TITLE

Economic Research Priorities for the Food Industry

Optimizing the Research (and Promotion) Needs of Specialty Crops in the US:

A Case Study of the Florida Citrus Industry's Response to Emerging Invasive Pests and Disease in an Environment of Slumping Demand

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ABSTRACT

Optimal advertising and research and development expenditures may be too large for any single firm to effectively provide and the benefits of these activities may spill over to all firms in the industry (free-rider problem). Thus, it may benefit the firms to pool their resources for generic advertising and research. This is the case for the orange-juice (OJ) industry where generic OJ advertising and research on citrus greening is occurring. The question is how much to spend on these different activities. The market place is used to guide the allocation through values consumers place on products.

The efficient allocation of funds to these activities is particularly important because these funds are being collected under the taxing authority of a state agency. Although only one industry is taxed, Florida citrus growers, equitable payments are ensured by state law. These funds are then public funds used to create a public benefit.

All food production is a commodity business at the farm gate. Farmers have little control over final prices and most are only the first step in the supply chain, which is largely controlled by food processors and distribution companies. Thus, commodity agriculture inherently lends itself to cooperative arrangements which require strict accountability and optimization of resource allocations. Accountability is achieved when stakeholders are engaged in the resource management decision-making process. Optimization results from economic rigor applied to the holistic system where resources continue to be applied until marginal costs become equal to or greater than the marginal benefits.

Economists will play a key role in defining the optimal allocation of resources between marketing expenditures and production-research expenditures.

INTRODUCTION

Malthus was wrong! Population continues to expand and people are finding ways to feed the population and exist in earth's limited space. Is there a future tipping point? That is uncertain, but ensuring that Malthus continues to be wrong will take considerable knowledge expansion, innovation, cooperation and coordination. Feeding a world of 9 billion by 2045 (+30%) (UN-DESA 2008) will require more coordination of resources (financial, intellectual, and physical) than ever before. And economic research should have significant influence on the resource-allocation decisions. One of the biggest challenges in the future will be developing reliable resource-allocation insights for public policy makers and private investors in their quest to feed the world population in a sustainable manner.

The United Nation's Brundtland Commission established that sustainability has four elements: environmental, political/social, economic, and institutional. This paper will focus on economic sustainability and specifically the optimal allocation of scarce financial resources and challenges economists face in their endeavor.

An interesting experiment of optimum resource allocation for the benefit of an agricultural industry is taking place today. Florida's citrus industry is fighting a disease for which no cure is known, in a marketplace that has many lower-cost competitors, while industry stakeholders are funding a large portion of the disease and production research (referred to as production research in this paper), as well as, funding generic marketing programs to enhance demand. In the 1930's, the State authorized the formation of the Florida Citrus Commission (FCC). The primary mission of the FCC is to enhance the welfare of Florida citrus growers through the use of market expansion tools, such as advertising and promotion, but additionally the FCC is involved in production research. The Florida Department of Citrus (FDOC) (FCC management organization) has taxing authority, and, as such, can generate significant funds for either or both initiatives. Today, growers are asking economists, "What are the right funding levels for each?" Unfortunately, we do not know.

To answer such questions, economists have constructed optimization models. At this point, the present optimization models are deficient in their lack of good estimates of production-research impacts or elasticities. That is, we don't know the improvement (reduction) in profits (costs) expected for every dollar spent on

disease-research investment. In contrast, there are many studies estimating demand enhancement or the elasticity of demand with respect to advertising. These elasticities have been developed mostly because the data exist and agencies have been forced to do the calculation in order to justify the marketing programs. The same is not true for production-research efforts.

This paper will examine the Florida citrus experiment and consider potential solutions that may be useful for other agricultural commodities facing similar resource-allocation issues. Best management practices with respect to organizational accountability discerned from the citrus experience will be discussed. The resource-allocation approach considered can be a critical tool once the organizational-accountability hurdles have been cleared.

BEFORE THE STORMS

Florida citrus was in trouble even before the hurricanes of 2004 and 2005. Prices were low, demand was declining, citrus canker was spreading, residential development was out of control, and big agriculture was being blamed for a number of issues including, unfair property taking, illegal immigration, water resource degradation, and preferential property tax treatment. The Florida citrus industry normally does a good job of dealing with issues on its own, but it is even better at getting others to help deal with those issues. However, with public sentiment waning, and housing construction propping up the economy, many of the friends of citrus were starting to disappear. The industry itself began to fragment and fissure as certain elements vied for more control of the smaller pie. But perspectives and attitudes changed due to the catastrophic event of absorbing five hurricanes crossing the citrus belt over a 16-month time period.

In order to understand how these events impacted the citrus industry, it is appropriate to examine the situation facing Florida growers up to and during the storm period. Florida citrus livelihood has always been affected by the weather (similar to any other agricultural commodity) and these hurricanes were no different.

Prior to the hurricanes, Florida was growing more citrus then it could profitably sell. Grower prices were at historically low levels (Chart 1) and the squeeze on grower profitability negatively impacted sentiment toward the generic marketing programs. Growers wanted every cent they could keep in their own pockets, limiting how much the FDOC could spend on generic programs. Individual firms (brands and processors) were

making good profits buying low-cost ingredients and keeping the shelf-price relatively high. As a matter of fact, orange-juice (OJ) prices are traditionally assumed to be the price umbrella in the refrigerated-juice case. Brands were not spending much money on advertising, choosing instead to promote products often and deeply, influencing consumer behavior and perspective. Brands spent much more on trying to take and keep market share than on expanding the pie.

Further complicating the demand side was a dietary trend towards reducing or eliminating the consumption of carbohydrates. It is estimated that 40% of consumers reduced their carbohydrate intakes by as much as 25% for some products during 2004. OJ was among the casualties.

The bottom line was that crops were at record levels, grower prices were low, OJ demand was declining, and a number of growers were not convinced that generic marketing programs could improve the situation.

At the same time, citrus canker and the federal rules associated with dealing with the disease were complicating the situation. Citrus canker is an infectious disease that attacks the citrus fruit and mostly makes the fruit unsightly, but can also cause fruit to drop sooner and cause trees to produce less fruit. Canker-infected fruit cannot be sold in the fresh market and many states and countries have restrictions against importing infected fruit. The disease is spread by the wind and the prescription for diseased trees is eradication. Since this disease is non-native, the federal government required eradication in states that had a commercial citrus industry, and a compensation plan was enacted for growers that eradicated trees. In some cases, the compensation was better than long-run returns for selling the fruit.

The State of Florida was actively eradicating trees in the late-1990's and early-2000's due to an outbreak in the southeast Florida growing areas. Backyard trees were also being eradicated at that time. Homeowners in Broward County sued to stop the "unfair taking" in 2004. A federal judge upheld their injunction. Eradication of backyard trees was stopped prior to the hurricanes of 2005, but commercial growers were still eradicating and getting compensation. Federal and state officials wondered, not so quietly, if the program could be continued in the future, given general public sentiment and the cost of compensation.

In 2004, the vast majority of stakeholder funding was going to generic promotion. Less than 4% ($2 million) of the $50 million in stakeholder funding was devoted to production-research issues. A group of

grower representatives, the Florida Production Research Advisory Council (FCPRAC), managed the state Citrus Production Research Order. They generally announced a competitive grant program each year and made awards to the University of Florida, Institute of Food and Agricultural Sciences, and the United States Department of Agriculture, Agricultural Research Services researchers. A typical project had one investigator, studied a specific problem, and was funded in the $20,000-$50,000 range for one year.

Like many specialty crops and non-program crops, the citrus industry relied on the public institutions for the majority of their research needs and innovation discoveries as can be seen in Chart 2. Researchable ideas were generated in the confines of these institutions, and were funded by the allocation authority of the institutions, albeit with limited influence from the industry. Given limited resources at the institutions and very little from the stakeholders, proposals received little attention unless the need was imminent.

WELCOME TO FLORIDA: CHARLEY, FRANCES, JEANNE, AND WILMA

From August 2004 to November 2005, four major hurricanes blew through the citrus-production areas of Florida (Figure 1). No growing region was untouched. As much as 50 million boxes of fruit, having an on-tree value of at least $300 million were left on the ground. Effects of the hurricanes on tree health impacted production for the next three seasons. But what was worse is that winds spread canker to all corners of Florida.

By January 2006, federal policy makers decided that the mandatory eradication of canker-infected trees was not feasible anymore. With a minimum of a 1,900-foot-radius (~250 acres) cutting circle around a find, it would not take long to cut down all of the citrus trees standing in Florida. Without eradication, compensation would end also. Regulators quit looking for trees, growers quit cutting them down, and the last compensation checks were issued in January 2007. Canker had become endemic. The only canker-related activity that did not stop was the lawsuits by disgruntled homeowners who wanted more compensation for their losses.

In the background was the discovery by the Florida Department of Agriculture and Consumer Services of citrus greening (HLB) in south Dade County in 2005. We had the primary vector of HLB, the Asian Citrus Psyllid (ACP), present in the state since the late 1990's, but, without the HLB bacteria, that vector was harmless. HLB is completely destructive and has no known cure or abatement. Any citrus industry that has encountered HLB is no longer commercially viable.

HLB also has a several-year incubation period. That is, it takes several years for a tree to show symptoms. Growers did not know they even had HLB in their groves until it was everywhere due to the long incubation period. From discovery in 2005 to 2010, HLB has been found in every citrus-producing county and most citrus-producing sections of land area. As a matter of fact, it is estimated that every tree in the ground today is at a minimum of two miles from an infected tree (Figures 2 and 3).

Commonly recognized best management practices for HLB is scouting, psyllid control and eradication of diseased trees. It has been estimated that this practice (including the additional resets) raises cost of production by 40%, or $450 per acre (Muraro 2010). Furthermore, it is not certain that you have eradicated all of the inocula, given the long incubation period. Uncertainty in the outcomes makes it much more difficult for growers to adopt this practice, and making it mandatory is politically unacceptable as evidenced by the canker-eradication experience. Solutions, other than eradication, are needed to allow the Florida citrus industry to remain viable into the future.

Starting with growers (FCPRAC), the stakeholders began a campaign to search for a sustainable solution to mitigate the risk of production loss from HLB, and capture returns on investment in disease research in general. Finding significant funding became the number one priority. A figure of $20 million was determined to be the target. Twenty million dollars was chosen rather arbitrarily, but it did amount to 2% of total on-tree revenue ($20mm/$1B). That combined with an annual spend of $20 million from the public research institutions creates a bucket of money that form the basis for a sustainable research effort. The only place to find that type of guaranteed money was the FCC, and its advertising trust fund. In January 2008, the FCC passed a resolution to “fund whatever is necessary.”

The dilemma was further complicated because the market for Florida citrus products was about to get much worse. Even though the impact of low-carb diets on OJ was starting to wane, other impacts were being felt. Brands responded to the crop reductions and future uncertainties in late-2005. The response included an unprecedented 29% increase in retail pricing, along with reductions in promotional activities and discounts from 2004-05 to the 2006-07 season. The combination of these actions reduced consumption by over 18%. Today, brands continue to feel supply pressures and are reacting by down-sizing their package offerings.

HOW IS THIS GOING TO BE MANAGED, AND WHO WILL MANAGE IT?

Several industry members, both public-agency staffers and stakeholder volunteers, set out in the fall of 2007 to find the mechanism to manage a research operation funded at unprecedented levels. Interviews with consultants and individuals resulted in two critically important decisions, both of which became policy. First and foremost, the management team for this research effort had to be professional, independent, unbiased, and have a stake in the outcomes. Second, projects would only be funded after recommendation from a third-party peer review system.

In February of 2008, the FDOC hired the National Research Council (NRC) of the National Academies of Sciences (NAS) to conduct the third-party peer review process for proposals, as well as, write a strategic plan for Florida citrus industry efforts to deal with HLB and canker. These were two distinct deliverables, the first requiring a ranking of priorities to use for a request for proposals (RFP), and the second requiring the convening of expert advisors to conduct a SWOT-type (strengths, weaknesses, opportunities and threats) analysis, and recommend strategies and tactics.

The priority ranking process and call for proposals were completed in the summer of 2008. By November 2008, 205 proposals had been reviewed, and 106 proposals had been approved for funding by January 2009. The strategic plan for Florida citrus was delivered in March 2010.

Simultaneous to this effort was the hiring of a consultancy firm with expertise in developing publicly created intellectual property (IP) into commercially viable products. The firm was Technology Innovation Group (TIG) and the lead consultant chosen for the project was Dr. Tom Turpen. TIG had two important distinctions from other consultants. TIG is highly experienced in moving publicly created IP from the institution to the stakeholder, and their project leader, Dr. Turpen, had extensive experience in agriculture, plant pathology, and biotechnology. As an independent consultant, TIG was able to move around without being encumbered with political baggage, as well as, they could also break down stovepipes and encourage collaboration because they were beholden only to the stakeholders.

By 2009, stakeholders were starting to gain control of their destiny, even if solutions for HLB were not evident yet. However, this research project, with NAS and TIG supporting efforts, had grown too large for the

FCPRAC. As a result, a research foundation was envisioned as the organization that could be responsible for managing the research efforts, while at the same time, taking responsibility for commercial development activities. No longer would the project investigator (PI), or the institution be relied upon to bring discoveries to the market, but now the stakeholders would have a role in making those discoveries available to Florida citrus growers.

In the spring of 2009, the Citrus Research and Development Foundation (CRDF) was formed and an industry-selected Board of Directors was seated. By July 2009, the CRDF had two employees (a director and an accountant), several consultancy contracts (TIG and Ecostat), and had issued its first call for proposals, CATP09.

PARADIGM SHIFT FOR RESEARCH INSTITUTIONS

It turns out that having a private foundation take responsibility for commercial development required changes to how IP ownership was managed by public institutions. The foundation was entering an area of responsibility that public institutions had solely owned for quite awhile. These institutions had created their own commercial development departments (sometimes called Office of Technology Licensing (OTL) or Technology Transfer Office (TTO)) who were responsible for working with PIs to develop patents, find potential licensees, protect those patents and licenses, and create royalty streams for the institution and the PI. The TTO is both a service center helping PIs take their discoveries to the market, and a profit center using revenue streams to offset administrative and activity costs. The TTO has missions, goals and objectives that do not always align with the desires of the industry stakeholders. Historically, these TTOs worked well for the institutions with respect to high-value pharmaceuticals and medical discoveries, but agriculture received much less attention and developed far fewer commercially acceptable solutions.

The creation of TTO had its genesis in the form of The Bayh-Dole University and Small Business Patent Procedures Act of 1980 (Bayh-Dole). Bayh-Dole allowed institutions to own and manage IP developed with the use of federal research funds. The goal was to bring innovation to commercial development and public access quicker and more effectively. It created an incentive for institutions and researchers to innovate to improve lives and improve productivity. At the same time, it allowed institutions to create another stream of revenue to

hire and retain researchers. Institutions with the best TTOs attracted the brightest research scientists. There are mixed opinions about the success of Bayh-Dole with respect to achieving its goal, however, no one would argue that institutions have embraced the concept and benefitted from its passage.

Consequently, Bayh-Dole is often used to protect institutions' IP ownership rights created with funding, partial or full, from outside agencies. Institutional standing regarding the IP ownership issue, whether justified or not, can demotivate funding agencies who desire preferential treatment to access and use of the innovation and a greater role in the commercialization process. Understanding this issue led the CRDF to the International Technology Transfer Institute (ITTI) at Franklin Pierce Law College and the *Executive Guide to Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices*. CRDF learned that Bayh-Dole has many benefits to society and public research institutions and many countries were emulating the policy, but "unintended consequences" sometimes impair its utility and suggest the need for revisions and/or exceptions.

A case in point is an article published in the Cordozo Law Review, entitled "States as Innovation System Laboratories: California, Patents, and Stem Cell Technology," by Michael S. Mireles, Jr. Mireles examines the relationship between the State of California and its public research institutions. The examination was published in 2007 and points out how practices institutionalized under Bayh-Dole policy can have unintended consequences by interfering with the rights of public agencies to obtain control of IP rights that have been developed at a state institution through funding from general public revenue.

In 2004, the State of California passed a referendum (Proposition 71) to raise $3 billion over 10 years to fund stem-cell research. The goals were to create industries and jobs for California citizens, as well as, make health and standard-of-living improvements for California residents. Residents approved the measure and a state agency, the California Institute of Regenerative Medicine (CIRM), was created to manage the money and outputs. Contracts were written and money started to follow from CIRM to state universities without regard to IP rights. The state agency had an epiphany when it determined it had no way of delivering on its goals without some preferential treatment for IP from the universities. The universities resisted, hiding behind Bayh-Dole. A public interest group, the California Council on Science and Technology (CIST), intervened and developed

recommendations for CIRM to use with respect to future contracts. Mireles points out that the final solutions for CIRM policy (and thus state policy) takes the favorable contents of Bayh-Dole for researcher ownership and incentives and combines with it public-agency desires for preferential treatment and some form of benefit sharing.

The CRDF has faced similar resistance from universities; however, the Mireles paper became an important description of alternative outcomes for CRDF to negotiate in the research contracts with various institutions. A satisfactory compromise has been reached with its primary research partner. In general, the university maintains ownership of IP and responsibilities for protection and development, however, CRDF acquired rights to participate in the decision-making process, share royalties, and provisions to "march in" if necessary or secure access and freedom to operate through limited non-exclusive licensing. These stipulations satisfy both parties' needs with respect to expediency and efficient technology transfer.

Having an equitable and effective solution for commercialization of products that resulted from the research program allows stakeholders confidence that benefits will be derived from their efforts and resources. Since, in the case of the citrus industry, funding was coming from the advertising trust fund (reallocated from marketing programs to research programs) the next question to resolve is, "What is the most efficient allocation of resources between these two activities?"

ECONOMIC VIABILITY: THE EFFICIENT ALLOCATION OF RESOURCES

Economists can have significant input into these discussions, in particular, when resources are secured from the public to generate a public good, or if public good expenditures are re-appropriated to a competing need. The latter is the case of Florida citrus and Brown and Spreen provided insights into this dynamic in their paper, "The Allocation of Advertising and Research Dollars in the Florida Citrus Industry." This paper uses existing and estimated elasticities to determine the optimum allocation of grower-collected dollars to the competing needs of disease research and commodity promotion.

This work is significant in that it is one of the first attempts to determine what the optimization model looks like for commodity programs. Many previous studies have documented elasticities for advertising and promotion, including optimization models for a combination of marketing programs. However, the

shortcomings of the Brown and Spreen results come from the fact that production-research elasticities are non-existent and estimates have to be used to drive the results.

The Brown and Spreen model included supply and demand equations for the U.S. and the rest of the world (ROW). The objective function of the model was to maximize Florida grower revenue net of advertising and research costs. The U.S. demand equation was allowed to shift based on the advertising level and a previous estimate of the elasticity of demand with respect to this factor. Both U.S. and ROW supplies were allowed to shift based on the level of research. Less is known about how supply might respond to a given level of research expenditures than how demand responses to a given level of advertising expenditures and assumed supply-shift scenarios were considered. Thus, the model provides a better indication of optimal advertising expenditures associated with assumed supply shifts, rather than predicting the optimal research level.

More quantitative work is required to estimate the range of returns to stakeholders for research and development investments in the food industry and in agricultural production. This is often approached by estimating the percent of revenue invested in research and development as a comparison to other leading companies within and between industries. To improve on this modeling effort, more work is needed on developing supply responses to production- and disease-research efforts. Economists should be an intergral part of the decision-making process when enhanced data-collection cooperation and econometric-modeling efforts become the norm.

ECONOMIC RESEARCH PRIORITIES FOR THE FOOD INDUSTRY

Studies of the economic impact of marketing programs are mostly mandated by the stakeholders. As a matter of fact, federal promotion orders require an evaluation every five years, along with the required referendum. In this instance, it is clear that stakeholders want and expect accountability from their promotion programs, and are willing to spend the resources to measure performance on a regular basis. Stakeholders view these activities as potentially having positive impacts to their bottom line in either selling more at the same price, or selling the same amount at higher prices. Revenue generation is a key element to satisfying the economic sustainability question.

Another side of the sustainability question is how to lower costs or increase yields. This element

deserves as much attention to accountability as the revenue side of the equation. This is especially important when resources are being reallocated from revenue generation to cost reduction. However, for whatever reason, the same level of economic evaluation has not traditionally been performed on these activities. Economic analysis must be included in these resource-allocation decisions on the macro and micro level.

Some evaluations to consider would include economic impact statements, cost of production analysis, input-output analysis, benefit-to-cost ratios, and return on investment.

Production-research programs have traditionally been funded by non-stakeholders. When stakeholders fund the programs, additional accountability to the stakeholders will become necessary. At that point, economists can provide valuable analytical tools, including empirical models and insights.

CONCLUSIONS

Population growth will continue to stress food production in the future in terms of environmental, social/political and economic sustainability constraints. Food producers, especially in developed economies, will have additional burdens trying to satisfy local rules for international markets. Resource-allocation decisions for public goods will be top of mind for stakeholders, policy makers and public advocates. Economists must be consulted early and often to provide proper insights for these decisions.

But first, economists must be engaged in the economic evaluation of production-type-research projects. Providing the proper economic evaluation perspective will ensure that production-research allocations get the same level of scrutiny as other allocations, including, but not limited to, marketing programs, trade benefits and barriers, and environmental assessments.

The key ingredient to command this type of evaluation is for stakeholders to take control of the research agenda. This will require an evolution of current relationships. Stakeholders will have to speak with one voice, and research institutions will have to cede control of certain elements to satisfy stakeholder needs. It will take time and effort, but it can be done, as the Florida citrus industry and citrus-production researchers have proven.

In the end, optimization models can be constructed and used to make resource-allocation decisions. Optimization of scarce resources is needed to solve the environmental, political and economic sustainability concerns, and it is the key element that will keep Malthus from being correct.

Chart 1. Real Delivered-In OJ Price vs. Florida and Sao Paulo OJ Production

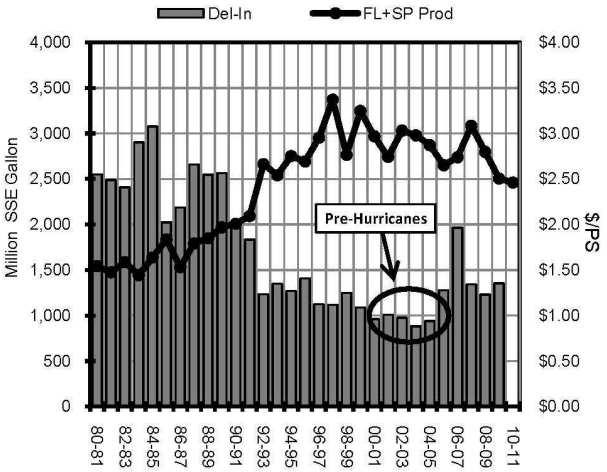


Chart 2. Historical Funding for Citrus Research in Florida

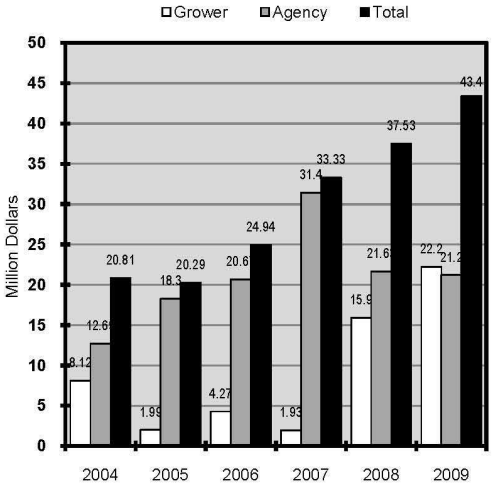


Figure 1

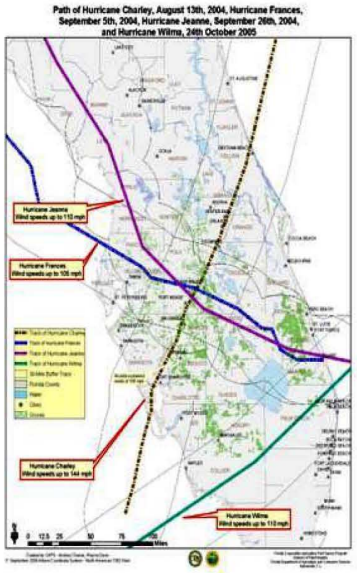
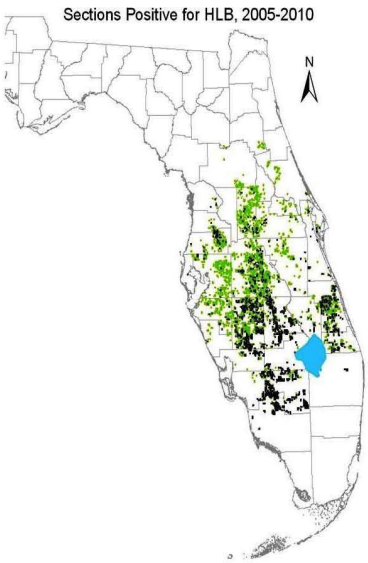


Figure 2

Figure 3



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