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An Examination of the Use of Pesticides in Puerto Rican Agriculture

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1. Introduction

Today, the majority of Puerto Rican farmland is dominated by industrial agriculture: a system of chemically-intensive food production implemented in enormous single-crop farms. This method depends on the purchase of pesticides and chemical fertilizers that have a negative impact on the environment and consumer health. It is designed to enrich the agro-industrial interests and uses large inputs of synthetic and poisonous products. This involves the use of a vast variety of pesticides that contribute to major health risks for both producers and consumers (Benedetti, 2011).

Companies focused on biotechnology have brought and developed this type of crop on the island and have caused the decrease of organic farming. Their methods are considered more lucrative, as these companies invest in the industry and create jobs. They also participate in the genetic modification of crops, which indirectly increases the use of pesticides. In the case of Puerto Rico, measures promoted by the government have helped eight of the largest companies involved in the genetic modification of seeds and produce which distribute products to the United States. These include companies such as Monsanto, Dow Agro Sciences, Bayer Crop Science and AgReliant Genetics.

These crops are concentrated in five municipalities in the southern and western parts of the island. The map (Figure 1) shows where these companies are located, and gives an

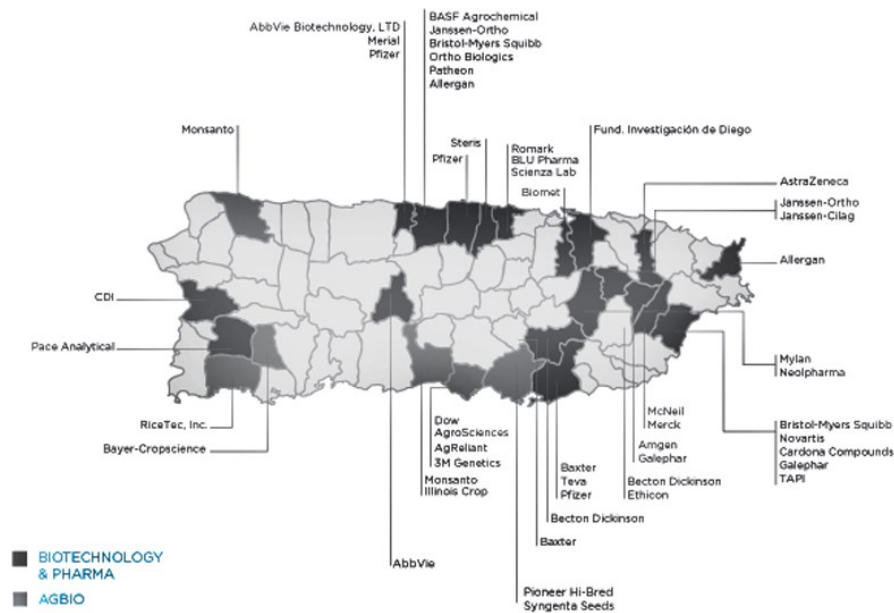


Figure 1. Map of life sciences in Puerto Rico and the presence of the world's top biotechnology companies. (Sheeran, 2015)

idea of the overwhelming presence they have on the island. The number of companies shows how lucrative this business is in Puerto Rico. The existence of these companies contributes to health problems that endanger the Puerto Rican population, and the destruction of what remains of the organic agricultural industry (Febles, 1994). The impact of industrial agriculture on the environment and public health make it an unsustainable way to grow food in the long term.

2. Pesticides

The purpose of pesticides and their primary use in agriculture is to protect crops from pests such as insects, fungi and weeds—therefore increasing the level of global food production. The use of pesticides is considered an essential part of maintaining industrial crops.

2.1 Types of pesticides

Chemical pesticides are mostly used for crops and are divided into three groups—organochlorines, organophosphates and carbamates. Organophosphate and carbamate compounds are found in a wide variety of insecticide preparations marketed for home, garden, and agricultural use. Since there are so many formulations with different trade names, identification of the active ingredients may be difficult without the help of a Poison Control Center (Slapper, 2004).

Some commonly used pesticides and their uses are:

- Insecticides - used to control insects on crops
- Fungicides - used to control fungi
- Herbicides - used to control the growth of the field.
- Acaricides - kills mites that feed on plants and animals
- Slimicides - kills snails and slugs
- Nematicides - destroys nematodes
- Ovicides - destroys the eggs of insects and mites
- Repellents - repels pests, including birds and insects (eg. mosquitoes, fleas, and ticks)
- Rodenticides - controls mice and other rodents

Organic pesticides comprise 90% of total production. Of produced organic materials, insecticides, fumigants and poisons to kill rodents comprise 47% of production (Alicea, 1984). The remaining percentage is composed by herbicides at 34%, and fungicides at 16% (Alicea, 1984). One example of a commonly used pesticide is glyphosate, an organophosphorus compound used in Monsanto's "Roundup Ready" system. Monsanto has a large presence in Puerto Rico and came to own more than 500 acres in 2013. This

pesticide is toxic to fish, birds and other organisms on which we depend to maintain a balance in the ecosystem (Benedetti, 2011). As stated by Benedetti et al.: “In studies documented in 2009 by Scientific American, levels of poisonous compounds consumed from foods treated with ‘Roundup’ can cause abortions, abnormal fetal development and other ravages of health in humans.”

Organophosphate insecticides such as parathion, malathion and other compounds are applied on surfaces or spaces within the plants through the roots, stems and leaves and move through the plant vascular system. The plant temporarily becomes lethal to insects that absorb their juices in their feeding process. The first insecticide used in this way was OMPA (Alicea, 1984).

2.2 Pesticide registration requirements

In accordance with Section 5(d) of Puerto Rico Pesticides—published by the Puerto Rico Department of Agriculture—the registration of pesticides and devices must be done through a local representative of the manufacturer. An application form must be completed, signed and submitted by a representative or resident of Puerto Rico. They need the following documents:

- Three labels of each pesticides or device to be registered
- Official letter of representative designation
- EPA approved labels (except for Section 25b Pesticides)
- SDS (Safety data sheet)
- Form 8570-5 (Notice of supplemental Distribution), if necessary
- Spanish label b (a translation of the original labels—only in case of restricted-use pesticides)
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2.3 Improving productivity

The productivity increases agricultural production in many ways. From 1948 to 1949 food grain production stood at a 50 million tons, and was found to have increased almost fourfold to 198 million tons at the end of the period of 1996 to 1997. This result was achieved by the use of high-yield variety of seeds and agricultural chemicals (Aktar, 2009). To give another example, the increase of productivity in corn yields in the U.S. has been due to several factors, including use of fertilizer and use of machinery. Pesticides have been an integral part of the process by reducing losses from weeds, diseases and insect pests that can markedly reduce the amount of harvestable produce (Aktar, 2009).

2.4 Relationship between genetically-modified organisms and pesticides

As explained by Benedetti et al. (2011), the growing use of pesticides in agriculture is linked to the production of genetically-modified food products that characterizes industrial agriculture. There is a direct relationship between the amount of genetically-modified crops and overuse of pesticides. Genetically-modified plants become more resistant to chemicals, which increases the need for the use of stronger pesticides—and a larger amount in application. Genetic modification and the misuse of pesticides in Puerto Rican agriculture has not been fully investigated. There is a rapidly growing biotech industry in Puerto Rico. Indirect costs for health problems, loss of biodiversity, food contamination, and impact on the environment are attributed to the dependence on this type of agriculture.

2.5 Pesticides and their health effects

There are some inconsistencies in the regulation of pesticides. As Benedetti et al. (2011) discuss, the Environmental Protection Agency, or EPA, "prohibits the use of certain insecticides in homes." But, as they explain, "these same chemicals are used without restriction in agriculture." They also mention that "The atrazine pesticide (banned in Europe in 2004), is widely used in Puerto Rico to control weeds in crops ranging from residential programs to planting sugarcane and corn".

The problem does not exist only in the consumption of food, but also in the consumption of contaminated water. Additionally, even when a country has restrictions on the use of certain pesticides, consumers are still being exposed to them through imports. The fact that agriculture is a globalized industry hinders the consistent application of restrictions on certain pesticides; in countries without such restrictions, they can still use these pesticides in agricultural production and then export the finished product—Puerto Rico itself being a country which relies mainly on imports from other countries.

Foods that are consumed daily are treated with excess amounts of pesticides. Pesticide residues accumulate in the human body, and this exposure seriously harms the health of the population in the long term. Pesticide residues in food have been associated with cases of cancer, diabetes, Parkinson's, Alzheimer's, chronic respiratory problems, and neurological disorders (Álvarez, 1994). In addition, exposure damages the nervous system, causes spontaneous abortions and infertility, and increases the risk of development of congenital malformations (Benedetti et al, 2011; Hsaio, 2015). Many farmers have experienced respiratory or skin problems applying pesticides; additionally, according to the United Nations, there are millions of people suffering from poisoning by pesticides worldwide (Febles, 1994).

Table 1. Absorption rates of pesticides through the skin on various bodily regions (Nesheim, 2014)

Body region	Percent relative absorption %
Forearm	8.6
Palm of hands	11.8
Ball of foot	13.5
Abdomen	18.4
Scalp	32.1
Forehead	36.3
Ear canal	46.5
Genitalia	100

2.6 Effects of pesticides on crops

The justification given for the continued use of pesticides on crops is that it is the most effective way to ensure that large quantities of crops continue to grow to be able to feed the global population. However, the same amount of crops is lost now when compared to the time before the widespread use of pesticides. The World Conservation Union, the United Nations Environment Program and the World Wide Fund for Nature (2007) found that even with the use of pesticides, pests cause a consistent loss of 35% to 40% of crops. Their continued use is also detrimental to soil conditions.

Table 2. Total estimated environmental and social costs from pesticide use in the U.S. (Pimentel, 2004)

Costs	Millions of \$ per year
Public health impacts	1140
Domestic animals deaths and contaminations	30
Loss of natural enemies	520
Cost of pesticide resistance	1500
Honeybee and pollination losses	334
Crop losses	1391
Fishery losses	100
Bird losses	2160
Groundwater contamination	2000
Government regulations to prevent damage	470
Total	9645

3. Chronology

Pesticides have been used throughout history. As explained by M.J. Sánchez and M. Sánchez (1984), the use of inorganic chemicals to destroy pests—mainly insects—can be traced to ancient times. The twentieth century marks the launch of the commercial use of pesticides with the beginning of large-scale agriculture.

Table 3. Presence of pesticides in the United States and Puerto Rico (Weeks, 2015)

Year	Events
1800–1930	Insects, fungi and weeds damage crops and spread diseases.
1905	The first Fertilizer Act of Puerto Rico was approved, ushering in the “Program Analysis and Agricultural Materials Registration”.
1923	The Law Regulating Food Inspection was approved in Puerto Rico.
1930–1940	Modern agriculture During the world war I and II, new technological advances were implemented. Among these developments is the discovery of the insecticide DDT and BHC. (Alicea, 1984)
1930	The discovery of the insecticide DDT, this compound was the first member of the first class of synthetic organic insecticides, chlorinated hydrocarbons (Alicea, 1984).
1940	The development of the insecticide DDT which is a synthetic compound that degrades slowly in the environment, it may persist for months or years depending on where it is deposited. (Alicea, 1984)
1972	Environmental Protection Agency (EPA) is created and authorized to review and register pesticides for specified uses.
1973	EPA bans use of DDT and other chlorinated hydrocarbon pesticides on food produced in the United States Department of Agriculture funds the first major federal research on integrated pest management (IPM), a pest control strategy that emphasizes biological tools, with pesticides as a last option.

1983-1996	Arrival of biotechnology companies in Puerto Rico The use of transgenic and increased use of pesticides in agriculture in Puerto Rico began with the arrival of Monsanto in the island. “Monsanto Caribe LLC is part of the agricultural biotechnology industry in Puerto Rico. Monsanto was established on the island in 1996 when the company acquired Asgrow Seeds. Asgrow had been operating in Puerto Rico since 1983 (Monsanto, 2015)
2009	The "Law of Promotion and Development of Agricultural Biotechnology Companies in Puerto Rico” was signed to encourage the establishment and growth of agricultural biotechnology oriented companies.
2015	March Against Monsanto With more knowledge about the damages that are caused by overuse of pesticides used in Monsanto’s crops. Hundreds of people demonstrated in San Juan to protest against the presence of the company. “Monsanto’s presence in Puerto Rico has had unfortunate consequences that are still being ignored by the government.” (Llorca, 2015) Use of banned Pesticide widespread in Puerto Rico and other U.S. territories The use of the pesticide methyl bromide is one of many pesticides used illegally in the Caribbean. (Fox News Latino, 2015)
2016	U.S targets Puerto Rico companies in toxic pesticide case Complaints were filed against a pest control company in Puerto Rico and two businessmen for the illegal use of a toxic pesticide that nearly killed an American family in the neighboring U.S. Virgin Islands. (CBS, 2016)

3.1 Use of the illegal pesticide methyl bromide in Puerto Rico

Some banned pesticides are still being used in the island. The use of the pesticide methyl bromide is one of many pesticides used illegally in the Caribbean. The reason why it is still used is because of lax governmental supervision, and because it kills pests in just one application. This, however, results in serious consequences in humans—causing headaches, dizziness, fainting and even paralysis and death. “Methyl bromide also has been used at hotels in Puerto Rico, officials say, but it is unknown if the island has taken any action. The territory’s Agriculture Department, which is responsible for monitoring pesticide companies, did not respond to questions on illegal uses of methyl bromide on the island.” (Fox News Latino, 2015)

4. Methods

Not many economic and social studies relating to industrial agriculture have been done in Puerto Rico—therefore, data is scarce. Thus, the need arises for an exploratory study. The method used for this research is used when investigating a topic that has not been studied to its full extent. It does not aim to provide a final solution, but it can help formulate problems for more precise studies, gather information and increase knowledge about a topic. (Pelaez, 2010)

5. Results and discussion

The Office of Agricultural Statistics presents no data relating to the use of pesticides in the island’s food crops and its negative effect on the environment and overall health of the Puerto Rican population. The impact of pesticides cannot go unnoticed. The current industrial food production methods are not sustainable systems—since they depend so heavily on the overuse of pesticides, which promote resistance, harm others non-target species and contaminate food crops and water (UNEP, WWF, UNESCO, 1994).

There are some options for a more sustainable agriculture in Puerto Rico. Organic farming can increase the quality of food—and it can produce significant quantities without depending on pesticides. The revival of organic crops on the island could bring economic, ecological and social benefits. Organic agriculture can remove dependence on biotech companies and foster the local economy with fair wages for farmers in addition to a safer workplace.

Important changes are needed to promote organic agriculture, such as further investigation into biotech companies that are located on the island and their use of pesticides. The overuse of pesticides has a negative effect on our health and our environment. It is a silent killer that is always present—in what we eat, and where we live. Its dangers cannot continue to be unknown to the public.

"The Puerto Rico Agriculture Department needs to stay vigilant. Even with the economic situation in Puerto Rico, they need more inspectors; they need to be educating the public."
—Fox News Latino, 2015

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