticides has seen phenomenal impact on supply chain increasingly concerning. Analysts have estimated that out of $6.4 billion tons of carbon dioxide emitted, more than 20% of global emission occurs through the production of traded goods (Dara O’ Rourke 2014) which is mainly due to demand and supply of goods. It was rightly said that speed and dynamism of modern supply chain creates lot of challenges for incorporating sustainability into production decisions (A. Nagurney et al. 2013) due to this there is a challenge in procurement of right supplies at right time and moreover lack of knowledge as mentioned earlier has been one of the prime reasons for detrimental effect of pesticides on human health especially in developing countries. With so many companies around the corner and with companies focusing mainly on the sales, profit and larger market share for their product there has been supply chain disruption risks related to weather events, resource shortages, commodity price rise and labor unrest (T. O’Shea et al. 2013, M. Heuer et al. 2011). One of the most important aspect that the companies should learn is that future of global production and consumption can and must learn from new supply chain management systems to improve the environmental and social sustainability (M. Pagell et al. 2014).