

Navigating Regulatory Regimes when Place Matters: Environmental Governance, Labor, and Power
in the Genetically Modified Corn Seed Industry

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ABSTRACT

This dissertation shows how place shapes socioeconomic development opportunities for transnational firms and local communities. Despite assumptions that firms in high-tech sectors rely on technology to render nature obsolete, I show that technology has made place paramount to corn seed firms' success. Tracing the development of modern corn seed from test tube to package, I find that firms establish research and development (R&D) stations where climate and other environmental assets increase their speed to market. This allows firms to more quickly secure place-based technology rents through patents. The genetically modified (GM) corn seed industry is an important case because firms' competitiveness hinges on staying in particular environments, rendering them somewhat place-bound – which may be used by local institutions as a negotiating tool for better environmental and labor arrangements.

My account is based on a multi-sited ethnography in the three main R&D hubs for GM corn seed in Chile, Puerto Rico, and Hawaii and in the headquarters of an industry-leading firm in Iowa. I use interview, observational, and secondary data to build a conceptual framework to understand the process by which firms' localization strategies reconfigure local regulatory regimes and respond to community resistance, questions that are central to community development and governance debates. I compare firms' localization strategies in Hawaii, Chile, and Puerto Rico where managers confront different regulatory structures, socioeconomic conditions, and degrees of activism. My work shows that firms must balance a site's natural endowments with its sociopolitical and regulatory context to remain competitive in an industry where a handful of firms control nearly 90% of the market. In contrast to theoretical approaches that view firms' localization as a single moment of decision-making, I conceptualize localization as a dynamic, relational, multistep process of negotiating a regulatory regime with local actors and institutions – not just shopping for the right environment, but shaping it, and actively taking actions to stay there. In proposing a power-sensitive approach to location and regulation theory, my work takes socio-historical patterns of inequality into consideration, contributing to our understanding of how corporate localization strategies affect development outcomes, particularly in the areas of environmental and labor governance.

Key words: regulation, agriculture, rent theory, environmental governance, labor, location theory

INTRODUCTION

Feeding nine billion people on dwindling resources is one of the greatest challenges of the 21st century. Genetically modified (GM) crops are seen as one important tool for meeting this challenge; however, their proliferation has sparked divisive debates over environmental and public health concerns as well as seed sovereignty (Kinchy 2012; Schurman and Munro 2010; Kloppenburg [1988] 2004; Pechlaner 2012). Meanwhile, public debate has given less attention to other consequences related to the rise in GM crops, such as the growing power of a handful of seed firms over local and national regulatory regimes. This dissertation investigates the criteria that guide transnational seed firms in their selection of research and development (R&D) sites for GM corn seed and explores how firms shape the regulatory environments of particular locations once they are sited. I argue that firms' localization strategies go beyond a simple search for places with cheap labor and loose regulations (Collins 2003; McKay 2006).

Transnational seed firms locate their R&D hubs in sites with climatic advantages that enable them to cut research times and maximize the benefits deriving from their patent rights by producing seeds in multiple cycles per year (Ipsen 2016). This enables firms to increase and extract technology rents through intellectual property rights, which is crucial to maintaining their competitiveness. However, to be successful, firms must balance a site's natural endowments with its sociopolitical and regulatory constraints. Thus, firm managers engage in an ongoing negotiation with local officials and communities to achieve the conditions they need to operate profitably in these locales. Because seed firms' competitiveness is contingent on the climatic features of particular natural environments, they are, to a certain extent, place-bound. This affects not only their profit margins, but also their actions and relationships with both formal and informal

regulatory actors. This place-bound condition may give communities and local governments more bargaining power than they might otherwise have.

The nature of the production process and that of rent extraction in the seed industry firmly tie these transnational corporations to place. Because there is so much at stake in being able to stay in these environments, firms are especially motivated to invest in crafting a regulatory regime that provides the other kinds of conditions they need, such as reliable, tractable labor and few regulatory restrictions for genetically modified crops. As such, firms must invest in preempting or opposing the nascent social movements that would challenge them. My research suggests that seed firms' localization strategies are not a single moment of choice; instead firms select their sites as part of an ongoing dynamic multi-step process that I call regime shopping, shaping, and staying. In presenting this case, my research offers an account of how firms locate in and shape regulatory contexts through multiple dimensions of power. These complex corporate strategies for coming to terms with the particularities of place not only affect the profitability of firms. They also profoundly affect power relations and the ability of local governments and communities to regulate and mobilize around issues of labor rights, environmental safety, and ecological diversity.

This dissertation illuminates the process by which firms make location and regulatory decisions to not only better understand corporate localization strategies and their effect on local institutions, but also to discover how communities, local governments, and social movements can leverage their place-based assets in negotiations for better labor and environmental arrangements. I examine three R&D hubs – Hawaii, Puerto Rico, and Chile – to understand when and under what conditions the place-bound nature of industries provides some power to communities, social movements, and local governments. In doing so, I compare three cases of firms' localization strategies. Hawaii offers an example of the kinds of actions that firms engage in to thwart what

they see as untenable environmental regulations. Chile, in contrast, is an example of the actions that firms take to craft a reliable and controllable labor force. Finally, Puerto Rico is a place where firms need to be less proactive at protecting their right to stay since high unemployment rates and the economic vulnerability of both the state and communities has led to the demobilization of social movements and the complicity of the state.

In this dissertation, I analyze the primary factors that explain the vast differences between these cases. I provide a brief history of each site, firms' localization activities, and the diverse effects of regime shopping, shaping, and staying on local communities and governments. These cases demonstrate that a community's ability to gain leverage from the place-bound nature of firms' investments depends on their place-based resources as well as their political economic vulnerability within a broader set of power relations.

Industry background

The production of seeds for profit is not new; yet the tensions surrounding seeds reflect dramatic changes in the industry over the last 50 years. The advent of patent protection for plants, together with shifting technologies, triggered an influx of agrichemical firms and a wave of mergers and acquisitions that has dramatically reshaped the seed industry (Howard 2009; Fernandez-Cornejo 2004). Seed production has become increasingly concentrated, vertically integrated, and high-tech. Today the \$45 billion global seed market is dominated by six agrichemical firms, "the Gene Giants" -- Monsanto, DuPont, Syngenta, Dow, Bayer and BASF. Since the introduction of genetically modified (GM) corn in 1996, the market share of the world's three largest seed firms has more than doubled, reaching 53.4 percent of commercial seed sales (ETC Group 2013). Monsanto, DuPont-Pioneer, Dow, Syngenta and AgReliant control 89

percent of the U.S. corn market, with Monsanto and DuPont alone controlling 70 percent in 2013 (Schafer 2014).

New technologies and regulations make it possible to patent plant life and to produce seeds that have higher yields, some herbicide and insect resistance, and lower labor costs for farmers (NRC 2010). These advanced technologies enable firms to overcome some of nature's barriers, but they also ironically serve to intensify the importance of place and nature in high-tech seed production, as industry competitiveness relies on getting new products to market first in order to gain intellectual property rights. Unlike other high-tech industries, seed firms largely achieve speed to market by drawing on nature's competitive advantage. They do this by locating research and development (R&D) stations in locales with specific natural endowments and multiple growing cycles per year, rather than in centers of high technology, or near skilled labor pools. This has implications not only for industry competitiveness, but also for the power relations between firms, the state, and local communities.

Research questions, methods, and data analysis

This dissertation seeks to understand under what conditions local actors and institutions can gain voice from the place-bound nature of the GM corn seed industry. As such, four overarching questions motivate this research. This dissertation asks: 1) What role does nature play in the competitiveness of the seed industry? 2) How are firms' R&D location decisions driven by the biophysical characteristics of seeds and where they can be grown? 3) How do firms balance and mediate other factors that might be less than ideal, such as labor markets, high operating costs, and political stability, given that they largely chose R&D sites based on regulatory and climatic conditions? 4) What tools do firms use to shape the local institutional and socioeconomic environments and how are firms in turn shaped by this process and by outside institutions?

In order to address these research questions, I relied primarily on in-depth interviews, ethnographic observation, and document analysis. My account is based on a multi-sited ethnography of three of the most important R&D stations for the top firms that control 90 percent of the U.S. corn seed market. I draw on semi-structured interviews and ethnographic observation, which I conducted during the summers of 2010 and 2011, and from September 2013-November 2014. I conducted 66 semi-structured interviews with seed managers, local government and non-governmental leaders, and seed association executives in the three main R&D hubs for the GM seed industry in Hawaii, Chile, and Puerto Rico, as well as in one firm's headquarter site in the Midwest. I visited and observed seven firms' operations at different points along their commodity chains, including R&D sites, biotechnology laboratories, headquarters, and production and packing facilities.

As in most case study research, I relied on purposive sampling of experts knowledgeable about various aspects of the topic. I strove to represent all relevant perspectives on the issue, including seed firm management, local government officials, and community, environmental, and gremial association leaders. I attended town hall meetings and conducted site visits to local and transnational firms' facilities, including four of the world's largest transnational seed firms. In addition, I gathered documents from trade journals and newspapers, seed firms, local seed and biotechnology associations, and government and legal sources.

I analyzed data by exploring and coding for key themes, such as the importance of climate, regulation, and local institutions. I constructed timelines for each of the study sites and used them to conduct an incorporated comparison of firms' interactions with communities. Because I am not comparing independent uniform cases, traditional comparative models do not provide a useful analytic frame. My cases (the research sites) are part of a larger self-forming whole (the industry),

making an incorporated comparison an appropriate methodological choice (McMichael 1990). Incorporated comparisons help us visualize how events and actions in each case affect the others, demonstrating how the larger political and socioeconomic context shapes the structure of the industry and firms. In addition I conducted a socio-spatial analysis of the natural and regulatory environments for GM seed R&D. I mapped the industry and its structure of production – mainly focused on R&D – through a commodity chain analysis to identify lead actors, degree of concentration and power, and sources of competitiveness. I used this analysis to identify major sources of rent for the industry and the process by which rent is extracted.

Research sites

I chose Hawaii, Chile, and Puerto Rico as my research sites because they represent the three major GM corn seed R&D stations for the U.S. corn market. There is a fourth site in Mexico, but currently Mexico does not allow for genetic modification of corn seed so I excluded it from my study. Examining three R&D sites allows me to document the different challenges that place represents for firms and how communities, local governments, social movements, and firms in diverse places react to those challenges. By studying the same companies across multiple sites in the same industry, I am able to make comparisons across research sites where the work is very similar, but more importantly I am able to use the cases collectively to better understand the industry as a whole.

Hawaii is home to the oldest operating seed research facility of this type in the U.S. In recent years GM corn seed has become Hawaii's most valuable agricultural product, exceeding that of pineapple and sugarcane, but it has not done so without controversy. The tensions surrounding biotechnology and pesticide use especially for corn seed have taken center stage in Hawaiian politics. In Kauai in 2013, county resolution 2491 passed into law. It established

restrictions around pesticide use and created buffer zones between pesticide-sprayed fields and public areas such as schools, hospitals and homes. The law was set to take effect in August 2013, but three of the world's largest agrochemical companies sued Kauai County to overturn it, claiming it was unconstitutional and would set a dangerous precedent. This debate grew as other islands in Hawaii began to pass similar legal initiatives. Ultimately, transnational seed firms won the legal battles in court, but their social license to operate in Hawaii remains an unresolved issue.

Arica, in the northern-most region of Chile, is marked by economic, social, and environmental extremes. It boasts one of the most active international borders in Chile, yet historically it has been plagued with high unemployment and poverty and a labor market of workers with low education levels and little labor experience. Local government officials estimate that immigrant workers make up 70 percent of the agricultural workforce in Azapa Valley (interview, government official, Arica, Aug 2011). Historically agricultural production here has been unregulated, low-tech, and small-scale. But over the last five years, Arica's agricultural landscape has shifted as transnational seed companies have moved in with their cutting-edge technology and strict regulations. While Arica offers advantages to seed firms with its predictable climate and low-cost workforce, its distant location, lack of infrastructure, and low-skilled workforce pose challenges for firms. Despite these trials, seed production quadrupled in Arica from 2008 to 2009 and a recent investment promises to add 1,000 jobs to the \$415 million industry in Chile. This growth has been met with some resistance as seed workers in Arica went on a 22-day strike in April 2013 that was resolved by the company partially meeting worker's demands.

Today Puerto Rico is home to the GM corn seed industries' largest R&D nursery site. Despite Puerto Rico's ominous economic situation, as reflected in its high unemployment levels and extreme poverty rates, the U.S. commonwealth has continued to provide economic and tax

incentives to fuel select industry expansion. Agricultural biotechnology is one of the sectors that has benefited from these programs in recent decades. In the mid-2000s, operational budgets and investment spiked dramatically, acreage planted increased by over 50 percent, and employment tripled. Unlike Chile and Hawaii, firms in Puerto Rico have yet to suffer a major set-back due to negative responses from local governments, social movements, or communities. In Puerto Rico the economic backdrop is such that social movements have little chance or power to emerge and mobilize.

Des Moines, Iowa is the headquarters and biotech research hub of one of the seed companies in this study. The firm was founded here in the mid-1920s. In the last 40 years, it has expanded its production across the globe. Today it has over 100 research centers internationally and nearly 10,000 employees. The firm continues to invest in its central Iowa location, pointing to the large scientific base and infrastructure as key factors that have propelled that investment. Today the firm employs around 2,400 in its central Iowa location. In September 2012, the firm opened a \$40 million dollar seed research facility focusing on genetics in its central Iowa location, creating 400 new jobs. While the firm continues to expand, the literature highlights the domestic labor shortage in agriculture across the U.S. Approximately 75 percent of hired farm workers in the U.S. were born in Mexico (U.S. Dept. of Labor 2005). Iowa is no exception; agriculture here has a strong dependence on Mexican and Latin American farm workers and their presence in Iowa is growing (Norman 2008).

Overview of dissertation

This dissertation is comprised of five chapters. The first chapter brings together location theory and rent theory to help us understand why firms locate their R&D in specific places. My research theorizes which locales are more likely to generate place-based technology rents for firms

and why. In the second chapter, I build a conceptual framework that enriches regulation theory by broadening the notion of regime shopping. This framework conceptualizes firms' localization as a multi-step process in which firms shop for, shape, and actively stay in particular places as a way of protecting their sunk costs and ensuring longer terms profits. By offering a power-sensitive account to regulation and location theory, I take social dynamics and historical patterns of inequality into consideration, contributing to our understanding of how corporate localization strategies affect local environmental governance and labor regulation. The next three chapters examine firms' long-term localization strategies in Chile, Puerto Rico, and Hawaii, answering the question under what conditions communities gain leverage from the place-bound nature of GM corn seed research and development. In the conclusion, I summarize my findings and suggest possible directions for future research.

CHAPTER 1. Manufacturing a Natural Advantage: Capturing Place-Based Technology Rents in the Genetically Modified Corn Seed Industry¹

While researchers have been discussing the “production of nature” for over fifteen years (Castree 2000), today scholars are more attentive to how nature and the political economy are mutually constructed and shaped. As Robertson (2012: 372) explains, “in this renaturing of the economy, economic geographers have begun to examine the way that ecological systems are themselves the production of economic and political regimes, [and] how states and markets have been dramatically reshaped” through this process. Because nature figures as a biophysical actor and not a neutral backdrop, nature’s animacy has important consequences for political economy (Castree 2008; Bakker and Bridge 2006). Part of this burgeoning literature on nature and materiality focuses on the attempts to commodify natural resources that pose intractable challenges to commercialization due to their biophysical characteristics (Bakker 2010; Robertson 2006; Kaup 2008).

Seasonality is an aspect of nature that capitalist agriculture has long searched for ways to overcome. In a foundational piece, Mann and Dickinson (1978) argue that Marx’s distinction between labor time and production time presented obstacles to the development of a capitalist agriculture, due to its seasonality. My research highlights how advanced technologies have blurred the line between labor time and production time. It demonstrates how the changing technology of seed innovation has broken down the biophysical limitations of seeds’ commodification, mediating the seasonality of agricultural production by using advanced technologies and continuous nursery sites to perform R&D. Thus, firms harness one of nature’s frontiers – seasonality – but in doing so they become more reliant on place and nature.

¹ This chapter is based on an article that I wrote for publication in *Environmental Sociology* in 2016 with the same title. It has been slightly revised for the purpose of this dissertation.

This chapter will show that by locating R&D in particular types of natural and regulatory environments, firms are able to use nature's seasonality to their advantage in order to extract technology rents. A rent is a payment to a factor of production in excess of the cost needed to bring that factor into play; thus a technology rent is such an advantage obtained through technological innovations and intellectual property rights. This chapter documents the importance of nature and materiality in shaping how and where corn seed R&D occurs, and how siting R&D in particular environments enables firms to generate profit. It also brings to light the politics and power relations behind scientific choices, as firms must build productive relationships with local institutions since the competitiveness strategies and technologies that firms rely on are embedded in specific places. Much of the recent literature on seeds has explored the topics of seed sovereignty or biotechnology and the energetic social movements surrounding them (Kinchy 2012; Pechlaner 2012; Schurman and Munro 2010). While this literature offers insights into how industry changes have affected certain populations, my research provides a critical backdrop that is missing from these studies by exploring the nature of oligopolistic competition among GM firms and the political economic role that place plays in firms' competitiveness strategies. By examining the process by which rent is captured in this high-tech industry, I show how technological shifts have made place a vital mechanism for profit generation.

Research questions

In this chapter, I explore how place-based aspects of nature, regulation, and technology shape seed firms' competitiveness strategies, focusing on GM corn seed R&D stations for the largest transnational firms. I identify the main factors that influence firms' selection of these sites, asking: 1) What role does nature play in the competitiveness of the seed industry?; 2) How are firms' R&D location decisions driven by the nature of the commodity – the biophysical characteristics of seeds and where they can be grown?; and 3) How do seed companies restructure

their R&D efforts to protect themselves from nature's unpredictable temperament? The answers to these questions elucidate the importance of nature, materiality, and power in shaping how and where corn seed R&D takes place, the process by which seeds are commodified, and how profit is extracted.

Nature, materiality, and commodification: Achieving rents through place

Kloppenburg, in *First the Seed* ([1988] 2004), documents the history of plant breeding in the U.S. and shows how efforts to control seeds' biophysical limitations shaped the emergence of today's agricultural biotechnology industry. He finds that hybridization was effective in eroding barriers of seed commodification, enabling capital to penetrate plant improvement. The hybridization of corn uncoupled agricultural producers from their means of production, as hybrid seeds could no longer be effectively saved and replanted. Thus, it opened a space for capital accumulation, prompting the entry of large corporations.

I take Kloppenburg's approach a step further. I argue that shifts in technology and division of labor are not enough to give firms their competitive edge. Today, seed companies are coupling both old and new technologies with advantageous climates in continuous nursery sites to produce high-tech seeds faster than ever before. In doing this, they mediate many of the risks associated with nature. In their quest to overcome natural barriers to seeds' commodification, firms find themselves in a paradoxical situation. Advanced technologies have not freed them from nature, rather they have reinforced firms' dependence on place and specific climates as means to increase speed to market and secure intellectual property rights. This is key to seed firms' success because it leads to maximizing what business historian Alfred Chandler (1977) calls "throughput." Throughput is an increase in the speed with which a production cycle is completed (Chandler

1977). Firms in the GM corn seed industry rely heavily on maximizing throughput to remain competitive because speed allows them to capitalize on innovations through technology rents.

Technology rents, according to Gereffi (1999), arise from asymmetrical access to key product and process technologies. In the GM corn seed sector, technology rents are the returns gained from intellectual property rights or utility patents; however these are not the only rents the industry relies on. Kaplinsky (1998) suggests nine types of economic rents: stemming from resources, policies, technology, human resources, organization, relationships, product and marketing, infrastructure, and finance. He points out that divisions between types of rents are often blurry, as rents are interrelated. I find that in the case of high-tech seed firms, firms' ability to appropriate technology rents is a function not only of advanced technologies and corporate dynamism, but also of favorable natural and regulatory environments. In other words technology rents are dependent on resource, policy, and relational rents.

Rent theory is a useful lens through which to view the high-tech seed industry. It posits that industry competitiveness is not contingent solely on productivity or perfect competition, as neoclassical economic theory asserts; rather market equilibria are constructed and subject to political, institutional, and ideological projects (Tomaskovic-Devey and Lin 2011). In the high-tech seed industry competition hinges on profiting through intellectual property rights, not producing more seed.

The state is an active player in defining the process of rent extraction, since the concept of rent describes "a world where the parties who control a particular set of resources are able to insulate themselves from competition by taking advantage of, or by creating barriers to the entry of competitors" (Kaplinsky 2004). In this process, the state creates the regulatory environment that partially determines who gains market entry and who does not. Firms seek to create and sustain

market niches or monopolies to shirk the restraints of competitive markets; the state may sanction this behavior by endorsing certain market rules through policies. In the seed industry, trade policies, phytosanitary restrictions, regulations on GM production, and intellectual property laws set the stage for state-firm interactions and industry competitiveness. First mover advantages, often seen in monopoly rents, (when a firm produces a product before the competition enters the market) can be very short-lived. As a way of capturing rents above market incomes for longer periods, firms try to secure state-sanctioned monopolies or scale-based barriers to entry to secure a relatively permanent advantage (Tomaskovic-Devey and Lin 2011).

Government policies are key to institutionalizing the benefits that leading firms gain by surpassing these barriers to entry, especially when economic power is converted to political power (Glenna and Cohoy 2009). Firms seek to shape regulatory frameworks through relationship building with key actors to extract longer term policy rents. Large firms in the GM seed industry have been effective at lobbying for regulatory changes because they have the expertise, social networks, and financial resources needed to enact the desired changes. They attract specialists with higher salaries through a revolving door between government and industry, resulting in an uneven playing field that further consolidates market concentration in the hands of few (Dal Bo 2006).

My work adds three overlooked elements to the discussion of technology rents. First I respond to Kaplinsky's (1998) call to identify new forms of subrents or co-rents. My work identifies the need for a concept of relational rent that encompasses the relationships that firms forge with the state and local institutions as a means to secure access to other types of rents – such as policy and resource rents. I call these place-based relational rents to differentiate them from Kaplinsky's (2004) relational rents, which he defines as relationships with other actors in a firm's supply chain, such as suppliers, marketing agencies, etc. Second, my work goes beyond identifying

types of rents to discuss the process of rent extraction. By focusing on how firms accumulate technology rents, I illuminate the different roles that subrents play in the process. In discussing the interrelationship of rents, I clarify that subrents are not all equal in the roles they play and in their significance in the rent-seeking process. I make an analytical distinction between co-rents and subrents. Co-rents act as mechanisms that enable firms to extract other rents. These are essential and nonnegotiable. Subrents play more of a cumulative or augmenting role; they heighten the potential for rent extraction, but are not essential to the process. Third, my study demonstrates rents' variability across place and the importance of geographic variation.

The GM seed industry is unusual because of the degree to which the ability of firms to capture technology rents depends not only on technology and the policy environment but also on place. In order to draw rents from biotechnology, firms must produce seeds in places with specific environmental and regulatory conditions to achieve the throughput necessary to capture technology rents. While firms have attempted to artificially create those natural conditions in high-tech automated greenhouses in the Midwest, they are as yet unable to mimic the benefits nature provides. Therefore, technology is a necessary, but not sufficient, condition for the appropriation of technology rents in this industry. Technology rents must be accompanied by place-based co-rents, such as resource rents.

Climate is not a simple resource rent in this equation, but an integral part of a high-tech production process that enables firms to capitalize on technology. This distinction is important, as place-dependency may limit firms' ability to capture technology rents, especially if the ideal place from a climatic perspective presents regulatory challenges at the local level. This is a crucial difference from other high-tech industries that draw their profit from technology rents, such as the pharmaceutical sector. In that sector, much like the seed industry, place plays a strategic role in

terms of policy rents and in relation to power and dependency (Gereffi 1978), but place is not key to the production process itself. This makes the capture of technology rents easier to obtain. By accessing the right type of natural and regulatory environment, seed firms are able to achieve maximum speed of throughput, and only then secure profits through utility patents. This has implications for theorizing the circumstances under which local communities that host GM seed industry players can draw negotiating advantages (with regard to labor rights, environmental protections, or other factors) from the dependence of firms on place-based technology rents.

Technologies of commodification in the GM seed industry

Historically farmers performed seed innovation by screening, selecting, and saving seeds from the plants with the most desired characteristics. This process of phenotypic selection gradually changed the makeup of many domesticated plant species, improving them over time (Tripp 2001). Alongside agricultural colleges, private seed companies began to gradually displace farmers, and later the government, as the main source of seed innovation (Goodman, Sorj and Wilkinson 1987; Lacy and Busch 1989; Kloppenburg [1988] 2004). Plant breeders were no longer simply looking for a superior plant, rather they sought specific traits that could be transferred to already established plant lines to improve quality.

Hybridization

As the industry grew, so did the technology to develop new plant varieties. Hybridization was increasingly used together with selection. Two plant varieties would be crossed, and new genetic variability would be generated by the mixture of their characteristics. In order to develop hybrid corn, an inbred line must be first created through self-pollination. Obtaining an inbred line is a lengthy process, which requires corn to be self-pollinated over six or seven generations to become a pure inbred line. Breeders want inbred lines because they are genetically uniform, which

makes them ideal parents because one can more easily predict what characteristics will be passed on to offspring. Once breeders have two inbred or parent lines, they cross them to produce a hybrid line. Hybridization made seeds more amenable to commodification than open-pollinated varieties; however the progeny of hybrid corn lack both vigor and uniformity. This biophysical barrier ensures that farmers who use hybrid corn must repurchase new seeds annually (Kloppenburg [1988] 2004).

Biotechnology

Biotechnology allows scientists to insert traits from one species into another, resulting in genetically modified crops (Tripp 2001). While the first GM corn variety was created in 1986 (Charles 2001), it was not until the mid-1990s that Monsanto developed bacillus thuringiensis (Bt) corn and Round-up Ready soybeans. Bt (a toxin that is lethal to some of corn's most persistent pests) and Round-up Ready or Liberty Link (resistant to the herbicides glyphosate or glufosinate in the case of Liberty Link), are the most important GM innovations in corn, but today most GM corn contains stacked traits – the inclusion of multiple traits in one variety, such as resistance to herbicides and Bt.

GM trait research is very costly. As the route to the ideal seed becomes more complex, reducing time to market has taken on a more pressing character. There are several techniques that firms use to reduce R&D timelines, one of which is marker assisted selection (MAS). MAS uses DNA markers to assist in plant breeding (Collard and Mackill 2008: 557). By identifying DNA sections of interest, crop breeders are able to make decisions based on a plant's DNA, instead of having to wait until the plant grows to see if it has the desired phenotypic characteristics (Collard and Mackill 2008). MAS laboratories use automated processes to analyze key segments of the corn plant's DNA. By using MAS, corn breeders no longer wait eight generations to fully incorporate

new traits through backcrossing (discussed in greater detail later); they can obtain results in three generations, significantly accelerating the rate of inbred line development.

Patents

The vast majority of commodity crop seeds in the U.S., such as corn, soybeans, and cotton, are patented. 86 percent of corn crops in the U.S. come from patented, genetically engineered seeds (Peng 2011). In 2009, two companies – Monsanto and DuPont – controlled approximately 80 percent of all utility patents on corn (USPTO 2009 as quoted in Moschini). Seed prices have risen dramatically in crops where patented genetically engineered varieties predominate, such as corn. According to a Center for Food Safety report (Barker et al. 2013), USDA Economic Research Service data show that since the introduction of genetically engineered seed, the average cost of corn seed per acre has risen 259 percent from 1995-2011. As a National Research Council report (2010) points out, prices have risen because of the R&D value that is invested in seeds. Most farmers are willing to pay those prices because of yield benefits, and cost savings in labor and pesticides, yet market concentration appears to also play a role in the dramatic price increases (Ibid).

New technological innovations in the seed industry have brought unprecedented expenditures in R&D. Because innovations are both time-consuming and expensive, firms seek to secure their investments through intellectual property rights, mainly utility patents. Yet this can be a tricky process with self-replicating, living organisms. Utility patents pertain to technological products and processes and are governed by the Patent Act of 1952. To be patentable, an invention must be useful, novel, and nonobvious. The maximum term of utility patent protection is 20 years from the date of application. Once the patent expires, others may employ the invention without payment.

While the 1930 Plant Patent Act and the 1970 Plant Variety Act laid the foundation for patenting crop varieties, the 1980 Supreme Court case *Diamond v. Chakrabarty* radically changed the legal landscape of plant patenting. It allowed the patenting of a living organism as long as the criteria of novelty, utility, and non-obviousness were met, and as long as it was not a product of nature, but of human manufacture (Kloppenborg [1988] 2004). This shifted seed firms' competitiveness strategies, making technology rents the main profit source in the industry.

Results: Mapping the commodity chain for GM corn seed

Today the production of corn does not begin on a Midwest family farm, but in a high-tech facility that feels much like a cutting edge laboratory in Silicon Valley. The workspace is sparsely decorated, accentuating the sparkling white floors and walls adorned with posters of advanced technological processes or the occasional photograph of rich farmland or picture-perfect crops. If it were not for these chance reminders of agriculture, you might forget you are witnessing the birth of modern corn. The spacious facilities behind locked doors exude secrecy and sterile simplicity. The centerpiece of these laboratories is the automated machinery and robots humming peacefully as they perform their continuous tasks. Periodically scientists in their lab coats appear to supervise the automated processes. They seem oddly out of place as they employ test tubes and petri dishes on stainless steel tables in the background. This seems less like a place where corn is produced than a scene out of the *Jetsons* or *Futurama*, where cartoon characters in a far-off future "grow" their food.

The development of GM seeds begins in these mainland biotechnology laboratories, often in the Midwest for the U.S. market. Here scientists, together with automated machines and/or robots, develop and insert new traits into corn. Once the trait is inside the plant, it is sent by airplane to an R&D nursery site. At the nursery site, plant breeders use a classical plant breeding procedure

called backcrossing to transfer select traits from the engineered variety of corn to another elite commercial line. In backcrossing, scientists cross two varieties – one that has the desired trait and another to which they would like to transfer it – and select offspring with the desired traits. They cross these with the variety without the trait, repeating the process for seven to eight generations to ensure that the DNA of the variety without the trait is almost entirely recovered. MAS can speed up this process considerably. These R&D stations are located in specific areas to take advantage of climate and other natural and infrastructural factors key to testing and developing new seed varieties. There is an important clustering of firms' nursery sites conducting year-round R&D in three main locations: Hawaii (Oahu, Kauai, Molokai, and Maui), Puerto Rico (southern coast), and Chile (Arica).

Once scientists develop hybrid lines, they send them to market destinations, typically between the fifth and tenth generation, to make sure they have higher yields and other characteristics desired in those places where they will be sold and grown.² Nurseries test thousands of varieties and crosses to end up with the best possible seeds. For example, at Pioneer, scientists begin with roughly 130,000 new experimental hybrids each year and only 15-20 are commercialized (Pioneer n.d.). Once scientists determine which varieties are successful, they grow them out in locations with large plots of land with good quality soil. This is rarely in R&D sites, since those sites have smaller plots of expensive land. Once seeds pass through these steps, they are tested for seed quality, dried, treated, and packaged for global distribution. According to Pioneer, by the time a hybrid is offered for sale, it has been tested in more than 200 fields at over 1,500 locations (Pioneer, n.d.). From start to finish the process averages 10-15 years and costs approximately \$136 million dollars to develop a GM seed (Phillips McDougall 2011).

² Large market destinations have corn seed developed specifically for their soil and climate. Many seed companies advertise that they develop a seed for specific zip codes, but if you are not in a large market destination, this is likely not true.

As seed firms engineer technological innovations to speed up the development process, they put themselves on an ever quickening technological treadmill (Schrager 2014). Firms draw a significant competitive advantage from their R&D work, much like the pharmaceutical industry, where product development has the same time pressures and high R&D costs. In research alone, large transnational seed firms invest at least \$1.3 million dollars daily (Cajiao 2012), making the barrier to entry significant. According to Monsanto's website, the firm spends \$3.8 million dollars a day on research (Monsanto n.d.). Since firms are in constant competition with each other to develop a product first and thus secure patent protections (and technology rents), investments in technologies like MAS, and in R&D sites that speed up production, are no longer optional but mandatory.

Today seed firms seek R&D nursery sites like those in Hawaii, Chile, and Puerto Rico to produce seeds in two to four cycles per year, as opposed to a single cycle in the Midwest. Using these sites, it takes on average 10-15 years to develop a new GM product (Phillips McDougall 2011). If it were to take two-three times longer – 20-45 years – R&D expenditures would be cost prohibitive and firms could not capitalize on patents that only last 20 years. Thus firms speed up the development process by maximizing nature. Nature becomes a critical input to the R&D process. This differentiates the seed industry from extractive industries where resource endowments determine location. This is because, while its place-bound nature can be partly attributed to the natural resources themselves, they are not what generates rent in this industry. Rather the endowments are the *means* through which firms achieve throughput and extract technology rents.

Table 1: Timeline and costs for new GM product development

Nursery Location	New Product Timeline	Patent Rights	Average Investment
Multi-cycle Site	10-15 years	20 years	\$136 million dollars
Single-cycle Site	20-45 years	20 years	\$272-408 million dollars

Note: Multi-cycle nursery site production data from Phillips McDougall 2011, single-cycle production estimated based on doubling and tripling the time and costs in that same study. Multi-cycle nursery sites are in Arica, Chile, Hawaii, and Puerto Rico. Single-cycle nursery sites refer to Midwest sites.

Results: Extracting place-based technology rents through resource co-rents

A changing industry: The development of winter nurseries and biotechnology

In the mid-1960s, corn breeders were wooed by the promises of tropical plant breeders like James Brewbaker at the University of Hawaii at Manoa. Brewbaker was one of the first to realize that Hawaii provided breeders with an edge in the seed industry, a year-round growing season. In 1964 Brewbaker's paper "Year-round corn in Hawaii" caught the attention of mainland plant breeders. Anxious to test Brewbaker's claim, Don Shaver, a California plant breeder, and another breeder at Illinois Foundation Seeds sent 20 hybrid lines for a winter trial with Brewbaker's team (Brewbaker 2006). The impressive results prompted Shaver to negotiate a five acre lease in Molokai in 1966 for Hawaii's first commercial winter nursery. Soon other major firms began taking advantage of Hawaii's temperate climate to produce seeds for research during the winter months.

1970 marked a critical moment for the development of the corn seed industry in Hawaii. Southern Corn-leaf Blight associated with T-cytoplasm destroyed almost half the corn seed crop on the mainland (James Brewbaker, Interview, 30 July 2014, Oahu, Hawaii). To protect U.S. corn seed against the blight "they came running to Hawaii with winter nursery work" (Ibid). Initially

operations were both temporary and trivial, due to the unpredictability of a new place and the fact that sugar and pineapple plantations held most of the farmland on the islands (Ibid).

For approximately 30 years, Hawaii was primarily used to provide an additional season for mainland plant breeders to grow out and test their seeds, since breeders could only grow corn varieties in the summer months in the Midwest. In theory the use of Hawaii as a winter nursery site could cut the time to produce a hybrid in half, but only if firms learned to successfully grow it in a radically different environment. While this strategy seems simple, firms approached it with caution. Hawaii came with different pests, diseases, and somewhat unpredictable weather, including tropical storms and heavy rainfall at inopportune moments in the development cycle (Ibid).

By the mid-1990s, Hawaii had become a permanent fixture in the seed industry. At the same time, because of the biorevolution, firms' profits became dependent on achieving speed to market. This provided a financial impetus for R&D expansion. Hawaii shifted from being a counter-seasonal service provider to a year-round continuous nursery site for R&D. In the period when seed firms saw intense growth, between 1998 and 2010, sugar and pineapple witnessed significant declines, decreasing in value by 54 percent (NASS multiple years). Pineapple and sugar plantations began to close down and relocate, making room for the corn seed industry. Today the top agricultural product in the state of Hawaii is not pineapple or sugar, but corn seed. For the 2012/13 season, the industry in Hawaii was valued at \$205 Million USD (NASS 2014), making it the fastest growing agricultural activity in the state.

While Hawaii is the oldest operating R&D site, it is not the only one. Firms operate multiple R&D sites as a risk management strategy to protect their access to resource co-rents. By having more than one site, companies spread risk and ensure that production demands are met even if a

storm or unfavorable event wipes out seeds in one site. As the industry's dependence on speed to market became crucial to success, so did its need to mitigate risk and expand to new nursery R&D sites. Today, most firms cluster their R&D sites in specific locations in Hawaii, Puerto Rico, and Chile. There is also a large clustering of firms in Mexico, but since GM production is not legal there, firms only conduct non-GM research there. This follow-the-leader pattern of foreign investment, in which rival companies in an oligopoly mimic one another's moves is known as "oligopolistic reaction." This behavior serves as a type of insurance for product pioneering firms to ensure that no investor breaks into a lead that others can't overtake (Knickerbocker 1973).

Arica, Chile: Buying a piece of the sun

My first visit to a transnational seed company was in Arica, a border town in northern Chile. Here, far from the agricultural heartland that I was accustomed to, I became aware of the puzzle this case presented. The modern facility stood in stark contrast to the makeshift houses, desert landscape and limited facilities that surrounded it. Azapa Valley, 10 miles outside of Arica, was dotted with rundown olive groves. Occasional rusty signs marked compounds of olive producers, surrounded by walls that blocked passersby from seeing the indigenous immigrant workers who live and work inside. High-tech seed companies with their new facilities and guarded gates, seemed out of place here. Why would transnational seed companies choose to locate their top-notch research facilities in a far-off, little known valley in one of the driest deserts in the world?

Over time, I learned six facts that deepened my perplexity: 1) Land prices in Azapa Valley are roughly ten times that of Chile's most productive agricultural region. 2) Soil and water quality are subpar, and require expensive treatment to be functional for agriculture. 3) Azapa Valley, where the year-round R&D facilities are located, is over 30 hours from Chile's capital by road, and the nearest town, Arica, offers no direct flights to the United States. 4) It is not a traditional

agricultural area, and logistical services are limited, including providers of international transport, agricultural machinery and parts, and highly trained agricultural employees. 5) Chile does not have a clear regulatory framework on agricultural biotechnology--it allows for the propagation of GM seeds for export, but not for their sale in Chile. 6) In 2012, workers in two transnational seed firms unionized in Azapa Valley; workers at one firm went on a 22 day strike during a critical production time.

When I asked one of the managers to explain why his firm was in Arica despite all of the challenges, he said in a matter of fact tone, “We’re not simply buying land, we’re buying a piece of the sun” (Interview, seed firm manager, Nov. 2013, Arica, Chile).³ He went on to explain the importance of Arica in the larger scope of the industry and reminded me that R&D stations don’t require large plots of land.

We can produce seeds 2-3 times a year here. That cuts research times in half or even more, which saves a lot of time and money. Our climate is stable, temperate and we don’t get those storms they get in tropical places like Puerto Rico. Sure, it’s a desert, but we have available water from the nearby mountains. And our location gives us the isolation from other corn we need to produce purer high-quality seeds. ... We can treat the soil and train workers, but we can’t produce sunshine. That’s why we’re in Arica...the sun (Ibid).

This analysis was repeated many times in my interviews. All of the fifteen seed managers I interviewed in Chile who work directly in the research process asserted that climate was a driving factor for companies selecting R&D locations. In Chile, while firms generate seeds in two-three cycles per year (instead of three-four in Hawaii and Puerto Rico), the desert landscape provides an exceptionally predictable and controllable climate. This combination of factors enables seed firms to draw resource co-rents from Arica. It might seem logical, even obvious, that climate would be

³ To ensure the anonymity of interview participants, I have used the generic term ‘manager’ for all interviewees in management positions. I do not list the name of the specific company or the date to further guarantee the interviewee’s privacy. All interviewees cited in this way were in positions of upper-middle to upper management at their R&D stations or headquarters. The primary interviews were drawn from DuPont, Monsanto, AgReliant, Syngenta, and Dow in Chile in 2013 and in Hawaii and Puerto Rico in 2014. In Chile, two additional national companies, service providers to these large firms, were also included.

a driving factor in agricultural site selection. However climate in this sector is not simply valued because it allows firms to produce more corn. Specific climates in this case become resource co-rents that add value to seed R&D because they enable firms to capture the benefits of advanced technologies and capitalize on place-based technology rents. Thus, resource co-rents in this case are place-based and non-negotiable. They must be present for firms to extract technology rents.

Puerto Rico and Hawaii: Harnessing the advantages of a year-round growing season

In Hawaii and Puerto Rico managers' reflections were similar. They consistently mentioned that advantageous climates offered firms extended growing seasons. Managers lauded the ability to plant every day of the year, which is key to deriving profits more quickly from newly-developed intellectual property. (Interview, seed firm manager, Nov. 2014, Puerto Rico; Interview, seed firm manager, Aug. 2014, Kauai, Hawaii). However managers pointed out that advantageous climates also come with challenges.

There is no perfect place for seed research, there are always risks to mitigate. For corn seed R&D firms want stable temperatures -- not too hot, not too cold -- good sunlight hours, low temperature oscillation, isolation from other corn, and available, but controllable water (Interview, seed firm manager, Nov. 2013, Arica, Chile).

While all three sites offer climatic advantages to firms, their strengths and weaknesses require firms to mitigate and balance risks within and between R&D sites. Managers often drew comparisons between sites to make this balancing act clear. While Hawaii and Puerto Rico share the threat of unpredictable weather, access to human resources and operating costs were markedly different. "Hawaii is expensive and they have a hard time finding workers. Puerto Rico has more people, skilled people, bilingual, even the lower level workers often have degrees" (Interview, Puerto Rico manager, Nov. 2014). "In Puerto Rico the storms and pests are a challenge, in Hawaii the cost of operations is high and finding labor is difficult. There are always challenges. We look for places with challenges we can deal with" (Interview, seed firm manager, July 2014, Oahu,

Hawaii). While all three R&D sites offer firms resource rents through their advantageous climates, the differences of place often require shaping and balancing in order for firms to effectively use them to harness technology rents.

An in-depth conversation with the Executive Manager of the Chilean Seed Producers Association (ANPROS) touched on an additional place-based factor that influences firms' location choices: proximity to markets. Reliable and efficient transportation and relative proximity to the U.S. is essential due to seeds' fragility and the high associated shipping costs (by boat or plane). In the case of Puerto Rico, managers praised its proximity to U.S. markets. Seeds can be moved quickly through direct flights to the mainland. It is less than five hours to Chicago by plane, something that Hawaii or Chile cannot offer (Interview, Puerto Rico seed manager, Nov. 2014). While Arica's remote location is not a logistical advantage, it is relatively proximate to the U.S. and has access to a reliable network of transportation options that offer frequent service to the U.S. in part due to Chile's successful fruit exporting business.

What implications does the importance of climate have for seed firms? Does it make them place-bound? The fact that roughly 90 percent of the corn in the U.S. at some point in its development spent time in one of these three research sites points to how strategic they are to the industry (Interview, seed firm manager, Chile, Jan. 2014). When I broached this subject with the Executive Manager of ANPROS, he silently opened his computer and pulled up a power point slide showing a map of the world. The map had three lines across it: the Tropic of Cancer, the Tropic of Capricorn and the Equator. He then pointed out that the R&D sites are clustered in very specific places – near the Tropics of Cancer and Capricorn, for climatic reasons. His response mirrored those of firm managers, but as I looked at the map, the number of options of countries

bordering the Tropics of Capricorn and Cancer seemed overwhelming. Weren't there better places that were less costly or posed fewer risks than Puerto Rico, Chile or Hawaii?

Results: Balancing place and regulation through policy and relational subrents

Seed managers in all three sites asserted that climate and natural endowments are not the only factors that seed firms consider when making location decisions. While climate is a necessary condition, it is not sufficient by itself (Interview, Executive Manager, ANPROS, Oct. 2013, Santiago, Chile). The broader policy environment cannot be ignored. Many potential R&D sites disappear when you eliminate countries that do not allow GM production and distribution (much of Europe and some of Latin America--Mexico, Bolivia, Peru, etc.). All of Africa and much of Asia falls off the list when you eliminate countries prohibited from importing corn seed into the U.S. for phytosanitary⁴ reasons according to the USDA Plants for Planting Manual (2012).⁵ Phytosanitary regulations seek to ensure the health of plant species and their products by restricting entry of plants with potentially destructive pathogens or pests. These regulations also serve as a barrier to entry, limiting the number of places from which firms can draw resource co-rents.

Beyond these legal requisites, regulatory frameworks influence firms' R&D site selection in a number of ways. Managers in Hawaii and Puerto Rico asserted repeatedly that "in terms of regulation, it's a clear advantage to be part of the U.S." (Interview, seed firm manager, Nov. 2014, Puerto Rico). "We prefer R&D sites to be in the United States. It isn't necessarily an ideal system, but it is predictable and based on science, and that makes it work for us" (Interview, Seed firm regulation specialist, Oct. 2014). This predictability helps firms draw technology rents through policy subrents in the case of both Puerto Rico and Hawaii. And while most firms prefer the U.S.

⁴ Phytosanitary refers to the protection of plant health, particularly agricultural crops. Phytosanitary measures seek to control plant diseases, which may restrict the importation of specific plant varieties or crops.

⁵ 109 countries are prohibited from importing corn seed to the U.S. For the complete list see: USDA 2012.

system to other less predictable systems, U.S. regulatory approval takes on average 5.5 years and costs firms between \$6-15 million (Phillips McDougall 2011). Despite an increase in U.S. regulatory timelines from 3.7 years in 2002 to 5.5 years in 2011 (Ibid), there is a focus on shortening this time in the US. In 2012, the USDA changed its rules to expedite the regulatory process for GM seeds, while increasing its regulatory budget (Mercola 2012). Firms prefer to situate their R&D work within the U.S. regulatory environment because of its predictability and centralized nature, which streamline lobbying efforts and get products to market quicker. While this rent-seeking strategy has the potential to augment technology rents, it is limited to those places that also possess the necessary resource co-rents.

While policy, legal, and phytosanitary restrictions alone do not explain why firms are in particular places for their R&D, they clearly reduce possible options. As Kaup (2008: 1741) asserts, “firms must not only account for the material difficulties of the resource and the physical constraints of the place, they must also negotiate the sociopolitical dynamics of people in the places” of production. “Seriousness” of the country or place is a concept that several managers invoked to explain why some places were better suited to seed research. Managers used this term to refer to anything from a predictable regulatory environment to strong phytosanitary institutions to respect for intellectual property rights, all of which are infused with notions of appropriateness and power. They present the “serious place” claim as a quest for predictable, rational, science-based regulation – which is inherently apolitical in managers’ eyes. Firms shop for things like climate and regulation, but in doing so, they also try to find rational environments that are favorable to them and their needs. Here strong networks and relationships are important because through them firms achieve place-based relational subrents.

One manager asserted “I do science, not politics” (Interview, seed firm manager, Nov. 2013, Arica, Chile); however doing science in this industry is contingent on a political process that constructs the environment in which seed firms are able to operate successfully. Even serious places play complicated roles in terms of their relationship to industry. They seek to create the conditions for vibrant economies – which means promoting jobs and economic investment, while offering economic incentives and a legal structure that protects the interests of industry. Yet serious places are also charged with ensuring healthy communities. It is often a complicated balancing act in order to meet the needs and demands of diverse stakeholders. This is particularly important when thinking about the case of Hawaii, where county councils and environmental advocacy organizations have proposed legal changes in the regulation of pesticides and GMOs in the last two years. These proposed regulatory changes provoked divisive debates between firms, local governments, and community organizations.

Managers in Puerto Rico differentiated their R&D hub from Hawaii by pointing to a cooperative environment in which the state and local communities foster their success instead of thwart it. Biotechnology has been a significant part of Puerto Rico’s industrial policy, not only in seed firms. While managers acknowledged that there was an occasional protest in San Juan regarding Monsanto (Interview, Puerto Rico manager, Nov. 2014), all firms’ R&D facilities are located in areas outside of the metropolitan area. Most firms are concentrated on the south coast where unemployment is particularly high and alternative job options are few.

In Chile, the majority of managers referred to the strong relationships with local agricultural institutions as well as Chile’s reputation as a “serious” country as a competitive advantage. Managers acknowledged that resource rents are necessary to firms’ localization strategy, but are not sufficient by themselves. They downplayed the local strike as an anomaly,

evoking Chile's long history as a "serious" place to explain why firms invested in Arica. Managers often drew on their prized asset of "seriousness" to explain why neighboring nation states, such as Bolivia, Argentina, or Peru, were less competitive, implying that these countries do not have the necessary structures and systems in place that enable the efficient functioning of a prosperous industry (Interview, seed firm manager, Nov. 2013, Arica, Chile).

Close ties with government institutions shape local regulation. These close ties not only ensure greater predictability in terms of institutional policies, but often enable a reciprocal relationship in which firm managers, together with local institutions, create the regulatory guidelines for the industry in country. As we will see in later chapters, this is particularly prevalent in places such as Arica or Hawaii where the expertise in a highly specialized field, such as agricultural biotechnology, is largely limited to past or present employees of seed firms.

Because agricultural biotechnology remains highly controversial, the number of places open to this type of work is limited. This presents challenges to firms as they search for R&D hubs that might be supportive of their work. Finding and developing "serious" places in which firms can thrive requires active lobbying at both the federal and local levels. As such, managers must forge close ties with local governments and communities to gain place-based relational rents to ensure their right to operate. While an advantageous regulatory environment is a plus, and something firms negotiate *in situ*, the advantages of place, as seen in resource co-rents, are necessary and non-negotiable for rent extraction in this industry. Competition in the seed industry hinges on being able to shape and balance both climate and regulation, because these are the mechanisms that enable firms to extract place-based technology rents.

Discussion: Place as an essential element in obtaining technology rents

Seed companies have developed new forms of competitiveness in response to the reorganization that came with hybridization and biotechnology. In this process, firms are continuously trying to remove obstacles to seeds' commodification by attempting to accommodate and harness the laws of nature. These technological advances have not made nature obsolete in the R&D process, rather they have increased the importance of place-specific resources that speed up the productive cycle, enabling firms to secure intellectual property rights. This has altered where and how firms create and extract value and the mechanisms that ensure its capture. R&D stations have shifted from functioning as service centers that complement production in the Northern hemisphere to strategic sites that offer a key competitive advantage in the industry – speed to market. Paradoxically, firms can often benefit from the advantages that nature offers only by using expensive and complicated engineering processes. This change in the industry relies not only on advanced technologies, but on maximizing and shaping place-bound natural advantages, such as climate and regulation, to ensure profitability through the capture of technology rents and place-based co-rents.

While the regulatory and climatic advantages of R&D sites are presented as obvious, even natural, by seed firm managers, they require continuous shaping and maintenance. While sites may be selected for climatic advantages, firms may need to spend exorbitant amounts of time and money to improve natural resources, such as bettering soil and water quality and controlling for unwieldy pests and disease at these sites. Regulatory environments also require shaping, as firms seek to develop “serious places” by actively building relationships (and the social and regulatory permissions that come with them) with communities and local governments.

Each R&D site possesses the requisite climatic assets and regulatory permissions necessary to extract technology rents from GM R&D; however firms harness the geographic variation in each site to distribute risk and maximize rent extraction. Managers capitalize on the strengths in each site -- Hawaii's rich policy subrents and resource co-rents, Puerto Rico's high policy and human resources subrents, and Chile's high natural co-rents and relational subrents— to balance their weaknesses—increased activism against GM and pesticide use in Hawaii, unpredictable weather and pests in Puerto Rico, and low human resource subrents in Chile as seen in the labor strike. The interrelation of these diverse rents in this industry emphasize that place is *the* necessary element that firms seek to maximize in each case.

My work advances rent theory by drawing attention to the interconnectedness of markets and the natural assets that firms require to secure place-based technology rents and maintain an oligopolistic market structure. The co-construction of unnatural markets and imperfect natures in this industry generates important insights into institutional rent seeking behavior. Here nature and markets are immune to the natural laws that are assumed to govern them, serving as spaces where power relations are enacted. By bringing a process centered approach to rent theory and by taking place into consideration, we see how firms, states, natural resources, and place-based technology rents interact to alter market rules and regulations. This illuminates where and how firms generate profit. While technology is often seen as *the* profit generator in high-tech industries, in the case of the GM seed industry, the innovation itself is not what enables firms to capture technology rents; rather it is the interaction of place-based assets, seen in relational subrents and resource co-rents, with technological innovations and regulatory shifts. Finally, my work highlights the ways that firms are rooted in particular places and points to some of the consequences that firms' place-boundedness may hold for firms and communities. Addressing how firms navigate place-specific

factors to remain competitive is critical to our understanding of how place may provide other actors leverage to mobilize for more just conditions.

CHAPTER 2. A Power Sensitive Framework for Regime Selection: Shopping, Shaping, and Staying

This dissertation seeks to understand the factors that steer high-tech seed firms' R&D location choices. More specifically, I look at one subset of place-based factors – regulatory regimes. I documented GM firms' quest to locate their R&D facilities in places in which they are able maximize a natural advantage through multiple growing seasons per year and favorable climate in an earlier chapter. In the coming chapters, I will focus on firms' other place-based preferences, specifically regulation and 'seriousness' of place. How do regulatory regimes matter in firms' location decisions? To what degree are firms successful at influencing local regulatory regimes, and what tools and strategies do they use to engineer potentially unfavorable environments to meet their needs? Given that firms largely choose their R&D sites based on climatic conditions and regulatory permissions, as seen in the previous chapter (Ipsen 2016), how do firms balance other conditions that might be less than ideal, such as labor, logistics, high costs, and political concerns?

Regulatory regimes: Understanding place-based factors in location decisions

Location theory

In today's globalized world, development scholars seek to explain what factors shape firms' location choices, what draws them to particular places, what pushes them out of others, and why. Location theory is one of the ways in which scholars have framed these discussions to reveal the processes by which firms choose new locations or relocation options. Classic location theory assumes a rational choice decision-making model, in which firms seek to maximize their self-interest by choosing locations that ensure both optimal economic gains and minimal risk.

Location theory scholars argue that firms choose locations in a two staged process (Blair and Premus 1987; McCann 2002; Shaffer, Deller, and Marcouiller 2004). First, firms choose sites

based on the costs associated with input and output factors. They establish the cost of raw materials, determine the market destination and then calculate the transportation costs. Once firms determine which is cheaper, input-related costs or output-related costs, they site the firm near the raw materials or the market. Second, firms then look at the characteristics of specific sites or communities and establish their businesses in the ones that provide the most benefit and less risk to them. For example, communities that offer tax incentives, available cheap land, and skilled labor might more closely approximate ideal locales in companies' eyes as they shop for and try out new sites.

Henderson and McNamara (2000) highlight that the factors that are most important to a particular firm depend on whether it is supply-driven, demand-driven, or footloose. They argue that supply-driven firms give preference to places near low cost and abundant labor and raw materials, whereas demand-driven firms select sites near product markets and efficient and cost-effective transportation systems. Footloose firms, according to Connor and Schiek (1997) have cost structures that are neither demand- or supply-driven, and therefore choose locations that provide the optimal mix of access to capital, labor, transportation, infrastructure, and supportive regulatory policies.

Many scholars have questioned the more classic versions of location theory that rely on oversimplified cost-benefit frameworks, as they overlook noneconomic factors that guide firms' interactions with local communities and the state. Globalization scholars have highlighted labor and knowledge as two of the most important location-specific factors at the global scale (Dicken 2003). Dicken (2003) finds that labor is still considered the "single most important location-specific factor" in determining investment strategies. This is due largely to the uneven costs that labor represents across space, labor's stickiness, and worker's potential to alter the labor process

(Storper and Walker 1989). Yet firms are concerned not only with finding appropriate labor at low cost, but with other labor force characteristics that may be difficult to quantify, such as skill level, productivity and trends of unionization, as well as location-specific factors.

As industries have become more capital intensive and globalized, the basis for industry competition has shifted. For example, in the GM seed industry, today competitiveness hinges on getting new products to market first in order to gain technology rents through intellectual property rights (Ipsen 2016). As such, transnational firms look increasingly to factors other than labor to cut costs and remain competitive. Firms seek out places with location-specific factors that are not widely available elsewhere, such as political stability, predictable regulatory environments, available infrastructure, labor and expertise (McMillan, Pandolfi, and Salinger 1999; McKendrick et al. 2000). In the GM seed industry, ecological assets are also of crucial importance in location decisions. In this industry firms privilege locales with specific natural endowments that enable them to produce and test seeds more quickly, rather than centers of high technology or those with skilled labor markets for their R&D facilities (Ipsen 2016). However as Storper and Walker (1989) argue, existing firms' localization patterns require us to shift our focus away from the spatial distribution of pre-existing factors of production to the ways that industry produces its own conditions of localization.

Political economic sociologists and geographers have sought to enrich location theory by drawing attention to the importance of embeddedness (Tigges and Noble 2012), power and institutions (McKay 2006), and history and path dependency (Friedberg 2004). Tigges and Noble (2012) find that social embeddedness is also vital to location decisions. In their examination of ethanol plant site selection, they find that location decisions were not determined primarily by profit maximization, as classic location theory would posit, instead by the personal relationships

that the person establishing the business had in specific host communities. McKay (2006) finds that power and local governance are key elements for understanding the paradox that globalization presents: the less place-bound capital becomes, the more important place-specific attributes are in location decisions. He challenges the overly generic characterization of globalized production, pointing out that independent of whether it is coercive or liberating, place matters. McKay demonstrates how firms and governments co-construct multiple layers of political apparatus in order to regulate high-tech production at different sites. He exposes the power that both the State and employers exhibit in shaping and controlling the labor market, playing on local differences to mold inequalities. Freidberg (2004) reminds us that today's global economic map is the result of a long period of development in which key relationships and structures of earlier periods have shaped those in later periods, influencing development trajectories and power inequalities between diverse actors.

I build on this work to explore the ways in which regulatory regimes extend beyond the state to actively include local institutions. I contend that regulatory regimes become institutionalized spaces of rulemaking and negotiation in which the state, firms, workers, and communities come together to barter over the value and shape of community's assets in the regulatory process. These spaces do not exist in a vacuum; actors bring historical legacies and political motivations to bear on regulation, affecting both the strategies firms utilize to site their operations and how they interact with local stakeholders.

While studies have enhanced location theory by adding noneconomic dimensions to the equation, scholars largely present the location decision as a single act made in a specific moment in time. My work complicates this idea. I will replace a more reductionist, static view of location theory with a dynamic political economic theory of location that is sensitive to power relations. I

find that firms make location decisions as part of an ongoing, negotiated, and often contested process – one in which firms, the state and local institutions participate in. Some communities and local governments may garner more power in this negotiation process than others. By comparing Hawaii, Chile, and Puerto Rico, I seek to understand under what conditions local communities and governments gain some voice over their regulatory regimes when the industry is place-restricted. While firms may select R&D sites initially based on an economic cost-benefit analysis, they often engage in a continual shaping process of the regulatory environment once sited. I will make visible the strategies that firms use to confront and mold places through regulatory regimes. Firms participate in regulatory shaping in their quest to create a more supportive regulatory space that will help them mitigate risk and balance it with their other productive and institutional imperatives. This practice of shaping may be in response to additional information, changing conditions or new opportunities afforded them by being active community members. It is important to note that institutions are not the only actors influenced, but may also shape firm's behavior and productive strategies.

Regulation theory and regulatory regimes

In order to understand why firms are drawn to particular places, we must understand what factors they evaluate to make sense of their possible options. While location theory is useful at pointing to some of the initial reasons that firms may be drawn to particular locales, it is limited in its ability to theorize more process-based approaches. Regulation theory overcomes some of the shortcomings of location theory by illustrating the dynamic role that regulation plays in locational decisions, and in highlighting the process that happens in the later stages of regime selection.

The regulation tradition was pioneered in France by political economists in the 1970s and 1980s in an attempt to theorize the patterns of post-war growth and the subsequent crisis that

followed (Lipietz 1987; Jessop 1992). The regulation school draws on an eclectic range of theorists and theories including Marx, the Annales School of History, institutionalism in political science and law, as well as Bourdieu (Wilkinson 1997). Regulation theorists acknowledge that rules drive a system, but highlight the dynamic nature of those rules, and the importance of social practices, in governing a system and in determining a path of development. While early approaches to regulation theory were criticized for being overly functionalist and concerned primarily with structural factors, the theory has evolved toward more institutional and situated action (Jessop and Sum 2007; Wilkinson 1997).

While the term regulatory regime is a common fixture in discussions on the role that regulation plays in different contexts, it has been conceptualized in numerous forms. Scholars typically define regulatory regime in a macro sense, referring to the economy as a whole in a specific time and place. For example, Ash Amin (1994: 8), in an edited volume on Post-Fordism, introduces “mode of regulation” in his discussion of regulation theory to explain the phases of capitalist development. He defines it as a set of institutions, rules, and norms that govern the process of accumulation in a particular place. Krasner (1982: 185) defines regulatory regime as the “principles, norms, rules, and decision-making procedures around which actors’ expectations converge in a given issue-area.” Similarly, Eisner (1993) and Drezner (2007) draw on a definition that incorporates norms, mechanisms of decision-making and a network of actors that are involved in regulation. Vogel (1996) maintains a more traditional focus on state actors in the regulatory process, but differentiates between two major components of regulatory regimes: regime orientation and regime organization. Broadly speaking regulatory regimes are an institutionalized space of rulemaking that seeks to govern diverse issues, arenas and sectors.

I use regulatory regimes in a slightly different way. I use them to examine the dynamics of a specific sector. I am guided by Peter May's definition as it more closely approximates the regulatory regimes I document in the genetically modified corn seed industry. May's definition is useful because he employs it to describe a single institutional cluster, much like Goodman, Sorj, and Wilkinson (1987) in their study of agricultural biotechnology.

A [regulatory] regime comprises an institutional structure and assignment of responsibilities for carrying out regulatory actions. The institutional structure is made up of rules that prescribe expected behaviors or outcomes, standards that are benchmarks against which compliance can be measured, a mechanism for determining the degree of regulatory compliance, and sanctions for a failure to comply with the rules (May 2007: 9).

I conceptualize a regulatory regime as a hybrid space in which different levels of government (federal, state, and local) and local institutions form part of the regulatory system as interdependent and dynamic actors.

While scholars tend to draw on the concept of regulation to examine a variety of different institutions or norms – from intellectual property rights to labor and environmental legislation, and global regulation – I will use the concept to explore how firms craft regulatory regimes as an on-going process in their search for ideal corn seed R&D stations. Seed firms are looking for particular places and regulatory and institutional spaces in which to conduct their GM corn seed research. I include three levels or types of regulation within my examination of the GM corn regulatory regime: First, product-specific regulations at the federal level (biotechnology frameworks for the U.S. and Chile); second, regulatory rules and norms for productive firms (labor, environmental, health and safety laws, and tax incentives); and finally, institutional relationships and local-level governance.

This regime sets the parameters for regulation, enforcement, and the definition of compliance in the eyes of the state, local officials, and communities, and is key for understanding

how firms approach regulatory decisions as an ongoing process. While I will lay out the regulations at the federal level, for both the U.S. and Chile below, as they have an effect on which nation states firms may see as more friendly to their cause, my empirical contribution lies at the local level. In the following chapters, I will focus specifically on how these place-bound firms mediate location risks by actively participating in a three-staged process of regulatory regime selection that I call regime shopping, shaping, and staying. Importantly, these are not stages in a classical sense. They may overlap and are not necessarily unidirectional. For example, firms select a particular site in the shopping stage and begin a shaping process, but they may return to the shopping stage if the shaping stage is not fruitful.

While regulation scholars have focused primarily on the ways that firms get around unfavorable regulations by shopping for particular types of regulatory regimes, I argue that this misses many actions that firms take once sited. The overemphasis on shopping takes for granted that all places are equal in their ability to meet firms' needs and ignores the dynamic nature of regulatory regimes. Instead of focusing solely on how firms shop for new regulatory environments, I argue that firms use a three-staged process of regulatory regime selection to mediate risks and ensure success. For place-based firms, such as those in the GM corn seed industry, I find that while shopping remains an important aspect of regulatory selection, shaping and staying strategies are paramount to firms' success. These stages are also most relevant for communities and local governments, as they seek to carve out a space to participate in the regulation and development of their communities.

Mechanisms of power in corporate localization practices

Gaventa's (1980) three-dimensional approach to power provides a useful entry point to conceptualize firms' localization process. It helps us understand the power dynamics between

firms and communities, how they may vary in different contexts, and how the absence of visible conflict should not be interpreted as consent. In Gaventa's first dimension, power is exhibited through superior bargaining resources. This is the most common dimension of power and is seen throughout firms' localization process. In power's "second face," power is exercised not only upon participants in the decision-making process, but with the purpose of excluding some issues and participants altogether, creating a "mobilization of bias...in favour of the exploitation of certain kinds of conflict and the suppression of others..." (Gaventa 1980: 9). In other words, the rules of the game are set up to consistently benefit certain persons or groups at the expense of others. Those who benefit are placed in a privileged position that enables them to *shape* regulatory regimes and *stay* in specific places by proactively defending their interests, determining which issues become visible. In the seed industry, this dimension of power is significant in the shaping and staying stages.

The third mechanism of power involves shaping the consciousness and ideas about inequalities of the less powerful group. This could include how language, myths, and symbols are shaped in power processes, ultimately serving to get the less powerful to act in ways that benefit the dominant. This dimension of power is prevalent in regime shaping, particularly in firms' 'becoming local' strategies. By bringing together these three mechanisms of power, we are able to take into consideration the social forces and historical patterns rooted in Gramsci's (1971) theory of hegemony. Drawing on this approach has implications for our understanding of how power may be used to shape how local governments and communities participate in power struggles, including the issues they are able bring to the negotiating table and the ways firms' actions may preempt overt conflict before it arises.

Constructing a power-sensitive framework on regulatory regimes

Much of the literature on location theory sees the selection of new sites as formulaic, in which firms plug in numbers to determine the potential profitability of a particular place. Scholars have complicated this simplistic, economic account by showing that firms are not simply looking for the cheapest labor or the loosest regulations. They are searching for favorable regimes with local fixes that help firms meet what can be contradicting goals, such as high quality, but low cost (McKay 2006; Collins 2003). However few scholars have set out to describe the *process* by which firms define ideal criteria and seek to actively shape local conditions to make them amenable to their productive and regulatory needs. I see regime selection as a complex multiple step process, in which firms shop, shape, and stay in particular sites. The process does not need to be linear, as new occurrences may provoke a shift in strategies or make a firm revisit the shaping or shopping stage.

Regime shopping is the first step in a multi-stage process of localization. This concept was first used by sociologist Wolfgang Streeck (1991) to discuss the effects of European integration on German unions. Streeck explores the regime competition that emerges in the nineties in anticipation of the creation of the single European market. This market sought to eventually guarantee the free movement of goods, services, capital, and people. He finds that firms “vote with their feet” by moving to another country within Europe as a way of avoiding country-specific regulations or norms that were seen as unfavorable to them (Ibid). In this way, he warns that regimes with loose regulations could crowd out those with more stringent standards.

This has been a growing concern of regulation and globalization experts as firms have become increasingly global, due in part to loosening capital controls, “free” trade agreements and advances in transport and technology systems. These changes have lowered transport costs and

tariffs, propelling flexible specialization to the forefront of global competition. Today it is not uncommon for the production of a single product to be spread across the globe. Far-flung locales in assorted countries compete to produce parts or components of a product that is eventually assembled in another location to later be re-exported. In today's globalized marketplace it is understood that firms must shop for regulatory regimes that best meet their needs in order to give them a competitive edge, yet little is known about the actual process itself. While this process often evokes the imagery of a transnational firm producing electronic components, high-tech agriculture has not been immune to these productive transformations. The GM seed industry is no exception, as genetic material is collected globally, transformed in advanced mainland laboratories, and then shipped to nursery sites to be bred. Later seeds are returned to the United States or other key market locations to be grown out and packaged for distribution across the globe.

Economic geographers and development sociologists have documented some of the spatial, labor, and development implications that the new production strategies of transnational firms have on states, workers and communities (McKay 2006; Harvey 2001; Lee 2007; Collins 2003). This dynamic has brought about locational shifts or "spatial fixes" (Harvey 2001), encouraging firms to seek out places where they are best able to impose change at the local level through flexible regulations and casualized work relations. Labor sociologists, Webster, Lambert, and Bezuidenhout (2008), find that firms today conduct regime shopping on another level. They expand regime shopping to examine the way global corporations are shaping the geography of production by instituting a new form of spatial competition within the corporation itself. The authors argue that transnational firms, such as Electrolux, pin their own factory locations against each other to maximize their returns and to manufacture consent through the constant threat of insecurity (Burawoy 1979). Firms threaten to shift certain projects or the entire operation to already

existing facilities in other locations that more easily abide by restructuring agreements to increase productivity by intensifying and casualizing labor. I extend their work by arguing that these shifts can also be a response to formal regulatory pressures, but also to informal ones. Firms may move projects as an outward sign of discontent regarding community pressure, legal changes, or regulatory practices the firm deems unfair or unfavorable to their interests.

Table 2: Shopping, shaping, and staying frame work⁶

	Decision-making	Activities	Stance
Shopping	Headquarters	Cost-benefit analysis	Proactive/Reactive
Shaping	On site	Improve local deficiencies Become local	Proactive
Staying	Headquarters	Legal tactics Leverage local embeddedness	Reactive

Regime shopping

While there is a rich literature on the concept of regime shopping, few scholars describe the information and actors that form part of the decision-making process. In this first stage, the materials that firms collect and analyze to make a decision on which places are best suited to meet their needs tend to be gathered by mid-level managers stationed at the headquarters, not at the site itself. This has an effect on what types of information is collected and how it is interpreted. The data may include basic legal, economic, political, and risk studies that form part of a cost-benefit analysis. Special programs to attract firms, such as tax incentives, may also be studied. Depending

⁶ The stages I discuss may have a prehistory of “seizing.” Regime seizing occurs when governments take over sovereign nations to acquire particular natural, socioeconomic, and political resources. I do not include it as a stage because firms are rarely leaders in this process. However firms may be embedded within power structures that make these decisions or nation states may make these decisions to appease the business class. Seizing opens up new possibilities for firms in the shopping stage, broadening the number of locales offering the predictability of the U.S. regulatory environment and other advantages stemming from the unequal power relationships in colonial or neocolonial contexts. Partial seizing is present when nation states use neocolonial relationships as mechanisms to acquire resources cheaply.

on the level of secondary data available, the analysis may have more of a focus on the region or state with fewer details at the local level. Other considerations might be industry-specific. In the GM seed industry, for example, laws that allow for genetic modification, as well as phytosanitary permissions to import seeds to the U.S. are vital to location decisions for firms selling to a U.S. market.

Often firms take a gradual approach to shopping and siting. They may gather data in stages and normally test new sites. They may partner with a local firm to produce seeds for them before establishing there; or they may open a small operation to assess the site's potential and to gather more data in the field before fully investing. For more local level data, firms often rely on partner organizations or on regional offices. This could include land prices, availability of land, water and infrastructure, wage and skill levels, unionization levels, information on specific labor and property laws, as well as a political economic overview of the area. This data collection and analysis can be part of a proactive or reactive strategy. If firms are fleeing locations in which staying strategies were unsuccessful, returning to the shopping stage will be a reactive strategy.

Regime shaping

Regime shaping is the second stage in the process that firms engage in to locate and develop a more supportive regulatory regime. Once firms have shopped and are on site, they then conduct a two-pronged shaping process. These strategies are often proactive and decisions are, for the most part, made locally by mid- to upper-level management, not at headquarters sites. First, firms identify subpar, yet strategic local assets, then they attempt to shape them in order to mitigate risks and to mold the less desirable characteristics of the regulatory regime to their liking. There are a number of activities that firms may engage in, depending on what element they are trying to change. For example, if they are in an area with smaller skilled labor pools, firms may partner with

local universities to train future workers through state-funded co-designed curriculum or online courses. If they are in areas where labor is difficult and/or expensive to secure, firms may incentivize workers by paying for part of their education; they may perform efficiency trainings and streamlining to make work processes as efficient as possible to stretch their budget. Reliance on subcontractors to find, hire, supervise, and train workers is a common strategy firms may employ. An additional shaping tool that firms use is the formation of business associations to act as lobbyist organizations to win over and educate both the community and local government. They may support politicians to promote the passing of certain laws that reflect their beliefs, such as labor laws on subcontracting, tax benefits, and environmental policies on pesticide use or environmental impact assessments. They may hire public relations firms, government affairs personnel, and legal teams with important local institutional contacts to defend their interests.

Second, firms take on what I call “becoming local” strategies. They shape the firm and its image to make it more attractive and friendly to the values of local people and the local environment in which they are situated. To do this, they get involved in local communities through schools, politics, and charities. Other representational strategies include inviting school children and local organizations to visit their facilities or hiring managers that closely represent local values or culture. Firms may also employ linguistic approaches to shaping. They may use language that appeals to local customs and traditions, and multilingual signage to reflect an appreciation for diversity in the workforce. The parameters for this shaping come largely from what the firm perceives as valued by the community and its institutions. It is often an unspoken, but interactive process between firms and local institutions.

Regime staying

The staying process is the third stage of regulatory selection. It is a reactive strategy initiated if communities have not been shaped sufficiently and there is institutional or community push-back against firms or their production or research methods. Firms find specific ways to stay. They do this by deepening their use of legal tactics; and by leveraging their socioeconomic and political embeddedness in communities gained during the shaping period. Firms intensify their use of the legal system overall in this phase through lawsuits or threats of lawsuits. They may also use economic justifications to stay by highlighting the firms' economic importance to the community, primarily through jobs and indirect investment. This is particularly important in small locales where there are few alternative employment options or in places where there is chronic high unemployment and limited industry.

Firms may also deepen the cultural ways they stay by using and leveraging their gained local social capital to call on employees, politicians, and government agencies to fight on their behalf. Community engagement takes on a coercive character as workers and local officials supported by the firm are pitted against their peers and other local institutions, having a divisive effect on communities. Workers, for example, may be afraid of losing their jobs to capital flight. They are encouraged to be active participants in the process by confronting sectors of the community that are hostile to the firm's needs to preserve their livelihoods. However in order to do this workers may be ostracized from their communities. If workers do not take on proactive roles, their loyalty may be questioned and they could lose their job anyway.

The explicit tactics that firms use are partly dependent on place and industry type, but also on firms' calculation of relocation costs versus the costs to stay. At this stage, firms seek to calculate their sunk costs, in economic terms, such as start-up costs or infrastructure, in addition

to legal, political, and sociocultural costs. Many of these costs are difficult to monetize, as they go beyond an economic calculation and point to issues of embeddedness. How do you quantify firms' sunk costs for the ability to sway political volition or for human capital, considering labor that is not only well trained, but disciplined to a firms' liking? At this stage firms are actively shopping for alternate sites, as they need viable (not theoretical) options to compare their current costs and benefits with. This analysis is meant to help managers decide what combination of factors will tip the scale toward staying and which ones will provoke capital flight. Despite the prevalence of more local decision-making in the shaping process, at the staying stage decisions largely return to those in upper-level management positions at headquarter sites. Local managers may be consulted on the design of specific programs and to enact strategies at the local level, but ironically the calculation or valuation of local assets is done by those outside the locale.

As we will see in the sections below, these strategies take different forms across diverse geographical spaces, as local histories and institutions interact in particular places to provide a window into the inner-workings of the GM seed industry as a whole. These strategies give us insight into the process by which transnational firms, despite their seemingly footloose characteristics, are more entrenched in specific locations than theories of globalization would suggest. This theoretical frame offers a more nuanced view of how firms actively seek to stay in locales by first shaping their environments, and then by defending their sunk costs using a multitude of strategies that make us question our assumptions about firms' mobility in this industry. The seed industry is an extreme case because incentives to remain in places with specific natural and regulatory environments are so high, thus when firms are confronted with contention, their staying strategies are going to be highly visible.

Regulatory frameworks for genetically modified crops in the United States and Chile

The emergence of genetically modified (GM) crop regulation

When early genetic technologies emerged in the 1970s in the U.S., much like today, they were a source of regulatory controversy. The development of recombinant DNA (rDNA) techniques brought public concerns to the forefront. Recombinant DNA implies taking a piece of one DNA, and combining it with another stand of DNA. These new technologies sparked fear and uncertainty as people claimed that mutant organisms would be released into the environment and cause irreparable damage. Some communities responded to this scare by attempting to spatially limit genetic research, banning it entirely for a limited time while local committees were formed to study how best to regulate it in places like Cambridge, Massachusetts (OTA 1986). Scientists also organized in response to changing technologies. They met in Asilomar, California in 1975 to discuss biotechnology and to reach a consensus on what biotechnology regulation should look like (Marden 2003). They proposed a model of self-regulation, which was structured by a set of guidelines that they developed (Nelkin 1978; Krimsky 1991). These guidelines were later adopted by the National Institutes of Health and became the de facto standard for private research on DNA until 1984 (Rogers 1977; Wade 1977).

In the mid-1980s the biotechnology industry was growing and the Reagan and Bush administrations began to outline federal policies to guide industry regulation (Krimsky and Wrubel 1996). Through working groups and policy statements, they laid out three tenets that would guide future policy: (1) The policy would focus on the end-product of GM techniques, not the process; (2) Regulation would be grounded in verifiable scientific risks; and (3) GM products are not significantly different from non-GM products, therefore existing statutes are sufficient to govern GM regulation (Marden 2003).

The Reagan Administration created an interagency working group within the White House Office of Science and Technology Policy (OSTP) to draft a federal framework for food biotechnology in 1984. This working group finalized the Coordinated Framework in 1986, which assigned the task of regulating GM products to the jurisdiction of existing regulatory agencies – Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and the U.S. Department of Agriculture (USDA) (Coordinated Framework for the Regulation of Biotechnology 1986). OSTP, together with other government agencies, later turned to the President's Council on Competitiveness, led by Vice President Quayle, to refine the scope of the framework and how the division of labor would be structured.

In 1991 the council published the "Report on National Biotechnology Policy" that specified that the Administration would seek "to eliminate unneeded regulatory burdens on all phases of the development of new biotechnology products – laboratory and field experiments, products development, and eventual sales and use" (President's Council on Competitiveness 1991). This report solidified the idea that the government should only implement new regulations on biotechnology in "those limited instances where private markets fail to provide adequate incentives to avoid unreasonable risks to health and the environment"(Ibid). According to a New York Times article, Vice President Quayle promised the industry that the policy on biotechnology was designed to support the fledgling industry in its quest to become a world leader by providing a sort of regulatory respite (Leary 1992).

In 1992, the OSTP completed its deliberations and released a draft policy statement on GM foods titled "Exercise of Federal Oversight within Scope of Statutory Authority: Planned Introductions of Biotechnology Products into the Environment" as well as a Final Statement of Scope (Office of Science and Technology 1992). While these documents were meant to provide

direction on the implementation of the coordinated framework, it was largely left up to the individual agencies to interpret the directives and implement the policy mandates. According to Marden (2003) the fact that officials from the USDA, FDA and EPA in this period were sympathetic to GM technologies, clearly influenced how the policy was interpreted, steering the direction that industry regulation has taken today.

The coordinated framework in the U.S.: EPA, FDA, USDA

Regulation of GM crops at the federal level in the United States is done in a “coordinated framework.” This mosaic of existing federal law divides the responsibilities of regulation between three agencies: the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and the U.S. Department of Agriculture (USDA). Each of these agencies regulates different aspects of GM crops. The EPA examines if products are safe for the environment. Similarly, the USDA assesses if products are safe to grow; and the FDA evaluates if they are safe to eat.

The EPA regulates biopesticides, which under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) includes *Bacillus thuringiensis* (Bt) toxins. Bt is a soil bacterium that produces a protein that is toxic to many types of insects, such as the corn borer. If a crop is genetically modified to carry a gene for a Bt toxin, the EPA requires the firm to verify that the toxin is safe for the environment. To do this firms conduct a food-safety analysis to ensure that the foreign protein is not allergenic (Peairs 2010). A part of the regulatory process includes environmental safety testing. This involves a study of the plant’s impact on the environment including growth, development, interactions with insects, diseases and other stresses. Firms must document that the crops they are producing meet these criteria.

The FDA is responsible for regulating the safety of GM crops that are eaten by humans or animals. The FDA considers most GM crops as “substantially equivalent” to non-GM crops,

designating them as “Generally Recognized as Safe” (GRAS) under the Federal Food, Drug, and Cosmetic Act (FFDCA). Thus they do not require pre-market approval. However, if the insertion of a gene into a food crop results in the expression of proteins that differ significantly in structure, function, or quality from natural plant proteins, the FDA reserves the right to apply more stringent requirements, such as mandatory pre-market approval of food additives, regardless of whether they are GM products (Jaffe 2008).

In 1997, FDA established a voluntary consultation process with GM crop developers to assess the “substantial equivalence” to non-GM crops before the new crop is marketed. This includes assessing the toxicity and allergenicity of the gene product and the plant itself. If the data that the firm provides in the food-safety assessment are satisfactory, the FDA notifies the firm that they can market the new crop.

Critics have highlighted that these assessments are not only voluntary, but that the process, if conducted, is not an independent scientific review, rather a process by which firms assert the safety of their GM products. The FDA policy places the responsibility of assuring product safety on the firm that produces it. “During the consultation process, the FDA does not conduct a comprehensive scientific review of data generated by the developer. Instead, the FDA considers, based on agency scientists' evaluation of the available information, whether any unresolved issues exist regarding the food derived from the new plant variety that would necessitate legal action by the agency if the product were introduced into commerce” (FrFood and Drug Administration n.d.).

The United States Department of Agriculture's Animal and Plant Health Inspection Services (APHIS) regulates GM crops under the Plant Protection Act of 2000. The Act defines “plant pests” as organisms that cause disease, injury, or damage to plants or plant products, including viruses, bacteria, fungi, and parasitic plants (APHIS n.d.). GM plants are regulated under

the Plant Protection Act if they were created through gene transfer with *agrobacterium tumefaciens*, which is considered a plant pest, or if they incorporate DNA from a plant pest (Federation of American Scientists n.d.).

USDA regulates GM plants through a permit or a notification system. Today most growers conduct GM tests through the notification process. According to the USDA (2005:2), 97 percent of GM field trials in 2004 were regulated through a notification process, which largely relies on self-regulation. The notification procedure is a streamlined process by which most GM field trials can be conducted without waiting for agency approval. Firms must notify APHIS 30 days prior to planting and they are required to submit a report on the field trial that includes generated data, observation methods and any negative environmental effects six months after the test concludes. The notification process is usually seen as a formality for familiar crops and traits, as they are seen as low risk. In giving APHIS notification of the field trial, firms agree to follow specific guidelines and rules, and are subject to monitoring and compliance inspections. For GM products that are deemed more risky, such as pharmaceuticals or industrial compounds, firms must obtain a permit 120 days prior to conducting field trials (APHIS n.d.).

When a company decides that it wants to commercialize a GM crop and produce seed for sale, it can petition APHIS for deregulated status. This process requires submitting risk-assessment data to demonstrate that the crop does not pose a plant-pest risk. The data is made available to the public and includes information on the susceptibility to disease, pests, the effects on other organisms, and the risk of gene flow to wild or related plant varieties (Federation of American Scientists n.d.). The exception to this is pharma crops, which have been ineligible for deregulated status since 2000, and must remain under permit even once they are available on the market.

The Biotechnology Regulatory Services (BRS), is the division of APHIS that prepares environmental impact studies as part the National Environmental Policy Act of 1969. BRS prepares either an Environmental Assessment (EA) and/or an Environmental Impact Statement (EIS) before making decisions about 1) issuing permits for the introduction of a GM crop or 2) issuing deregulated status for a GM crop. These procedures give the public the opportunity to submit written comments on EA and EIS drafts before the agency submits its final decision (APHIS n.d.).

The current USDA regulatory system is not without its critiques. While the industry finds the system cumbersome, opponents find the largely self-regulatory framework problematic. Critics point out that regulation is minimal in part due to the understaffing of the USDA, passing the costs, but also the permissions of conducting scientific assessment onto firms. Additionally, the USDA created a two-year pilot program in 2011, which allows seed firms to conduct their own environmental assessments (Shea 2011), raising deep concerns from environmental advocacy groups. Moreover, communities find the lack of transparency in terms of the non-disclosure of field testing sites and the pesticides being sprayed disconcerting. They see the government as complicit in permitting firms to anonymously plant GM materials and spray undisclosed chemicals. Yet the government and firms assert that this anonymity is necessary as it protects firms' intellectual property and trade secrets. Additionally, it protects crops and facilities from potential acts of vandalism (Jaffe 2006).

The pilot program is not the only change that GM regulation has sustained recently. Under new USDA rules, seed companies that produce GM crops will get speedier regulatory reviews. Making the review process more efficient is seen by government officials as essential to remaining competitive in the marketplace, enabling firms to get new technologies to market quicker (Kaskey

2012). The new rules propose cutting the time needed to approve biotech crops in half—from an average of three years, to approximately 13 months for new versions of existing GM crops, and about 16 months for new GM technologies (Mercola 2012). To assist with this effort, Congress has increased the APHIS 2012 budget for biotechnology regulation from \$13 million to \$18 million. One of the ways that the USDA plans to speed up approvals is by asking for public comments as soon as a petition for the deregulation of a GM crop is filed, rather than waiting until the end of the review. The Center for Food Safety, a nongovernmental environmental advocacy group, asserts that the change in regulatory timeline is not an attempt to improve seed firms' competitiveness or to make regulation more efficient, rather a way to prevent opponents from effectively expressing criticism of the regulatory methods. "They are trying to work the system so they can dismiss public comments more quickly and easily in order to speed things up" (Kaskey 2012).

Chile: Federal regulation of genetically modified crops

While Chile and the United States are leaders in producing GM seeds for U.S. markets, their regulatory environments are markedly different. Chile's seed industry exported \$625 million USD worth of seeds in 2013, making Chile the top producer of seeds for export in the Southern Hemisphere. (ANPROS n.d.). Chile's seed industry exports primarily corn seed (78 percent of exported seeds from Chile were corn seed) of which 85 percent is genetically modified (Ibid). However, Chile does not have a clear regulatory framework on agricultural biotechnology. This is largely because the country allows for the propagation of GM seeds for export, but does not allow GM seeds produced in Chile to be sold there (SAG n.d.). Since only the reproduction of seeds to be re-exported is allowed under strict control from the Agricultural and Livestock Service (SAG)

under the Ministry of Agriculture, biotechnology in Chile is regulated by a few simple resolutions, not a broader biotechnology framework as in the United States.

The implications of this were pointed out briefly to me in an interview with the Executive Manager of the National Association of Seed Producers in Chile (ANPROS). He reminded me that the current system has its advantages and disadvantages for the seed industry. The fact that the State's permission to produce GM seeds hinges on one regulation is disconcerting for some managers. The regulation allows for GM production for export today, but tomorrow it could change, as regulations largely depend on the political volition of those in the Ministry of Agriculture. Because the resolution is not part of a larger legal framework, it can be altered from one day to the next. While industry insiders did not feel it was likely to change in the near future, with the investments in GM R&D in Chile growing exponentially, it is something firm managers have in the back of their minds and as such is a active item on ANPROS' lobbying agenda.

The Agricultural and Livestock Service (SAG) is charged with regulating biotechnology in Chile through Resolution 1523 from 2001. This resolution establishes the norms for the introduction of genetically modified organisms to the environment. Chile's approach to regulation is partially explained in the resolution's preamble: "genetically modified organisms may represent an important resource to the production of food and raw materials, but at the same time, the treatment of these organisms in a confined system and their introduction to the environment, may provoke significant harm to vegetable health, to the development of Chile's agriculture, forestry and livestock, to the conservation of renewable natural resources, to the environment and to human health given possible deviations that may affect biodiversity" (Resolución Exenta 1.523 de 2001). Therefore Chile's position is somewhat of a middle ground approach. It seeks to maximize its capacity as a producer of quality high-tech seeds, while also limiting the potential impacts of GM

innovations by not allowing for the production and sale of those same seeds within Chile. In some ways this may work to firms' regulatory advantage, as it could make communities and local governments less likely to protest or push-back against GM production, since the production process is highly regulated and the end products do not remain in Chile.

Resolution 1523 establishes the basic rules for GM field trials in Chile. They are under the strict purview of SAG and must be approved in advance of planting. The resolution introduced a traceability system that documents requirements for all GM seeds, including information about where those seeds are planted. The resolution clearly lays out the timeline for notification and the approval and reporting processes. As part of the process for every field trial approval, biosafety measures are established, such as physical isolation from sexually compatible species and post-harvest management – all seeds and related GM materials must be destroyed after the field trial, as no GM seeds can remain in country. An official from SAG should be informed at all stages of the field trial, from the date that firms receive the seed shipment, to planting, to harvesting, to export, and local post-harvest processes. They conduct audits and inspections to ensure those reporting requirements are accurately met.

Establishing a more all-encompassing biotechnology framework has been proposed unsuccessfully in Chile since at least 2006, when a group of Senators presented a proposed law regarding biosecurity of genetically modified vegetables (Urquieta 2011). The initiative would have allowed for the commercialization of GM crops in Chile and would have set up a framework to regulate the industry. While it passed the first round in the Senate after two years, it was later stalled. This has not gone unnoticed by the United States government. Given that in 2013, 59 percent of Chile's seed exports went to the United States (ANPROS n.d.), the U.S. has a vested

interest in Chile's regulatory approach to GM. According to a USDA Foreign Agricultural Service report (2010),

The main objective regarding regulation is to have Chile adopt a framework that is science based and that does not impose trade barriers; to accomplish this goal we have taken congressmen to the U.S. so they can get knowledge in situ of the regulatory process of biotechnology in the U.S. They met with all the regulatory agencies and growers to have a better understanding of the benefits of this technology so they can better regulate in Chile.

In 2011 these efforts seemed to have made an impact, as the law was revived by key politicians and the Ministry of Agriculture. Despite a strong start with the law being supported by several congressmen and the former President Piñera, the law remains stalled and has not yet come to fruition (Chile Bio 2013).

Conclusion

The dynamic nature of regulatory regimes has been largely overlooked theoretically. I bring together the literatures on location theory, regulation theory, and regulatory regimes to show the process by which firms select their R&D sites and the ways that their long-term localization strategies shape local environmental governance. I argue that location choice is a process that is driven not only by industry specific factors, but that it is contingent on myriad place-specific dynamics through which multiple dimensions of power are enacted. My research takes a relational, process-centered approach to regime selection by adding a consideration of how firms use power to shape and stay in particular sites.

My case study locations in Hawaii, Chile, and Puerto Rico share similar characteristics that make them favorable environments for GM seed R&D. Puerto Rico and Hawaii fall under the same U.S. regulatory and agricultural biotechnology frameworks, yet they are remarkably different in other ways. While they share similarities with Chile, in terms of long growing seasons and predictable pro-business environments at the federal level, their local regulatory regimes vary

greatly. Firms rely on this difference to diversify and distribute risk in their value chain. The political economic interactions between firms, the state, and local communities take on diverse forms in different locales, affecting the techniques that firms' use to shop for, shape, and stay in specific places. Through an incorporated comparison, I will discuss the ways that firms confront their choices around local regulatory regimes to gain a more macro-level understanding of the active roles that the GM corn seed industry as a whole plays in molding regulatory environments.

CHAPTER 3. Hawaii: Island Paradise or Regulatory Minefield?

Today Hawaii seems an unusual location for agriculture, due to high costs, scarce farm labor, and mounting political tension; however this was not always the case. Agriculture was one of Hawaii's main industries before tourism took off in the 1970s. Mainland agribusiness firms and Hawaii have a long history, one entrenched in Hawaii's colonial past. Previously Hawaiian agriculture was dominated by sugar and pineapple plantations, owned primarily by powerful U.S. businessmen. While the sugar industry sought Hawaii for its temperate climate, long growing season, and low labor costs, the economic and political prowess of plantation owners contributed greatly to industry expansion. "The social, the economic and the political structure of the island alike are built upon a foundation of sugar" (Liebes 1938:32). Between Hawaii's annexation in 1898 and its statehood in 1959, the sugar industry prospered, developing complex irrigation and transportation systems, a disciplined immigrant workforce, and agricultural institutions that secured market and regulatory advantages to protect its interests. The seed industry would come to rely on these built assets a century later when it replaced another "Big Five,"⁷ one that monopolized sugar and controlled much of Hawaii's best land in the twentieth century.

Hawaii's sovereignty was closely tied to its most prized commodity and its strategic geography. Former Secretary of State James Blaine captured this sentiment well, "I think that there are only three places that are of value enough to be taken. One is Hawaii. The others are Cuba and Puerto Rico" (Kent 1993 citing U.S. Secretary of State James Blaine 1889). Hawaii's incorporation as a state had clear implications for the development of Hawaii's agriculture, creating market and regulatory advantages for modern corn.

⁷ The "Big Five" are: Alexander & Baldwin; American Factors; Castle & Cooke; Charles Brewer; and Theo Davies. Most were founded by missionaries or descendants of missionaries and got their start in the whaling industry.

I argue that Hawaii represents an extreme case of staying for seed firms. Firms' localization strategies seek to shape local regulatory environments in three main ways. First, firms draw on their superior bargaining resources to protect their right to operate. Second, they deepen their advantageous economic position by participating in local leadership roles to defend their vested interests. They draw on local symbols and language, as well as respected locals to speak on their behalf in order to make their work more appealing to local communities. And finally, they reframe contentious debates by using legal tactics to create a barrier to change. Despite firms' power advantages, communities and local authorities are able to gain some voice in the regulatory process. To do this, they leverage their place-based resources. They access important outside networks to gain visibility, legitimacy, and legal expertise for their regulatory battles. They also evoke Hawaii's tourism industry as an economic mainstay and draw on its reputation as an elite destination that is in need of protection to create an opening for contestation and negotiation. As this chapter shows, these activities enable communities to carve out a limited space for participation, slightly tempering firms' power.

Shopping for Shangri-La

Statehood was a beacon of promise for U.S. industries that sought to capitalize on Hawaii's natural and regulatory advantages. In the mid-1960s, corn producers were wooed by the promises of sweet corn breeders like Dr. James Brewbaker at the University of Hawaii at Manoa. Brewbaker came to Hawaii in 1961 and soon realized that it provided plant breeders an edge, a year-round growing season. Slowly, corn seed joined Hawaii's agricultural landscape of sugar, pineapple, and coffee. Some firms were already using winter nursery sites for corn seed development in Nicaragua and Florida; however Florida posed the risk of frost and Nicaragua was unstable politically

(Interview, Plant breeder, June 2014, Wisconsin). Hawaii outshone them with its temperate climate and predictable regulatory context.

In 1964 Brewbaker's paper "Year-round corn in Hawaii" caught the attention of Don Shaver, a plant breeder in California. Shaver's firm was growing the large seeded Cuzco germplasm that did not perform well in Florida's winter nurseries. As such, Shaver and a breeder at Illinois Foundation Seeds sent 20 hybrid lines for a winter trial with Brewbaker's team, obtaining impressive results (Brewbaker 2006). Soon Shaver was touring the islands for an appropriate winter nursery site. In 1966 he negotiated a five acre lease in Molokai for Hawaii's first commercial winter nursery for seeds. It later became Molokai Seed Service, the early roots of Monsanto Hawaii. Soon other firms followed suit. Holden's Foundation Seeds set up Hawaiian Research Service in 1967; Trojan Seed began in Maui in 1967; in 1968 Cargill set up a nursery in Molokai, and Pioneer moved some materials to Kauai (James Brewbaker, Interview, 30 July 2014, Hawaii).

In 1969, Brewbaker spread the gospel of Hawaii's potential for seed production at the American Seed Trade Association in Denver (James Brewbaker, Interview, 30 July 2014, Hawaii). 1970 marked a key juncture that deepened Hawaii's importance to the seed industry. The T-cytoplasm blight on the mainland destroyed nearly half of the corn seed crop (James Brewbaker, Interview, 30 July 2014, Hawaii). In an effort to protect U.S. corn seed against the blight "they came running to Hawaii with winter nursery work" (Ibid). That same year the Seed Industry Council established the Hawaii Crop Improvement Association (HCIA), which today is the trade association that represents the seed industry in Hawaii.

The industry relied on the allure of an island paradise to forge close networks and business relationships between continental seed firms and Hawaii. Improved air travel offered a tropical

escape to Midwestern farmers fleeing arctic weather. Molokai Seed Service organized educational, tax-deductible seedsmen holidays (Schrager 2014). These trips capitalized on the appeal of the warm weather and exotic imagery of Hawaii. A private jet shuttled passengers from Indianapolis and Des Moines to Waikiki Beach, combining “business and pleasure” (see appendix: Seedsman Hawaiian Holiday 1971). The trip offered managers and owners the possibility of observing the winter research program Molokai Seed Service offered on Hawaii’s beautiful islands.

Seedsmen were timid shoppers. They often contracted their winter nursery needs to a third party, such as Molokai Seed Service, before establishing their own operations. Initially facilities were temporary and inconsequential, concentrated on small plots of land in Maui, Molokai, and Kauai. In 1969 it was a \$500,000 a year industry with 500 acres under production (Brewbaker 1969). The slow adaptation to Hawaii was a strategic move, as firms needed time to adjust their breeding tactics to a vastly different natural environment. However the slow start was also due largely to limited land options. At this time, sugar and pineapple still dominated the farm land on these small islands (James Brewbaker, Interview, 30 July 2014, Hawaii).

While the seed industry was drawn to Hawaii in part because of its favorable natural environment, Hawaii also had structural and regulatory advantages that proved attractive to firms. They took advantage of the transportation infrastructure, irrigation systems, and highly trained and disciplined agricultural labor that were put in place by plantation owners (Takaki 1983). Firms’ arrival coincided with a moment of union peacefulness when national level politics linked unionization with the red threat. At this time sugar and pineapple plantation owners began to look to cheaper countries to expand their agriculture, undercutting local unions’ bargaining power (Kent 1993). As a result, the highly unionized workforce “lost its radical aura” (Ibid: 138), posing less threat to expanding agribusiness firms, such as those in the seed industry.

Statehood offered firms the advantages of a U.S. regulatory system, with federal funding for programs to develop Hawaii's agricultural industries. Federal monies were funneled into infrastructural projects that would encourage large firms to relocate to the hub of the Pacific (Kent 1993). With this boom came concerns over land speculation and urban growth, leading to the first statewide zoning measure in the U.S. in 1961 (Suryanata 2002). The Land Use Law sought to preserve agriculture and conservation land, while making urbanization as efficient as possible. As Langlas (1998) points out, the Land Use Law was successful at restricting the power of major landowners, but it did not break up the large landholdings of Hawaii's plantation class. This ultimately would favor the seed industry as it expanded in the late 1990s.

Seed firms benefited from an extensive network of powerful agricultural institutions that supported and lobbied for large agribusiness interests such as the Hawaiian Crop Improvement Association (HCIA), the Hawaiian Agricultural Research Station, and the Hawaii Farm Bureau (Brewbaker 2014). Firms also relied on the Agricultural Cooperative Extension Service and the College of Tropical Agriculture and Human Resources (CTAHR) to train farmers, technicians, and agronomists.

By 1978 the sugar and pineapple industries had begun to decline, as Hawaii could no longer compete with destinations that possessed cheaper labor and looser environmental regulations. They witnessed a 73 percent reduction in productive land from 1970-2000 (Schrager 2014), prompting policy makers to address the growing anxiety about the future of agriculture in Hawaii. Lawmakers amended the Hawaiian Constitution to require the state to “conserve and protect agricultural lands, promote diversified agriculture ... and assure the availability of agricultural suitable lands” (Article XI, section 3). A commission was tasked with developing a land assessment system to identify important agricultural lands (IAL) to be protected from rampant

development (Garrod and Plasch 1993). However their plan was stalled due to lack of political support, only to be taken up again in the 2000s.

The seed industry was built on a foundation of unequal power relationships through which plantation owners used their economic power to create and deepen regulatory advantages for the sugar industry and led the movement for Hawaii to be incorporated as a state. Plantation-style agriculture left important resources in place, such as infrastructure, networks, and highly-controlled labor, which provided attractive assets and superior bargaining resources for seed firms' in their search for viable nursery sites. For nearly 30 years Hawaii flourished as a winter nursery site in which the seed industry benefitted from "a long growing season, predictable weather, a U.S. regulatory environment, and good transport" (Interview, seed firm manager, July 2014, Hawaii). Acreage was small and infrastructure was limited. Most firms opened and staffed nursery sites sparingly only in the winter months (Interview, seed firm manager, July 2014, Hawaii). Hawaii's initial role was a humble one of basic plant propagation (Schrager 2014) that would later grow with the rise of biotechnology. Producing corn seed in Hawaii had the potential to cut research times in half, but Hawaii came with different pests, diseases, and unpredictable storms that could affect seeds' development (James Brewbaker, Interview, 30 July 2014, Hawaii). It also came with a markedly different political and cultural environment. The success of the industry would ultimately depend on simultaneously balancing and shaping them both.

Shaping paradise a la carte (1995-2012)

By the mid-1990s, the biorevolution was in full swing. The corn seed industry was becoming concentrated in the hands of few firms, as agrichemical companies entered the market in full force by acquiring and merging with smaller seed firms (Howard 2009). Competition intensified and speed to market became a defining factor in order to maximize 20-year patent rights

(Ipsen 2016). It was in the 1990s that firms began to consider the option of being in Hawaii full-time (Interview, seed firm manager, July 2014, Hawaii) because three or four generations of corn could be developed in one year. This laid the groundwork for Hawaii's emergence as a prominent R&D site and was of crucial importance to firms' competitiveness by shortening the time and investment it takes to develop a new GM corn seed variety. In 2011 it took on average 10-15 years and \$136 million dollars (Phillips McDougall 2011). "Hawaii shifted from being a counter-seasonal service provider to a continuous nursery site where R&D is conducted year-round, redefining place as a prominent input in the R&D value chain (Ipsen 2016).

The industry had a slow growth curve from the 1990s until the mid-2000s when firms saw the potential to acquire more land and expand to other islands (Interview, seed firm manager, July 2014, Hawaii). Oahu was incorporated as a risk management strategy, in partial response to hurricanes and a corn virus that emerged in Kauai in the 1990s (Interview, seed firm manager, July 2014, Hawaii). Seed firms were able to expand because pineapple and sugar plantations began to close down and relocate, making extensive plots of land available (Interview, seed firm manager, July 2014, Hawaii). By the mid-2000s corn seed replaced sugar as the top valued agricultural product in Hawaii (Loudat and Kasturi 2013). In just over ten years the seed industry's value increased tenfold, from \$22.8 million in 1997 to \$247 million in 2010 (Schrager 2014). The seed industry was well positioned to meet the government's pressing mandate of filling the local economy and agricultural land with high-tech jobs and new tenets. "What started as a small 405-acre project in 1968 has expanded to a continually productive seed crop industry, comprised of five companies currently operating 5,930 acres of farms and facilities on Oahu, Kauai, Molokai, and Maui" (HCIA fact sheet 1 2012).

To encourage industry expansion, the government, farm lobbyist organizations, and seed firms worked hand-in-hand. While the industry growth in Hawaii was fueled by advances in biotechnology, it was also fomented by government incentives and tax benefits. The state offered long-term leases of state land below market value. It improved irrigations systems, and offered tax incentives through programs that targeted both agricultural and high-tech firms. Seed firms were active lobbyists in this process, as firm managers came to hold important leadership positions in the State Agribusiness Development Corporation, HCIA, the Water Resource Management Committee, County Workforce Investment Boards, CTAHR, and the Hawaii Farm Bureau (Cocke 2013). Through these positions they shaped decisions about land and water use, agricultural policy and regulatory changes, all key for an expanding agricultural industry. This exemplifies one of the ways that firms leverage their power to shape and defend their vested interests.

In 2005 the government passed the Important Agricultural Land (IAL) Laws which attempted to identify the land that was best-suited to agricultural production. In 2008 the Hawaii Department of Agriculture worked with the Hawaii Farm Bureau, CTAHR, the Hawaii Agricultural Research Center, the Land Use Research Foundation, and local governments, to develop IAL incentives (HDOA 2012). These incentives include refundable tax credits for agricultural costs for up to \$7,500,000 annually, loan guaranty, and low interest rate loans, expanded funding for irrigation systems, as well as expedited agricultural processing facility permits at no extra cost (Ibid).

Hawaii also offers labor-focused tax incentives to firms. The Work Opportunity Tax Credit (WOTC) Program provides tax credit incentives to firms hiring new employees that are from vulnerable groups, such as welfare recipients, ex-felons, and veterans. The tax credits range from \$9,000 over two years for long-term Temporary Assistance for Needy Families recipients to

\$2,400 for most other groups (WDD n.d.). Hiring someone from a disenfranchised group offers a dual benefit for firms. They receive tax subsidies to lower labor costs and achieve a disciplined labor force through an institutionalized vulnerability fix. This approach enables firms to meet their labor needs while capitalizing on the disenfranchised status of their labor force at the same time. This strategy makes visible the unequal power relations between workers and managers, as these types of workers have fewer labor options, making them easier to control and discipline and less likely to leave.

The Workforce Development Council (WDC), in which seed firm managers actively participate, shapes workforce development initiatives beyond the tax incentive program. They convoke industry-specific panels, such as the Agricultural Skill Panel, which brought together over 600 stakeholders to discuss how to develop a vibrant agriculture industry that is also “a strong economic pillar in the state” (Workforce Development Council 2013: 3). The panel produced an extensive report that offered recommendations that mirrored the needs that seed firm managers identified during our interviews: an expanded labor pool, skill upgrading, better perception of agriculture, and more government support. Through programs like this, the government seems to be proactive at internalizing some of these challenges as their own. While the state is an active agent in this process, the participation of firm managers and other firm representatives in organizations such as this one should not be underestimated. These representatives leverage the economic power of the seed industry to shape the goals of community development and the actions taken to meet those goals. This is important because it not only has the potential to determine what issues are seen as legitimate and are ultimately addressed by the state, but it may also squelch other issues that are in discussion that firms deem are not in their best interest, a clear example of power’s second face in Gaventa’s (1980) framework on power.

However some academic and social movement activists see the close relationship between local government and industry as a conflict of interest, one in which economic power sways local politics.

[Hawaii] has a political system that is amenable to what firms are doing. [They get] the red carpet. [They have] the power structure in their pocket with special benefits, high-tech tax breaks, access to government land...The government and regulation have been captured by the industry (Interview, CTAHR, July 2014, Hawaii).

The President of an anti-biotech group agreed. “Our major concern is that the lines between corporations and government are blurring right in front of us. ... It’s an absolute conflict of interest for our Senate president to appoint a registered Monsanto lobbyist to a position where he would be appointing water commissioners” (Cocke 2013). The industry, on the other hand, disagreed with that assessment. Managers universally called for more government support. “Agriculture needs the support of state legislators. They don’t understand where seeds fit into the agricultural tapestry” (Interview, seed firm manager, July 2014, Hawaii).

It’s a bureaucratic system...it’s unfriendly to operate...It’s a nice place to live, but companies don’t stay here... Firms start here and have to move to the mainland because they can’t make a go of it here. There’s no support. [The] government needs to be more proactive at helping industries stay (Interview, seed firm manager, July 2014, Hawaii).

“It’s the 50th [state] in the nation in terms of ease to operate” (Interview, seed firm manager, Aug 2014, Hawaii). Perhaps because of this, managers in Hawaii consistently engaged in outreach not only as part of their job, but as “part of who they are.”

My job is to interact with people in other organizations related to agriculture and business, the Farm Bureau, the chamber of commerce, universities... I work with elected officials, and talk to state agencies about our freedom to operate. I build academic relations through university professors, speaking events, and internships (Interview, seed firm government affairs manager, Aug 2014, Hawaii).

The manager explained that normally firms do this type of work on a regional level, with one person overseeing multiple states. But most firms in Hawaii have their own government affairs

person because of the intensity of the work required to shape the local regulatory context to better meet their needs. However firms attributed the need for this position to a lack of knowledge about farming in Hawaii.

We don't have a dealer on every corner like the Midwest. We have a small footprint here. Few people understand how food is produced. So we spend a lot of time educating. When faced with these [anti-GM] laws, the first approach all firms took was keeping our heads down. Now we educate. It takes time, energy, resources, but my hope is [that] most people are logical when they look at the facts. ... [however] most people don't speak science so it's a challenge. (Interview, seed firm manager, July 2014, Hawaii).

One manager affirmed,

We want to be a part of our community. We offer tours every day. [We put] a lot of effort in our planting demonstration plots. We talk about farming and breeding, not GM. [We explain] why farmers pay for [our] seeds, why we're here. We're part of the supply chain. An important part. ... We're willing to talk about GM, but we want to talk more about the importance of agriculture and the value of GM to farmers. It's in demand, we wouldn't sell GM seeds if it weren't (Interview, seed firm manager, July 2014, Hawaii).

Though as another manager pointed out, firms' ability to shape the local environment does not rely solely on science, it relies largely on politics and the power required to do politics effectively. "For Hawaii freedom to operate is a social and political issue" (Interview, firm manager, Aug 2014, Hawaii).

Lack of knowledge about farming or residents that don't "speak science" are not the only trials that firms try to overcome by shaping the local context. The labor market is another challenge firms seek to mediate. Unemployment is low, agriculture is stigmatized, and wages are higher than in other R&D sites.

It's difficult to compete with the tourism industry. Agriculture is seen as a hard job, outside in the sun. Younger generations prefer other types of jobs. Here field workers are 2nd or 3rd generation immigrants from former plantations. The average age is 58 (Interview, seed firm manager, Aug 2014, Hawaii).

As such, firms are strategic in maximizing and incentivizing their labor force. “The more efficient the better. We do a lot of hands-on training to teach workers to make processes more efficient. Everything is streamlined. That saves money” (Interview, seed firm manager, Aug 2014, Hawaii).

Firms are proactive in their strategies to find labor and retain it. They use temporary employment agencies to meet some of their labor needs, and most firms prioritize hiring locals. Some firms “give anyone a chance” (Interview, seed firm manager, Aug 2014, Hawaii). One manager suggested that the large operations “get desperate. If you can walk and breathe, they’ll hire you” (Interview, seed firm manager, Aug 2014, Hawaii). This person went on to intimate that during the boom period, firms stopped doing drug tests because the low unemployment levels made it so difficult to get workers. Interestingly a former drug dealer appears in a local news story defending the seed industry and the chance it gave him to have his first solid job (Hofschneider 2014b). So while seed firms face their labor challenges by extending jobs to locals and the underclass, this survival strategy may also endear them to local communities. Since these workers may have more to lose if they are fired or laid off, they are likely to form a labor force with few other options. They become firm advocates in moments of crisis, serving as solid bridges between communities and firms.

By offering educational incentives, seed firms have been more successful at retaining workers. Three firms offer generous education packages to their workers.

We had a lot [of workers] from the mainland before, not now. They typically didn’t last more than a year, cultural shock. ... There was huge turnover, but we changed our strategy. We hire more locals now. We offer education to people, using the internet ... B.A. degrees, Associates Degrees. We work with local community colleges and universities on the mainland remotely. If workers are full-time it’s almost 100 percent covered (Interview, seed firm manager, Aug 2014, Hawaii).

Firms also use educational opportunities to break down language barriers, instill worker loyalty, and to open the door to future generations of workers.

We spend lots of hours training [workers]. It's one of the main components of our success. ... Key trainings [are] in Ilocano.⁸ It takes longer, but they live here and won't leave. It's the right path helping people from the community...molding kids to think about doing this type of work (Interview, seed firm manager, Aug 2014, Hawaii).

Firms use externships to reach younger generations, recruiting teachers to learn about their work and take it back to their schools (Interview, seed firm manager, Aug 2014, Hawaii). Managers recognize that the schools in many island communities are "limited at best" and play active roles in fomenting better science and technology education. Monsanto Hawaii has spent over \$1.2 million dollars and volunteered hundreds of hours in schools (Monsanto Hawaii n.d.). They do this as part of a shaping strategy that seeks to make agriculture attractive to future generations of workers and to encourage residents to be empathetic of the work they do.

All firms encourage workers and managers to donate their time and resources to local organizations that have a connection to their mission or a special meaning to local stakeholders. Donations and volunteer activities revolve around farming, science education, natural resource preservation, and organizations tied to the ethnic heritage of their workers, such as the Filipino Community Center. Volunteer programs and direct donations are common strategies that firms use to secure a revered place for themselves within communities. If communities see firms as sympathetic, they may offer them the benefit of the doubt when contentious issues arise. These types of activities shape how communities envision their relationship with the firm and with inequality, encouraging workers and community members to speak on firms' behalf even when it may be divisive and not in their best interest.

By the late 2000s the humble beginnings of the seed industry were no longer recognizable. The scattering of small firms with temporary installations in Hawaii were replaced by multi-million dollar R&D and production facilities. Hawaii become a mainstay in the corn seed industry

⁸ Ilocano is the predominant language spoken by workers of Filipino descent in Hawaii.

and the industry became an important pillar in the Hawaiian economy. Governor Abercrombie reflected this sentiment in his speech at the Annual HCIA meeting in 2011.

I am not going to sit here and lament [that] sugar and lament [that] pineapple [are] gone. That was a monoculture that had its time, had its place in other centuries. ... Many of the people in this room today represent the seed industry which is I think the new foundation and basis for agricultural prosperity in the state (HCIA 2011).

By the end of the 2000s, corn seed had successfully shaped not only the agricultural landscape in Hawaii, but the relationships between the state, local communities, and firms. Firms became embedded in the contours of local communities and the state through the proactive development of multifaceted relationships with some of Hawaii's key institutions.

Staying legal, becoming local

Today Hawaii is one of the most important centers for GM seed testing in the world (Callis 2013). The explosive growth of the industry here did not go unnoticed. Intensive year-round production goes hand-in-hand with heavy pesticide use. This prompted residents to question the long-term effects this might have on their health. This questioning deepened after school children and teachers in a west Kauai school, near a seed firm's facility, complained of noxious odors and went to a hospital to seek medical attention. The island of Kauai was portrayed as "the little island that could" (Hooser n.d.) when the County Council, backed by environmental NGOs, passed Bill 2491 in October 2013. The law created pesticide buffer zones and required disclosure of restricted use pesticides. As a result, Hawaii's island nirvana become famous as the "ground zero" for the testing of GM seeds and for the vociferous anti-GM movement this work brought to life. This tension has clear consequences for seed firms, as they seek to develop a strategy to stay in a divided community that holds a tactical place in the corn seed value chain.

Seed firm managers pointed out that the GM debate in Hawaii goes back to the early 2000s around the same time the Center for Food Safety (CFS) began working with and supporting the

foundation of community organizations, such as Hawaii SEED, a nonprofit advocating for awareness about GM.

It's not new, it started ramping up in 2003/4. The 2005/6 legislative session (in Hawaii) had more anti-GM bills than any other in the country. There were between 22 and 26 bills in those years... In the past it was the state legislature, but in the last three years it moved to the counties (Interview, Seed firm government affairs manager, Aug 2014, Hawaii).

The tension culminated in Kauai in October 2013. In a 19-hour meeting, after heated public testimony and several marches of thousands of people, Kauai County Councilmembers voted to approve the pesticide disclosure bill. It was described as "the most contentious issue our county has ever dealt with" (Interview, Kauai Councilmember, Aug 2014, Hawaii). Bill 2491 became law in November 2013 after the County Council voted to override the Mayor's veto of the bill. The law required farms to disclose pesticides use and the presence of genetically modified crops if they spray more than five pounds or 15 gallons of restricted-use pesticides annually. It also required a 500-foot buffer zone near medical facilities, schools, and homes (Lincoln 2013).

Contention spread across the Hawaiian islands as Hawaii County passed Bill 113 in December 2013, which banned all new GM crops. Maui County voters passed a ballot initiative in November 2014 that put a moratorium on all GM crop operations until a health and environmental impact study is conducted. These initiatives were not received passively by seed firms. They used their economic power to shape politics. They intensified community outreach and public relations programs, negotiated voluntary accords, and increased their legal budgets. HCIA offered them a space to strategize collectively over lobbying efforts and joint legal actions. In 2014 CFS reacted by opening an office in Hawaii, one of four in the nation, to "add the legal, scientific, and organizational capacity that community groups need to push their efforts forward," said Lukens, Director for the Hawaii Center for Food Safety. (Shimogawa 2014).

The debate was polarizing – on one side a potential economic downturn and loss of jobs, and on the other a potential health risk. As I prepared my research trip in 2014, some residents and scholars advised me to avoid Kauai, that I was about to step into a “civil war” where people wore their politics on the sleeves of their shirts. Residents evoked a verbal imagery of war to describe the local context. Environmental NGOs spoke of being “on the front line” and that Hawaii is “ground zero” for testing GM seeds and agrochemicals. A local newspaper called the seed industry “a terrorist group” (Interview, seed firm manager, July 2014, Hawaii). The Aloha state became a world stage for the divisive debate over the price of paradise, more poignant because of its familiar tropical island backdrop with white sands, lush vegetation, and turquoise waters.

In the midst of this debate, seed firms struggled to show their good neighborliness through community outreach programs, volunteer efforts, and a reframing of their work as a reflection of local communities’ values and history. Firms do this through a twofold staying strategy that first protects their legal right to stay in Hawaii and; second forges a deep sense of belonging, leveraging their embedded in local communities. The two strategies are often at odds, resulting in an industry that ironically sues the same community from which it seeks legitimacy and belonging.

The legal strategy

Kauai’s victory against seed firms was short lived. On January 2014, three major seed companies filed a lawsuit against Kauai County over the enactment of the ordinance. In a joint statement, firms indicated that the law “arbitrarily targets our industry with burdensome and baseless restrictions on farming operations by attempting to regulate activities over which counties in Hawaii have no jurisdiction” (Gonzalez 2014). Firms cautioned that disclosing the chemicals used and the locations of their fields would unnecessarily expose them to “corporate espionage, vandalism, and environmental terrorism” (D’Angelo 2014). While advocates of the bill pointed to

concerns of long-term pesticide use, firms highlighted their participation in the Kauai Agricultural Good Neighbor Program. In it firms disclose their pesticide use and respect 100-foot buffer zones. However critics point out that this voluntary program holds no legal consequences for firms (KAGNP n.d.).

While the Hawaii County bill did not affect seed firms directly, HCIA was among the plaintiffs suing the county over the laws' legality. For managers, the moratorium in Maui was the largest threat.

If you can't do state-of-the-art research, there's no point in being here. For us, if biotech becomes a tool we can't use and you're in a business that relies on that, there's no point. ... If something like that passed, we'd be out of business (Interview, seed firm manager, Aug 2014, Hawaii).

The two firms in Maui and Molokai quickly filed a joint lawsuit questioning the constitutionality of the moratorium just a week after the ballot initiative.

When I asked if firms were considering leaving Hawaii due to the legal challenges, every manager was emphatic that "the benefits outweigh the challenges" (Interviews, seed firm managers, July and Aug, Hawaii). "We could set up other locations, but Hawaii is the U.S. There is a robust regulatory system and it's functionally very good from a stewardship perspective" (Interview, seed firm manager, July 2014, Hawaii). While managers uniformly praised the federal regulatory framework, they were vocal opponents of state and local level regulation, seeing them as impediments to their right to operate. The manager went on to say, "All of our locations are valuable, but Hawaii is our first choice". Paradoxically managers were unequivocal in their determination to stay here. "We'll only leave if driven out" (Interview, seed firm government affairs manager, Aug 2014, Hawaii). "We're going to stay in Hawaii no matter what. It's very difficult to close Hawaii" (Interview, seed firm manager, Aug 2014, Hawaii).

Despite their determination to stay, firms approached the unfolding legal battles with caution. Two managers signaled they might reduce planting, another manager put expansion plans on the backburner (Interview, seed firm manager, Aug 2014, Hawaii). Notably, some firms expanded facilities in Puerto Rico in the same period. Several managers insinuated that finding the right place to operate is a continual process of shopping and shaping. At the corporate level “they might be evaluating other options” (Interview, seed firm manager, Aug 2014, Hawaii). This manager went on to say “if the seed industry finds a way of accelerating traits in a different way, in contained structures where we can control the environment, we’d do that...become a type of Epcot Center. Industries like this will always continue to search for ways to do things more efficiently.”

Other actors find little substance in firms’ resistance to the proposed local regulations. “This law means very little [for seed firms]. Their objections are political and rhetorical in general. There’s no real financial impact. ... It just looks bad to have counties restrict you” (Interview, Lawyer, July 2014, Hawaii). The lawyer for an environmental organization went on to discuss the relationship between firms and the state in creating legal doctrine that is fundamental to these legal battles.

The central issue is preemption. It is a legal doctrine that says whatever law the federal government passed may be the only law that regulates that issue. About 20 years ago it was decided that federal law didn’t preempt state and local efforts. So chemical companies went to state legislators. [They] wanted them to preempt local law. 43 states have passed those laws, Hawaii wasn’t one of them.

This explains in part why firms’ legal strategies in Hawaii center on the court’s interpretation of preemption. Given that U.S. law relies on legal precedent, the outcome gains importance as it could open or close the door to a legally binding act elsewhere. Managers are

aware of this threat. “It sets a precedent and that’s dangerous” (Interview, seed firm manager, July 2014, Hawaii).

If we allow this to happen today, tomorrow they will do the same for other issues. A moratorium will become a common tool. What about fuel for cars? It contaminates, should we use horses instead? ...We are obstructing research that will enable us to feed our nation. [By making this illegal] it’s like [committing] terrorism on ourselves...biotechnology is out there to help (Interview, seed firm manager, Aug 2014, Hawaii).

Others argue that the legal cases are about corporate power, not feeding the world. “The entire world is looking at Hawaii. They don’t want to give an inch... it’s becoming a world stage” (Interview, CTAHR, July 2014, Hawaii). “At the end of the day...it’s about empowerment. It provides for a safer community and allows us to set an example for communities. These people, the executives, don’t actually get to make all the decisions...We are empowering small communities” (Interview, County Councilman, Aug 2014, Hawaii).

In August 2014 the legal decisions began to roll in and quell some of managers’ anxieties. U.S. Magistrate Judge Kurren ruled in favor of the plaintiffs declaring that the Kauai County ordinance is expressly preempted by federal and state law. In November 2014, the same judge made a similar decision in the case of Hawaii County. These cases are being appealed to the Ninth Circuit Court of Appeals (Hofscheider 2015). A collective sigh of relief from seed companies was heard across Hawaii on June 30, 2015, when Federal Judge Mollwoy found the Maui ordinance “invalid and unenforceable” because it is preempted by state and federal law. Sheehan, a member of the Sustainable Hawaiian Agriculture for the Keiki and the 'Aina (SHAKA) movement and defendant in the Maui case, disagrees. “This law was written specifically because there was no state or federal law regulating genetically modified organisms...The state and county have the responsibility to protect the health of the environment, which they’re not doing” (Hofschneider 2015a).

Leveraging local embeddedness

In addition to their legal actions, firms take on a multi-faceted staying strategy of ‘becoming local’ which includes leveraging economic, social, and political resources to facilitate staying in communities once opposition has been raised. As part of this strategy, firms hire managers and workers that look like and speak to local communities. While firms do this to lower high turnover rates, this localness can also be used as a sociopolitical asset in the battle to stay in Hawaii. Seed firms frame their work as farming, rather than biotechnology, to suggest a connection to the land, evoking a more sympathetic image than one of unfamiliar scientific processes. An NGO leader reflected on seed firms’ framing of the debate by calling it a false debate. In this person’s view, it is not about farming or producing seeds, it is about chemical companies and corporate accountability (conversation, NGO leader, Aug 2014, Hawaii). Yet the debate extends beyond farmers vs. agro-chemical companies, forcing countless historic inequalities between local communities to surface: haoles⁹ vs. Hawaiians, rich vs. poor, north shore vs. south shore. One interviewee spoke insightfully about these divides, pointing to a “recolonization” by both the NGOs and the seed companies, alluding to a type of colonial relationship in which those with power appropriate the voices of those without, claiming to do so with the best interest of the community at heart. On the one hand, national-level NGOs, and on the other, transnational seed firms. Neither are really local. The community is caught in the middle.

Firms used advertising campaigns and economic data to draw attention to the economic contributions they make on the islands, where plantation style agriculture has largely abandoned communities in favor of more cost effective locales. These actions took on an urgent character in November 2014, as a precursor to the ballot initiative in Maui. Firms commissioned economic

⁹ Haole is usually considered to be a neutral term denoting foreignness, whiteness in particular, although it is also used with a disparaging intent to denote distrust of foreigners or outsiders.

studies, polished discourse, and dispersed information through public hearings, editorials, and public relations spots on primetime television. The campaign appealed to the “immediate and irreparable harm” that Maui County would suffer if the moratorium were to pass. The Citizens against the Maui County Farming Ban, in which seed firms were strongly represented, raised \$7.9 million in an attempt to defeat the ballot initiative (Kerr 2014). However “money doesn't always buy you love. ... At the end of the day, money doesn't vote. People vote” (Kerr 2014).

The marketing campaign capitalized on the image of an economically suffering community, highlighting Molokai where unemployment is twice the state average, and where a third of the island relies on food stamps (Hofschneider 2014a). Since the seed industry employs 10 percent of the total island workforce, unemployment could rise to 18 percent if it left (Ibid). In Maui County, according to Brewbaker (2014), the seed industry generates “\$84 million in economic output and more than 950 jobs including multiplier effects, county-wide”. Tensions have been high in the face of potentially losing the island’s main employer. Governor Lingle reflects on the loss of a similar employer in 2008. “The loss of this many jobs in such a small community like Molokai is equivalent to 23,000 people in Oahu losing their jobs on the same day” (McAvoy 2008).

The campaign uses several framing strategies to make firms more appealing to locals. Ads misinform residents by characterizing the initiative as a farming ban. The bill does not permanently ban farming, it puts a *temporary* moratorium on *GM* farming until an environmental impact study is conducted. Another ad states that the ban would put “hundreds of people out of work, costing our economy millions of dollars” (Hofschneider 2014b). While most firms avoided direct threats of leaving, this ad implies a clear path for capital flight. Several ads use well-known locals as advocates. One ad features the Past President of the Maui Chamber of Commerce. Her local accent and Filipino heritage are meant to appeal to a broad audience, particularly to workers, as Filipinos

make up 50-70 percent of the industries' workforce. In another ad, a well-known native Hawaiian rancher, famous for his panolo cowboy traditions (Jennings n.d.), pleads with residents "to join family farmers in voting no on this shutdown initiative." He states "Molokai is an island of farming and ranching and a shutdown is something we cannot have. We are in great need" (Hofschneider 2014b). These ads attempt to convey a sense of connection to local customs and values, demarcating the fuzzy line of belonging that tenuously separates locals from outsiders. In these ads, firms rely on respected locals, use Hawaiian words, and evoke cultural symbols like leis and panolo cowboy culture to resonate with local residents. As Gaventa's (1980) third dimension of power suggests, firms may do this to get the less powerful [the community] to act in ways that benefit the firm, ultimately instilling and maintaining hegemonic power relations.

Firms also leverage the relationships they forged with organizations in earlier stages to speak on their behalf. "Now we're at the point where we're trying to get assistance from other groups in the food industry. To get them to help us, to spread our message...our credibility. It's not an easy task (Interview, seed firm manager, July 2014, Hawaii). Some managers discussed how the community tensions affected their families, particularly their children, provoking some of them to defend their parents' work publically. "My daughter spoke out at the hearings. She wanted to testify...to support us. Four or five kids spoke out" (Interview, seed firm manager, July 2014, Hawaii). By having others, particularly children, speak on their behalf, firms gain a veneer of respectability. Workers and managers are also encouraged to participate in outreach campaigns. "Overall we encourage any employee to be involved in the community through the Filipino chamber of commerce, some sort of board, to be involved in school... in a way it's to represent yourself, but also to represent our company" (Interview, seed firm government affairs manager, Aug 2014, Hawaii). Encouraging workers to participate in public outreach can take on a coercive

character as employees are faced with the option of publically defending the firm or looking disloyal. This is another example of Gaventa's (1980) third mechanism of power, illustrating how firms leverage their power to encourage workers to act in ways that protect and benefit the firm. "Our employees in Maui, they realize it could mean jobs...they're passionate about telling their story" (Interview, seed firm manager, July 2014, Hawaii).

In the face of such highly visible controversy, firms defended their position by questioning the localness and the validity of the opposition. "There's a lot of purposefully wrong information out there. People hear it and take it as truth. Some are from the university and use their logo in their presentations and others have the title of doctor before their name" (Interview, seed firm government affairs officer, Aug 2014, Hawaii). Advanced degrees or university affiliations typically offer legitimacy, although seed firms caution that not everyone is a trustworthy source.

To me [there is] a lot more influence from the mainland. ... How many mainland NGOs are getting legislators to carry their water for them? They want us off the island. NGOs get a pass on any scrutiny. No one asks how they're paid or what their incentive is (Interview, seed firm manager, July 2014, Hawaii).

Firms recognize that not every voice garners the same level of respect in local communities. The shift in hiring practices – to a larger pool of local hires – is one way firms may harness social capital and place-specific knowledge to garner support. "I'm a local so I have more impact when I speak in the community. I tend to come across a lot better" (Interview, seed firm manager, July 2014, Hawaii). Firms incorporate people into their camp who can speak and look local. Some seed firms have brought in Chilean or Puerto Rican managers believing (correctly) that will be perceived as locals because of their skin color, as well as their more hands-on, discursive management style, and perceived family values (Interview, seed firm manager, Aug 2014, Hawaii). As one firm manager said, "I have a different style. Even though I'm not from here people

see me as more local because I'm not haole, I blend in better.” (Interview, seed firm manager, Aug 2014, Hawaii).

Seed companies also use politics as a means to ensure their right to operate in Hawaii. From January to April, 2014, Monsanto, Syngenta, DuPont Pioneer, and their trade groups have spent more than \$50,000 lobbying the state Legislature to make laws like Bill 2491 unenforceable (Wilse 2014). Firms have shaped the political landscape through campaign donations. The industry's big five contributed over \$700,000 to state and county candidates from November 2006 through December 2013 (Wilse 2014). Lukens posits,

the impact of this corporate cash on local politics is not just that representatives are pressured to vote based on donations to their campaigns. Rather this cash has been strategically spent to create a mirage of confusion and disagreement around very mainstream issues like pesticide disclosure and GMO labeling (Wilse 2014).

The GM and pesticide debates have shifted from being fringe to mainstream, encouraging new faces to join Hawaii's political scene. So while some argue that recent tensions have revitalized the politics as usual style, forcing incumbents to revamp their strategies (Eagle 2014), Barbara Polk, Chair of a non-partisan grassroots group, points out that the influx of big money has resulted in “politicians statewide increasingly placing the interests of corporations over the interests of citizens,” toeing the corporate line (Wilse 2014).

Conclusion

Hawaii's strategic place in the corn seed value chain has shifted since the 1960s. Understanding its importance is key to comprehending the deep financial, social, and political investments that seed firms have sunk into Hawaii. When firms' shaping tactics were insufficient in thwarting public outcry, they shifted to a staying strategy in a context that has been described by many as a civil warzone. Despite the initial successful mobilization of local communities and governments to pass laws to regulate GM crops and pesticide use at the local level, firms limited

communities' ability to enact these laws by using the legal system to create a powerful barrier to change. By reframing the debate from one over the safety of pesticides to one over governance, firms created a "mobilization of bias" (Gaventa 1980) and temporarily – at least legally – contained their opposition. However firms seem cognizant of the need for a social license to operate in Hawaii. As such, they seem to be seeking out less conflictive spaces for their operations, shutting down one operation in Kauai in favor of another in Oahu (Hofschneider 2015b), while expanding operations in Puerto Rico and scanning the global landscape for new locales that offer less defiance. The challenge to GM crops and pesticide use in Hawaii represents an extreme case of staying for seed firms. These tactics suggest that firms still view activists and mobilized communities in Hawaii as a threat to their continued profitable operations.

In the next chapter I turn my focus to Chile, a place where push-back against seed firms centered on workers' rights instead of environmental concerns. Despite this difference and others that will be explored in the following chapter, there are important parallels between the cases of Hawaii and Chile. For example, in both sites, firms used legal tactics to temper public outcry; they also shifted some programs to Puerto Rico as a way of disciplining the local state and workers for enacting regulatory regimes that firms see as threatening their right to operate. As I will show in the next chapter, Chile represents a middle ground case between the two extreme cases of Hawaii and Puerto Rico. Chilean workers gained some voice at the negotiating table with firms despite the structural limitations they suffered due to the vestiges of authoritarian rule within the broader political economic and legal structures and the export-oriented economic model that requires Chile to continually prove itself worthy of international investment by disciplining the local state and workers.

CHAPTER 4. Redefining a Serious State in Chile: Labor, Politics, and Regulation in Transnational Seed Firms

Arica is home to one of the driest deserts in the world, yet paradoxically it is one of the most sought-after locations to conduct corn seed research and development in the world. In the past five years, the valley oasis outside of Arica – Azapa Valley – has become the Silicon Valley of seed production (Revista del Campo 2012). Transnational seed firms were drawn to this valley because of its predictable climate, year-round growing season, and Chile’s reputation for having serious phytosanitary institutions and political stability. While Arica offers important advantages to seed firms, its high land prices, distance from the U.S. market, and low-skilled workforce pose challenges for transnational seed companies. Since seed R&D demands quick turn-around times to test new seed varieties, factors such as soil quality and land prices are less important, but skilled labor capable of precise production is imperative.

Despite the assertion that science is not political, politics and science are not easily separated in the seed industry. As we have seen in the case of Hawaii, the success of seed firms’ scientific endeavors hinge not only on doing science, but also on shaping regulatory regimes by doing politics. Chile is no exception. Much like Hawaii, the rapid growth of the seed industry in Arica has been met with resistance. While in Hawaii, the focus of community push-back was on the safety of pesticides and genetically modified crops, in Chile, resistance centered on labor rights. Unprecedentedly, seed workers in two transnational seed firms organized and formed unions at the end of 2012. In one of these firms, workers went on a 22 day strike in April 2013 when a collective bargaining agreement was not reached. Government officials in Arica frequently referred to this incident as one of the most contentious issues in Arica’s labor history (interview, government official, Arica, November 2013).¹⁰ Eventually after interventions by the government

¹⁰ All interviews in Chile were conducted in Spanish. They were translated to English by the author.

and the Catholic Church, the seed firm and the union negotiated, and the company partially met worker's demands in a collective bargaining agreement.

While the previous chapter documents the ways seed firm management in Hawaii addressed the public tensions surrounding environmental governance by managing public impressions – by offering tours of their facilities and explicitly focusing on outreach activities to educate the public on GM production and pesticide use – the management team in Chile had a radically different approach for dealing with local tensions within their R&D facility. The facility shut its doors figuratively by prohibiting its employees from discussing their work in any way with the public. After the labor strike, it became the most difficult study site to obtain information despite numerous contacts in the industry and prior positive exploratory field research visits. The historical legacy of Chile's 17-year dictatorship (1973-90) also seems to have played a role in shaping relevant socioeconomic and labor policy, management styles, and perhaps contributing to a sense of distrust between workers and managers.

As this chapter will detail, Arica represents a middle-ground case of firms' localization strategies. It falls between two extreme cases, Hawaii and Puerto Rico, in which firms use their power to protect their right to operate and to shape local conditions to meet their needs. In Arica, communities confronted stark power inequalities by organizing labor unions and mobilizing around labor issues in a geographically and politically isolated area with few good jobs. While workers achieved some leverage through the organization of labor unions, their power was tempered by a legal system that was largely structured under an authoritarian regime in an economic system that remains disciplined by the threat of economic repercussions by transnational capital for appearing unserious or unworthy of international investment.

Chile: Shopping for a “serious place”

Seriousness of place is a concept that managers drew on to explain why a firm would choose one location over another to site its GM corn seed R&D. While managers in all sites described characteristics that evoked this concept, managers in Chile relied on it frequently to explain why transnational firms would be drawn to a place like Chile, particularly Arica. They used the term in multiple ways to describe a place that has strong phytosanitary and regulatory institutions and prioritizes the development of agricultural industries. They also used the concept to describe a place that values the rule of law, in particular one that has a pro-business environment that respects intellectual property and private property rights. Firms see this as an attractive asset in the shopping stage, particularly in places outside the U.S. jurisdiction, because it enables them to leverage their superior bargaining resources institutionally. In addition to Arica’s climatic advantages for growing seeds, managers repeatedly assured me that Chile’s competitive advantage in the seed industry had much to do with its “seriousness,” something they felt was a rare commodity in the region. As one manager asserted,

the climate is fundamental, but there are other places where the climate might be even better than Arica, like across the border. But in Chile, agricultural biotechnology is legal, unlike Peru or Bolivia. And things work in Chile...the institutions, the roads, the banks. Our phytosanitary institutions are well respected internationally...It’s a serious country (Interview, seed firm manager, November, 2013, Arica, Chile).

Chile’s reputation as a “serious” country was partially established during the fruit boom – which began under a dictatorship as part of one of the strictest neoliberal experiments in the world. Market rules dominated the new development strategy of Chile under the Pinochet dictatorship where Milton Friedman’s Chicago Boys were charged with the task of resurrecting and “modernizing” the countries’ economy. Deregulation and market liberalization were key. The state was rolled back; state industries were privatized and social services were cut. There was a

significant focus on stimulating export-oriented growth, particularly in the form of primary goods such as fruit and copper (Gwynne and Kay 1999). During this period, workers were highly controlled, labor unions were initially outlawed, and the unruly were killed or exiled, as the military rule served to minimize both political and economic dissent. This helped to ensure that the neoliberal policies were rolled out smoothly and that the power relations embedded within the economic model offered clear advantages to industry.

Despite the violent rule and its devastating effects on workers and the poor (Winn 2004), Chile's economic turnaround was soon deemed by many the posterchild for neoliberalism. Foreign investment grew significantly in the 1980s as export incentives and peso devaluations took effect (Murray 1997). Chile's low trade tariffs, its booming economy, and its wealth in natural resources, such as fruit, wood, wine, and copper, made it a desirable trading partner and a rewarding investment opportunity. Investors were drawn to Chile by its cheap prices, extremely low wages, large available pool of highly-disciplined workers, and beneficial tax breaks and other economic incentives (Buchi 2006). This favorable investment climate also came with a legal system that guaranteed private and intellectual property rights and a pro-business labor code.

The infrastructure from the fruit boom and other export-oriented primary resources made trade easier, as Chile developed excellent transportation networks and cold storage. It also contributed to the construction of reliable and respected phytosanitary institutions and customs agents with little corruption, low likelihood of strikes, and officials who were trained to follow the rules. As one seed firm manager stated, "the professionalism of the authorities make the difference. Customs is very serious" (Interview, seed firm manager, Chile, Jan 2014). This not only ensures that products are duly inspected to avoid bringing unwanted pests or disease into the country, but

it also means that export-oriented goods make a timely departure to their destination, key to the success of industries that rely on meeting quick deadlines for fear of spoilage.

Chile's entrance into the global seed industry began similarly to Hawaii, with one seedsman acting as a lobbyist during a time of environmental crisis that affected firms' ability to produce effectively in the U.S. Fernando Ruiz Figueroa approached industry giants in the U.S. to promote the advantages that Chile had to offer as a winter nursery site. His proposal came at a key moment, as a drought plagued U.S. corn production in 1982/3. This marked an entry point for Chile into the industry, as U.S.-based firms realized they could use Chile as a risk management strategy if the U.S. crop did not go as planned. Because of the counter-seasonal advantage that Chile offered – when it is summer in Chile, it is winter in the U.S. – firms could meet the needs of the U.S. market by producing what they were unable to produce in the US summer in the following months in Chile. It gave firms a larger production window to produce seeds that would be planted in the following summer in the U.S. Firms were quickly drawn to Chile's main agricultural valley. It was near the capital, had excellent soil quality, a wealth of well-trained agronomists and farm workers, and produced high quality seeds.

Another advantage that Chile presented to seed firms was its strong agricultural tradition. Agriculture was seen as an opportunity for Chilean development, and thus received priority in terms of government programs. There are strong university agronomy programs, a pool of expert farm laborers, and government and private institutions to support and lobby for firms' interests. ANPROS, the Chilean Seed Producers' Association has a long history in Chile. It began in 1959, a product of a joint government initiative of the Chilean Ministry of Agriculture and the U.S. government to help develop agriculture in developing countries. Today it represents its members in the development, commercialization, and exportation of seeds. It also seeks to put Chile on the

map as a country that produces excellent quality seed, while promoting its reliability as a producer (ANPROS n.d).

In 1983, Pioneer¹¹ acquired land in Chile and built the first commercial seed dryer in Chile's Central Valley. By 1984, the site yielded excellent quality seeds with high purity, solidifying Chile's newly acquired position in the seed industry. By 1986, other transnational seed firms began to explore production options in Chile. Some reached out to local seed firms that acted as third party service providers to produce seeds for them, while others began to set up independent operations. It was common practice, except in the case of Pioneer, to use local firms to test the area first before establishing operations here. The late 1980s brought important changes to the global seed industry. Pioneer closed its winter nursery sites in New Zealand and in Homestead, Florida due to the long distances and Florida's winter frost. By 1997, Chile's Central Valley operation had the largest seed production plant in the world. Chile's success as a production site encouraged firms to begin to shift their operations in Chile from simple winter production to one that also included research in the Central Valley.

The late 1990s marked the beginning of a very small corn experiment near Chile's northernmost city, Arica. It started out as a far-fetched idea of the former Country Manager of Dupont-Pioneer Chile, Alvaro Eyzaguirre.¹² He wanted to find a way to be competitive with Hawaii and knew that the Central Valley's climate would not allow for year-round production. In 1989 he began experiments in Arica to test the unlikely site as a viable option for year-round corn production (for research), collecting data during only one period of the year. Initially the industry

¹¹ Pioneer was acquired by Dupont in 1999. I refer to the company as Dupont-Pioneer after that date. Although in my quotes, there are times that the firm is referred to simply as Pioneer.

¹² Eyzaguirre was the Country Manager of Dupont-Pioneer Chile from January 2006-May 2016.

did not share his vision. “They didn’t pay attention to me at first” (Interview, Alvaro Eyzaguirre, January 2014, Chile).

For most people, Arica seemed like an unlikely place to conduct high-tech corn research. It is not a traditional agricultural center; it is located in one of the driest deserts in the world; and has historically been one of the poorest regions in Chile. Yet as the industry grew, so did its R&D hubs. Pioneer opened research operations in Puerto Rico and in Puerto Vallarta, Mexico. In the meantime Eyzaguirre waited patiently for Arica’s opportunity. In 1995, the firm authorized a small project in Arica. Eventually with that work,

we showed that Arica was possible! In 1997 we hired a few more people and formed a small office. We only had one person working for us on rented land previously. In Chile the secret of Arica was well-guarded at first. Pioneer is like McDonald’s. It arrives first, then the others follow (Interview, Alvaro Eyzaguirre, January 2014, Chile).

While industry experts heralded Dupont-Pioneer as the trendsetter in the seed business in Chile, all of the seed giants are there. However only Dupont-Pioneer, Syngenta, and Monsanto conduct corn seed research and production in Chile. Today these three firms have their own land, offices, and research facilities in the Central Valley, but only two firms have their own facilities in Arica. Arica is one of several research sites for corn seed in Chile, but it is the only one that can conduct year-round research, planting between two to three cycles a year. Expansion to Arica would have been an extremely unlikely scenario for firms to bet on without having a proven track record in Chile. “Yes, maybe that’s why the growth was so incremental, we had time to collect a lot of data and show it was a good investment,” ensured one manager (Interview, seed firm manager, October 2013, Chile).

Chile’s entry into the global seed industry was not by chance. Its growth was initiated by the lobbying efforts of Ruiz and Eyzaguirre, and propelled forward by natural forces, as well as the broader political economy. “While Chile is no longer the cheapest place to develop seeds, it

offers reliability, advantageous climatic conditions, and institutions that work well with excellent regulatory oversight,” giving it a competitive advantage as a serious country to invest in and conduct business with, reflected the ANPROS Executive Manager (Interview, ANPROS Executive Manager, October 2013, Chile).

Shaping place-based advantage through science and politics

While Arica has registered small amounts of corn since the 1990s, it was not until the turn of the century that Arica appeared on the radar of seed firms. A local seed firm owner, Rodrigo Marambio, began to study his firms’ options for expansion in 2001. “We began to carefully review the agro-climatic situation in all of the valleys north of Santiago” (Revista del Campo 2005). The results pointed to an unexpected place, the desert. The long summers and temperate winters were ideal for overcoming the challenge of winter production. The firm did two years of trials in valleys near Ica on the Peruvian coast and Arica, Chile’s most northern city. While Marambio found Peru to be cheaper than Chile, particularly in terms of labor, “we prefer to do it here [Azapa Valley] because the conditions are better. There is more stability in terms of politics and the economy. [There’s] more social tranquility” (Revista del Campo 2005). Marambio’s project was one of the first success stories for growing seeds in Azapa Valley, but it was not without challenges. His reflections on the initial trials of adapting to the area’s natural conditions mirrored those expressed by transnational seed firm managers in my interviews. “It is like planting in the desert” in one of the most arid places in the world (Revista del Campo 2005). The soil is sandy and saline.

[It is] like a fine powder. ...We primarily take advantage of the ideal climate here, sometimes the soil is so bad that we actually use planters. And water is also an issue, we have to be as efficient as possible (Interview, seed firm manager, October 2013, Chile).

Managers recognized that developing Arica as a first-rate research site is something that required continual work and shaping of the natural and built environment. It required expensive

treatment of the ground water and soil to make them amenable to agriculture and it also required political volition. Thus once firms established operations here, they sought out collaborations and support from local institutions to learn how to maximize the natural environment through the nexus of science and politics. Firms take advantage of university and government programs to research and partially fund high-tech equipment to improve local conditions.

Because the desert landscape also makes water a sought-after commodity, firms developed high-tech irrigation systems to minimize evaporation and use water as efficiently as possible. Around the same time that firms' activities were ramping up in Arica, the government began a desalination project together with the Inter-American Development Bank to fund a water treatment plant in Arica to assist with the water demands from both mining and agriculture (IDB 2009). Firms also built green houses and screen houses to protect the plants from temperature fluctuations and pests. While the desert sun fuels plant growth, its piercing rays require workers to cover themselves from head to toe in white astronaut-like suits and hats to protect their skin from exposure.

By 2007, the first transnational R&D station for corn seed in Arica was underway. It went from 60 hectares in 2008 to 250 in 2013, which also meant an explosion of growth in personnel. In 2009, Dupont-Pioneer built its offices and began the expansion of its operations in Arica, going from 30 employees to 300 in approximately three years. Recruitment was fast and loose as one manager recalls. There was no human resources personnel in place, just someone who did the accounting part of it. People were recruited by word of mouth. In order to fill temporary positions, firms used third-party placement agencies that formed in response to this growth (Interview, seed firm manager, November 2013, Chile). In 2012, a national news magazine routed Arica as “a

cocktail made of ideal climate and high quality professionals, spiced with the security that Chile offers to do cutting-edge research” (Revista del Campo 2012).

We have gotten a lot of recognition for the quality of our services. You have to think that for a researcher it is like they are giving us their babies to take care of for several months, explains Francisca Acevedo, Manager of New Crops Development for Syngenta (Revista del Campo 2012).

Yet finding high-quality researchers and agricultural workers in Arica is a challenge that managers and government officials alike often brought up as one of Arica’s disadvantages. Several managers in Arica acknowledged that while they went happily to Arica to jump start their research careers, they saw it as a stepping stone to bigger things outside of Arica (interview, seed firm manager, October and November 2013, Chile). Firms recognize that Arica is not seen by many as a desirable place to relocate to. Its isolated location and lower socioeconomic status poses challenges for attracting and maintaining high-level talent, particularly professionals with young children (Interview, seed firm manager, December 2013, Chile).

One way that firms try to ameliorate this situation is by making the move temporary. It is a common practice for firms to promise mid- to high-level researchers from Santiago the possibility of transferring back to Santiago or elsewhere after working for three years in Arica. One manager told me that he came to Arica with the idea of staying for three years. After three years, he extended his time in Arica for a few more years, but by 2013 he had returned to the Central Valley. An opportunity had arisen that would take him and his wife closer to their extended family and friends and he was ready, especially since his children were approaching school age.

It’s a different world here. It takes some adjusting. I have really liked it and it has been a great opportunity for me professionally, but socially it’s hard. People are different here, more standoffish...it takes a long time to make friends and you’re far from your support network. And the educational opportunities for our kids just aren’t the same as they are in Santiago...and in Chile as you probably know, that really matters (Interview, seed firm manager, October 2013, Chile).

Another way that firms try to incentivize high-level professionals to come to Arica is with the promise of educational opportunities paid for by the firm. Many of the mid- to upper-level management have participated in online advanced degrees or certificate programs with universities in Chile or in the U.S. Given the challenges of recruiting talent from outside of the region, firms are increasingly setting their eyes on local talent. Currently, the majority of those that work in the industry in Arica are locals. According to one manager, firms have been proactive at hiring and training local talent. Currently 95 percent of laborers (*operarios*) and 90 percent of technicians and entry-level agronomists are local, mainly from the University of Tarapacá and Santo Tomas.

The goal is that 100 percent [of workers and management] come from Arica. To that end we've done studies to assess the deficiencies of local students and what they need to improve. In response, the University of Tarapacá has added two specific courses to help meet those needs (Interview, ANPROS, November 2013, Chile).

Today, however, the 10 percent that are not local hires tends to be upper-level management positions held almost exclusively from people outside the region (Interview, seed firm manager, October 2013, Chile). Incidentally, this hierarchical division between locals and outsiders – mainly those from Santiago – was mentioned as a source of tension that some workers felt was the impetus of the formation of labor unions at the end of 2012.

As the seed industry flourished, labor was not the only issue that firms sought to mediate. Policy reforms took on growing importance, prompting ANPROS to deepen its activities and lobbying efforts. It has developed specific subcommittees on issues such as biotechnology, phytosanitary improvements, and intellectual property. Given the importance of Arica in the seed industry, ANPROS created the only place-based committee that focuses on “supporting the industry to develop its activities and form a network of support with the authorities in the region” of Arica-Parinacota (ANPROS n.d.). While the offices of ANPROS are in Santiago, in 2012 ANPROS hired an expert in public relations in the position of community manager to better firms’

bargaining position over key issues by acting as a liaison between the community, the government, and the seed firms in Arica. The responsibilities include educating the public and the authorities on biotechnology and the activities of seed firms by organizing workshops, conferences, and meetings (Interview, seed firm manager, November 2013, Chile).

While Chile and the United States are leaders in producing GM corn seed for U.S. markets, their regulatory frameworks for agricultural biotechnology are notably distinct. Since only the reproduction of seeds to be re-exported is allowed under strict control from the Agricultural and Livestock Service (SAG) under the Ministry of Agriculture in Chile, biotechnology is regulated by a few simple resolutions, instead of a broader framework. In 2005, when biotechnology in agriculture began to take on more importance in Chile, the Chilean government expanded oversight on the issue by passing another resolution, in addition to the earlier Resolution 1523, to support SAG in achieving its regulatory mission.

Resolution 6966 established the formation of a technical committee to advise the National Director of the SAG on matters dealing with genetically modified organisms (Resolución Extenta 6966 de 2005). It tasked SAG with the job of evaluating and resolving on a case-by-case basis the applications for authorization regarding GM crops. The group meets biyearly to establish regulations and guidelines and to define the agency's official position on GM. In addition, the committee established working groups on specific topics to help the agency lay out the necessary procedures and systems that seek to limit the potential negative impacts of biotechnology in Chile. In these working groups, SAG officials work directly with industry leaders and seed associations, as well as other state agencies. In many ways this establishes a mobilization of bias, as these working groups institutionalize a set of norms to govern GM R&D in Chile, determining how firms operate, how they are regulated, and under what conditions they are sanctioned. By

embedding firms within the decision-making structure, they are placed in a preferred position to defend and promote their interests, a clear example of power's second dimension.

Seed firms work closely with government officials from SAG and the local seed association to co-create the practical guidelines and mechanisms to ensure that regulatory mandates are met (ANPROS n.d.). For example, ANPROS established an elaborate GPS system in 1999 as a way to safeguard genetic purity of seeds, something the seed industry in Chile is known for. The system permits the spatial ordering of the industry at a national level. It consists of entering the coordinates of specific crops in an isolation software, which identifies the points where eventually undesired contamination could occur. To support the software, a committee has produced an Isolation Manual that defines specific distances of isolation and dates of inscription for each variety.

The close relationship between the seed industry and the government in Chile affects how local policies are made and how regulation is enforced, producing a symbiotic relationship between firms and local institutions. For example, in Arica a seed firm manager was fired because he did not account for the entry of new seed varieties in the specific way that the law stipulated. Ironically, today, he is the head of the government institution that inspects those very issues. This revolving door between firms and governments is particularly prevalent in areas such as Arica where the highly specialized skill sets needed for agricultural biotechnology are possessed by few. So while firms gain a superior bargaining position through their participation in decision-making structures as industry experts, they also leverage that expertise within the state, as seed firms' former employees come to hold key government positions that determine the rules of the game.

In addition to the close relationship between firms and the government in crafting regulatory frameworks, firms also take advantage of several government programs to increase local employment and a program that offers incentives to firms that site their operations in the

“extreme regions,” including the regions of Magallanes and Aysen in the south and Arica-Parinacota in the north. These include labor subsidies and tax incentives, including tax credits for up to 30-40 percent of investments, among other benefits (Interview, Government official, December 2013, Chile). While some of these benefits have existed to a lesser degree since the late 1970s, seed firms have mostly benefited from them since the mid-2000s. The program for extreme zones has increased government funds especially since 2012 to support the development of these isolated regions by improving public works and infrastructure, which indirectly benefit firms seeking to develop their research or productive activities (Fuentes Besoain 2014).

In addition, InvestChile and InnovaChile are programs that seek to incite innovation and technology transfer. They provide firms with government subsidies with funds from the development agency in Chile (CORFO) (Revista del Campo 2008). Seed firms have received support for their operations in the Central Valley and in Arica through “employment subsidies to provide training to employees and the acquisition of fixed capital” (Verdad Ahora 2011; Interview, Government Official, December 2013, Chile). Firm managers recognize that these benefits tip the scale in their favor. According to Alfredo Villaseca D. the former Monsanto Chile President, “the environmental conditions, the institutional framework, and support for the investment in advanced technologies from CORFO-InvestChile are the reasons that Monsanto Chile chose to develop their project [in Chile]” (Verdad Ahora 2011). In 2013, the government began a program that sought to double the investment in R&D in Chile. It offers firms that invest in R&D directly or through a third party, a 35 percent tax credit on all R&D investments.

Firms also have a series of social responsibility activities in Arica, as well as in the Central Valley. As one manager told me about the varied actions his firms does with local communities, he also highlighted the rationale behind the activities.

These activities are key to having a good relationship in the community. We sponsor a neighborhood association, as well as a school, giving them materials. These activities are important because we know that in these schools or in the neighborhood organization, many of the members are children of our workers, our workers, or even future workers (Interview, seed firm manager, October 2013, Chile).

In addition, one firm helps fund a project with the University of Tarapacá to conduct research on and preserve a remarkable native corn variety (maiz lluteño) in the neighboring Lluta valley. Workers are encouraged to volunteer in schools and in the community; they have a college prep course in the Central Valley; and donate money to local preservation efforts and community organizations. These activities not only insert managers and workers in the community in a visible way, but they seek to instill loyalty among their workers by donating to causes that are important to them.

So while Chile's counter-seasonal advantages and climatic conditions were what initially drew firms to site operations here, all managers highlighted the costs that accompanied those benefits. Firms went to great lengths to adapt the physical and social environment to meet their needs. Managers spoke confidently about the role firms play in building infrastructure and in creating value through science, but they were much less comfortable discussing the politics and power infused in the science. As we will continue to see, the shaping process in Arica is one in which science is not easily separated from politics.

Staying by threatening to leave

Arica as a research site took off in the late 2000s. From 2008-2013, Dupont-Pioneer went from having five full-time workers to having nearly 300. The explosive growth of the industry in Azapa Valley was impossible to ignore. It was on display to any passerby. It dominated conversations in cramped shared taxi rides from Arica to the Valley, as passengers shared

anecdotes and gossiped about the strike and discussed who was profiting most from high rental prices. It was also present in the Valley's shifting visual scenery and land use change.

During the course of my fieldwork, the monochrome desert landscape with its makeshift structures and straggly olive groves was increasingly replaced by fields of corn, white company pick-ups, and modern facilities with guarded gates. These changes brought out tensions within firms and with the community. Community members observed the sharp rise in land prices and land use change. Historic olive groves – a source of community pride – were cleared to rent to seed firms at high prices. In addition people commented on an increasing equity gap among those inside the firm in terms of treatment and salary. One worker suggested that the company had “Chileanized,” becoming more hierarchical after the initial *gringo* manager had left. Another commented on the growing salary differences between professionals with degrees and those with work experience within the company, citing the resulting power differential as a major impetus for union formation.

For managers, the intense growth translated into a workforce that did not have time to acculturate and take on the corporate culture. One manager said,

It was impossible to have organic growth at that rate. The core values in this company are well defined, but when you're growing that quickly, the identity of the company gets left behind. There is no selection process that could transmit to people the skills and values we needed in so little time, especially thinking of the labor market in Arica that isn't very abundant. So the firm brought in whoever they could. There was no filter for workers. There were people that had other values and aspirations inside [the company]. I think that marked the formation of the union (Interview, seed firm manager, December 2013, Chile).

Managers called for a resocialization of workers, as a way of filtering out undesirables. This entailed actively instilling the corporate culture. Firms did this by increasing supervision, vetting potential employees through interviews, and by containing and controlling company information. They prohibited workers from talking about their work at all levels. They streamlined

communications, mandating that all communications must be approved by Dupont's Communications Department located in Buenos Aires, Argentina. This process of socialization and control of information are ways in which dominance is maintained. They are clear examples of the third dimension of power.

According to managers, the unionization efforts caught them off guard. In November 2012, workers in both transnational seed firms formed unions. While northern Chile is known for the unionization of copper miners, Arica is not a mining town. And agriculture in Chile is particularly ununionized. Chilean labor law allows for unionization, but the government labor offices recognize not only that unions are frowned upon by firms, but also that Chilean labor law makes unionization difficult and ineffective, and firms often seek retaliation. This political backdrop makes unionization difficult. As Bachrach and Baratz (1970) argue, the mobilization of bias in power's second dimension is primarily sustained through "non-decisions." These "non-decisions" may be force, threat of sanctions, or invocation of preexisting bias in the political system to oppress a threatening demand (Ibid: 43). As we will see, in the Chilean case, firms draw on all three of these non-decisions to maintain their power. The formation of two unions in large transnational seed firms in Arica was unexpected and received poorly by firms. While one firm negotiated a collective bargaining agreement, the other initially refused to negotiate, which led to a 22-day labor strike.

In Arica, firms sought to control the local environment by highlighting that they were one of the few companies in the valley that offered "good jobs." They used the threat of taking that away as a form of disciplining workers, but also the region in general. Dupont-Pioneer confronted collective bargaining and the impending strike with inflexibility. They were unwilling to negotiate with workers. One manager recounted,

workers wanted to pressure us, to get better conditions, more money. We didn't agree because we pay above market value already. It's a good job. They just wanted something like what they get in mining and that's impossible. What gets me is that before we came here these people never had jobs, stable jobs, only temporary work in uncertain conditions. They were paid less, had no contract...you know? ... We are convinced that our motives are noble. It's a good job and that was our position. They just wanted to have a bonus like the miners, but no... (Interview, seed firm manager, October 2013, Chile).

Managers also pointed to changes in workers' expectations as a way of explaining the tensions between workers and the firm. They drew on indirect mechanisms of power to defend their position. By highlighting the powerlessness of workers in obtaining an equal position elsewhere, they try to get workers to see their demands as unrealistic and to rethink their needs and demands.

In the beginning they were impressed with this work, the security, the norms, they were happy, content. But today they're making a lot of noise. They're demanding, demanding more, more quality, more comfort, more money, because they know the company can. But truthfully these workers are overvalued in terms of what they get paid. They are making a salary larger than their skill set. They aren't going to make that salary at any other company in the valley. ... Unfortunately due to a cultural issue in the region or the type of people they are, they don't realize or value the effort the company makes to maintain these things. They're just interested in money (Interview, seed firm manager, December 2013, Chile).

Managers often drew on a cultural argument to explain why their values clashed with workers and the broader community. Workers, on the other hand, found the firm to be imposing and disrespectful of their culture. One worker said,

one thing that bothers me about these companies is that they have their system, a singular system that they use for China, the U.S., Chile...it doesn't matter. I think that what happens here, not taking culture into account, must also happen in China and Peru, you know? They're in *our* house, they should be more flexible, respectful. ... Managers treat everyone like they're dumb. But they do it especially to people from ethnic backgrounds. They assume that since they're Aymará or whatever, they... and the sad thing is people believe it. The people don't push back. They don't do anything. They don't have that spark. Firms look for people like that, very quiet types. That's in part why we formed the union (Interview, Worker, December 2013, Chile).

Culture in many ways seemed like a proxy for talking about labor control, power, and socialization. Firms' used it to justify the need for greater labor control and workers drew on it to push back

against a corporate culture that sought to instill a strict hierarchy, increased productivity demands, and unequal power relations.

One agriculture expert linked the lack of respect for local culture with a lack of opportunities for laborers.

Other firms that have roots here or managers that have lived here longer, they respect the local culture, you know, ethnic things...the crosses they put on the hills around the valley. They support it. They incentivize their laborers, encourage them to get more training. They don't do that in the seed companies, only with the upper-level people, but not at the lower-level.

Despite policies that offer educational opportunities to workers, one manager confided that the company tries to avoid that non-professional workers get too specialized as way of controlling mobility, but also as a way of mitigating demands from workers.

Some workers think because they are specialized that they can demand more. But the truth is that in agriculture the specializations are fairly basic. Seed companies try to avoid having people in strategic positions with a really specialized skillset and knowledge, at least at the non-professional level. That's why they use professionals for that stuff. People with studies, degrees, formation. If you invest in workers that's what happens. They start saying, 'I'm the only one who knows how to do this and you should pay me more.' Strategically firms don't look for specializations in laborers, just professionals (Interview, seed firm manager, December 2013, Chile).

Managers tended to find workers' demands unreasonable. When the strike was mentioned it was common practice to draw on Arica's low level of development and to blame workers and the local culture for pushing important firms out.

Working with the culture in Arica has been challenging. Before in Arica there was Wrangler and big auto plants. But the unions and the people forced them out. The people in Arica don't like to progress much economically. They aren't willing to negotiate certain things. They want to have their cake and eat it too (Interview, seed firm manager, December 2013, Chile).

There was a sense that workers have a responsibility to the development of the region and should take that into consideration before they act. One local expert said,

We are the ones that are going to lose, not the companies. Because the companies employ 1,200 people here. That advantage that we have as a serious country...we have to protect it...take care of it...maintain it. We can't take that for granted. That's why it makes me mad when a Congressman comes out against the companies...he needs to say, 'you know what Arica, we have spent 30 years being ignored and taken for granted, and now the companies have arrived. Let's take care of them. We should do this and that. Keep tabs on things, admit when we make mistakes, keep tabs on each other, come together to protect things.' But it doesn't happen (Interview, Local expert, November, Chile).

Firms used the threat of leaving as a way of staying. They used it to leverage their power, trying to influence the wants and demands of workers, as well as the potential sanctions of local regulators. They employed this strategy to discipline workers and the state, particularly when negotiating with the unions. One union leader recalled that when they organized the union,

shit hit the fan...it was a disaster for about a month. A lot of people were speculating, the firm turned the supervisors loose and started talking about letting people go...they said they were going to close the company. We all knew these threats might come up. That's why we took our time preparing and preparing the workers.

There was a moment in which the company came to one of the union leaders and suggested they figure things out in private. By attempting to find a private way to deal with public issues, firms tried to control what, if any, issues reached a more public decision-making arena.

They wanted to change my salary. Increase my salary and offer me a new position. It was very indirect. They didn't come right out and ask me to leave the union, but it was understood. It came at an important time, a critical moment. I immediately said no. It was one of those things we were prepared for...we knew it could happen. But it makes you nervous, you know... it generates a lot of mistrust (Interview, Worker, December 2013, Chile).

Divergent paths: A conciliatory approach or an authoritarian stance

The two firms took different approaches to resolving tension with the unions. The collective bargaining agreement ended up going relatively smoothly at Syngenta. Syngenta workers felt that the fact that workers at Dupont-Pioneer had gone on strike first and had such a public clash with the company had worked to their advantage. They felt that waiting to collectively

bargain had been strategic. But the community relations manager remembered the process somewhat differently.

They wanted a 3.000.000 pesos (roughly \$4,300 USD) end of conflict bonus....like they get in mining. The manager at Syngenta handled this well. He said, 'I can pay you the 3.000.000 pesos and we close the plant or we negotiate the other things on your list and you keep working.' He said, 'I've calculated the salaries and that's what I pay. What do you want?' The Central Workers Organization (CUT) who was providing the union with support in the negotiation said, 'don't be idiots [huevones]. In Arica we've never had these salaries, training, contracts, do you want to lose everything?' So they negotiated (Interview, Community relations manager, November 2013, Chile).

This exercise in collective bargaining offers an example of how negotiations often takes place on an unequal playing field. The union presented this as a successful case of collective bargaining, and certainly it was when compared to the case of Dupont-Pioneer. However, it also exemplifies one of the ways in which firms use their power to determine which potential grievances are addressed and which ones are kept out of the decision-making arena.

While the union and management in Syngenta negotiated upfront, things in Dupont-Pioneer were markedly different. According to one local seed expert, Dupont-Pioneer managed things poorly. On Palm Sunday, the workers took over the cathedral in Arica. The expert recalled mentioning the contentious event to a manager at Dupont-Pioneer, whose response was, 'I don't work Sundays. I'm a scientist, not a politician.' The expert offered to help get conversations moving with the local government to address the labor issue. While Syngenta took this route, initially Dupont-Pioneer resisted. As the expert recalled, the manager said he/she didn't want to get involved in politics and that meeting with the Governor would be just that. After Syngenta reached an agreement with their union, then Dupont-Pioneer reconsidered and sought a meeting with the local government in Arica. As the expert recalled, "In the end they talked. I guess the Governor asked Dupont-Pioneer to send him the worker's demands. And they refused to send

them, saying they were confidential! And they wonder why it ended so badly” (Interview, Seed expert, November 2013, Chile).

The union in Dupont-Pioneer took a different route. According to one government official there was no possibility of dialogue in the collective bargaining process between the union and Dupont-Pioneer. The firm refused to meet with the workers to talk so the workers took a hard stance. They took over the property and the police intervened because they were burning tires and blocking entry to the fields. They were strategic and took over the property when the management from the U.S. was visiting. They also took over the cathedral in Arica and the one in Santiago on Easter Sunday. One government official recalled,

The strike affected everyone. It radicalized everything. We mediated at first, it was a failure the second and third time that we sat down to negotiate. They finally signed an agreement. At first the collective bargaining agreement petition had 39 items and they kept reducing them. There were gaps between what they asked for and what they got. At the regional level we've never lived anything like that before. They asked for 100 and got 20. It was exhausting...a process that wears you out (Interview, Government official, November 2013, Chile).

Another government official detailed his office's role in the process of mediation. First, he explained that in Chile, there is a five-day mandatory period of mediation, after which it is voluntary. The labor office serves as an impartial third-party that tries to help the conflicting groups or individuals reach an agreement, particularly on the key issues within a collective bargaining agreement. He mentioned three key issues. First, salary readjustment, which is important because it affects workers' monthly incomes. Second, other economic benefits like bonuses, are less important because they tend to be one-time events. Finally, the end of conflict bonus. He went on to discuss the importance that end of conflict bonuses have in Chile in terms of addressing income inequality.

In Chile, in the mining sector these are legendary. Workers can get up to 15 million pesos (roughly 21,800 USD). I'm not so critical about workers getting these. They work at high altitudes, are away from their families for long periods of time, it's cold, they work at night. I don't blame them for taking advantage when they can. And in Chile, the collective bargaining agreement is the only instrument that seeks to redistribute wealth. It's a huge deficiency in Chile. There is a small group of people that has most of the wealth. People keep waiting for the trickle down to happen, but it never does. Or it seems to always trickle down in the same direction if you know what I mean (Interview, Government official, November 2013, Chile).

The collective bargaining agreement was ultimately more beneficial to the firm than it was to the workers. It locked workers into a stagnant situation for four years, the maximum duration. The outcome meant not much money or validity for the union, after taxes, the 22 days of work were discounted, and the lawyers were paid, workers went home with less than \$100 USD each, which significantly undermined the validity of the union in some workers' eyes. The lawyers, on the other hand received \$30.000.000 pesos (roughly \$44,000 USD).

During my time in Arica, many people brought up accusations of the firm buying out union leadership as it all turned over after the strike. In Chile, union leaders are protected by law from firing during the duration of their term; however the union president left the firm and the others who remained in the firm did not hold union leadership positions after the strike. The human resources data I reviewed while I was in Arica still showed union leaders as employees; nevertheless I was unable to verify whether they remained on the payroll and why, or if the data I received was outdated. The firm told me that the leadership resigned. The union continues to exist, but with different leadership. In 2016, the union president had "slave" at Dupont-Pioneer listed as his job on his facebook page.

The strike in Arica also had other repercussions. A number of legal actions came out of the strike and served to instill legal and social intimidation and to discipline workers and local-level

government agencies. The firm began a series of lawsuits, several of which went to the Supreme Court level in Chile, and some workers lost their jobs. As one government official recalled,

[The strike brought] lawsuits on all sides from Pioneer. Every week there was a new one, every week their fancy lawyers would fly in from Santiago. It was a ton of work for us, for everyone. A big headache. It was inconceivable. We all knew the company didn't have financial problems. It was about power, that's all. They just wanted to fight and find a way to make up anything they lost in those 22 days of the strike. They went over the top with the lawyers, lawyers for everything. It was terrible (Interview, Government official, December 2013).

So when threats of sanctions initially did not deter workers, firms took overt action to defend their right to operate by replacing striking workers. One of the major reasons for the clash between the local-level government and seed firms was a citation for anti-union behavior. The labor inspectorate cited Dupont-Pioneer for anti-union behavior when they replaced striking workers with workers they bused in from Santiago (about 30 hours) before the law allowed striking workers to be replaced. The law allows the firm to replace striking workers on the first day of the strike if the last offer of the firm meets certain conditions. In this case it did not, so the firm, by law, could replace workers on day fifteen. However they replaced workers on the eighth day.

The case went all the way to the Supreme Court where the firm eventually won through a legal loophole. The firm relied on a preexisting bias within the legal system – a system known to be unfriendly to unionization – in order to oppress the threat that the strike held for them. As the Supreme Court saw it, the firm didn't hire new workers, it just shifted around workers it already had. The court interpreted this as legal, despite earlier rulings that found it to be explicitly against the law. The labor inspectorate however felt otherwise.

Sometimes we don't agree with the courts. At times we see some practices as anti-union behavior and they don't. We still believe in our vision. ...we say A, the courts say B. ...At the end of the day they are political decisions. The rules are clear, but the courts find a loophole to have a different outcome. We don't agree with several laws regarding unions because they are such weak laws. In some cases you just can't do anything about it. Strikes, for example, they don't work at all after fifteen days. If they don't come to an agreement before fifteen days there's not much you can do because companies can replace striking workers after day fifteen (Interview, Government official, November 2013, Chile).

The firm also sued the labor inspectorate, saying that it should not intervene in the next collective bargaining agreement. However, in the middle of the lawsuit they changed their mind and withdrew it. Then the firm asked for a protection remedy saying that the labor inspectorate should have done something when the workers blocked the road. They also withdrew this. The lawyer for the labor inspectorate said,

it was an aggressive strategy on their part. There were so many lawsuits that their lawyers came once or twice a week from Santiago. That meant flights, hotels, lawyer fees...it was crazy. We couldn't get any work done (Interview, Government official, November 2013, Chile).

In addition the company presented a criminal complaint against the labor inspector that went to verify the anti-union behavior, saying that she lied and that lying in a public position is a crime.

One government official intimated,

the idea of the company was to scare us. It was a threat. To intimidate us, to teach us a lesson that the next time we went that we should be prepared... Two weeks ago the case was presented and was dismissed due to lack of evidence. It was a threat (Interview, Government official, November 2013, Chile).

This threat seemed to have a disciplinary effect on officials. Another official went on to say,

If we need to look into something again with that company, we're going to be extra careful... it's like a marriage, you know that at the end of the night you have to sleep in the same bed (Interview, Government official, November 2013, Chile).

Following the strike, the company also sued the labor union because during the strike they blocked the road, burned tires, and committed some acts of vandalism. The lawsuit ended in an agreement in which the union asked for public forgiveness in the newspaper, an act that served to

signal firms' power to the community, as well as humble and discipline workers. They took out a whole page. One government official lamented the events,

They killed the union, little by little. The secretary of the union was accused of sexual harassment a few days after being elected, about the same period they started the collective bargaining process. According to the worker the whole thing was a set-up. We investigated it. Not the sexual harassment, but the fact that they told him he was accused of sexual harassment and had 10 days to defend himself, but they wouldn't tell him who accused him of sexual harassment or when it supposedly happened. The denial of the right to defend himself was the thing that we investigated. We fined them and we won that in court, but they appealed and took it to the Supreme Court level. They started from the basis that he was guilty. I don't know, but given that he was a union leader, it makes you think that they just wanted to get rid of him. He was condemned to pay a \$1.000.000 pesos (roughly \$1,400 USD) in costs. He had to pay the legal fees of the firm. He didn't appeal because the lawyer said he couldn't do anything more for him. After that the company put in a petition to take away his legal protection [because he was protected by law since he was a union officer]. Once that was done, they fired him. Eventually the union President couldn't cope with the pressure and he left too. Some say the company paid out his contract (Interview, Government official, November 2013, Chile).

According to one local seed expert the firm also had other ways of punishing union activists.

Pioneer closed a program in Arica. 34 people were fired the month after the strike. I think it's related. Revenge...it's too much of a coincidence that the people most involved in the strike worked in that area and lost their jobs. You tell me (Interview, Seed expert, November 2013, Chile).

This expert was one of three to link the transfer of this program to Puerto Rico as an act of retaliation. Although there was one firm manager who claimed that the program was moved because the regulatory environment in Chile required much more paperwork for this particular program than Puerto Rico.

Ultimately, firms relied on a coercive strategy that leveraged the threat of taking away good jobs to elicit a disciplined workforce and a more amenable regulatory environment. They also relied on a legal system that is unsympathetic to union organizing and whose regulations were

largely crafted during a repressive dictatorship to set the terms for bargaining with organized workers.

Conclusion

Although Arica posed clear challenges for firms in terms of its unclear biotechnology framework, its organized workforce, and increasing costs, firms made an active choice not to leave. However the two companies took different approaches to staying. Syngenta took a rational cost-benefit approach. They negotiated with union workers by offering to give them more benefits in lieu of a salary increase. In many ways the negotiation that the firm offered workers, was a fictitious one, one without choice; accept our offer or lose your job. However their approach was perceived by the broader community as reasonable and in the interest of developing the region.

Dupont-Pioneer took a more authoritarian path, one of non-negotiation, which elicited further push-back from workers and local regulators. The firm confronted this with aggressive legal tactics and by actively instilling a corporate culture that institutionalized unequal power relations. This staying strategy encouraged more labor control – increased supervision, bureaucratization, deskilling, and surveillance. In doing so, they alienated the local community and undermined local authorities' power, appealing to the federal level. Here 'seriousness' sets the parameters for development; it prioritizes firms' right to operate over the rights of other stakeholders. This approach provokes tension between the states' role as a guarantor of political freedom and the neoliberal economic principles that have guided Chile's growth since the late 1970s.

Much like the case in Hawaii, Arica highlights the tensions and contradictions among different layers of the state, something that is often glossed over in theoretical discussions about the role of the state in a globalized society. States are instructed to promote economic and job

growth – which often means attracting business and jobs, offering tax breaks and protecting and enforcing intellectual and private property rights. Yet they are also mandated to regulate industries to make sure they abide by guidelines to ensure healthy communities. States also make and interpret the rules of the game through legislation and the courts. However the state is not monolithic. It has multiple levels and its institutions often represent competing interests. Firms exploit these tensions. Through the use of litigation, firms seek to keep governance at the federal-level because these structures are often more supportive of industry and are easier to lobby and predict.

In the cases of Hawaii and Arica, firms relied on the federal government as their ally, whereas workers and local institutions turned to the county or municipal-level governments to represent them and push their claims forward. This is important for understanding how regulation works at different levels, but also in talking about power relations, governance, and potential for change. While local authorities have often gained more responsibilities under decentralized models of government that accompanied neoliberalism, in many cases – including Hawaii and Arica – local-level governments do not have the power to enact changes or to enforce regulations that are unpopular with powerful actors such as transnational firms. In the previous chapter we saw this through the county's attempts of passing new laws to regulate pesticide use and GMO safety in Hawaii; in Arica, we see it through the labor inspectorate's frustrated attempts to enforce labor rights in Chile.

Despite numerous similarities, the cases in Hawaii and Arica portray important differences. Unlike Hawaii, the resistance in Arica was very localized. The strike and legal battles received little national-level attention and no international recognition. As such, communities were unable to capitalize on outside advocacy networks which limited their visibility and made establishing

legitimacy beyond local communities difficult. In Hawaii, firms relied on a staying legal strategy that shifted the debate from one over environmental concerns to one over the technicalities of governance. In Arica, one firm's took an adversarial legalism approach (Kagan 2001) to staying, asking the courts to interpret labor laws in their favor, while at the same time, using the law to discipline labor unions, labor organizers, and the local labor inspectorate. While community and workers' demands were not fully realized given the structural impediments they faced, it is not insignificant that the labor unions they organized continue to exist. In both transnational seed firms in Arica, unions are active in mobilizing to protect workers' rights. In addition, the labor inspectorate actively supports them by providing training and by accompanying them to meetings with firm managers to negotiate the shape of the local regulatory regime.

In the coming chapter, I will explore the final case, Puerto Rico. It is an extreme case, which lies at the other end of the power spectrum from Hawaii. Here, given the dire economic situation, communities and local authorities seem unable or unwilling to negotiate the conditions of their regulatory regime with seed firms. On the contrary, in Puerto Rico, firms are welcomed by the state and a local community, who see them as sources of jobs and as economic engines of development in an era of extreme fiscal austerity and economic depression. As such, firms' rely mostly on a shaping strategy that is cooperative and proactive as a way of maintaining a regulatory context that deeply benefits them. However, while Puerto Rican communities do not appear to actively organize and mobilize observable push-back against firms, this seeming quiescence should not necessarily be interpreted as consent.

CHAPTER 5. Puerto Rico: Regulatory Predictability in the Face of Fiscal Uncertainty

In Puerto Rico, firms conducted the shopping, shaping, and staying process in a context of regulatory predictability but fiscal uncertainty. The webpage for Business in Puerto Rico reads like a glossy travel magazine luring a pallid Midwestern tourist in the depths of winter in an all-inclusive paradise at bargain basement prices. Puerto Rico is proposed as an investor's dream, offering clear competitive advantages, solid infrastructure, a skilled bilingual workforce, a strong institutional framework, and a robust legal system. "Few places on earth offer a return on investment the way Puerto Rico does" (Business in Puerto Rico n.d.).

The island offers all of the advantages of the U.S. mainland, but with the added benefit of aggressive tax incentives, no federal income tax, and the lower wages and costs associated with a developing nation. This set of characteristics can be partially attributed to Puerto Rico's position as a commonwealth established by the Federal Relations Act in 1950. This arrangement allowed the island significant autonomy in local matters, while limiting its power to govern issues such as defense, external trade, and international relations. This in-between status – neither state nor sovereign nation – allows the federal government to benefit from its strategic location and local resources, while not enfranchising local populations or providing them with the same rights as states. As we will see, this power inequality has shaped local development trajectories.

Today Puerto Rico offers significant incentives to firms as a way of attracting long-term investments and jobs to the island. These incentives are of crucial importance given the 13.7 percent unemployment rate and the striking 44.9 percent poverty rate that is twice that of the most impoverished state in the U.S. (Bloomberg View 2015; Foxman 2013). While some see Puerto Rico's industrial policies as strategic, others view them as a sign of dependence and vulnerability,

leading skeptics to refer to Puerto Rico “as America’s own Third World country” or “Puerto Pobre” (Long 2012; the Economist 2013).

Puerto Rico’s economy has been a topic of much debate in recent years, not for its beneficial tax incentives for businesses, but for its dire financial situation. Public debt has risen from 60 percent of the gross domestic product to more than 100 percent since 2000 (Bloomberg View 2015). In February 2015, Standard & Poor reduced Puerto Rico’s credit rating by three levels to the lowest ranking (Kase 2015). As earlier predicted by Moody’s Investor Service, Puerto Rico defaulted on \$174 million in debt payments in January 2016 (Williams Walsh 2016). Today even debt restructuring through bankruptcy seems improbable, as Puerto Rico’s commonwealth status would require passing an amendment to the federal bankruptcy code to treat Puerto Rico as a state under chapter 9. Given this ominous economic backdrop, it is surprising that substantial tax incentives for businesses have remained in place despite severe government spending cutbacks and recent tax increases of \$1.3 billion dollars in other areas of the economy (Larkin 2013). These policies have been part of Governor Padilla’s fiscal recovery plan in response to a decade of deep recession and a stagnant economy that have experts evoking comparisons to Detroit and Greece (Foxman 2013; Long 2012). While the sustainability of Puerto Rico’s economic policies is clearly worrisome, the benefits seem to outweigh the concern for seed firms.

Puerto Rico exemplifies an extreme case of firms’ localizations strategies, one in which communities and local authorities have little power in directing how this process unfolds given Puerto Rico’s economic and political vulnerability. As this chapter will demonstrate, two main factors contribute to Puerto Rico’s lack of power in this scenario. First, Puerto Rico is confronting a devastating economic situation. The increasing public debt, high unemployment levels, extreme poverty rates, and few economic alternatives for jobs severely limit development trajectories for

the commonwealth. This puts seed firms in advantageous positions vis-à-vis communities and local governments. Firms offer jobs and economic investment that is very much needed locally, making communities and local authorities unwilling to challenge firms' power. Second, Puerto Rico suffers from political vulnerability which further contributes to its fragile economic state. Puerto Rico's status as a commonwealth puts it in an unequal power relationship with the United States, restricting the economic and political decisions it can make. This neocolonial relationship contributes to the institutionalization of a type of dependent development (Evans 1979), resulting in a complicit state and compliant communities whose actions serve to deepen power inequalities in favor of firms.

Puerto Rico's approach to development was rooted in a neocolonial relationship that prioritized giving economic benefits to corporations as a way of spurring growth; though in the long-term, the strategy more often generated dependency. As Dietz (1986: 207) chronicles, "to get U.S. capitalists to invest, Puerto Rico had to be made *irresistible*. The enhancement of the investment and profit opportunities is the story of the development program from the late 1940s to the present." Puerto Rico's journey to irresistibility was made by offering rent subsidies, federal tax exemptions, the Industrial Incentives Act which extended additional tax exemptions to specific industries, work-training programs, and low-interest loans. Despite the fact that producing in Puerto Rico was four to five times cheaper than producing on the mainland in the decades prior to 1970 (Rivera-Batiz and Santiago 1998), these policies were seen as necessary to counterbalance relocation costs and subpar infrastructure.

Together these policies made up Operation Bootstrap, a program whose slogan was "industrialization by invitation" (Dietz 1986). Much like today, the financial press advertised Puerto Rico as a "taxpayers' paradise" offering "bounty for industry," (Perloff 1950 cited in Dietz

1986; Gensler and DeMuth 2015), making clear the unequal power relations embedded in the process of developing industry at the expense of local communities. As a result, Puerto Rico became the poster child for economic growth in the 1950s-1970s. It was “a shining example of how political stability, democracy, and open-market economic policies” translated into robust growth (Rivera-Batiz and Santiago 1998). The environment was particularly attractive for light-weight assembly manufacturing operations. Manufacturing plants increased from 96 in 1950 to 910 in 1963 (Dietz 1986).

In the mid-1960s, Puerto Rico began targeting more capital-intensive firms in an attempt to diversify its economy and to become more resistant to the ebbs and flows of the mainland economy. Unfortunately this strategy proved unsuccessful. The boom period came to a close in the 1970s when the U.S. economy entered into recession. Unemployment skyrocketed from 5.6 percent in 1970 to 24 percent in 1983 (Rivera-Batiz and Santiago 1998). The reaction to the crises was to enact laws that would incentivize firms to stay in Puerto Rico, while encouraging new firms to invest. In 1976 the Tax Reform Act replaced section 931 with section 936. This allowed subsidiaries of U.S. companies in Puerto Rico to repatriate income generated from their investments on the island to parent companies on the mainland tax free. Their only obligation to Puerto Rico was to pay a 10 percent “tollgate” tax on the dividends paid. The tax was reduced to less than 4 percent if some of the earnings were invested in bonds and certain types of bank deposits.

Pharmaceutical firms were among those who benefitted most from these tax policies, receiving half of all section 936 benefits, equal to three times the wages paid per employee (Dietz 2006). By 1990, over 80 percent of the most prescribed drugs in the U.S. were manufactured in Puerto Rico (GAO 1992). Unfortunately these and other policies, while they initially attracted

more capital-intensive industries, such as the pharmaceutical industry, they did not expand the growth of the economy and were also highly sensitive to U.S. business cycles (Dietz 1986; Weisskoff 1985). The U.S. recession in the early 1980s provoked massive unemployment and closures of plants in Puerto Rico, but investment incentives for U.S. firms continued to dominate industrial policy until the mid-2000s. Still, for firms considering locating in Puerto Rico, the financial benefits generally outweigh the potential risk from the uncertainty of the local economy.

An investors dream, shopping for comparative advantages

The first seed companies came onto the scene in Puerto Rico in the 1980s as a way to diversify their winter nursery operations in Hawaii. While firms were attracted to Puerto Rico because of the climatic advantages it offers with three to four growing seasons per year, the cost advantages and a U.S. regulatory system were also crucial (Ipsen 2016). All of the firm managers in the five major seed firms interviewed in Puerto Rico stressed the importance of being part of the broader U.S. regulatory system (Interviews, seed firm managers, November 2014, Puerto Rico).¹³ One manager laid out some of the basic costs and benefits for siting seed R&D in Puerto Rico.

[Puerto Rico] remains one of the best options for [R&D in] seed companies. It is part of the U.S. – the same regulatory framework – USDA, EPA... we can plant twelve months a year, there is available skilled labor, and we have next day shipping [to the mainland]. No other place has that! That is why Puerto Rico is the biggest R&D site in everything, in land, seeds... (Interview, seed firm manager, November 2014, Puerto Rico).

Managers differentiated Puerto Rico from the other U.S. R&D hub, Hawaii, in three key ways. First, they highlighted the availability of labor, both highly skilled and temporary workers. “Hawaii is expensive and they have a hard time finding workers. Puerto Rico has more people, skilled people, bilingual, even the lower level workers often have degrees; the university is close-

¹³ All interviews in Puerto Rico were conducted in Spanish and translated to English by the author.

by” (Interview, seed firm manager, November 2014, Puerto Rico). Second, they pointed to a cooperative environment in which the state and local communities contribute to their success instead of thwart it.

We don’t have problems with the community. Sometimes people protest in San Juan, in bigger places or about Monsanto, but not here. This government has been explicit in supporting us. We bring employment to the community. In this area unemployment is high, in Salinas it is 25 percent (Interview, Puerto Rico manager, November 2014).

The relative isolation of seed firms’ R&D facilities in Puerto Rico – in a largely rural, poor backdrop – facilitates and smooths the production process for firms, as communities here are less likely to have other employment alternatives and are also unlikely to be part of larger networks of power that might mobilize to oppose this type of work.

Finally, they pointed to their proximity to U.S. markets. Seeds can be moved quickly through direct flights to the mainland. It is less than five hours to Chicago by plane, something that Hawaii or Chile cannot offer (Interview, Puerto Rico seed manager, November 2014). One Manager pointed out that Mexico might be closer, but it does not have the advantage of U.S. laws and it does not permit GM corn production (Interview, seed firm manager, November 2014, Puerto Rico).

While seed companies were drawn to Puerto Rico because of its long growing season and the U.S. regulatory environment, they started out incrementally here much like other R&D sites. It was seen as a cost-effective alternative to Hawaii to diversify winter nursery activities, helping firms distribute the risk of a potentially uncooperative natural environment (pests and rain), as well as a potentially uncooperative sociopolitical one. Puerto Rico was significantly cheaper than the mainland or Hawaii. It had abundant high-quality labor, high unemployment rates, and large government incentives (taxes, rent subsidies, and a wage level for agriculture that fell below the federal minimum wage), contributing to firms’ already existing superior bargaining resources.

Labor is a particular area where firms save costs. Seed firms in Puerto Rico pay a minimum rate of \$5.25 per hour. After wage subsidies, they pay \$2.73 per hour, a cost savings of more than 60 percent if compared to the Federal Minimum Wage. The manufacturing sector reaps similar benefits from wage savings. “Compared with the U.S. mainland, the average cost of a Puerto Rican worker in manufacturing is about 65-70 percent of what a company would have to pay there” (Caribbean Business n.d.). Despite Puerto Rico’s clear advantages, firms are limited to how much they can increase operations here due to the islands’ small size and limited available land. In addition, the volatile and fragile local economy is also a risk that may well translate into fewer financial incentives if budgets are reallocated and existing power imbalances are disrupted.

By the late 1980s, two major seed firms had a small presence on the island, but as biotechnology came onto the scene in the late 1990s, there was a push to expand to new locations that would help to achieve the speed to market necessary to ensure returns from intellectual property rights. Growth intensified as the location proved itself valuable to firms. By the mid-2000s all major seed industry players were thriving in Puerto Rico. As more seed firms established R&D facilities on the island, they sought to deepen their power and presence as a group. In 1995 these biotechnology companies came together to found the Puerto Rico Agricultural Biotechnology Industry Association (PRABIA). “Its main function is to promote the development of the research and production of genetically improved seed in Puerto Rico” (PRABIA 2009).

The same year the program Bona fide Farmer was instituted by the Department of Agriculture in Puerto Rico. It was initially developed for agricultural producers to revive local agriculture. After significant lobbying, seed companies later qualified for the program (Interview, seed firm manager, November 2014, Puerto Rico). The most important benefits of this program include: 1) salary subsidies for field workers (equivalent to \$2.52 per hour); 2) local and state tax

exemptions; and 3) the opportunity to qualify for the program of agriculture incentives program. Under this program the Department of Agriculture of Puerto Rico (DAPR) covers 50 percent of the cost of authorized agricultural investment projects up to \$20,000. Today all of the seed companies in PRABIA receive salary subsidies, while seven of nine reported receiving tax benefits (Segarra Aknestuca n.d.).

In 1996 there was an important change in tax incentives offered to U.S. firms in Puerto Rico. Congress decided to phase out Section 936 over ten years, which further shifted Puerto Rico's economy towards less labor-intensive manufacturing such as apparel and more capital-intensive investments like those in the pharmaceutical industry. However, local leadership continued to see tax and other incentives as essential to attracting investment to the island. They could no longer offer federal-level tax incentives, but they found ways to ensure that some tax deferral policies and local tax incentives remained in place (Gerow 2014). These initiatives were not enough to keep the pharmaceutical industry here, as many point to the decline of the industry in Puerto Rico post-2006.

Shaping Puerto Rico through tailor-made legislation

Seed firms played a significant role in shaping the development of new laws that would economically favor them. The presence of the seed industry was consolidated in the 1990s and took off in the mid-2000s. The effects of firms' ability to shape their environment were clear. Between 2006 and 2010 the acres planted by seed companies in Puerto Rico increased by 58 percent, at an average rate of 12 percent per year. In 2010, the operational budgets of the companies in agricultural biotechnology ascended to \$74.6 million, while capital investments surpassed \$10 million. Capital investments reached 26.5 million in 2012. Employment also drastically increased. It tripled from 2006 to 2010 – from 188 permanent employees to 572. Temporary employment in

the sector in 2010 was 2,482, making the total number of employees in these firms equal to 18 percent of agricultural employment in Puerto Rico as a whole (Segarra Aknestuca n.d.). The annual growth of the industry has been 17 percent in both 2008-9 and 2009-10. Its growth coincides with the establishment of several beneficial programs and laws that directly benefit seed firms.

In 2009, Puerto Rico's new governor, enacted two major laws intended to boost foreign investment by reducing income taxes on returns in real estate and passive income, almost to zero (Government Development Bank of Puerto Rico 2015). Since 2013, a newly-elected administration, Governor Padilla, has brought major shifts to economic policy, increasing taxes on high-income, domestic earners, while shrinking public funding for schools and pensions. However, one element that has remained constant throughout the administrations (and over time) has been the tax incentives offered to instigate foreign direct investment (Slavin 2014). This is reflected in the recent blog post of the Executive Director of the Puerto Rico Industrial Development Company, where he writes that Puerto Rico is "a U.S. jurisdiction with the freedom to write our own tax code, a tax code that works for businesses" (Medina 2015).

Padilla and his predecessor, Fortuño, emphasized development strategies that call for deepening the shift from labor-intensive manufacturing to more knowledge-intensive industries. They have done so by targeting specific industrial sectors to increase their investments in Puerto Rico and by crafting policies that are not only favorable to them, but regulatory environments that seem to mirror these firms' needs and preferences. This may be reflective of some of the indirect mechanisms of powers' third dimension, in which the sense of powerlessness may lead to altered demands or an internalization of the rules of the game of the powerful as an adaptive response (Gaventa 1980). Today there are several programs and policies that establish favorable tax benefits for industries, particularly the biotechnology industry. Many manufacturing firms and some

pharmaceutical firms fled the island when tax benefits were initially reduced in 2006. But the seed industry, because it is focused on research and development, is seen as an industry that will bring high-quality employment and long-term investment to the island (Interview, seed firm manager, November 2014, Puerto Rico). Because they have Bona Fide Farmer status they have some incentives that were unavailable to manufacturing and pharmaceutical firms.

PRABIA and seed firms were active lobbyists in molding and passing three laws: Act No. 62, Act No. 73, and Act No. 20. In 2009, Act No. 62, the Business Promotion and Development of Agricultural Biotechnology Law, expanded agricultural biotechnology in Puerto Rico, seeking to make it “a mecca for seed companies.” It gave firms fast-track permits, facilitated the acquisition of appropriate facilities and infrastructure, and provided diverse financial incentives. Firms also promoted two other laws. Act No. 73, the Economic Incentives Act for the Development of Puerto Rico, which provided a favorable tax environment for direct foreign investment. And more recently, Act No. 20 of 2012, which provided attractive tax incentives for companies that establish and expand their export services businesses on the island. This law targets investments on research and development initiatives by granting credits and exemptions for these activities. Eligible investments receive a 50 percent tax credit; and scientific R&D labs pay a 4 percent income tax rate, while “pioneer” activities have a 0-1 percent income tax rate (Business in Puerto Rico n.d.). Seed firms molded local laws which promoted industry expansion and increased their socioeconomic and political power.

Firms’ privileged position in Puerto Rico created a participatory space within the state for them to shape laws to better meet industry needs. As Martinez (2011) explains, during public hearings only seed companies and government agencies with vested interests in the law testified. Act 62 mandates the Puerto Rico Industrial Development Company (PRIDCO) and DAPR help

firms obtain all permits in less than a year, otherwise they must compensate firms. It also cites the DARP as creating an “unnecessary bureaucracy” that discourages investments (Puerto Rico Legislative Assembly 2009).

This prompted some experts to express concern over the influence that seed companies have over the policies and laws that have been instituted in Puerto Rico in recent years. They claim that the law is written to suit seed companies’ interests. “If on the one hand you allow them to perform mass production and on the other you allow the law to be amended to meet their needs,” claimed Law Professor and Director of the Interamerican University's Environmental Law Program, Jessica Rodríguez Martín, “you are putting in their hands the power to manipulate our legal system to their liking” (Martinez 2011). One of the major advantages that the local government offers firms is tailor-made legislation that benefits the seed sector. This has consequences not only for the development of the local economy, in terms of what productive activities get prioritized and what types of firms receive special advantages and incentives, but also for local governance. This prompts several questions that are worth considering. Are prioritized sectors held to the same standards as others in terms of legal compliance and enforcement? Does the reliance on a few sectors limit the governments’ ability to mediate some of the potential negative risks that might accompany their growth? This shaping strategy has clear implications for environmental governance, as firms are active agents in co-creating laws that they explicitly benefit from and which may adversely affect others.

As a result of the productive relationship firm managers cultivated with the state, firms are offered 100 percent exemption on taxes for agricultural equipment and property taxes, a 90 percent exemption on contribution of earnings from agricultural activities, and a 50 percent tax credit for

eligible agricultural investments. While these policies target both research and development initiatives, as well as agriculture, the advantages extend beyond the financial benefits.

Monsanto, Pioneer Hi-Bred, BASF Agrochemical, Bayer-Crop science, Syngenta Seeds, and Rice Tec are among many seed companies that have found the island to be fertile ground for R&D with our tropical weather, consistent water supply, and ease of commerce with the U.S., attractive incentives and top-quality agricultural science talent. Due to weather conditions, four to five crops could be produced in a year, as opposed to the United States rate of one crop per year (Business in Puerto Rico n.d.).

The Business in Puerto Rico website advertises Puerto Rico as a place with “an appreciation for agricultural practices” and cutting edge technologies. These phrases may be interpreted by firms as promises of available infrastructure and highly educated bilingual laborers who are accustomed to long hours and to getting their hands dirty. The site summarizes the advantages in a succinct sentence. “If you are looking for a place with great weather, tax incentives, a U.S. jurisdiction, solid infrastructure, great human capital, and a propitious environment for Bio-Agricultural businesses, this is definitely the place” (Business in Puerto Rico n.d.).

Besides the local and sectoral advantages mentioned above, the Labor Department also offers benefits to firms. The Workforce Investment Act of 1998 is the primary federal program that supports workforce development activities, including job search assistance, career development, and job training (AMSI n.d.). In Puerto Rico, training and retraining activities of workers takes priority. Firms are offered up to 50 percent of the salary of on-the-job training and customized training programs. The program covers 100 percent of the cost of retraining for up to 50 percent of the salary of the participant during the training period. This adds up to significant cost savings as R&D facilities’ budgets are labor heavy. In interviews, seed firm managers estimated that labor made up somewhere between 50-75 percent of their budgets. Finally, the Puerto Rican Industrial Development Corporation (PRIDCO) offers rent subsidies for industrial spaces, such as laboratories. Two companies in PRABIA declared having received rent subsidies

under this program (Segarra Almestica n.d.). The government funded a biotechnology bachelor's degree program at the Catholic University in 2008-2010 with USDA monies (Ibid). Additional funding from the USDA was sought to continue the program. Its Biotechnology Center was developed with funds from the U.S. Commerce Department and the U.S. Department of Economic Development. PRIDCO provided the facility at a reduced rate, shaping the environment by subsidizing the training of future workers to meet firms' needs.

Managers recognized that maintaining fruitful relationships with local institutions was a central part of their job as it affected their right to operate. Despite all of the benefits that firms have secured from the state, the first challenge that all seed firm managers in Puerto Rico mentioned in interviews was the cultivation of a productive relationship with local government. They recognized that it takes a lot of time and effort, particularly when there is a change of power. While all managers tempered their statement by pointing out that the Governor was very supportive of the industry, they stressed that there were some local authorities and academics that were less sympathetic to the industry. "The relationship with that woman from Mayaguez [the Secretary of Agriculture] is less clear" (Interview, seed firm manager, November 2014, Puerto Rico).

This can create problems for companies. They have proposed taking away some benefits...and the 500 acres limit [a law from the 1952 Constitution that limits land ownership to 500 acres] has come up. The state rents the majority of the land. A lot of contracts are not being renewed (Interview, seed firm manager, November 2014, Puerto Rico).

This is where managers saw PRABIA's role as important. "Through PRABIA we try to secure the permanency, growth, continuity, and competitiveness [of the industry] and strengthen our freedom to operate within Puerto Rico" (Interview, seed firm manager, November 2014, Puerto Rico). We compete for resources, land, and skilled workers, but everything else we work

together on” (Interview, seed firm manager, November 2014, Puerto Rico). “We meet with officials and try to explain to them what we do and why GM is important. We are in constant contact. There’s a lot of misunderstandings. We do a lot of educating...even with the government” (Interview, seed firm manager, November 2014, Puerto Rico). Firms also cultivated relationships with the community. One manager said,

we go to schools to answer questions, help out with the science programs...you know, it is important. They are always coming to us and asking for help for something. A raffle, a donation, something. We are happy to do it. (Interview, seed firm manager, November 2014, Puerto Rico).

These relationships are instrumental to firms’ success as they provide a social and legal license to operate, tipping the balance of power in firms’ favor.

In light of these incentives, it is unsurprising that investments by seed firms in Puerto Rico have increased dramatically in the past five years. In 2011, Monsanto invested \$4.3 million to establish a biotechnology laboratory in Juana Díaz to develop genetically modified seeds. Economic Development and Commerce Secretary, José Pérez Rivera stated,

Monsanto's project is precisely the type of investment that the Government of Puerto Rico has fostered. This Monsanto investment serves to consolidate our position as an optimal destination for the bioscience industry, while advancing our mission to promote an innovation economy (Martinez 2011).

Dupont-Pioneer invested \$6 million to establish an agricultural biotechnology research laboratory in Salinas and AgReliant in Santa Isabel opened a development center for hybrid corn at a cost of \$800,000. More recently, in 2015, Dow AgroSciences expanded its operations in the Salinas/Guayama area to increase its R&D capabilities. The new site is a multi-million dollar investment, including 16 buildings covering over 70,000 square feet. “We see this opportunity as an additional economic development tool that will strengthen Puerto Rico’s R&D capabilities

towards the future,” explained Antonio Medina Comas, executive director of the Puerto Rico Industrial Development Company (Dow 2015).

The list of available programs and incentives specific to the industry helps us map the engineering of a “friendly environment towards biotechnology” in Puerto Rico. Firms and the state are active agents in this process. They have had a lobbying organization on the island since the mid-1990s. Through PRABIA, firms’ input was influential in extending the Bona Fide Farmer Act to seed firms and was a consideration in the crafting of new legislation in 2012 to promote the agricultural biotechnology sector. On another front, firms are embedded in the community through relationships with universities, local schools, and community organizations. During the last two decades the efforts to create a new development strategy for Puerto Rico frequently makes reference to the need to advance towards a knowledge-intensive economy and take advantage of the high-skilled labor force. The agricultural biotechnology industry has played an important role in that strategy. These recent programs and incentive structures illustrate how deeply embedded seed firms are in the industrial policies of Puerto Rico today. Seed firms are seen as the backbone of local development strategies and the programs have been clearly shaped by the needs of seed firms. Because there are few economic alternatives in the area, the local government is particularly attentive to creating a regulatory regime that will keep firms’ in Puerto Rico.

Staying: Risk mitigation or a vulnerability fix?

Puerto Rico has yet to confront a groundbreaking controversial issue that makes the local communities or the government challenge the industry. In this scenario, firms seem to rely on the maintenance of shaping activities, rather than an aggressive staying strategy. However all firm managers mentioned that the ongoing need to maintain the status quo requires a significant time investment on their part, more than in the past. Managers see their role in educating both new

government officials and those that are less supportive as critical to ensuring their freedom to operate in Puerto Rico, especially in light of Puerto Rico's economic austerity (Interview, seed firm manager, November 2014, Puerto Rico).

Puerto Rico is broke. If politicians create new taxes, the same thing is going to happen that happened with the pharmaceutical industry. They left because of the taxes. They went to the Caribbean where they didn't have to pay [taxes]. It's a worry...the tax burden...unstable government (Interview, Puerto Rico seed firm manager, November 2014).

The previous statement indirectly implies that if existing power relations are altered and seed firms do not continue to receive these tax benefits, they may look to greener pastures. However it is important to recognize that in the case of seed firms, relocation may be more complicated than in less place-bound industries. Seed firms, unlike the pharmaceutical industry, are not able to capitalize on a simple "spatial fix" (Harvey 2001) to geographically restructure production and mitigate risk since seed R&D requires a very specific natural environment in which multiple generations of seeds are produced within one year to capture technology rents (Ipsen 2016). Because R&D work is relatively place-bound, firms rely on what Collins and Mayer call a "relational fix" (Collins and Mayer 2010: 152). Firms satisfy their needs for profit accumulation and expansion by engaging in a range of race to the bottom tactics that place workers in vulnerable positions where many labor rights and protections do not apply. As Collins and Mayer explain in the case of workfare and prison labor, the conditions under which they labor are determined by their status as partial citizens and "failed workers who have relinquished their claims to certain rights and protections" (Collins and Mayer 2010: 153).

In the case of the seed industry in Puerto Rico, firms benefit from existing regulations and power relations that give them special privileges, creating what I conceptualize as a *vulnerability fix* much like Collins' and Mayer's (2010) relational fix. Here, firms rely on regulations that

capitalize on the flexible and partial citizenship rights of Puerto Ricans, keeping their job security flexible through outsourcing agreements and their wages below the federal minimum to ensure firms' profit margins remain high. Firms actively participate in the creation and maintenance of these regulatory regimes that generate growth for firms and local employment, while simultaneously producing a highly disciplined state and workforce that is both dependent and vulnerable. This creates a largely deregulated enclave of compliant workers and a complicit state.

Finally, unemployment has a crucial effect on the relationship between firms, workers, communities, and the local government. Seed firms are concentrated on the south coast where the climate is drier and soil is rich, but unemployment in this area is among the highest in the country (25.8 percent in Salinas). While all managers mentioned a supportive relationship with local communities, they also directly related the lack of push-back of communities to economic vulnerability and limited labor options.

They do not have the luxury to worry about and protest over things like GM or pesticide use like they do in other places. They are worried about meeting basic needs like finding employment and securing the necessities for their families, like getting enough to eat (Interview, seed firm manager, November 2014, Puerto Rico).

“The community is clear what we do here [for them]. The industry tries to extend that message” (Interview, seed firm manager, November 2014, Puerto Rico). Several managers felt uneasy about the ability to exploit even highly educated workers due to the economic realities of the area.

Yea, I still remember one woman who came here looking for work. She was a doctor. A doctor! And she was applying for a temporary field position. She needed to work, she had kids and just could not find work anywhere. It made me really sad (Interview, seed firm manager, November 2014, Puerto Rico).

This statement points to some of the disturbing externalities of high unemployment that potentially create wider equity gaps not only in relation to income and wealth, but also access to other fundamental long-term resources for healthy communities. It also makes evident firms'

advantageous position in terms of power. In this scenario, staying strategies are currently unnecessary as siting in vulnerable areas with chronic unemployment and poverty clearly shapes how communities and workers think about inequality and how they envision their options. This is a clear example of how Gaventa's (1980) first and third dimensions of power coalesce in practice.

Currently firms have not enacted an aggressive staying strategy, but still they are proactively protecting their financial interests. They are active participants in securing the many advantages of power and place that Puerto Rico offers them. They capitalize on their influential economic position to protect their interests through lobbying the local government and participating in PRABIA, and the Farm Bureau. The local Farm Bureau has been an active lobbyist in the battle to maintain tax benefits under the Bona fide Farmer Act. Seed companies are influential members of this association across the United States, including Puerto Rico, where the number one priority is biotechnology (Farm Bureau n.d). Local Farm Bureau President, Hector Cordero, lashed out in response to the recent value-added tax proposal that would include taxing agricultural products.

[The Farm Bureau's] legal and tax advisory team has sent the message to the lower chamber and the Treasury Department to extend the tax exemption to agricultural products, as highlighted in article 7, paragraph (a) (8), of Law 225, which disposes that bona fide farmers are exempt from paying taxes on items acquired for agricultural use (Sierra 2015).

Firms are confronting the uncertainty this provokes by taking a proactive approach that further embeds them into local networks. All firms mentioned cultivating ties with local communities by having a stronger presence in school activities, supporting local food pantries or 4-H groups, and offering tours of their facilities for the local community. Additionally, as a block, the industry giants hired a public relations expert as the Executive Director of PRABIA in November 2014. One of the criteria they searched for was someone with "good government contacts" (Interview, seed firm manager, November 2014, Puerto Rico). Having a productive

relationship with the local government enables firms to protect their interests and to maintain the benefits that come from existing power relations. Firms triangulate this expertise by build social capital on multiple levels. At least three firms have community relations managers on staff and several firms also have government relations personnel that develop productive relationships and oversee touchy issues at a regional level.

This proactive strategy may be as much of a reaction to the recent tensions in Hawaii as to those in Puerto Rico. The hiring of the public relations expert happened the same month that the ballot initiative was won in Maui County to place a moratorium on GM seed research. “We have a really good relationship with the community in Puerto Rico, but we want to make sure it stays that way. Prevention is important. We don’t want what happened in Hawaii to happen here and it could” (Interview, seed firm manager, November 2014, Puerto Rico). Firms embed themselves within the community by developing relationships with diverse local institutions as a way of securing a social license to operate which may be called on if needed to avert or quell opposition.

Despite the supportive environment for firms in Puerto Rico, there has been tension surrounding land issues in recent years as the industry has grown. Managers were reluctant to make a direct correlation between proposed expansion in Puerto Rico and the undesirable regulatory regime in Hawaii; yet the two firms that are directly affected by the moratorium in Hawaii said that their growth in Puerto Rico was “probably” a partial response to the situation in Hawaii. Firms’ proposed growth did not go unnoticed locally. Social media has played a role in pushing for more public conversations about the legal limits of agricultural land holdings. This is a particularly pressing issue since several firms expressed the possibility of expanding their facilities in Puerto Rico; however the 1952 Constitution limits land ownership to no more than 500 hectares.

Firms expressed different strategies for dealing with property law. All firms in this study operate on more than 500 hectares in Puerto Rico, but some do not own that much land, they rent it. Most firms own some land and rent the rest from private individuals and the majority from the government. The majority of firms openly discussed the quantity of land they rented, but some were reluctant to discuss the amount they owned. However most managers had no problem referring to the land purchases of their competition, making it easier to ascertain that at least two firms own more than 500 hectares. It is common knowledge that one firm divided its land holdings by purchasing land under two different subsidiaries, while another consulted the Secretary of Justice from the previous administration before purchasing a land holding that more than doubles the size of the legal limit in the 1952 Constitution. They were told “the law does not apply to industry only individuals” (Interview, Puerto Rico seed firm manager, November 2014). “It is an old law that was part of the agrarian reform. It was meant to ensure that people had access to land and to avoid monopolies... It does not apply to companies that rent” (Interview, seed firm manager, November 2014, Puerto Rico). This legal decision remains in force until another one is instituted.

However seed managers remain concerned. One seed manager mentioned that a lot of government rental contracts had not been renewed recently and that one seed firm had problems with the renewal of its Bona fide Farmer status despite having it for 18 years (Interview, seed firm manager, November 2014, Puerto Rico). According to him, these types of issues arose when local authorities were less supportive of seed firms, making it necessary to educate them in order to maintain access to benefits. Overall, the state has been instrumental in maintaining firms’ access to benefits by interpreting land laws to their advantage and by passing laws that favor firms’ expansion.

Both workers and the state are affected by the power relations embedded in the regulatory environment. Given the vulnerability of the Puerto Rican state, the incentives they offer to attract firms may become a double-edged sword, increasing the power of firms over the state, instead of simply serving to augment investments. This type of investment comes at a cost. It may institutionalize a type of dependent development (Evans 1979) between firms and the state in which the state subsidizes its own discipline, especially in regions that are suffering from greater economic and social marginalization. Firms may be the ones capitalizing on their investments, not the state, by tempering the behavior of local politicians, state regulators, and even workers at the expense of the state.

Conclusion

As this chapter has shown, Puerto Rico represents an extreme case of firms' localization strategies for GM corn seed. Puerto Rico's economic and political vulnerability has created a situation in which communities and the state are unwilling or unable to negotiate with firms over the shape and nature of their regulatory regime. In fact, the actions of communities and the local state often serve the powerful, deepening existing power imbalances, and thus, contributing to a model of dependent development (Evans 1979) that may not be in the best interest of Puerto Rico in the long-term. As such, it is not surprising that firms use Puerto Rico to discipline other R&D hubs within its corn seed operations. It is not a coincidence that after opposition was raised in both Hawaii and Chile, Puerto Rico expanded, whereas sites in Hawaii and Chile consolidated or decreased operations. After contentious acts that firms viewed as challenging their right to operate in both Hawaii and Chile, firms closed a R&D site in Hawaii and moved a program that was located in Chile to Puerto Rico. While managers were reluctant to attribute this as a response to community push-back, local experts in both places spoke openly of these acts as retaliation, a way of

disciplining workers, the state, and communities to obtain a flexible regulatory regime that actively bends and shifts to meet firms' needs.

CONCLUSION

This dissertation has shown how place shapes socioeconomic development opportunities for firms and communities. I have analyzed how transnational companies are rooted in specific places and why place matters to firms' success in the corn seed industry. I have examined the localization practices of the largest and most influential firms within the GM corn seed industry, that together control nearly 90% of the U.S. corn market. I have done this by conducting a multi-sited ethnography in the three main GM corn seed research and development stations for the U.S. market – Hawaii, Chile, and Puerto Rico – and in the headquarters of an industry leader in the Midwest. My findings contribute to two main areas of research. First, I examine the criteria that guide the GM corn seed industry in its selection of strategic R&D sites. I bring together location and rent theory to theorize which locales are more likely to generate place-based technology rents for firms and why. Second, my work offers a new way to conceptualize corporate localization strategies by going beyond how firms shop for regulatory regimes to discuss how firms shape regulatory regimes once sited. I incorporate theories of power into the literature on localization strategies, regulation theory, and regulatory regimes to show how firms' localization practices intersect with local governance and power.

To better understand how place serves as a mechanism to enable firms to maximize rent extraction in this industry, I explore the role that the biophysical characteristics of seeds and nature play in firms' localization strategies in an era of intense competition. I argue that technology shifts have not minimized the importance of place for high-tech seed firms; instead, place has become a vital mechanism for profit generation. GM corn seed firms choose R&D sites with particular natural and regulatory assets that allow them to grow and test seeds in multiple cycles per year. This enables them to speed up the development of new seed varieties and thus to more quickly

profit from intellectual property rights through place-based technology rents. I find that firms use their different R&D hubs to distribute risk and maximize rents. Each site possesses different strengths and weaknesses that firms balance to maximize place-based rents. For example, Hawaii offers rich policy subrents and resource co-rents, Chile provides high natural co-rents and relational subrents, and Puerto Rico is valued for its high policy and human resources subrents. Firms use each site's positive assets to balance its weaknesses – increased environmental activism in Hawaii, low human resource subrents in Chile (as demonstrated in the unionization of workers and the subsequent strike), and the unpredictable economic conditions, along with weather and pest risks in Puerto Rico. The interconnection of these different types of rents emphasizes the multiple ways that place matters to firms as they seek competitive advantage in the seed industry.

My dissertation also makes contributions to the study of corporate localization decisions and to regulation theory. My work problematizes the idea that regulatory regime selection is a decision made in a single moment in time. I find that regime selection evolves over the course of a long-term dynamic process, in which communities, firms, and the state engage in continual negotiation. I characterize the stages of the process as shopping, shaping, and staying. Throughout this process, firms seek to craft advantageous regulatory environments that ensure their right to operate by maintaining and leveraging their power in strategic ways. Communities and local states seek to carve out productive spaces inside these regulatory regimes to ensure that development occurs within a sphere that protects the long-term environmental and economic health of their communities.

Power relations in situations of inequality are another central theme in this dissertation. In general, the literature on localization strategies says little about power. In contrast, I use Gaventa's (1980) three-dimensional approach to power to shed light on the crucial role that power relations

play in firms' negotiation of their regulatory regimes. By overlaying Gaventa's three-dimensional approach to power onto the shopping, shaping, and staying framework, we see that firms' localization actions throughout these stages are not gratuitous; they are strategic, relational, and power-laden. Firms draw on the particular histories and political economies of place to protect their sunk costs. Each of the three cases in the study serves to illuminate the process by which local regulation gets made, who sits at the negotiating table, and how power relations are contested locally, influencing both the shape of regulation and environmental and labor outcomes. Because firms in this industry are somewhat place-bound, due to the fact that place is the necessary element in rent extraction, they have more vested interests in staying in very specific natural and regulatory spaces. As such, firms' shaping and staying strategies take on more important roles than regime shopping in their localization process.

As this dissertation has shown, it is in the shaping and staying stages that Gaventa's (1980) three mechanisms of power are most visible. First, firms shop for places that offer them superior bargaining resources – such as tax incentives, low land prices, and other economic and infrastructural advantages – but they also actively maintain this powerful bargaining position throughout the shaping and staying stages. Second, firms take actions in the staying stage to pre-determine the agenda of struggle. By determining whether certain issues ever reach the decision-making arena, firms are able to squash rebellion before it fully develops or to shift the debate in their favor, as in the case of Hawaii. Finally, in the shaping stage, firms' activities mold the needs, possibilities, and strategies of challenge in situations of latent conflict. To do this, they use the media to manipulate symbols and language and to control information. They also employ processes of socialization in the case of Chile, for example, to elicit a more disciplined, controllable workforce. By drawing on this three-dimensional approach to power in situations of inequality,

this study offers a deep sociological account of how and why firms locate in particular spaces to capitalize on the power advantages embedded in place-based political economic structures. And how communities negotiate and/or manifest opposition (or not) to these strategies. This is key for understanding how power shapes the possibilities for *local* participation in *local* governance, as well as labor and environmental outcomes.

This dissertation examined three instances of firms' localization strategies in the GM corn seed industry. Through these examples, I explored the conditions under which local communities were able to gain voice, or not, through place-based economic processes. The three cases I examined lie on a continuum in terms of the amount of leverage communities, workers, and local authorities obtained through their place-based resources in their negotiation with GM corn seed firms. I argue that Hawaii and Puerto Rico represent two extreme cases and Chile represents a middle-ground case. In each place, firms responded to a different issue and local regulatory regime by applying unique fixes. In Hawaii, firms relied on a staying local and legal strategy; in Chile, they gained power by employing litigation to discipline and threaten labor union leaders and the local state; and in Puerto Rico, firms drew on a "vulnerability fix" to achieve the regulatory regime that they desired.

Summary of comparative cases: Hawaii, Chile, and Puerto Rico

Between the three study sites, I find that communities in Hawaii were most successful in gaining some power in their quest to shape environmental governance. Initially they successfully mobilized to create and pass laws and ballot initiatives to change the local regulatory regime. Through this process, local communities and authorities created diverse networks and drew on the expertise and visibility of prominent advocacy groups. However, this process was highly contested, provoking multinational firms to take a coercive, reactive strategy for staying legal and

staying local. Firms used a staying local strategy to highlight and exploit pre-existing socioeconomic and political divides within the community to garner more support. When this was not enough to halt opposition, they used litigation to shift the debate from environmental safety to governance. They drew on their expertise and power within the courts to take advantage of the repeat player advantage (Galanter 1974) to temporarily, at least legally, dampen the debate and instill a barrier to regulatory change. Hawaii's moderate success in negotiation with firms over the shape of the regulatory regime can be attributed to three main factors: Hawaii's prominence as an elite tourist destination that is in need of ecological protection; the economic power that its tourism industry has in terms of generating jobs and fostering business development; and its access to highly-visible advocacy networks that serve to broaden the oppositions' stakeholder base, legitimize their claims, and assist with legal strategies and funding.

Chile is presented as a middle-ground case, in which the focus was on labor rights instead of on environmental safety. Here, two seed firms successfully organized unions to protect workers' rights. One union achieved a relatively uneventful collective bargaining agreement, partially meeting some of its goals. The other union, however, was confronted with a firm that was unwilling to negotiate. Therefore, workers chose to go on a contentious 22-day strike, ending with a negotiation between the union and the firm after both the state and the church intervened. While workers eventually achieved some of their goals, the reactive strategy that the firm took was highly coercive and punishing. In this case, the firm used legal strategies not to shift the debate as they did in Hawaii, but to discipline and retaliate against union organizers, workers, and the local state.

So while workers in Arica were somewhat successful in protecting their rights by organizing unions, they did not achieve the same level of visibility and were not given legitimacy by ties to outside networks as was the case for Hawaiian activists. The marginal socioeconomic

status of Arica within Chile was important in shaping this outcome. Arica is not a tourist destination, nor is it an economic powerhouse within Chile. Because Arica has historically been left out of Chile's economic development project and is isolated geographically, firms had more power here than they likely would have had elsewhere. Firms were able to largely contain media attention, thus limiting the ability of communities and local authorities to capitalize on the resources and networks of outside advocacy groups, as their counterparts were able to do in Hawaii.

Another significant difference between the cases of Hawaii and Chile lies in firms' approach to the local culture. In Chile, firms often sought to differentiate themselves and their behavior from the local culture, whereas in Hawaii they tried to appropriate it. Managers, mostly from outside Arica, frequently disparaged the local culture, attributing the areas' lack of economic opportunity and development to its backward values. They portrayed locals as undisciplined, unappreciative, and in need of guidance. In contrast, managers presented firms' actions as rational – the strong hand needed to lead the community into the age of modernity. Ultimately, Chile's authoritarian past, which continues to influence local regulation in the neoliberal era, limited the power that communities, unions, and the local state wielded.

Finally, Puerto Rico lies at the other end of the power spectrum. It is a case where the local state and communities did not organize major visible opposition against seed firms. However, as Gaventa (1980) points out, even when contestation is not visible or acted upon, it may be present. Here, relentless government austerity measures, together with high unemployment and poverty rates, and an ever-increasing public debt, serve to condition the behavior of local institutions in favor of industry expansion. Firms use this to their advantage to discipline the state and workers through a vulnerability fix. This strategy tends to deepen power inequalities between local

stakeholders and firms. As Lukes (1974: 23) posits, “the most effective and insidious use of power is to prevent such conflict from arising in the first place.” While Puerto Rico is a tourist destination like Hawaii, and the islands share a colonial history with the U.S., Puerto Rico’s in-between status – neither nation nor state – places it in a more economically and politically vulnerable position than Hawaii, creating a situation of highly unequal power relations and dependency. Puerto Rico’s territorial status limits both the actions the local government can take and the choices it has. In many ways, this status prevents self-determined action on the part of the commonwealth and its citizenry. This may limit the democratic experience out of which critical consciousness grows, leading to the internalization of the values of the dominant and a culture of silence (Freire 1972). In this case, Puerto Rico does not draw power or advocacy support from its tourist economy. The south coast, where seed operations are located, is not an elite tourism destination in need of international protection, like Hawaii. It is rural, largely Spanish-speaking, and economically marginal.

Discussion: Implications of corporate localization practices and power

The cases of Hawaii, Chile, and Puerto Rico show that the differential abilities of communities to push back is rooted in local histories of power inequality, in the resources that the local state and communities possess, in the networks to which they have access, and in their capacity to pursue alternative paths of development. While firms shape the regulatory context to develop an environment conducive to their productive and regulatory needs, local institutions also shape firms. They tend to be more successful in doing this when they are supported by allies and networks that offer resources, legitimacy, and visibility to their claims.

By bringing together the theories surrounding location choice, regulatory regimes, regulation, and power, my research draws attention to the interconnectedness between firms’

localization strategies, place, and environmental and labor governance. My conceptualization of regime selection as a process highlights the interactive and relational dimensions that are often missed by scholars who focus on one aspect of regulatory regimes. Focusing on the process of regime selection makes evident an element of temporality that is often glossed over in environmental governance. I contend that firms engage in different types of activities and leverage different mechanisms of power at different stages in regime selection. In the GM seed industry, firms' actions take on a more cooperative nature in the shopping and shaping stages, whereas they are inherently more coercive in moments of staying. This has practical implications for local governments and social movements, as well as for policy makers. By understanding why firms are drawn to particular spaces of production, communities, local authorities, and social movements can not only become better informed about firms' competitiveness strategies, but also they can better leverage the place-based assets that firms value at the negotiating table to achieve a more participatory regulatory regime that reflects their needs.

Finally, my research illustrates how firms' concerns over regulatory regimes extend beyond narrow economic considerations to include broader governance issues in which power is central. Through an incorporated comparison, my research documents the importance of power and place in shaping local regulatory outcomes. Despite belonging to the same federal regulatory context and sharing colonial histories, Puerto Rico and Hawaii presented different challenges for firms and thus seed companies employed diverse strategies to mediate them. In Puerto Rico push-back was largely tempered by high levels of unemployment and severe fiscal austerity – in part due to its neocolonial relationship with the U.S.– which firms capitalized on as a vulnerability fix to discipline and socialize workers, the community, and the state into compliance. This ultimately

kept communities and workers out of key decision-making arenas, giving quiescence the face of consent (Gaventa 1980).

In Hawaii, communities were concerned about the safety of pesticides and GM crops. Here, the increased visibility of the local regulatory struggle – due to the presence of important advocacy groups and Hawaii’s reputation as an elite vacation destination that offers pristine nature, exotic cultural vestiges, and an alternate source of jobs and economic investment – weakened firms’ power and offered a space, albeit somewhat contained, for participation and contention. Communities drew leverage from the natural and cultural assets partially rooted in tourism’s prominence in the local economy. This generated openings for contestation and negotiation with firms and the state over the shape of the regulatory regime. In response firms enacted a *staying local* fix that reflects one of the communities’ prized assets – its culture.

Chile is neither part of the U.S. regulatory environment nor a U.S. colony, but nonetheless is a useful comparative case as it enables us to see whether firms behave similarly in regulatory contexts outside of the U.S. Despite Chile’s different regulatory framework, firms’ actions in the country/ Arica largely mirror those taken in Hawaii and Puerto Rico. They exert their power to shop for, shape, and stay in regulatory environments that they see as advantageous to them. In the Chilean case, firms use this regulatory disadvantage – not being part of the U.S. system – as a pretext to continually elicit a predictable regulatory behavior that emulates the U.S. regulatory context and ultimately benefits firms. Because Chile’s economic success was initially, and in many ways continues to be, garnered by shaping itself to meet the needs of external markets under an economic model that was structured by an authoritarian regime, the state is complicit in disciplining local communities to protect the interests of transnational capital. While we see push-back at the local state level, much like in Hawaii, the courts in Chile take a more proactive stance

in protecting trade. In doing so, they construct an institutional barrier to regulatory change, setting the parameters for local development within the boundaries of a state with a pro-business labor code. The legal system in Chile prioritizes firms' legal right to operate over the protection of workers' rights.

By replacing a reductionist view of location theory with a power-sensitive political economic approach, my work shows that firms make location decisions as part of an ongoing, negotiated process. In this process, local institutions are not only shaped to meet the needs of firms, but as active agents they also set the parameters for belonging in their communities. In doing so, local institutions bring important governance issues to the forefront and shape transnational firms' actions, not only symbolically in terms of how firms frame their work, but also in terms of participating in more transparent reporting mechanisms of their pesticide use in Hawaii and in making communities and the state aware of local labor violations. These spaces of negotiation hold the potential for a different power relationship between communities, workers, the state, and firms.

Future research questions

By examining the factors that guide transnational firms in their selection of strategic R&D sites in the GM corn seed industry, and in particular, the strategies that local communities, authorities, and workers employ to gain more voice in the regulatory process, I have addressed two relatively narrow areas of inquiry. I have illuminated the complex role that place plays in rent extraction in the GM seed industry. I have also created a conceptual framework that helps us understand how local regulatory regimes are constructed, molded, and maintained through the interactions of diverse, and often conflicting, stakeholder groups. I have theorized under what conditions local communities and institutions gain leverage in negotiations with firms through place-based economic processes to make local governance more inclusive and responsive to their needs. At the same time, my dissertation raises a host of other important questions about regulatory

regimes, environmental and labor governance, as well as the seed industry more broadly, that are not addressed here. I will limit my discussion to what I see as three fruitful areas of future inquiry in the paragraphs below.

My analysis of the GM seed industry focused exclusively on R&D hubs for *genetically modified* corn seed for the U.S. market. However, in order to fully understand how technology and place matter for firms' competitiveness in this industry, we should know more about the productive processes and regulatory practices that firms use to research, test, and produce *non-genetically modified* corn seed, particularly because much of the world does not currently allow for the production and/or sale of genetically modified crops. Mexico is one such place where GM corn is currently illegal to produce. While a body of research has been conducted on corn in Mexico – particularly around the issue of seed sovereignty and the related social movements – little is known about three key issues: how the industry extracts and maximizes its rents; how firms engage in negotiations with the state and community actors over the local and national-level regulatory regime; and finally, when firms use litigation to shape the local regulatory context. Because the fourth major R&D site for seed corn in the U.S. market is in Mexico, and seed firms and Mexican communities have been active in using litigation, it would offer an insightful comparative case to the current study.

While this dissertation found place to be paramount to firms' ability to extract place-based technology rents, the value of place was rooted in the productive process tied to genetic modification. An unanswered question, therefore, is how to assess to what degree the technology itself influences the role that place plays in firms' ability to maximize rent extraction in the seed industry. Since technology is highly dynamic in this industry, better understanding the ever-changing relationship between technology, place, and regulation in multiple scenarios is key to

advancing our understanding on how high-tech industries maintain their competitiveness, but also to informing local communities and diverse social movements as to how they might create potential sociopolitical openings to engage in more meaningful negotiations regarding environmental and labor regulation and community development.

Second, with this in mind, researching technological innovation in the seed industry should not only interrogate new sites, but also new technologies. For example, the emerging genome editing technology, CRISPR-Cas9, offers a ripe area of research to ask not only how technological advances shape the importance of place, but also how they shape regulatory regimes. Understanding the process through which new technologies like CRISPR come to be regulated or unregulated, and subsequently how these regulatory decisions and emerging technologies affect industry concentration and competitiveness is helpful in comprehending the interaction between regulation, the state, and transnational capital. This also raises key questions about industry self-regulation, its effectiveness, and its broader implications.

As this dissertation discusses briefly in Chapter Two, the U.S. biotechnology framework is one in which firms largely self-govern and regulate their own actions. Here, much like in other high-tech industries, the rationale behind self-regulation lies in the idea that those best able to regulate the industry are those within it, as they possess a very specialized skill-set and the requisite deep pockets to finance it. The emergence of CRISPR offers an opportunity to revisit this debate which extends well beyond agricultural biotechnology to CRISPR's other uses in human research and in disease prevention. In the U.S., this type of research holds promise in uncovering answers to questions regarding how regulation gets made within a self-regulating structure. Outside of the U.S. this work offers great comparative potential to document how different regulatory approaches elicit differential impacts and implications. Further study on this topic will enable us to better

understand the process by which governments and transnational firms shape the direction of emerging regulatory issues and how these technological and regulatory shifts affect firms' competitiveness, local communities' sustainability, and farmers' livelihoods.

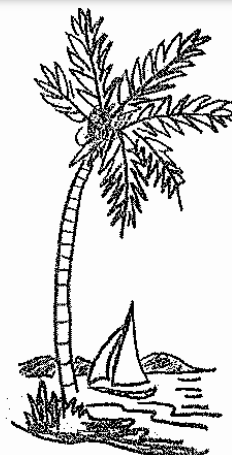
Finally, as this dissertation has shown, technological shifts in corn production were accompanied by intense concentration of the industry, but they were also accompanied by global expansion. In recent years, firms have broadened and deepened their reach by acquiring local seed firms, establishing their own operations in diverse countries, and/or forming joint ventures with other firms in large emerging market countries, such as China, India, and Brazil. While seed firms have historically preferred R&D sites with predictable regulatory regimes to develop new seed varieties, recently these firms have begun forming R&D hubs in sites without these features in order to access markets that otherwise would be off-limits due to regulatory and phytosanitary constraints.

In this case, firms prioritize locating in places where the market size merits the extensive financial, regulatory, and sociocultural investments needed to develop, test, and produce seeds specific to a country's natural environment. This innovation to firms' localization strategies brings with it new challenges for firms, as well as fresh areas of inquiry for researchers. For example, how do firms move technical production processes into areas that may not (yet) be ideally suited for them? How does this affect regulatory regimes, as well as states' development strategies, and communities' well-being? By seeking out places where the market – and not regulatory flexibility – is a driving force behind firms' localization strategies, this line of research can help us better understand how firms adapt to sites in which their social capital is limited and regulatory regimes are often less predictable. It would offer further insights into how environmental governance is constructed on the ground, and by whom, in diverse locations.

APPENDIX



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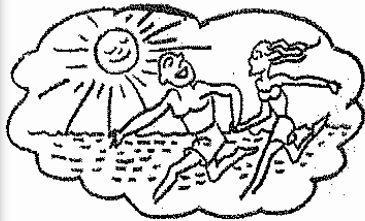
SEEDSMEN'S HAWAIIAN HOLIDAY

Just a short progress report on the Hawaiian trip for Seedsmen that we are coordinating. There has been a tremendous amount of interest in this educational trip. Reservations have been coming in rapidly and the seats will soon be filled. Remember, this is a business expense trip so it is a deductible item for income tax purposes.

Several seed companies are using this as an incentive type program for their sales organizations during the important selling months of November and December. Also, it offers an excellent opportunity for many owners, and management people to observe the fine winter research program that Molokai Seed Service offers to the seed industry.

We still have seats available but we urge you to send your reservations in promptly! This trip offers everyone an opportunity to combine a business and pleasure trip to the beautiful islands of Hawaii. Hope YOU can join us on this enjoyable trip!

Remember . . . the Seedsmen's Hawaiian Holiday is being offered at the fantastic price of \$390.00 per person which includes jet air fare, resort hotel accommodations on Waikiki Beach, and a day at Molokai Seed Service. In addition the plane will pick up passengers at Indianapolis, Indiana and Des Moines, Iowa.



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