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HUMAN SYSTEMS

AGRICULTURAL USE OF PESTICIDES ON SANTA CRUZ

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Agricultural use of pesticides on Santa Cruz

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Introduction

Pesticide application within the agricultural sector of the Galapagos Islands has the potential to lead to environmental degradation and loss of ecological uniqueness. Currently, the resident and tourist populations of the Galapagos Islands are heavily reliant on food imports from the continent. The high agricultural demands of a growing community and tourist destination, along with the continual spread of invasive species, have put pressure on Galapagos farmers to adopt pesticides as a necessary tool (Figure 1). Understanding the current state of pesticide use on Santa Cruz is critical to developing appropriate policies and regulations to ensure island sustainability.

The goal of this research is to look at the current use of pesticides and what motivates farmers to use these pesticides. Understanding the factors that influence farmers to use or not use pesticides will benefit agricultural organizations and governmental institutions in policy development.

While there is a lack of research published on pesticide use in Galapagos, research in other Latin American countries demonstrates a series of fundamental influences on the behavior of farmers and their use of pesticides. A study in Costa Rica surveyed local farmers to identify their personal reasons for pesticide use. The study, along with several others, found that the use of pesticides is influenced by multiple factors, which are ingrained within the society's institutions, policies, economy, demographics, and the environmental attitudes of farmers (Galt, 2008; Ecobichon, 2001; Lichtenberg & Zimmerman, 1999).

Methodology

Twenty-seven farmer households in the agricultural region of Santa Cruz, out of a total of about 100 households, were surveyed during July and August 2012. Collectively, the surveyed farmers cultivate 197 ha of land. Each survey included 48 questions about farming experience and practices, economics, and environmental knowledge and attitudes. The sample of 27 farmers was chosen through convenience, but included farms within the three agricultural subsectors of coffee, open-field, and greenhouse farming.

The surveys were supplemented by ten interviews with knowledgeable individuals who offered diverse perspectives on and interactions with the agricultural and economic issues related to pesticide use and organic farming. Workshops were attended at the Ministry of Agriculture (MAGAP - Spanish acronym) and Agency for Quality Assurance of Agriculture (AGROCALIDAD - Spanish acronym) and backed up with extensive literature reviews to understand current policies.

Figure 1. Pesticide bottle in tree on Santa Cruz. Photo: @ Megan O'Connor

Results

Demographics

Demographic information is important for understanding what factors influence a community and where leverage points exist to create effective policies and programs (Table 1).

Of the surveyed farms, 85% sold their crops to the local markets; there is no export market for any of their crops. One organic farmer sold to a tourism venture. Many of the farmers also mentioned using their crops for private consumption, particularly within the households with income from other sectors. For example, many households consisted of three to five adults, not all of whom farmed as a full-time occupation. Many of those households relied on their crops for private consumption, as opposed to income generation.

Table 1. Demographics of the 27 farmer households included in the survey.

ITEM	RESULT	
Average age	47	
Birthplace	**Galapagos**: 15%	**Mainland:** 85% (48% from Loja)
Farming as primary source of income	Yes: 81%	No: 19%
Average size of farm (ha)	14.4	
Average number of adults in household	3.2	
Average number of minors in household	1.5	
Average highest level of education	Secondary school	
Average highest level of education within immediate family	Secondary school	
Agricultural coursework taken	Yes: 67%	No: 33%
Knowledge of organic agriculture	Yes: 89%	No: 11%
Use of pesticides	Yes: 67%	No: 33%

In Galapagos, due to migration regulations and a strong economic incentive to work in the tourism industry, the pool of individuals available for agricultural labor is very small (Lu *et al.*, 2013). Farmers with larger properties are more able to afford the cost of labor (US$25-35/day), which can be almost five times the cost of labor on mainland Ecuador (Pui pers. comm., 2012; Brewington, 2011).

Results of the surveys indicated that the level of education is an important factor determining pesticide use, along with the size of the farm. Three basic categories of education and pesticide use emerged.

Group 1 included farmers with higher levels of education (secondary through university) and large tracts of land (greater than 15 ha). This group was likely to use pesticides. These farmers were often relatively wealthy in comparison to the other farmers. The use of pesticides is often more prevalent when farmers supervise the pesticide application but are not physically involved in it. Therefore, farmers with sufficient capital to hire workers and who own larger tracts of land are more likely to use pesticides. The exception to this was the one organic farm that partnered with a tourism venture to provide natural, organic food, and to give tours to select groups of visitors.

Group 2 included farmers with higher levels of education (secondary through university) but with smaller tracts of land (less than 15 ha). These farmers were less likely to use pesticides. Many of the farmers within this group or members of their immediate families attended university, bringing back effective methods for manually controlling invasive species or alternative means to generate income. Many of these farmers belonged to agricultural groups that worked with MAGAP to develop organic techniques. Awareness of alternative farming methods through coursework and collective action within community groups has helped to shape the decisions and behaviors of these farmers.

Group 3 included farmers with lower education and smaller tracts of land (all less than 15 ha). These farmers had a higher tendency to use pesticides. This could be related to their level of education, but other potential factors included their desire to maintain a high enough yield to sell produce at the local farmer's market and/or that they had multiple jobs and the land they farmed was used to supply food for their entire family.

Invasive species

All of the farmers surveyed reported that invasive species were a problem on their land. The most frequently cited invasive animals included ants, rats, slugs, and wasps, while the most frequently cited invasive plants included blackberry, lantana, guava, and elderberry.

These results correspond with the Galapagos National Park's list of the most aggressive invasive species in Galapagos (GNPS, 2009). With ever-increasing resident and tourist populations, the invasive species problem is likely to expand. A study in 2011 showed that 22% of households that were interviewed had abandoned their farm properties due to invasive species and 84% of interviewed farmers identified invasive species as a threat to their production (Brewington, 2011).

Three farmers reported that they previously used pesticides but had since converted to organic farming. Each claimed they had used pesticides on farms (not necessarily their own) in the past when it was necessary to reduce labor costs or effectively control pests. The six farmers who stated they had never used pesticides cited the following reasons: it is bad for their health, too difficult to do, or too expensive.

The farmers who consistently used pesticides indicated that they used them under the following conditions (numbers in parentheses indicate the number of farmers):

- After the initial planting regardless of evidence of pests (3);
- When problems (pests and plagues) began to present themselves (11);
- To improve the harvests and reduce the costs of production (2);
- To improve the leaves of the plants (1);
- Due to the number of pests/prevent the number from increasing (3);
- For the ability to quickly control pests (12).

Environmental attitudes

Farmers who were concerned about pesticides affecting their health, their family's health, the ecosystem, the wildlife, and the water supply, were predominantly organic farmers who exhibited conservation habits (Figure 2). However, only 33% of those surveyed farmed organically, while 49% of surveyed farmers were worried about the effects of pesticides. This result aligns with previous research, as farmers may worry about pesticide use, but may not be able to change their behavior due to the perception or presence of barriers, including pesticide dependency, invasive species growth rate, or inability to hire help (Lichtenburg & Zimmerman,1999; Tanner, 1999).

Results of the surveys and interviews highlighted a number of variables that influence decisions by farmers regarding pesticide use (Figure 3). While this article predominantly focuses on the individual farming households, it is important to note that the inability of some policy-making

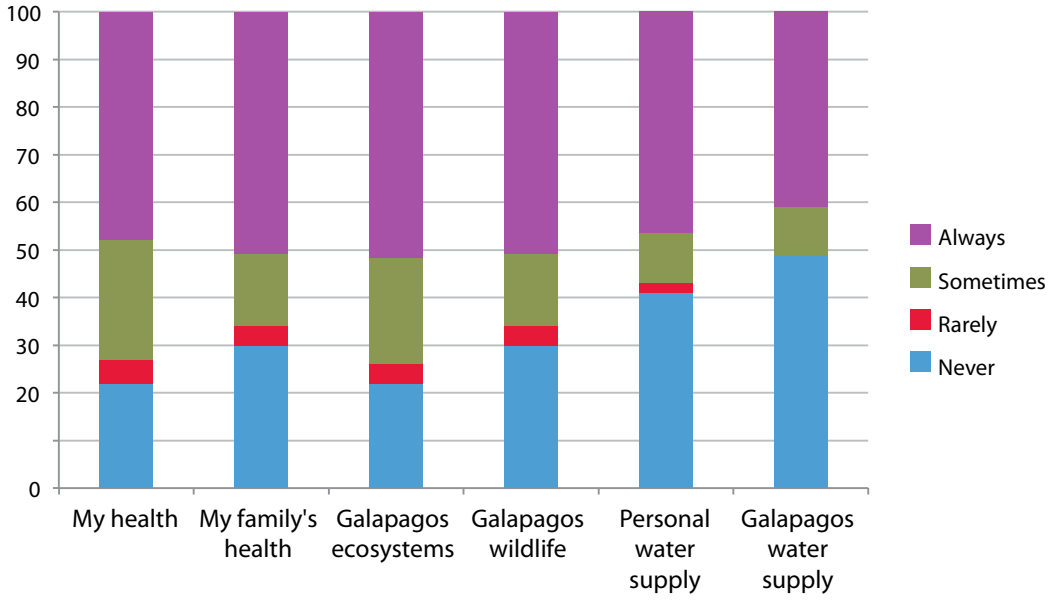

Figure 2. Environmental attitudes of the farmers included in the survey, in response to the statement, "I currently worry about pesticides affecting ..."

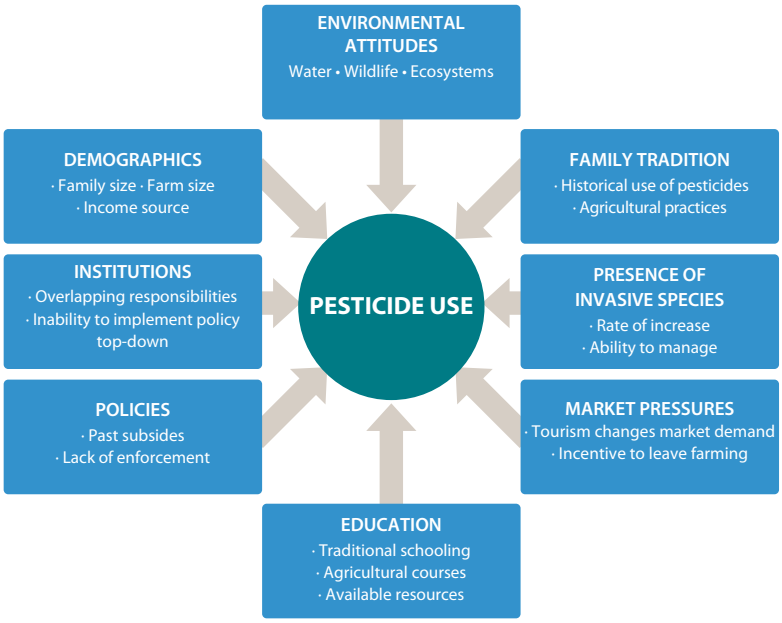

Figure 3. Variables that influence farmers' decisions regarding pesticide use.

institutions on the island to enforce their policies likely plays a role in the availability of banned pesticides and lack of public awareness of updated regulations.

Conclusions and recommendations

Based on the results of this pilot study of pesticide use in Santa Cruz, we recommend that a more comprehensive study be carried out to gather information on the actual application frequencies, quantities of applied pesticides, and impacts on soil and water. Although the pesticides reported in this study do not have high environmental toxicities, soil and water sampling may highlight risks related to application patterns and/or interaction with the island's subsurface structure.

The three major leverage points for altering pesticide use in Galapagos are the level of education, environmental attitudes, and the role of the local market. The following two recommendations interact with one or more of these leverage points.

1. Increase learning and training opportunities to expand knowledge and raise awareness of organic

practices, proper application techniques for pesticides, alternatives for pest control, health, and environmental connectivity, and the economics involved with local agricultural markets.

2. Strengthen incentives for partnerships between the tourism sector and organic farmers to create a greater local market for organic produce. A locally implemented organic certification program might involve "participatory guarantee systems" or PGS. Facilitated by the International Federation of Organic Agriculture Movements (IFOAM), PGS is a means for organic farmers to establish a local market with the help of nonprofits and to provide organic produce to shareholders; local farmers are encouraged to collaborate with individuals who will purchase the final organic product (IFOAM, 2014).

Eliminating pesticides in Galapagos through a ban on their use would be premature and could negatively impact farmers at the moment that there is a growing need for local production.

Using the recommendations listed above, appropriate pesticide use and alternative methods of producing high quality crops may in itself reduce the level of pesticides used.

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