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WORKING WITH MAIZE:

LIVELIHOOD, AGROBIODIVERSITY, AND UNEVEN DEVELOPMENT IN MEXICO'S CENTRAL HIGHLANDS

A Dissertation in

Geography and Women's, Gender, and Sexuality Studies

by

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Abstract

This research investigates the complex relationship between agrobiodiversity and livelihoods in the Central Highlands of Mexico by studying the everyday lives of four key categories of actors: 1) small-scale commercially-oriented maize producers; 2) agricultural research scientists; 3) agricultural extension agents; and 4) maize populations. This inquiry is prompted by a seeming empirical paradox, according to leading theories of agricultural modernization: populations of genetically-diverse locally-bred varieties of maize, along with the diversity of knowledges and practices that maintain them, persistently dominate the small-scale farms of Mexico, even as these varieties are increasingly rendered obsolete, at least within the dictates of a global commodity market, by the recent economic transformations of agricultural modernization. The country's Central Highland region provides a unique opening for inquiry into these dynamic relationships. It is at once home to some of the world's foremost centers of maize research, which partner with regional and multinational biotechnology companies to aggressively promote the adoption of "modern" scientifically-bred maize varieties, and also to small agrarian communities that consistently and, in many cases, exclusively cultivate maize varieties they have bred themselves. Three major questions have been insufficiently explored in academic research: First, how do those involved in maize production, both directly and indirectly, conceive of and engage agrobiodiversity? Second, how do relationships to agrobiodiversity vary within and across maize-centered livelihoods? Third, how do these relationships shape development institutions, agricultural technologies and practices, and trajectories of agricultural change, and whose purposes do they serve as a result – i.e., why do certain socioecological relationships emerge and persist?

My dissertation research addresses these questions by examining the contradictions of agrobiodiversity and agricultural modernization in Mexico's Central Highlands through the perspectives and practical activities of the four groups, enumerated above, whose lives are implicated in the dynamics taking place. Bringing these perspectives together, I argue that processes of uneven agricultural development in the region are highly negotiated, with actors working from within and without existing social and institutional structures to pursue multiple, overlapping objectives. These tensions have produced a dynamic and contradictory landscape of persistent maize genetic diversity, for which adequate explanations are currently lacking.

In this research, I find that maize diversity is persisting in the Amecameca Valley because farmers are maintaining economic diversity. This research also finds that, despite all rhetoric to the contrary, the current agricultural development projects at work in the region are undermining, rather than supporting, smallholder maize producer livelihoods.

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INTRODUCTION

This research investigates the complex relationship between agrobiodiversity and livelihoods in the Central Highlands of Mexico by studying the everyday lives of four key categories of actors: 1) small-scale commercially-oriented maize producers; 2) agricultural research scientists; 3) agricultural extension agents; and 4) maize populations. This inquiry is prompted by a seeming empirical paradox, according to leading theories of agricultural modernization: populations of genetically-diverse locally-bred varieties of maize, along with the diversity of knowledges and practices that maintain them, persistently dominate the small-scale farms of Mexico, even as these varieties are increasingly rendered obsolete, at least within the dictates of a global commodity market, by the recent economic transformations of agricultural modernization. The country's Central Highland region provides a unique opening for inquiry into these dynamic relationships. It is at once home to some of the world's foremost centers of maize research, which partner with regional and multinational biotechnology companies to aggressively promote the adoption of "modern" scientifically-bred maize varieties, and also to small agrarian communities that consistently and, in many cases, exclusively cultivate maize varieties they have bred themselves. Three major questions have been insufficiently explored in academic research: First, how do those involved in maize production, both directly and indirectly, conceive of and engage agrobiodiversity? Second, how do relationships to agrobiodiversity vary within and across maize-centered livelihoods? Third, how do these relationships shape development institutions, agricultural technologies[1] and practices, and trajectories of agricultural change, and whose purposes do they serve as a result – i.e., why do certain socioecological relationships emerge and persist?

[1] Including, but not limited to, different maize varieties.

My dissertation research addresses these questions by examining the contradictions of agrobiodiversity and agricultural modernization in Mexico's Central Highlands through the perspectives and practical activities[2] of the four groups, enumerated above, whose lives are implicated in the dynamics taking place. Bringing these perspectives together, I argue that processes of uneven agricultural development in the region are highly negotiated, with actors working from within and without existing social and institutional structures to pursue multiple, overlapping objectives. These tensions have produced a dynamic and contradictory landscape of persistent maize genetic diversity, for which adequate explanations are currently lacking.

I undertake this study through an in-depth, multifaceted analysis of the lives and livelihoods at stake in this landscape. My analysis links local agricultural and development practices with broader political ecological forces, considering how seemingly noncompliant farmer responses to agricultural modernization have, in turn, shaped those who work on behalf of agricultural research institutions and modernization programs, and biotechnology companies. Drawing on ethnographic observation, other qualitative methods, and a market survey – and employing political ecology theories of contested agricultural development – this research moves toward a rigorous explanation of how and why maize agrobiodiversity persists. By deepening our understanding of the relational processes through which the meanings and material practices of agricultural development are negotiated, this research takes important steps toward the realization of policy that effectively serves the priorities of farmers in a region where maize cultivation is a source of food security, livelihood, cultural identity, and biodiversity.

[2] Without ascribing sentience to maize, I maintain curiosity about the everyday lives of plants as well, and their active role in the process of what Anna Tsing (2015) calls "multispecies world-making."

In the remainder of this Introduction, I summarize existing knowledge and debates on two broad questions which frame the subject of this research: 1) Why Does Maize Agrobiodiversity Persist? and 2) Where Do Agricultural Development Workers Come From? The following Literature Review Chapter situates these two overarching questions and the three central research questions (see p1) in interdisciplinary scholarship, and outlines the remainder of the dissertation.

Why Does Maize Agrobiodiversity Persist?

To the surprise of many in national and international scientific and policy circles, the overwhelming majority of Mexican farmers have persisted in small-scale cultivation of maize varieties that they breed themselves, despite decades of government policies designed to concentrate agricultural production in large-scale industrialized operations, thereby freeing up land and labor from the peasant sector and transferring them to supposedly more efficient uses (McAfee 2008; Avalos-Sartorio 2006; Levy & van Wijinbergen 1992). Mexico is the global center of maize agrobiodiversity, which has been maintained here through traditions of knowledge reproduction and small-scale cultivation of farmer-saved seed since maize was domesticated over 7,000 years ago (Bellon & Berthaud 2006; Sluyter & Dominguez 2006). Maize is also Mexico’s most important crop: it currently occupies about 8 million hectares annually, the largest area planted to any crop in the country (Barkin 2002; Eakin et al 2014), supports about three million farm households, and accounts for two-thirds of the country’s total caloric intake (McAfee 2008). For the majority of Mexican maize farmers, who continue to produce maize at a small-scale in rain-fed areas for self-consumption, as well as for the market to varying degrees (de Janvry, Sadoulet, & de Anda 1995), the crop plays multiple key livelihood functions including a source of food, income, cultural identity, social status, and as part of an economic safety net (Bellon & Hellin 2011; Bellon 1996; Bellon & Brush 1994; Perales, Benz, & Brush 2005). Of this maize, over 75% of the seed sown in the country each year has been saved by farmers from their previous harvest (Aquino et al 2001). While not all farmer-bred varieties are landraces, landrace varieties of maize constitute at least half of the seed planted in Mexico each year (Perales and Golicher 2020).

National investment in this kind of maize farming, the small-scale cultivation of farmer-bred varieties that continues to sustain the country's population, has declined severely. Until the 1980s, there was historically strong government support to the maize sector in Mexico. Such support shifted dramatically in recent decades, from upholding a protected and almost insular national maize economy, to promoting trade liberalization and export-oriented development (Bellon & Hellin 2011; Eakin 2006; Avalos-Sartorio 2006; Levy & van Wijinbergen 1992). The loss of federal assistance programs and the reduction in maize prices associated with trade liberalization and the 1994 implementation of the North American Free Trade Agreement (NAFTA) has drawn Mexico into a globalized market that is hostile to any maize other than the "modern" varieties designed for export-oriented commodity production (Fitting 2006; de Janvry *et al* 1995). However, despite significant national and international investment in modernizing Mexico's maize sector, most small-scale farmers have declined to adopt the promoted technologies as recommended, instead selectively incorporating technologies piecemeal into cultivation systems that integrate innovative and alternative practices with indigenous and peasant traditions. In some regions of the country, such as Chiapas, small-scale commercial farmers have been found to cultivate both "modern" (industrially-bred hybrid) and "traditional" (farmer-bred open-pollinated) varieties of maize simultaneously, gaining different but overlapping benefits from the two (Bellon & Hellin 2011). In the Central Highlands, landrace varieties dominate almost completely (Perales, H. 1998), and small-scale commercially-oriented farmers have integrated themselves into local, regional, and national markets for maize without adopting the so-called “improved” hybrid varieties at the heart of agricultural modernization interventions (Perales, H., Brush, S. and Qualset, C. 2003; Eakin et al 2014). The Central Highlands is one of the regions with the greatest diversity of maize in Mexico; a survey of existing research finds that the relative abundance of landrace maize has not changed considerably since 1950, and that there were not signs of genetic erosion (loss of local landrace populations) from 1943 to 2010 (Perales and Golicher 2020).

Scientists have thoroughly documented heterogeneous biogeographical, agronomic, economic, and cultural logics for the persistence of maize diversity, as well as numerous motivations for farmer selection of traditional varieties over modern ones (e.g. Sauer 1971; Perales, H. 1998; González 2001; Tuxill 2004; Christie 2006; McAfee 2008; Arslan and Taylor 2009; Eakin et al 2014; Perales and Golicher 2020). Using detailed available population data, studies have found correlations, in some localities, between ethnolinguistic diversity (used by the Mexican government as a marker of indigenous populations)[3] and maize diversity in Mexico. In Chiapas, mestizo populations were found to be significantly more likely to rely on commercial (hybrid) seed, while indigenous Mayan populations were found to maintain landrace varieties of maize, regardless of environmental conditions (Brush and Perales 2007). Many communities across Mexico have organized – at intersecting scales from the hyper-local to the global – around ideas

[3] “Until 2000 the sole criterion used for ethnic classification in the Mexican census was an individual’s ability to speak an indigenous language,” (Villareal 2014: 781).

of food justice, food sovereignty, and seed sovereignty. These efforts have mobilized, at turns, a nationalist anti-globalization or anti-corporation framework (Galicia García 2003; Sín Maíz No Hay País 2016), a rights-based framework (Patel 2009; Via Campesina 1996; Via Campesina 2009) and, at times, a spiritual framework of moral and social obligation to reproduce one's ancestral *milpa* agroecosystem (Hernández et al 2020).

However, these patterns do not fully explain the persistence of maize agrobiodiversity in the Amecameca Valley. Census data for the area reports less than 1% indigeneity (marked by Nahuatl-speaking as a primary language); all maize farmers participating in previous research surveys of the region were identified as Mestizo and spoke Spanish as their primary language in the home (Perales and Brush 2007). Furthermore, my research encountered no direct links between small scale maize farmers in the Amecameca Valley and the extensive nearby organizing of food sovereignty networks and social movements. Peasant resistance organizations in neighboring valleys (FPDT 2020), indigenous agroecology cooperatives from neighboring states Galicia Gallardo et al 2021), and social and ecological justice organizations based in nearby Mexico City (ETC Group 2021) each has an international presence and travels regularly throughout the region to mobilize supporters. In several cases, the farmers with whom I worked in Amecameca had heard of these groups or their demonstrations. And yet, I did not encounter anyone from the Amecameca Valley farming communities who had engaged directly with such efforts, nor even knew anyone who had. Most tended to demur when asked about food sovereignty, while a few described it as a struggle taking place elsewhere. Their choices about what maize to grow and how did not appear intentionally linked to a national or international campaign, nor targeted to an audience outside these maize farming communities.

Interdisciplinary scientists have mobilized the powerful tools of ecology, anthropology, geography, rural sociology, and applied agricultural sciences to study these dynamics from many angles. For decades, researchers have been demonstrating a persistent farmer preference, under certain conditions, for landrace maize varieties over so-called “improved” and “modern” varieties in Mexico’s Central Highland region (see Perales 1998; Perales, Brush, and Qualset 2003; and Perales, Benz, and Brush 2005). Studies in the tropical lowland regions of Mexico likewise document complex farmer decision-making in which maize agrobiodiversity is a central foundation of smallholder livelihoods (Bellon and Hellin 2011; Keleman, Hellin, and Bellon 2009; Badsute et al 2007; Brush and Perales 2007; Bellon and Berthaud 2006; Bellon et al 2006; Badstue et al 2002; Bellon and Brush 1994).

Efforts to support *in situ* conservation of maize agrobiodiversity continues to be hampered by an overall lack of data. However, specialists have worked to develop both methodological models of particular regions in Mexico (Perales 1998) and maps of maize diversity across the country over time (Perales and Golicher 2020), which document no evidence of rapid decline in maize landraces in the country’s most diverse biogeographic regions.

Scholars have begun to more seriously explore smallholder maize production “beyond subsistence,” and the significant contributions of alternative small-scale commercial production to the conservation of maize agrobiodiversity (see Bellon et al 2021). Amid continued persistence of peasant farmers and alternative economic practices in many different contexts across Mexico, this interdisciplinary work highlights the potential of heterogeneity in food markets (Eakin, Perales, Appendini, and Sweeney 2014; Keleman, Hellin, and Flores 2013 ; Keleman 2010; Keleman and Hellin 2009).

That this volume of evidence has not much shifted the underlying neoliberal assumptions of most agricultural science or policy, reflects the ongoing power of a global maize industry, within which the economic superiority of hybrid germplasm remains unquestioned. And yet, there also remain genuine gaps in our understanding of smallholder decision-making under changing conditions. Despite significant bodies of illuminating work on the issue (see above), we continue to lack a rigorous explanation for the persistent dominance of maize agrobiodiversity in the Central Highland region (see Perales *et al* 2003), leaving open questions of whether and how such patterns will continue in the face of ongoing political economic restructuring. Several scholars have noted the apparent importance to smallholder livelihoods of alternative, local, and so-called “specialty” or niche markets for farmer-bred maize varieties in the region (Rudiño 2011; Eakin et al 2014). Eakin et al, taking note of a shift in national rural development policy, express hope that these smallholder farmers and their farmer-bred varieties of maize may receive more public investment and services moving forward:

> With the support of the International Maize and Wheat Improvement Center, CIMMYT, the Mexican Government launched a new programme, MasAgro, in 2011 designed to enhance the productivity of smallholder maize and wheat producers, through improved hybrid and landrace seeds and agronomic management. Together these results and programmes suggest a new interest in market-oriented smallholders (Eakin et al 2014: 151).

My dissertation begins at the outset of this new program, the Sustainable Modernization of Traditional Agriculture (known by its Spanish acronym MasAgro). Using the theoretical frameworks discussed in Chapter 2, I seek to unpack how agricultural modernization is invoked, contested, and complied with through the livelihood practices of the smallholder farmers, development researchers, and agricultural extension agents at work in the region, in a context of renewed state interest in national maize production. Among the points of interest in this research is whether state and smallholder interests came to be aligned during the launch of MasAgro, as Eakin et al hoped it might.

Where do CIMMYT workers come from?

CIMMYT grew out of an exploratory philanthropic venture, begun in 1941, when the Rockefeller Foundation sent a team of scientists to survey the state of Mexican agriculture. By 1943, in a somewhat fraught collaboration with the Mexican government, the Foundation had established the Mexican Agricultural Project (MAP) to tackle what they saw as a lack of productivity on the country's grain farms. The following year, they hired a promising young biologist named Norman Borlaug to develop new wheat varieties, and new methods in crop breeding. Borlaug's specialized varieties, his "miracle wheat", were designed to increase grain yields per unit of land area under conditions of irrigation and chemical inputs (fertilizer, herbicides, and pesticides). In 1963, MAP sent hundreds of tons of these wheat seeds to India and Pakistan, establishing Borlaug's approach to plant breeding as a lynchpin technology in the rising tide of global agricultural restructuring that USAID would later crown the "Green Revolution." Borlaug was subsequently awarded a Nobel Peace Prize (1970), and the Mexican Agricultural Project was expanded into the International Maize and Wheat Improvement Center or, in Spanish, El Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT) (1966), a founding institution of the Consultative Group on International Agricultural Research (CGIAR) (1971). For the more than fifty years since, the humans (and plants) of CIMMYT have navigated a turbulent political, economic, and ecological landscape, each a part, in their own way, of the institution's mission "to provide bread for a hungry world."

When I first stayed at CIMMYT's visiting scientist dormitories, on a three-month reconnaissance research trip during the summer of 2010, it was a remarkably sleepy place. Though it remained a central member of the CGIAR network, national and international funding for public research was drying up. Mexico's government had been aggressively divesting from rural development since the 1980's. Non-profit research institutions like CIMMYT found it difficult to compete for investors with for-profit multinational agribusiness, though they did partner with multinationals such as Monsanto and DuPont on certain projects. The private and public funds that were available to CIMMYT tended to prioritize research on behalf of countries other than Mexico. The first summer I was there, all the posters and pamphlets lining the hallways of the research building on CIMMYT's campus featured East African farmers and lauded the plant breeding CIMMYT was conducting on behalf of the Alliance for a Green Revolution in Africa (AGRA), a recent partnership between the Rockefeller Foundation and the Bill and Melinda Gates Foundation. In September of the same year, shortly after my reconnaissance trip ended, CIMMYT and the government of India would announce the launch of a "Second Green Revolution in South Asia," including a Gates Foundation-funded new research center, the Borlaug Institute of South Asia. CIMMYT's most visible role at this time centered on the extraction of maize germplasm from Mexico, the crop's center of origin and global reservoir of genetic richness, for deployment as “improved” varieties in capitalist-led agricultural revolutions on other continents.

There were, of course, a number of other active research agendas within CIMMYT that did not often make it on to glossy posters or website homepages, including intensive and participatory work with Mexican farmers. During the summer of 2010, among some researchers and Mexico-based field officers, it was common to hear jokes that institutions such as CIMMYT were obsolete, no one funded public agricultural research anymore, that they probably didn’t have too much longer in these jobs but they were going to enjoy it while it lasted. Two employees independently commented to me that this lack of external pressure granted them a productive kind of freedom to decide their own line of inquiry and publish according to their particular interests as researchers. However, behind the scenes, this unhurried workplace was preparing for a radical shift in pace.

During the four years (2009-2013) that I spent planning and conducting the bulk of my fieldwork in Central Mexico, CIMMYT received a series of seismic contributions that helped to reorient its research and extension programs. In 2009, with funding from Monsanto and the Mexican government, CIMMYT formally launched its Conservation Agriculture program, including: experimental platforms for testing techniques and seeds; a network of regional hubs for connecting Mexican farmers to technologies and extension services; and a certification program for training technicians and extension officers in conservation agriculture. In 2011, the Mexican government did an historical about-face on funding agricultural development, and committed million USD additional funds to a new national project, the Sustainable Modernization of

Traditional Agriculture (known by its Spanish acronym MasAgro), a budget which increased to a total of over 52 million USD over three years. This money funded a focus on increasing production of maize and wheat in Mexico. In 2013, the Mexican government pledged an additional 138 million USD to MasAgro over the coming decade, and CIMMYT began construction on a 25 million USD new bioscience research complex, paid for by the foundations of Bill Gates and Carlos Slim, the two richest men in the world at the time. These seven new buildings nearly doubled the square footage of CIMMYT's headquarters in Texcoco, and housed greenhouses, laboratories, and machinery dedicated to advanced breeding and genetics research. Extensive renovations undertaken at the same time created additional auditorium, office, and classroom space, making way for an expansion of CIMMYT's staff and training programs.

This growing national power leaves CIMMYT in a rare liminal role between that of government institutions, nongovernmental organizations, and the agricultural industry. While it does not formally represent the state, and is not directly governed by a state agenda as are the national secretariats, a large share of its funding for the MasAgro program is public money provided by the federal government. In fact, MasAgro is in many ways supplanting the role historically played by government agencies such as SAGARPA. As documented in my research, many farmers, who have suffered decades of disinvestment, neoliberal restructuring, and, in some cases, state terror, do not differentiate the MasAgro program from other initiatives fully under state control. In addition to carrying responsibility for achieving many national agricultural development goals, CIMMYT also wields relative international influence, as a CGIAR institution and recipient of millions of dollars of international philanthropic funds and development grants. The question of how the institution will use this influence, and its degrees of autonomy from the Mexican state, remains a politically potent one, with implications for CIMMYT's relationships to rural Mexican communities.

Between December 2011 and November 2012, I visited the CIMMYT headquarters at least once a week. The atmosphere was almost unrecognizable when compared to the summer of 2010. Construction crews were everywhere. More rebar seemed to puncture the skyline with every visit. By 8:30am, every room on campus would be buzzing with activity. Work meetings often bled into the lunch hour and ran past 5:00pm. New job openings were posted to CIMMYT's website on a regular basis, and new faces kept arriving to join this team, or that one. Glossier and more elaborate publications appeared on the hallway magazine racks each month and, suddenly, they weren't exclusively about a New Green Revolution in Africa or South Asia. Now, color photos of Mexican farmers and Mexican farm fields graced the covers of journals promoting CIMMYT's newly funded work on Conservation Agriculture in Mexico. MasAgro had unleashed a torrent of work to breed new maize and wheat varieties and facilitate their adoption, along with conservation agriculture technology, in every region of the country.

In the flurry of new hiring since the launch of MasAgro, employees are organized into two main groups. The field researchers, lab scientists, project and financial managers, data analysts, administrators and other high-ranking positions within CIMMYT are filled through international contracts which, in the words of the institution's career webpage, offer "internationally competitive salary and benefits include housing allowance, car, comprehensive health and life insurance, assistance for children's education, paid vacation, annual airfare, contribution to a retirement plan, and generous assistance with relocation shipment." These employees come from countries all over the world and are required to be fluent in English, with Spanish language skills considered an added bonus.

The second main group is hired on “local” contracts, which target Mexican nationals. In addition to fulfilling the provisions of Mexican Labor Law and national social welfare programs, these contracts provide a year-end bonus, “vacation premium,” life and medical insurance, “supermarket coupons,” and a savings fund. Most of the administrative assistants, cooks, janitorial staff, and other workers who keep the institution running, but whose professional duties don’t necessarily require technical training in agriculture, come from Texcoco and the small towns surrounding the campus. For these workers, CIMMYT is one of the largest local employers and a relatively generous one.

Those hired on local contracts who do have expertise and certification in agricultural research and extension come from many regions of the country, often from farming families themselves. Farming has never, in its history, been an easy life, but it has become significantly more difficult to make a living as a farmer in Mexico in recent decades. IMF-mandated austerity policies of the early 1980’s slashed spending on public services and infrastructure, while neoliberal economic restructuring initiated by President Miguel de la Madrid, and codified in the 1994 ratification of the North American Free Trade Agreement, led to the rapid privatization of communal agrarian land and the flooding of Mexican markets with highly subsidized agricultural imports from the United States. Far fewer farmers could access the resources and infrastructure they needed to grow their crops; among those who managed to do so, many no longer had anywhere to sell their harvest. NAFTA caused the loss of an estimated 1.3 million agricultural jobs in Mexico, primarily smallholder maize and bean farmers. Some of the children of these displaced farmers journeyed to large industrial farms in northern Mexico, the United States, and Canada. Some others sought certification and employment as extension agents, serving the Mexican farmers who remained.

Structure of the Dissertation

This research is satiated at the interface of two interdisciplinary disciplines: Geography, and Women's, Gender, and Sexuality Studies (WGSS). In order to explore the interdependent working relationships between maize and humans, I draw on this dynamic interface, and on the following four bodies of literature in particular (see Figure 1): 1) Political Ecology of Food and Agriculture; 2) Feminist Geographies of Knowledge Production; 3) Trajectories of Agricultural Change; and 4) Livelihoods, Conservation, and Development. Both Geography and WGSS lend crucial analytical tools to the study of agrobiodiversity and agricultural development, in conversation with cognate disciplines in the humanities, social sciences, and natural sciences.

In Chapter 1, the Literature Review, I discuss these analytical contributions in detail, situating this dissertation in a broader interdisciplinary conversation, and identifying the original innovations particular to my approach, as a feminist geographer. This chapter makes the case that an intersectional and geographical feminism is necessary in order to understand how and why maize agrobiodiversity is persisting in Mexico's Central Highlands.

Chapter 2 explains the methodology of this dissertation, which draws from the theoretical framework established in the Literature Review and centers on an ethnographic approach to interpretive research. This chapter discusses the original research design and its intentions, while also describing changes in methodological approach that emerged over the course of field work in response to research participants.

Following the Methods Chapter, the empirical chapters of the dissertation are divided into two parts, which correspond to the spatial division of my field research landscape; the Texcoco Valley, and the Amecameca Valley. Part I, the Texcoco Valley, begins with a prelude. This prelude situates the reader and the research in the economic and political geography of this mixed agrarian and urban landscape, through a second-person narration of the complex negotiated travel routes to the city of Texcoco, and to CIMMYT, the international agricultural research campus nearby. Chapters 3 and 4 explore the livelihood decision-making and relationships to maize agrobiodiversity of two CIMMYT employees, known here by their pseudonyms: Gabriel and Lilian. Part II, the Amecameca Valley, begins with its own prelude, a thick description of a weekly street market in the valley that serves as a regional hub for the exchange of maize seed and agricultural knowledge.

Like Part I, the Amecameca Valley section contains two empirical chapters. Chapter 5 is a study of this weekly street market, of the authoritative role of women in the economic innovations taking place here, and of the complex process through which the producers and consumers of maize agrobiodiversity maintain its social and economic value. Chapter 6 focuses on the livelihoods of the smallholder maize farmers who maintain in-situ agrobiodiversity in the Amecameca Valley, particularly their access to and control over resources, and the gendered divisions of labor through which access and control are negotiated. The concluding chapter summarizes findings from this research and directions for future research, while the coda offers a final non-linear reflection on the meanings of maize.

CHAPTER 1: THEORETICAL FRAMEWORK

The proposed research is situated at the intersection of four bodies of literature: 1) political ecologies of food and crop diversity; 2) feminist geographies of knowledge production; 3) theories of agricultural change; and 4) studies of livelihoods, conservation, and development. These four bodies of literature are connected by two themes. First, they are each thoroughly *interdisciplinary*, drawing on the traditions of thought in disciplines cognate with geography from across the humanities and the social and natural sciences. Second, their application to this research is fundamentally *feminist*, attending to how gender matters to maize farming and agricultural development, to how certain forms of scientific and environmental knowledge are privileged, and to how power is leveraged across intersecting lines of social and ecological difference. This analysis of maize production in Mexico's Central Highlands also contributes to critical geographies of everyday life, for the mundane routines and livelihood decision-making of those who care for and work with maize are where global economic restructuring and environmental change are being engaged, reproduced, and contested (Katz 2004).

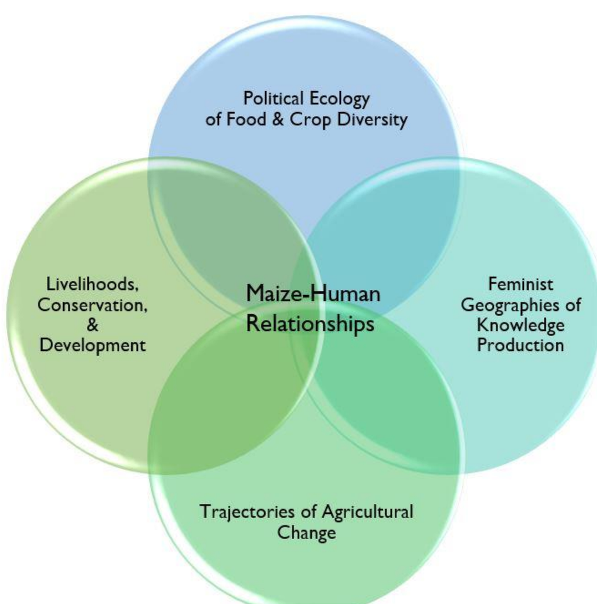

Figure 1: Interdisciplinary Theoretical Frameworks used to Approach Research Subject

Political Ecologies of Food and Crop Diversity

An adequate explanation for the persistence of locally-bred varieties of maize must move beyond an analysis of how various populations navigate a given terrain, to one of how actors negotiate the terms under which they live in relation to one another. Social and ecological forces do not automatically result in one pattern of agricultural practices or another; these forces are not passively received by people (or plants, for that matter), but rather are actively accommodated, harnessed, subverted, and resisted. It is here that political ecology provides useful analytic tools designed to highlight struggles over access to and control over natural resources. The importance of engaging the variety of socioeconomic, agroecological, and cultural forces influencing farmers' decision-making is widely recognized (Chambers and Brush 2010), and political ecology provides a conceptual framework with which to explicitly examine the multiscale power relations that mediate these forces and their impact on the environment (Bassett and Zimmerer 2003; Paulson, Gezon, and Watts 2003; Forsythe 2003). Though political ecology has grown rapidly into a substantial and wide-ranging literature since its emergence in the 1980s (see Watts 1983; Blaikie and Brookfield 1987), the body of existing research on political ecology and smallholder crop management is relatively small (Zimmerer 2011; Zimmerer 2010; Abbott 2005). This literature contributes an innovative approach to conventional studies of small-scale agricultural systems, which are typically situated within ethnobotanical or agroecological studies, exploring the influence of social relations, institutions, and processes on farmers' selection and cultivation of diverse crop varieties. Political ecology concepts are used to analyze agrobiodiversity dynamics as an indicator of local resilience (Zimmerer 2011) and a consequence of adaptive responses to changes in resource use and management (Zimmerer 2010; Abbott 2005). An important subset of this literature centers on Andean landscapes and crops, and develops conceptual frameworks that are readily applicable to a Mexican context; in particular the effort to understand how the management of farmer-bred crop varieties is affected by social difference, power, and conflict (Zimmerer 2011) and by agricultural modernization and extension activities (Abbott 2005). Of particular note are the long-established links between economic divisions within Andean farming communities and access to diverse crops, as well as the central role of gendered knowledge and livelihood practices in maintaining in-situ conservation of crop diversity (see Zimmerer 1996). Research in Peru has documented both the precarity and promise of agrobiodiversity; in hotspots of both potato and maize diversity, agrobiodiversity is undermined by social and economic inequality, but emergent forms of agrobiodiversity can nevertheless, under certain conditions, improve nutritional security, enhance food sovereignty, and even contribute to ongoing efforts to build more just food systems (Garret Graddy 2013; Zimmerer et al 2020).

In the past two decades, many political ecologists have increasingly incorporated aspects of actor-network theory into their studies of nature/society relations as a means of analyzing the agency of nonhumans and critiquing dichotomous thinking (see Swyngedouw 1999; Castree 2002). However, there is a concerning tendency within actor-network theory to even out asymmetrical power relations, to over-privilege the agency of non-living "actors", and to dismiss important structural ways in which patterns are produced and reproduced. The proposed research therefore incorporates certain concepts from actor-network theory selectively, following examples from recent work on human-environment relationships (e.g. Cupples 2011; Zimmerer 2011; Birkenholtz 2009). Of use to this research is actor-network theory's emphasis on relational thinking, which recognizes the mutual influence of social and natural processes. Also useful is the metaphorical concept of a network, which involves the "unique alignment" of humans, machines, plants, animals, and other devices "in relations that vary in stability, time-space extension, and time-space form," (Castree 2002: 118). These concepts lend analytical leverage to studies of the messy, heterogeneous human-environment relationships of everyday life without resorting to reductionist binaries of nature and society. In the case of maize production in Mexico, integrating concepts from actor-network theory helps to reveal the contingency of agricultural modernization and multinational biotechnology corporations, and to better understand the potential for political transformation within local livelihood struggles.

At the same time, I draw on a tradition of feminist, postcolonial, and decolonial scholarship that recognizes the oppressive complicity of binary ontologies in which society and nature are understood as separate and opposed to one another (Harding 1986; Tallbear 2015). Some indigenous and feminist political ecologists argue for greater attention to "socionatures," a term used to frame more-than-human entanglements and relationships in non-binary, non-hierarchical, and less anthropocentric ways (Tallbear 2015; Nightengale 2019). Such an approach engages literatures on socio-ecological systems while also offering critique, and seeking to better understand what is lost when we break complex systems into parts.

One of political ecology's greatest contributions to interdisciplinary scientific research has been to demonstrate that access to and control over resources are central to social inequity and environmental change in both rural and urban contexts the world over (see Peluso and Watts 2001). Of greatest use to this dissertation research are political ecologies of resource access that employ an explicitly feminist approach. Feminist political ecology recognizes that gender and intersecting subjectivities are not static qualities, but rather social process that is mutually constitutive of ecological change. This lens enables more rigorous and critical engagement with conflicts and struggles that emerge over resource access. When considering labor resources, for example, gender not only shapes who is involved in what kind of work, but the environmental outcomes of that work. When top-down development programs construct a focus on particular environmental resources (export-oriented commodity grain fields, rather than intercropped multi-use fields), they do so through assumptions about gender roles within a given community. As Nightingale finds, in her feminist political ecology of community forestry in Nepal, "These assumptions (re)enforce particular axes of difference, making it difficult for marginalized people to contest those subjectivities effectively with variable but significant ecological implications," (2006: 180). Neglect by development planners of the interdependence of labor relations and ecological change leads to, in Nightingale's words, "unexpected and often disastrous consequences," (2006: 181).

Hausermann (2014) likewise finds unexpected outcomes to development interventions in her feminist political ecology of land in Mexico. She demonstrates how Mexico's recent neoliberal agrarian counter-reforms triggered "novel subjectivities and practices": state actors charged with carrying out the privatization of communal ejido land, and bearing gendered assumptions that have historically excluded women from land access, ended up facilitating the departure of men – as self-imagined private property owners – from communal land governance, thereby opening up new space for women to become registered land managers and leaders for the first time in the ejido's history. By using a feminist political ecology approach, Hausermann recognizes the ways in which "processual policy, subjectivity, authority formation, objects, and environmental narratives combine to produce new political trajectories," (2014: 784) with, at least in this time and place, positive implications for rural women and the regional agroecosystem.

In her feminist political ecology of "kitchenspace," the combination of indoor and outdoor food preparation spaces of Central Mexico, Christie demonstrates the mutually-constitutive processes of gender, ethnicity, and food access: "the house-lot garden is a space where old and new elements are in constant engagement and where changing cultural identities are negotiated, re-created, and celebrated as "tradition" is continually redefined," (2004: 370). In a context of shifting, typically decreasing, access to agricultural land in the region, those in charge of food preparation negotiate complex dynamics of subjectivity in relation to accessing resources such as culinary knowledge, ingredients, nutrition, and cultural rituals. These everyday negotiations and decisions are political acts of world-making. As Weismantel (1998: 194) reminds us: "The act of cooking food, and thus transforming it, is a means of expressing what people think of themselves, who they are, where they live, and what their place is in the natural and social world and in the political and economic systems of the nation."

Zimmerer et al (2020) bring a feminist political ecology approach to agrobiodiversity, demonstrating that maize agrobiodiversity can serve as a resource for greater food sovereignty among indigenous smallholders in Huánuco, Peru, even as it is itself contingent on access to quality land and other agricultural resources. The authors argue that, if we are to pursue more just food and agricultural systems in the face of uneven development, the climate crisis, and other social and economic shocks, we cannot misunderstand the human-environmental relations at play. As the authors note, echoing other feminist political ecologists: "categories such as indigenous smallholders and market/non-market do not bear linear, a priori, or automatic relations to food and agrobiodiversity dynamics but rather emerge from place- and time-specific relations, (Zimmerer et al 2020: 99).

Likewise developing a feminist and decolonial approach, Graddy-Lovelace (2020: 241) argues for recognizing agrobiodiversity as a “landscape of care”, “that meticulous, multifaceted, accumulative attention to a plant's well-being.” Such an approach alerts us to the interdependent resources and relationships at stake in agricultural politics, and helps us recognize the ways in which modernized agriculture, with technologies that disrupt-in-order-to-commodify socioecological reproduction, also accomplish the devaluation of labor and lives that are gendered and racialized.

There have been calls within political ecology for greater attention to how development research and practice impacts the conservation of in-situ agrobiodiversity. Graddy (2014) highlights the tension between these conservation goals, and the institutional restructuring of the CGIAR, including CIMMYT, in 2008, with the goal of extending and deepening the public institutions’ partnerships with dominant private-sector players, including private donors and transnational corporations. Geographers have long offered both collaboration and critique to CGIAR institutions (see Bebbington and Carney 1990), and recognized their (and our) complicity in contradictions of capitalist development. Graddy calls, in particular, for focused attention to the tensions regarding CGIAR support for smallholder farmers and in-situ agrobiodiversity conservation:

> “Farmers’ ongoing contribution to genetic reserves is recognized as necessary, even as they are increasingly targeted as potential consumers for “improved” seeds. [. . .] “In general, more research is needed to investigate and help break through this paradoxical peripheralization of in situ by learning more about its unlikely persistence: the deliberate and grassroots regeneration of on-farm realms of cultivation. (Bio)diverse agriculture has never been more needed—or more elusive. Its marginalized resilience begs many questions: Who is still cultivating it? How, where, why, with what obstacles, and to what effects? What are such growers articulating and actualizing with this practice?” (Graddy 2014: 431-2)

In this research, I respond to Graddy’s call, and extend her questions to engage, not only the articulations and actualizations of those farmers maintaining maize diversity, but also the CGIAR researchers and extension agents at work in this landscape of contradiction.
Political ecology, itself alive with contradiction, thus provides the tools with which to understand maize as a resource, one that is both a site of profit extraction and a source of livelihood and wellbeing, and also maize as a social relationship, one that can make possible more just imaginations of the world and the future (Collard et al 2015).

Several studies in geography and related disciplines have analyzed the political ecology of maize production in Mexico. These studies do not fully attend to the political role of everyday practices and routine decision-making, which is essential in order to understand the intricacies and contradictions of global processes (Katz 2004; Wright 2010). They also do not directly engage the agrobiological and political implications of hybrid maize varieties, though these are the only alternative to farmer-bred maize varieties that most smallholder maize farmers actually encounter, either materially or discursively, in their everyday lives. The maize debates in Mexico are highly bifurcated. While oppositional demonstrations, national and international media, and most critical political ecology and STS (science and technology studies) scholarship focuses on the potential threat posed by transgenic introgression to Mexican maize biodiversity (see McAfee

2003a; McAfee 2003b; McAfee 2008; Mercer and Wainwright 2008; Wainwright and Mercer 2009; Kinchy 2010; Wainright and Mercer 2011; Fitting 2011), this discursive terrain is highly uneven. Many, perhaps most, smallholder maize producers in the country, particularly those from communities less-often noticed by international audiences, do not engage the controversies over transgenic maize, despite heated transnational debate (see Fitting 2011). While scholars and activists contest the merits and risks of transgenic technology to Mexican maize varieties and farmers, agricultural development and subsidy programs, and public and private extension services across the country have been aggressively promoting farmer adoption of non-transgenic hybrid maize varieties, and arguing for their superiority over farmer-bred varieties, for more than half a century. The discursive presence of hybrid maize seems likely far more pervasive, than that of transgenic maize.

Maize farmers are overwhelmingly more likely to encounter hybrid maize materially as well. The cultivation of transgenic material itself is well, if precariously, contained in Mexico through research restrictions and suspended government permitting programs; accidental introgression via farmer recycling of transgenic maize seed imported from the United States as grain seems to be the primary mechanism of gene flow into landrace maize populations (Bellon and Barthaud 2004; Perales et al 2009). Hybrid varieties, on the other hand, are freely available for purchase at most farm supply stores, cultivated commercially in every Mexican state, and dominant in both public and private research programs. While extensive literatures in applied agricultural and development studies have attended closely for decades to farmer decision-making processes regarding hybrid (often referred to as “improved” or “modern”) maize varieties in Mexico (see

Bellon and Brush 1994; Bellon and Hellin 2011; Bellon at al 2021), political ecology and cognate fields have largely failed to bring a critical theoretical approach to this important issue.

This research seeks to fill these gaps in the literature and to critically engage the larger-than-life ideas of modernity and tradition by examining the *everyday politics* of maize agrobiodiversity from the perspectives of those whose livelihoods depend on negotiating the overlap between the two. By focusing on farmers, scientists, and development practitioners in places where their agricultural work is often in tension yet deeply interdependent, this research sheds much needed light on the contradictions and possibilities produced through agricultural development.

Feminist Geographies of Knowledge Production

As a feminist geographer with broad training in ethnographic research and nature-society relations, I consider the connections between agrarian livelihoods, the politics of knowledge production, and global economic restructuring – particularly the revanchist dispossession of uncooperative social groups through agricultural modernization. I begin from the premise that the farmers I study, as part of their daily work routine, are constantly engaging and defying the political, economic, and ecological conditions under which they live. I consider social and spatial reproduction to take place through the repetition of discourses and practices, processes which are in turn mediated by our intimate, often fraught, relationships with nonhuman actors.

Feminist geography establishes a foundation from which to recognize these relationships in which, in Wright's words, "the constitution of knowledge is simultaneously the constitution of political subjects," (Wright 2008: 380; see also Pratt, 2004; Bondi and Laurie, 2005; Monk, 2006). Such an approach is crucial for tracing the processes of subjectivity formation and environmental change, as detailed in the section above on feminist political ecology. But feminist geographies of knowledge production enable us to more fully analyze the radical implications of everyday practices that may not be explicitly linked to feminism. In order to understand a given set of socioecological relations, we must often take a step back from the intentionalities of the moment, and observe the patterns of ideas and patterns that unfold over time.

As feminist geographer Geraldine Pratt has written, discourses are "sociospatial circuits through which cultural and personal stories are circulated, legitimated, and given meaning," (Pratt 1999, 218). This attention to discourse and spatial practice is central to my research here. Feminist geography enables me to trace how myths – from the inherent superiority of modern maize varieties, to the disposability of poor and indigenous women and youth in modern Mexico (see Wright 2006; Wright 2019) – shape the livelihood decision-making of smallholders and development workers. These frameworks allow me to consider the ways in which these women and men may transgress the symbolic and material boundaries that inscribe gender onto the everyday spaces of home-lots, farm fields, street markets, offices and hallway cubicles, even the branded pickup trucks provided for extension agents' commutes to farms across the region. As Wright explains, "feminist geographers bring particular insights to bear as the emphasis on spatial practice exposes the gendered dimensions to struggles even when those dimensions are not articulated verbally or in activists' own accounts of their political goals," (Wright 2008: 382).

These approaches exceed the admittedly undisciplined discipline of geography, drawing from long traditions of interdisciplinary feminist research, and contributing to advancements in the rigorous application of critical social theory to environmental science, science and technology studies, and rural sociology. Feminist critiques of science have highlighted what indigenous and critical race scholars, and communities of color have long experienced and articulated: how the knowledge production processes that Donna Haraway (1991) calls "Science with a capital S" consolidates epistemic authority to delineate what counts as legitimate ways of knowing (see Kobayashi 1994; Demarais 2007; Tallbear 2013). Within colonialist and imperialist science, the knowledge of women and people of color can be dismissed and ignored, resulting in the perpetuation of old forms of inequities and oppression, the proliferation of new violence, and in the degradation of scientific rigor on its own terms. I am interested in how Science-capital-S is negotiated, not only by nonhumans (Tsing 2015) and the humans whose knowledge is marginalized (Shiva 1993), but also by those who, among other tangled allegiances, work within those scientific institutions formally sanctioned by dominant powers. In this research, I contribute to emerging literatures on how ethnography and critical methodologies allow us to grapple with the violence and death our ways of living and knowing have inflicted on more-than-human life, and what the possibilities may be for living with one another. Following those who meet development and conservation workers where they are (see Salazar Parreñas 2018), I explore how those who work for public agricultural research institutions engage the contradictions of their work, their position in relation to the humans and crops on the receiving end of their interventions, and the impossibility of development and conservation as imagined.

Bringing a feminist theoretical framework to her analysis of food sovereignty movements, Anne Portman (2021) identifies the internal tensions and contradictions that have worked to undermine the goals of gender justice with these movements, and argues that an ecofeminist approach – which frames ideas of gender, race, nature, and science as interrelated and socially, historically, and discursively constructed – can help harness these tensions toward productive collaboration. Bryant and Pini (2006) issued a call more than a decade ago for the growing body of political economic research on agricultural biotechnology to pay better attention to gender. Amanda Shaw (2021) renews this call, focusing our attention to the ongoing "paucity of reliable, critical, and nuanced" research into the issues raised by transgenics and accompanying agricultural technologies. Shaw argues that this persistent dearth of research is, in part, an outcome of the very power dynamics in need of critical scholarly attention. When the knowledge, as well as the interests, of people of color, particularly women of color, are dismissed or ignored, science will certainly overlook important research questions, and is more likely to fail to answer well the ones it does ask. Shaw draws on the example of Mexican maize and Bonneuil et al's (2014) study of the global controversy over possible transgenic introgression into indigenous landraces in Oaxaca. This research analyzes the biocultural processes of rendering transgenes visibile or not-visible, and demonstrates that "in vitro based DNA-centered knowledge came to marginalize other forms of knowledge" and externalize key dimensions such as the human dimensions of gene flow (Bonneuil et al 2014: 901). By obscuring the complexity of how crop diversity is maintained, this scientific intervention, what Bonneuil et al call "molecular imperialism," failed to consistently and accurately detect the presence of transgenes, whereas attention to common knowledge and practices of farmers in the region could have easily identified the pathways by which transgenic maize germplasm was routinely introduced to local maize populations.[4]

To Shaw's clarion call for rigorous attention to the mutual construction of gender, race, and transgenic crops, I would add older, less flashy, more pervasive, and severely understudied technologies, particularly, in the case of maize, hybridization. A compelling body of literature exists on the political economy of hybrid crop technology (see Kloppenburg 2004), but pays even less attention to gender and other forms of social difference than those on transgenic and digital agricultural technologies. In this dissertation research, I make a modest contribution to this gap: by looking through a feminist lens at the everyday lives of farmers and development practitioners, I am, in part, studying how certain kinds of maize and maize relations are rendered visible and invisible in the landscape of Central Mexico.

Under conditions of global capitalism, of course, the politics of recognition and visibility are yoked to the politics of valuation. Interdisciplinary feminist literatures, including a political ecology of food and agrobiodiversity, enable a more nuanced and effective analysis of current sources of harm, and imaginations of alternative futures. In the case of agricultural biotechnology and development, feminist science studies remind us that the relationship between the construction of gender and technology is constitutive, not deterministic, with cracks and openings emerging all the time for unintended and unexpected possibilities (see Cockburn and

[4] Only molecular biology knowledge and polymerase chain reaction (PCR) methods were deemed sufficiently rigorous for publication in leading international scientific journals; these methods are unable to reliably detect the presence of marker proteins at such low levels and transgenes were not consistently detected, belying what anyone who grew maize, or who talked to maize farmers, knew already, which is that farmers often planted hybrid maize varieties, imported as grain from the United States, in with their landrace maize as part of their routine experimentation with novel germplasm and plant breeding.

Furst-Dilic 1994; Haraway 1991; Bryant and Pini 2006). This requires that we pay as close attention to the implications of discourses emerging from social justice movements as we do from state-industrial complexes. For example, the discourses of "natural purity" and "natural/unnatural binaries" relied upon by anti-transgenic activists and campaigns have been used to normalize social inequalities, homogenize peasant and indigenous populations, and obscure the lived realities of those farmers who actively maintain crop diversity, in addition to foreclosing any possible benefits that such technologies, in some form under some conditions, might have (see Carroll 2017; 2018).

Graddy-Lovelace (2020a: 239) argues that research on in-situ agrobiodiversity "requires the feminist analysis of care along with a science and technology studies perspective," (see also Martin et al 2015). Writing on the subject of crop "pre-breeding" surveillance technologies, Graddy-Lovelace (2020a: 239) further cautions against simplifying these technologies as either good or bad:

> Technologies themselves could be used to supplement, expedite, and connect farmers' field observations, seed selection, and participatory plant breeding. Yet, the current treadmill of capital-intensive technologies mimic and threaten to displace human agrarian care skills. [. . .] Although useful, these technological advances emerge from and, thus far, perpetuate an epistemology – and political economy – that devalues agrarian care skills.

Interdisciplinary tools of feminist analysis thus help us to more fully understand the intimate harm that particular constructions of technology can cause, while also opening up new possibilities of harnessing technology in order to improve social and ecological wellbeing.

This dissertation grapples with how biodiversity matters as a tool for political change. I investigate agricultural biodiversity, in particular, as an expression of social and spatial difference, produced and maintained by generations of attentive human practice, and implicated in the workings of identity and power. One objective here is to show how the agrobiodiversity of these maize systems plays a central and collaborative role in farmer innovation, not only in terms of selective crop breeding and cultivation, but also in terms of imaginative economic practices and knowledge production. I am likewise interested to explore researcher and extension agent relationships to maize: with what varieties do they engage, and how do the characteristics of these varieties shape their everyday work routines. Nonhuman agents – including diverse maize germplasm, high-altitude volcanic valleys, agrobiotechnology, and markets – mediate human livelihood struggles and decision-making, facilitating certain ways of using and valuing maize, and constraining or undermining others. I demonstrate how agrobiodiversity plays an important role in generating openings for political and economic change, and presents unexpected challenges to decades of agricultural modernization interventions, particularly concerted government attempts to effect the widespread adoption of hybrid maize seed. Here, I am following the lead of feminist geographers who consider the material processes of everyday discourse and practice and how they are productive of certain bodies and certain political and economic landscapes (Wright 2008, Sharp 2007). This approach demands that we rethink what constitutes the "human" in this era we have come to know as the Anthropocene. It also allows for an analysis of the collective performance of farmers and maize, of agrobiodiversity and social difference, as a form of refusal, with the potential to illuminate new, more accountable agricultural possibilities.

For those of us who see an alternative vision of change, one that sees value in criollo varieties of maize and the human lives entwined in them, is to pay careful attention to their presence in the mundane realm of the everyday. Working with maize is taking place, not only on the farm field, but in the home, in the streets, and in the halls of development institutions. It is in the nooks and crannies of daily livelihood routines, not the occasional dramatic moments of protest visible on an international stage, that we find the creative ways in which people engage and defy the relentless exigencies of colonial and capitalist expansion (see Katz 2004).

Trajectories of Agricultural Change

Classic modernization theory defines traditional forms of cultivation as activities conducted by marginalized social groups in marginal agronomic environments, and assumes that traditional varieties will be entirely displaced by scientifically-bred commercial varieties due to the superior yield and profitability of the latter (Frankel 1970; NRC 1972; Harlan, 1975; Plucknett et al 1983; Altieri and Merrick 1987). However, recent work in human-environment and nature-society geography has vividly illustrated how important local variation and heterogeneity are to the spatial dynamics of globalization. Attention to the fundamental unevenness of development from the perspectives of both political economy (Smith 2008) and political ecology (Peet, Robbins, and Watts 2011; Zimmerer 2007; Paulson, Gezon, and Watts 2003), has helped to counter overly simplistic theories of global environmental change. Geographical scale has been central to political ecological analysis for decades, but recent theoretical work has added complexity and rigor to Blaikie’s (1985) original hierarchical conception, engaging different scales as relational, simultaneous, and socially-constructed (Turner 1999; Marston 2000; Natter and Zierhofer 2002; Zimmerer and Basset 2003).

In addition to advancing conventional understandings of *scale*, recent work on agricultural change has contributed a geographically rigorous conception of *place*. Spatial complexity and increasing linkages between rural and urban spaces have produced emergent hybrid landscapes involving "messy and malleable configurations of plants and people," (Head and Atchison 2009: 236; see also Lerner and Eakin 2011; Whatmore 2002). Rather than defining particular places in terms of static dichotomies such as rural-urban, agrarian-industrial, North-South, etc., recent studies frame places as dynamic and unfolding (e.g. Neumann 2005). Place is also imbued with social meaning, and relational analyses of place help us to better understand how the milieu in which actors live and work affects the structures and ideas they engage and the decisions they make (Bebbington 2003).

From this political ecological perspective, the persistence and even dominance of traditional agricultural practices does not reflect the absence of modernization in a given place, nor is it somehow vestigial or otherwise external to processes of agricultural globalization. Rather, such persistence is actively taking place in relation to the current global economic restructuring, of which modernization is a part. To better understand the characteristics and implications of these relationships is a central component of this study. Geographic analysis is helpful in identifying the hopeful possibilities, as well as the challenges, of globalization and agricultural change (Zimmerer 2007). The proposed research contributes to this growing body of geographic literature by exploring how the diverse maize varieties and agricultural practices of Mexico's peri-urban Central Highlands have persisted in the face of global economic restructuring.

Since the beginning of the twentieth century, Mexico's political and economic managers, in a somewhat fraught collaboration with US agribusiness industry leaders, have been working to transform the country's maize production system from a peasant system based on locally adapted, farmer-bred *criollo* varieties to a capitalist system based on industrialized, commercially produced hybrid varieties. In 1943, the Rockefeller Foundation and the Mexican government founded the pilot agriculture program to experiment with breeding innovative crop varieties, which would later grow into the International Maize and Wheat Improvement Center (CIMMYT). By the 1960s, this research center was generating new kinds of maize and wheat conducive to the increasing use of chemical fertilizers and machines, and serving as a catalyzing force in the global transformation of agricultural technology that has come to be known as the Green Revolution. The 1990s witnessed unprecedented trade liberalization, through the North American Free Trade Agreement (NAFTA), combined with the systematic dismantling of long-standing government support for small-scale maize production such as input subsidies, affordable credit, price-fixing, guaranteed markets and distribution, and land reform (Keleman 2010). While facilitating maize farmers' entry into national and international production chains was one primary objective, this agricultural restructuring was also intended to replace smallholder maize cultivation with large-scale industrialized operations (McAfee 2006; Avalos-Sartorio 2006; Levy and van Wijinbergen 1992). The state has consistently marketed this agricultural restructuring in technological terms; the representation of national modernity rests on new hybrid varieties of maize, as opposed to traditional *criollo* varieties.

Hybrid maize breeding and seed production thus functions as a vehicle for development policies designed to displace Mexico's small-scale farmers from the countryside. By examining recent changes in Mexico’s maize industry, we can see the state’s geopolitical and geoeconomic efforts to profit from globalizing agricultural trade while maintaining certain controls over both the territory under cultivation and the agricultural producers themselves.

Prior to the post–World War II industrialization of agriculture and concomitant emergence of a commercial seed industry, all maize farmers in both the United States and Mexico were also maize breeders. At the end of each harvest, farmers carefully selected the highest quality seeds from that year’s crop and saved them to plant the following year. In this kind of farming system, the maize seed itself is a nexus of the biological and social reproduction of the farm, one over which the farmer has sovereignty.

Control over the seed is a key measure of control over the entire agricultural means of production. For US and Mexican commercial interests invested in the development of capitalist agriculture, imposing the commodity-form on to the seed is a central strategic concern. This has not been an easy task for, as Kloppenburg (2004: 37) states, “The seed presents capital with a simple biological obstacle: Given appropriate conditions the seed will reproduce itself manyfold.” Thus, a top priority for elite political and economic actors has been to separate farmers from the reproduction of the seed.

There are two approaches through which capital has historically penetrated plant breeding (see Kloppenburg 2004). Both have, through the active involvement of public as well as private actors, facilitated private investment in plant breeding by forcing farmers to return to the market every year for a fresh seed supply, rather than replanting the seed from their harvest. One is a social approach: assign private property rights to unique plant traits and varieties. Property rights are assigned to privately developed plant traits and varieties. Patents, which make it illegal for anyone other than the patent holder to plant the seed in question without permission and/or payment, can theoretically be applied to any kind of plant variety, from those bred through open-pollination or hybridization to those engineered through genetic modification. However, since the U.S. Patent Act of 1930 on through the WTO Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS) in 1995, institutions for patenting plant genetic material have systematically protected intellectual property rights for commercial technologies while denying such protection for genetic source material (primarily originating in the Global South).

The other approach is a technological fix: develop plant varieties that do not reproduce successfully if replanted. Which regulations and technologies are supported by a given state depends in large part on their particular geopolitical goals. Some examples include ‘genetic use restriction technologies’ such as engineered ‘terminator’ or ‘traitor’ genes, whereby plants are bred so that the seeds they produce are sterile, or so that they will only exhibit the desired traits when triggered by the application of a specific chemical (Shiva 2006; Tansey 2011; Hubicki and Sherman 2005). Another example of such a technological fix – in which the United States invested fully before switching to transgenic technologies, and to which Mexico remains committed – is hybridization. Unlike open-pollinated varieties of maize, which are fertilized by pollen dispersed by nearby plants by wind and insects, hybrid maize is produced by a highly controlled process of inbreeding. Inbreeding begins with an open-pollinated variety, which is self-pollinated over successive generations until a pure-breeding, homozygous inbred is produced. (An inbred offspring, if self-pollinated, produces progeny that are genetically identical to each other and to their inbred parent.) When two inbred lines are cross-pollinated with one another, they produce hybrid progeny, which are sometimes dramatically more vigorous than their inbred parents and the original open-pollinated variety from which they were derived. However, this phenomenon, known as heterosis or "hybrid vigor", only lasts for one generation. And, whereas open-pollinated seeds will yield consistent results if harvested and replanted by the farmer, hybrid seeds will be increasingly uneven in yield and quality in subsequent generations. Thus, the farmer whose livelihood depends on this maize has no choice but to return to the market each year to purchase new hybrid seeds. As Kloppenburg (2004: 11) states, 'although hybrid seed is not biologically sterile like the mule, it is in effect 'economically sterile':

> Because the progeny of hybrid seed cannot economically be saved and replanted, it has use-value and exchange-value only as grain, not as seed. . . Hybridization has proved to be an eminently effective technological solution to the biological barrier that historically had prevented more than a minimum of private investment in crop improvement. It opened to capital a whole new frontier of accumulation that commercial breeders moved rapidly to exploit.

Hybrid maize also allows for extreme control over the plant's phenotypes; being genetically identical, every plant in the field will ripen at the same rate, produce ears of the same size and at the same height, with uniform kernels, all characteristics which greatly facilitate the mechanization of planting, harvesting, and post-harvest processing. Hybrid maize was bred to respond to chemical fertilizers, thus enabling the agricultural industry to absorb surplus nitrogen production left over from the military needs of World War II. Focusing on hybrid maize illuminates the uneven and contingent nature of neoliberalization in Mexico. The past four decades have witnessed national deregulation, increasing importation of US maize, and the withdrawal of much state support from the agricultural sector – all central components of what

Elizabeth Fitting (2006) calls the “neoliberal corn regime.” However, the Mexican state has also mobilized huge resources specifically to combat many of these neoliberal trends, particularly with regards to maize production. This presentation of “security” rests on the erroneous but firmly entrenched shibboleth of development that equates the increased production of food crops with the feeding of a greater number of hungry people.

As decades of research have shown, in today’s world of corporate agribusiness, the overproduction of food is actually concomitant with the escalating production of hunger. As geographer David Nally (2011: 49) has argued, this agricultural restructuring is a key mechanism of violence in the modern world: “The spatial paradoxes of the global food system require new mappings that show how scarcity and abundance, privilege and suffering, and life and death are mutually constituted.” Maintaining the narrative that new technologies like hybrid maize varieties are a solution to poverty and hunger requires erasing the role these technological interventions have played in reproducing the very inequalities used to justify them. It requires erasing the routine violence of the global food economy and also the alternative food systems that farmers and others around the world are struggling for.

In recent years, scholars interested in tensions between the United States and Mexico over agricultural development have increasingly turned their attention to prominent debates over transgenic maize. This reflects, in large part, the dominance that transgenic maize has assumed, in terms of US production and policy, since the commercial planting of transgenic maize in the country first began in 1995. According to the US Department of Agriculture, 88% of US corn planted in 2012 was genetically engineered.62 Of the total US corn acreage planted in 2012:

15% was Bt maize, containing traits derived from the Bacillus thuringiensis bacterium that cause the altered plants to produce insecticides; 21% was HT or 'herbicide tolerant' maize, developed to survive application of specific herbicides that previously would have destroyed the crop along with the targeted weeds; and 52% contained both Bt and HT (stacked) traits (USDA 2012). McAfee, who has spent years studying the dynamics of the debate between the two countries, argues that "having placed its bets on transgenic technologies, the US government has worked zealously to convince publics and prime ministers that genetically engineered crops and products are safe, superior, and the solution to virtually all agricultural challenges," (McAfee 2008: 151) The US Departments of Agriculture and Commerce, in their fervent promotion of transgenic technologies, have extolled the ability of future generations of crops to solve the ecological challenges of food production and alleviate hunger and rural poverty. Since the late 1990s, these agencies, backed by the six or so transnational corporations that currently dominate international agribusiness markets, have made the purported superiority of transgenic crops a central feature of their long-standing push for the liberalization of food trade and the global enforcement of intellectual property rights to agricultural technologies. Mexican authorities have exhibited great ambivalence toward the deregulation of transgenic maize. In 1998, they placed a de facto moratorium on the commercial cultivation of transgenic maize, citing concerns that it would likely cross-pollinate with native varieties and thereby transfer genetically engineered traits, with consequences that we do not yet fully understand.

In 2009, the Calderón administration broke this ban by granting 196 permits to three international biotech corporations – Monsanto, Dow AgroSciences, and DuPont's Pioneer Hi-Bred – for experimental cultivations of transgenic maize in northern Mexico. In 2012, these three were joined by the seed and agrochemical conglomerate Syngenta, and together the four companies submitted seventy new applications for permits to plant transgenic maize, fourteen of which were for commercial cultivation on almost 6 million hectares. However, the biotech giants are currently stalled in their efforts to expand transgenic cultivation; a decade-long concerted opposition movement expanded dramatically in late 2012, with farmers' groups, environmentalists, artists, and prominent intellectuals mobilizing to hold workshops, public forums, and demonstrations in many Mexican states and countries around the world to demand a moratorium on the planting of transgenic maize in Mexico (Riberio 2014). As of January 2014, a collective civil action has accomplished a temporary suspension of transgenic permits, and the campaign against transgenic maize remains a prominent and powerful movement in many parts of the country.

However, these popular uprisings and heated controversies over the risks of transgenic maize have seemed to largely pass over the farmers of the Amecameca Valley. Those who cultivate maize in this part of Mexico claim to pay little attention to newspaper headlines blaring the latest research findings that transgenic maize causes cancer in rats (La Jornada 2012), or to prolific editorial pieces by prominent public intellectuals on the cultural patrimony of Mexican maize diversity (Enciso 2012), and they don't frequent the Zócalo in Mexico City where youth dressed in maize *lucha libre* costumes dance, play punk rock, and demonstrate against Monsanto (Jiménez 2013). A burgeoning body of literature has focused on transgenic maize as representing the arrival of a "neoliberal food regime" in Mexico (Fitting 2004; Pechlander and Otero 2008). Struggles over the fate of the peasantry and maize agriculture have been increasingly framed – by academics, NGOs, and social movements – in terms of support for or opposition to transgenic technology. As McAfee states (2008: 151), "In Mexico and other parts of the global South, criticisms of GMOs have contributed to – or serve as proxies for – counter-arguments in favor of protection of domestic agriculture and 'food sovereignty." However, international focus on "the GM maize debates" (Fitting 2004) has obscured other, equally important dimensions of the ongoing struggles within Mexico over the future of maize production.

Like the US, the Mexican state has staked its vision of national food security on the genetic composition of its maize. In ways that somewhat parallel the US's heavy investment in transgenics, the Mexican government has placed its bets on hybrid maize technologies and has been aggressively promoting the adoption of hybrid varieties among the nation's maize farmers for over seventy years. In their portrayal, modern Mexico is a place from which *criollo* maize has disappeared.

Criollo maize is erased from the state's conception of food security, despite the fact that these local varieties have nourished the country's population for thousands upon thousands of years, and that a significant majority of Mexican maize farmers currently cultivate *criollo* varieties, declining to adopt the officially sanctioned hybrid varieties. The reality of *criollo* maize production is not even acknowledged in official government records. National statistics estimate that *criollo* varieties make up 80% of national maize production. This may seem high, particularly relative to the almost complete absence of native varieties in the neighboring United States, and yet the figure is almost certainly a severe underestimate, for the National Agricultural and Livestock Information System (SIAP 2006) fails to account for a significant portion of the maize produced outside of the dominant commercial markets. In the State of Mexico, for example, SIAP records the production of *pozole* maize in only one municipality, Calimaya, in the western half of the state, and the production of blue maize only in the northernmost municipalities. These criollo varieties, along with several others, are grown almost exclusively by farmers in the southeastern municipalities of the Amecameca Valley, but their struggles are nowhere to be found on national maps of maize production. The challenge for those who seek to promote the vision of Mexican agricultural modernity is to deflect attention away from the persistence of *criollo* maize in the country, so that what international audiences see is a national maize industry that is leaving behind cultivation systems marked by poverty, hunger, and the peasant maize varieties of the country's past. Political and economic elites appear to have had many successes, given the dominance of popular narratives of the inevitability of agricultural globalization, biodiversity loss, and the displacement of peasants from the land. This physical eradication of devalued plants and people is affected in no small part through the discursive erasure of women's agricultural labor and expertise (see Sachs 1983; and Sachs 1996).

My research, which reconsiders the premise of agricultural modernization alongside those at work in landscapes scoured by it, is one small contribution to remaking the map of which plants and people matter.

Livelihoods, Conservation, and Development

Conceptions of place-based livelihoods have proven themselves increasingly useful to analyses of agricultural development (Zimmerer 1996; Bebbington 2000; Bebbington and Batterbury 2001). The concept of *livelihood* foregrounds the multifaceted agency of actors who are seeking many different things (income, security, power, happiness) as they engage with their environment, with structures of capitalism, with development interventions, etc. (Bebbington 1999). Livelihood as an analytical framework has been employed with great success in countless studies of small-scale agriculturalists, but there is an existing need for further study of the livelihoods of actors operating within development institutions (Bebbington 2003). The proposed research posits that applying a livelihoods framework to maize producers and also to agricultural scientists, development program officers, technicians, engineers, and extension agents will help to understand how and why they interact with one another and align their work with particular varieties of maize in the ways that they do.

Crucial to my consideration of livelihood is the concept and research approach, from feminist geography, of diverse economies (see Gibson-Graham 1996), which seeks to "open up an imaginative space for economic alternatives," (Gibson-Graham 2008: 613). As a collaborative community project, diverse economies provides an opening to imagine – and, perhaps, remake – and "outside" to the contradictions of capitalism. As an analytical framework, diverse economies enables us to recognize these contradictions more clearly as such, and to render more visible the alternative economic practices already taking place in the worljd. Such a framework is crucial for understanding how social and natural relations come together to promote particular relations of production and exchange (see Nightengale 2019). In the case of maize in Mexico, a diverse economies approach pushes back against conventional understandings of smallholder farmers and their criollo maize as vestigial or obsolete, and their maize markets as unworthy of attention. I take seriously the economic practices that farmers choose, which have enabled survival in the face of global economic restructuring that has sought to make them disappear. Gibson-Graham (2008: 617) note that "'marginal' economic practices and forms of enterprise are actually more prevalent, and account for more hours worked and/or more value produced, than the capitalist sector." This is dramatically true with maize production in Mexico where, to the dismay of generations of development practitioners, the overwhelming majority of farmers persist with less capital-intensive modes of farming and less-commodifiable forms of maize.

Recently, geographers have argued that globalization has produced an increasing interface of environmental conservation management with agricultural practices and development interventions (Zimmerer 2007; Zimmerer 2013 PNAS). The complexity and contradictions of this interface are clearly evident in the maize landscapes of Mexico's Central Highlands, where the cultivation of local maize for commercial and subsistence use simultaneously accomplishes the in-situ conservation of agrobiodiversity. Furthermore, the livelihoods of development practitioners are often staked to conservation efforts as well. CIMMYT frames its agricultural modernization programs as sustainability initiatives, though "conservation" in these instances largely means that an emphasis is placed on reducing tillage and soil degradation. But many of the researchers involved in agricultural modernization projects are committed to deeper forms of environmental protection than are the projects themselves. According to preliminary research findings, many researchers have longstanding involvement in efforts to advance the in-situ conservation of diverse varieties of maize while simultaneously working on behalf of projects dedicated to the widespread adoption of improved varieties. The varied interactions between agriculture, livelihoods, development, and conservation range from antagonistic to synergistic, and these relationships have great implications for the changing peri-urban landscape of the Central Highlands.

Decades of interdisciplinary research has built a strong scientific consensus regarding the importance of small-scale agricultural work as a source of empowerment for women in rural communities around the world. In many countries, women are the primary producers of food for local consumption in rural communities (FAO 2010). They are key stewards of agro-biodiversity, know place-specific crops and skills necessary for sustainable food production, and are essential to local food security (FAO 2005). However, the value of rural women's work usually goes unrecognized in economic policy, and economic restructuring often functions to undermine women's agricultural practices along with the communal social and ecological benefits they generate (Howard 2003). Globalization and trade liberalization have caused the expansion of international food markets and the widespread adoption of crops and cultivation techniques that caters to them. These shifts favor large-scale agricultural producers who have more resources, access, education, and capacity to compete in global markets, meanwhile excluding poor and small-scale producers such as women (World Bank 2009).

Development policies of the 1970s and 1980s sought to address women's subordination across the world by incorporating women into existing strategies and programs. In agriculture, such interventions often focused on training women in various techniques and giving them access to the latest technology. By the 1990s, international organizations and women's organizations argued that little had been done to enhance women's equality or empowerment for two decades, and that rural women in particular were becoming increasingly vulnerable as governments in many countries retreated from rural development (Sachs and Alston 2010). As stated in one government reference manual, "the feminization of agriculture has been a trend which, unfortunately, has grown hand in hand with the feminization of poverty" (Commonwealth Secretariat 2001). Following the 1995 World Conference on Women, gender mainstreaming became the policy strategy of the future: rather than focusing on women's participation and perceived challenges, gender mainstreaming aimed to transform social and institutional structures in order to make them responsive to gender and beneficial to those who are less empowered (UNEP 2006; Sachs and Alston 2010).

Yet, this approach too has stagnated in recent years. To date, many efforts to "mainstream gender" have been limited to technical interventions that fail to challenge inequitable power structures. Gender disparities remain among the deepest and most pervasive of inequalities (UNDP 2005; UNEP 2006). Such concerns are summarized in a policy document from the International Food Policy Research Institute, which critically assesses a decade of development interventions and policies designed to increase poor female farmer's access to and control over productive resources. The review concludes that, in order to have anything more than a superficial impact on gender inequality, future interventions must rigorously consider the "context specificity" of gender relations (Quisumbing and Panfolfelli 2009).

This dissertation research is premised on the argument that bringing an explicitly geographic theoretical framework to research on gender and agriculture may provide precisely the kind of rigorous approach to gender analysis that development researchers have been calling for. Geography has regularly been described as a "science of context," an analytic approach that seeks to explain how places and spatial patterns are produced by relationships between humans and their environments at multiple, interactive scales (Knox and Marston 2010). Indeed, due to their central focus on relationships and processes, geographers were among the first to call attention to the important role that women play in traditional agricultural systems (Sauer 1952), and among the most consistent to warn of the harmful social and ecological consequences of gender-blind development policies (Rocheleau et al., 1996; Zimmerer, 1996; Momsen, 2004; Chambers and Momsen 2007).

Conclusions

This dissertation takes a feminist geography approach to the study of how and why maize agrobiodiversity persists. The four theoretical approaches outlined above enable my research to advance our understanding of this persistence, its contingencies, and its socioecological implications. They provide the tools necessary to unpack the contradictions of agricultural modernization, in which the very farmers maintaining reservoirs of crop genetic diversity are the ones whose livelihoods are most at risk from development interventions. This interdisciplinary theoretical framework illuminates the connections between the livelihood decision-making of those make a living growing diverse varieties of maize, and those who work for institutions dedicated to “improving” maize production. Most research on maize diversity focuses on the decisions of smallholder farmers as an essentialized cultural category, without considering the dynamic politics of this identify formation, while obscuring the decisions of agricultural development institutions and those who work within them. My dissertation research, in contrast, considers the subjectivity of both farmers and agricultural development workers as a process, unfolding across time and in place, in intimate relation to the nonhuman agency of maize agrobiodiversity. In this way, I seek to understand our working relationships to maize in new ways, and to seriously consider the contradictory dynamics of gender, agrobiodiversity, economic practice, and development at play, and at work, in Mexico's Central Highlands.

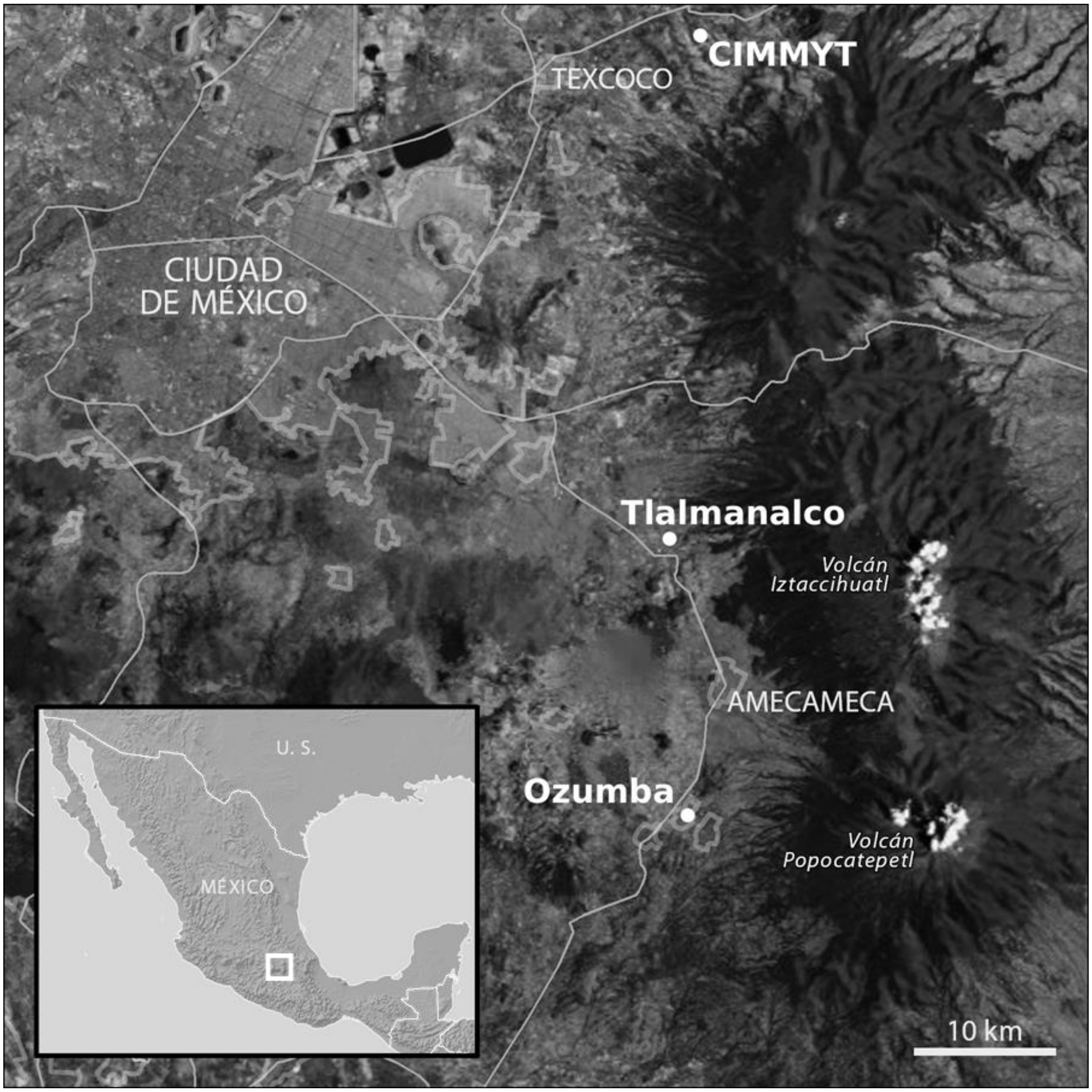

Figure 2: Map of research sites in the southeastern portion of the Central Highland region of Mexico. Cartography by Paulo Raposo

CHAPTER 2: METHODOLOGY

Those working both inside and outside of development institutions engage in livelihood practices that subvert agricultural modernization in partial yet significant ways. This research centers on two primary research sites and four primary research subjects – three groups of human participants and one group of nonhuman actors – as detailed below. I focus on a particular relationship between place and livelihood as the institutional unit of analysis, and on a given participant's engagement with agrobiodiversity as the theoretical unit of analysis. My research interests focus on participant's understandings of and motivations for engaging in the agricultural practices and partnerships they do; my methods are therefore be intensive and inductive rather than extensive or deductive. I conducted 14 months of ethnographic fieldwork in the region, while studying the indigenous Nahuatl language and cosmology with a native speaker and local indigenous rights activist. During the summer of 2010, I conducted reconnaissance research of my field sites, and lived in the visiting scientist dormitories at CIMMYT. While collecting data between January and November 2012, I rented a room in a working-class neighborhood in the town of Amecameca. This research was approved by Penn State's Human Subjects Review Board in January 2012 under IRB#38028, and all data collection and management were conducted in accordance with IRB requirements.

Research Sites

This research examines agricultural development, agrobiodiversity conservation, and economic innovation in place, seeking to better understand how the constraints and opportunities of a given landscape shape the livelihood struggles of those who live and work there. The study therefore focuses on two research sites that have each been produced by a long history of agricultural labor, and on the ways in which the conditions and meanings of these places work in relation to livelihood and agricultural practice. These two sites are connected by, among other things, the Mexican government's newest national agricultural modernization initiative: The Sustainable Modernization of Traditional Agriculture (MasAgro) project targets small-scale maize producers for the adoption of conventionally-bred, high-yielding maize varieties, seeking to more fully integrate Mexican farmers into commercial markets (CIMMYT 2011). MasAgro is a collaborative initiative of Mexico's Ministry of Agriculture, Livestock, Rural Development, Fisheries, and Food (SAGARPA) and of scientists at the International Maize and Wheat Improvement Center (CIMMYT) in partnership with regional and multinational agricultural biotechnology companies. The project was launched in 2011 with an initial ten-year budget and has already established dozens of experimental platforms and enrolled thousands of farmer participants. This project's size and scope, and its explicit efforts to transform "traditional" farmers into "modern" ones make it an ideal case study for this research.

The first study area is a site of agricultural technology production: the Texcoco valley, a consortium of public universities, national research stations, and an international agricultural research station located less than 50km due north of the Amecameca Valley (see Figure 2). The International Maize and Wheat Improvement Center, known by its Spanish acronym, CIMMYT, is a non-profit agricultural research and training institute that is a member of the CGIAR system. CIMMYT grew out of the Mexican Agricultural Program, which was initiated by the Rockefeller Foundation in 1943 and dedicated to the development of high-yielding varieties of hybrid maize. Since its establishment, CIMMYT has been a world leader in the development and dissemination of modernized maize technologies (Kloppenburg 2004). Research at the center was led for many decades by agronomist Dr. Norman Borlaugh, and the legacy of the Green Revolution is clearly evidenced in CIMMYT's ongoing emphasis on the breeding and mass-production of high-yield crop varieties. The MasAgro project is currently one of CIMMYT's largest ventures, and their largest Mexican-based project by far, in terms of budget size, number of personnel, and the scale of ambitions involved. However, the narrow conception of "agricultural development as technological development" that dominates most CIMMYT publicity materials belies the complexity of the work being done by those who work on behalf of CIMMYT projects. Beneath a prevailing narrative that privileges large-scale intensive monocropping systems and the (*ex-situ*) conservation of genetic diversity in seed banks, many CIMMYT scientists have conducted extensive inquiry into participatory breeding methods and the importance of in-situ (on-farm) conservation of maize diversity (e.g. Smale *et al* 2001; Keleman *et al* 2009; Bellon and Hellin 2011).

The second study area is a site of maize agrobiodiversity production: the Amecameca Valley, a collection of small agrarian communities located in the southeast corner of the Central Highlands on the outskirts of Mexico City. The Amecameca Valley is located the State of Mexico, about 40km southeast of Mexico City and at the foothills of the snowcapped Iztacihhuatl and Popocatepetl volcanoes, and includes seven municipalities: Ayapango, Amecameca, Juchitepec, Tepetlixpa, Ozumba, Atlautla, and Ecatzingo. This part of the Central Highland region (called *Valles Altos* or "high valleys" in Spanish) presents a temperate subhumid climate and ranges in altitude from 1,900-2,500masl. Mean annual temperature (14.8˚ C) is relatively low, compared to surrounding areas, though summer conditions permit a growing season of more than six months

(Perales 1998). Frosts are common between November and January, though they can occur as early as September and as late as March. Early frosts can be particularly harmful to maize crops as they can cause damage during its final maturation period in November. There is no major river system in the Amecameca Valley, and rainfall is substantial. The rainy season is established by June, though it can begin as early as May, and lasts through September, with a short drought, known as *canicula*, commonly occurring between July and August. If the *canicula* lasts longer than two weeks, it can be severely damaging to maize crops. Scattered showers can occur between November and May that maintain soil moisture and enable early maize planting in the valley (see Perales 1998).

The Valley's long, sustained history of small-scale rain-fed maize production makes it representative of the MasAgro program's primary target beneficiaries, and its close proximity to the CIMMYT campus (see Figure 1) allows for a close study of the partnerships that form (or don't) between farmers and agricultural development institutions. In addition, the unique characteristics of maize production in the Amecameca Valley provide several key openings for insight into the contradictions of agricultural development in Mexico. First, though it exhibits the landrace persistence typically attributed to environmental marginality (see Brush, Taylor, and Bellon 1992; Meng, Taylor, and Brush 1998) the deep, friable volcanic soils, gentle slopes, ample rainfall, and long growing season make the Amecameca Valley one of the most productive areas of Mexico's highland regions (Perales 1998). Second, the valley is a center of *in-situ* (on-farm) conservation of maize diversity and an accompanying diversity of knowledges and practices rooted in indigenous cultures dating back for millennia, but it lacks the cohesive farmer organizations, ethno-linguistic diversity, and subsistence orientation of farming regions in southern Mexico, where powerful maize-centered food sovereignty and indigenous rights movements have recently emerged (Lockhart 1994; Tutino 1993). Census data report that fewer than 1% of residents in the Amecameca Valley speak Nahuatl, though it is worth noting that local Spanish is steeped in and reworked by Nahuatl terms and cultural meanings. Third, the valley is located in in Mexico's most economically-developed region and proximate to Mexico City, the country's largest marketplace. The Amecameca Valley has higher-quality roads and general infrastructure than many surrounding areas. Residents are not less educated or more culturally conservative than those in surrounding valleys, where many farmers cultivate hybrid varieties of maize. In addition, local farmers are highly market-oriented in comparison to surrounding areas; Perales *et al.* (2003) report that farmers in the Amecameca Valley sell 70% of their maize while those in nearby lower elevations sell less than 30% of their maize.

Maize is the dominant crop in this valley, planted in more than 90% of the crop area, with beans and squash typically planted as intercrops (Perales R. 1998). Most households in the region depend on off-farm income, often jobs in the urban and suburban areas in and around Mexico City, to subsidize their agricultural activities. The small-scale farmers in this rain-fed agrarian landscape grow maize for subsistence, and many also sell part of their harvest, typically in local and regional markets organized by the producers themselves. The average area cultivated per farmer in the Amecameca Valley is 2-3 hectares, and most rely on agriculture as their primary source of income (Perales 1998). Local varieties of white maize – processed into masa dough and used to make tortillas, tamales, atole, and other local staples – are the primary crop for these commercial farmers, though many also cultivate smaller populations of maize that are blue, blue-black, red, yellow, or mixed in color. None of the farmers in these communities reported purchasing scientifically-bred varieties in a survey conducted in 1995 (Perales 1998: 100). Some maize is saved for household consumption, animal feed, and as seed for next season, and the rest is sold in local and regional markets. The year-round municipal market in the town of Ozumba is a central hub of seed exchange and commercial interaction for maize producers in the region, and serves as a focal point for participant observation and recruitment in this study.

Research Participants

This research examines how particular livelihood strategies, each shaped to varying degrees by the places above, reach across scales and affect processes of agricultural development. Based on three months of reconnaissance fieldwork, I identified four key categories of actors whose lives (and, in the humans' case, livelihoods) depend upon local maize production, and who play influential roles in development interventions in the Central Highland region. Some of these actors are far more mobile than others; some have work and identities that are deeply rooted in place, while others are highly transient, affecting the places above as they move through them. But all of them negotiate interscalar relationships to one another as part of their everyday lives.

> 1***. Maize Producers***: This category includes small-scale commercially-oriented farmers involved in the planting, cultivation, harvesting, post-harvest processing, and marketing of local maize. In the Amecameca Valley, maize producers comprise household units working a combination of private and communally-titled *ejido* land, many of whom hire local labor during harvest season (Perales 1998). Though men are typically designated heads of household and, as such, often the exclusive participants in studies of farmer

decision-making, women play a hugely influential role in many stages of maize production from seed selection to the processing and selling of maize products.

2. ***Agricultural Research Scientists***: This category includes the researchers employed by CIMMYT and actively involved, whether part-time or full-time, on MasAgro-related activities. Researcher scientists include agricultural economists, maize breeders, crop geneticists, GIS specialists, engineers, and agronomists, some of whom work exclusively on knowledge and technology production, and some of whom do collaborative research with maize producers. Program officers and technicians are dedicated to the coordination of MasAgro's network of partners and participating farmers and the management of the program's "experimental platforms", which serve as regional sites for technology transfer and networking between MasAgro technicians, external extension agents, and maize producers.

3. ***Agricultural Extension Agents***: This category includes program officers (hub managers, project coordinators, etc.), and technicians actively involved in implementing the MasAgro program. These technicians are primarily dedicated to building relationships with maize producers and promoting the commercialization of maize production and the use of certain agricultural technologies, particularly hybrid maize seeds, accompanying packages of inputs (fertilizer, pesticide, etc) and the machines and infrastructure associated with water and soil conservation practices.

4. ***Maize Populations***: This category includes the nonhuman, non-sentient but nevertheless highly influential maize plants actively growing in the region. These plants cannot participate in interviews, but their agency shapes human lives and decision-making, and this agency is one central focus of the ethnographic observation at the heart of my research. Maize varieties in this region are identified as belonging to five types of germplasm following the criteria established by Bellon *et al* (2006): hybrids, recycled hybrids, open-pollinated improved varieties (OPVs), creolized varieties (originally improved varieties that have been under farmer selection for several generations), and landraces.

Data Collection Methods

When I first designed this research project, my intention was to take a parallel methodological approach to two distinct participant groups: development practitioners, and the targeted beneficiaries of development interventions. In this case, development practitioners are the agricultural researchers and extension agents employed at CIMMYT, and the targeted beneficiaries of CIMMYT's programs are smallholder maize farmers. There can be analytical power in applying the same data collection tools to different groups of research subjects; the observed dynamics can be considered and compared across, as well as within, subject groups which are, for these purposes, posited as equivalents. In the case of my research, these groups are considered equivalent in narrow terms: that of their status as workers. Both subject groups – CIMMYT's researchers and extension agents, and smallholder maize farmers – comprise heterogeneous individuals and dynamics. In addition, they are set apart from one another by historical patterns of divergent resource access, institutional support, and agricultural practices.

However, they share a daily practice of livelihood decision-making in relation to the regional landscape of agricultural development in which they work. By approaching these two groups as equivalent in terms of their status as agricultural workers, this research is able to analyze areas of overlap as well as divergence in the priorities and socioecological relationships that smallholder farmers, researchers, and extension agents use to guide their livelihood decisions.

The methodological approach of this research makes innovations to political ecological studies of agricultural development on two fronts. First, research participants included not only the maize producers in question, including those involved throughout the production process, but also researchers, program officers, and technicians who likewise have a livelihood stake in negotiating the terms of development but are rarely the subjects of research themselves. Second, a combination of semi-structured livelihood interviews, structured livelihood survey, market survey, and participant observation were be used to access the livelihood practices and perceptions of each category of participants. My proficiency in Spanish allowed me to conduct, transcribe, and translate surveys and interviews, while my ongoing training in written and spoken Nahuatl gave me insight into the indigenous words and cultural meanings that permeate vernacular uses of Spanish.

Semi-structured Livelihood Interviews

In-depth, semi-structured livelihood interviews were conducted with participants in each of the human categories of research participants – 3 maize producers (all male), 6 MasAgro scientists (3 female, 3 male), and 5 extension agents (2 female, 3 male) – who testified, based on their personal work experience, to regional dynamics of maize cultivation and to relationships between local farmers and development programs during the past ten to thirty years. Each interview consisted of gathering participants' personal reflections on events in recent decades and their causes and effects (Plummer 1983; Creswell 2007). These interviews narratives took place during a conversation that was at least an hour long (some interviews went on much longer, at the participant's request) allowing each narrator to develop and enrich the narrative.

Drawing from reconnaissance work in the region and discussions with both farmers and agricultural researchers, I identified key historical events in the region – such as the 1982 national debt crisis (and accompanying abolishment of farmer subsidy programs), the 1994 ratification of NAFTA (and accompanying Zapatista uprising), and the 2010 launch of MasAgro – that were used to provide touchstones and a flexible structure in common for the interviews. Participants' interpretations and experiences of agricultural transformations since the Green Revolution, including changes in technology, varietal selection, declining terms of trade, rates of migration, land reform, and climate variations, provide important insight into how the perspectives that guide their decision-making and interactions today have unfolded over time. These interviews were then analyzed for patterns in the ways that participant's views of agricultural change and of particular maize production practices and technologies (including agrobiodiversity) articulate (or not) with one another and with the official objectives of development projects and policies. A thematic analysis of interview narratives traces how engagement with and perceptions of particular development interventions vary across participants, yielding information about how individuals are enabled and constrained by their socially situated roles (Chase 2005). Participants' perspectives on agricultural change and livelihood struggles are compared and analyzed as they relate to discourses of modernization.

My research interests center on their livelihood practices; the multiple objectives and purposes of their work, either as maize producers or development researchers/practitioners; and the resources they draw on as part of these livelihood practices. Interviews elicited information relevant to each participant category. For maize producers, this includes information on household characteristics, education and employment history, labor allocation, sources of income, agricultural assets, and maize production, with a particular focus on the maize varieties planted and farmers' participation in government subsidy/technical assistance programs. For development researchers/practitioners, this included information on household characteristics, education and employment history, the particular maize varieties and agricultural technologies emphasized in their work, and their networks among farming communities and development organizations.

Also of primary interest are how interviewees articulate the objectives of their own livelihood practices and the challenges they face in achieving them, how they relate these efforts to the goals and practices of regional development efforts as they perceive them, and how they may employ conceptual categories of "modernity" and "tradition" to define normative terms of agriculture. An analysis of cross-cutting themes and resonant patterns within and among these interviews helps to explain how and why certain relationships have formed between local maize producers and particular agricultural technologies, markets, extension services, and development programs.

Structured Livelihood Surveys

Structured livelihood surveys were conducted with only members from the first group of research participants: maize producers. Twenty-one maize producers, who were also vendors selling the maize they grew in the Ozumba tianguis, or street market. The twenty-six questions contained in this survey can be found in the attached Appendix, and a more detailed description of the survey and tianguis observations can be found in Chapter 5.

These structured livelihood surveys were a data collection method developed in the field, in response to participant feedback, and represent a departure from my original research design. As described above, my intention had initially been to apply a parallel methodology to all three groups of human research participants, in part so as to compare participant responses, and in part to assert equal consideration of their role as a research subject, despite a long history of scientific research treating poor farmers, scientists, and development practitioners very differently. However, this research project cannot be extricated from this problematic history, regardless of my intentions to counter it. The positionality of myself – a U.S. citizen and white female researcher – relative to my various participants makes a difference in conducting this research, as does the political and historical context of divergent knowledge systems in the region. Many communities do not organize their everyday lives, nor orient their sense of self, around Western Enlightenment notions of individualist reason. Postcolonial landscapes often feature a tension between such knowledge systems, in which each (masculine) individual is the sole possessor of their expertise, and indigenous and immigrant knowledge systems in which memory, epistemology, and knowledge production are collective (DeRocher 2018).

This tension shaped my research, and ultimately restructured my approach to data collection. I found that research scientists and agricultural extension agents were eager to respond to a flexible interview format by narrating their life's trajectory and personal decision-making process, and aspirations. This degree of confidence and individualist subjectivity allowed for an expansive conversation in which I offered small prompts, and spent the vast majority of our time listening, responding, and taking notes while my participant talked about themselves. However, this format did not work well with my maize producer participants. Despite having agreed to sit for an interview, they tended to lapse into awkward, truncated, monosyllabic responses as soon as the interview began.

The difference was not strictly demographic, for most of the extension agents and some of the research scientists come from the same towns as the maize producers, with similar household economic status. Nor is it a matter of loquaciousness, for the very same farmers who fell silent in their interview, would talk for hours upon hours in extravagant detail about every aspect of their livelihood and life history, while we worked together in the daily household routines of the kitchen, the garden, the maize field, and the street market.

And, so, I changed my methodological approach. Rather than the relatively confrontational and isolating format of a one-on-one interview, I developed a livelihood survey for maize producers that would likely be more familiar to them, given its similarities to the surveys administered by various agronomists and researchers who frequently with farmers across the region. Instead of targeting an entitled, individualist, and subjective narrative, as in the semi-structured interview - “what did you want to pursue as a career?” “what do you think about agrobiodiversity conservation?” – this livelihood survey solicited information in the form of empirics and common sense. This placed the responsibility on me to immerse myself enough in local everyday life to be able to interpret the meanings of these responses, and to parse internal contradictions and debates, rather than demanding that my participants cater their perspective to the ignorance of an imagined outside audience.

Maize producers responded to the survey in a collective setting, often while working in the Ozumba street market, which elicited rich exchange between household members and other market-goers. Ultimately, this change in methods enabled a deeper engagement with the collective epistemologies, relationships to maize, and livelihood strategies among these maize producers than had I continued with my original research design. Credit for this improvement goes to the farmers, whose critical feedback reminds me of the practical importance of reflexivity in research, and whose common sense provides a rich opening for critical inquiry.

Market Survey

Following a much-simplified version of established methods for surveying the ethnobotany of markets (Cunningham 2001), I conducted a single survey of the five-blocks devoted primarily to maize, as well as the adjoining alley dedicated primarily to the sale of maize husks, or ojas, for use as tamal wrappers. I counted every maize vendor present on this day, recording for each: 1) the type of maize being sold; 2) the origin of the seed; 3) the town where the maize had been grown; and 4) the sale price. The survey took place on a Tuesday morning, the weekly peak of activity, in early April, which vendors reported was the annual peak sale period of maize seed for planting. While this survey does not assess annual variation in price or varietal availability, it does provide a detailed illustration of the patterns of farmers' preferences and perceptions that emerge from my observations and data from the longer livelihood surveys and interviews. Both producers and consumers identify particular valued traits with certain maize varieties, and prices in the tianguis are negotiated accordingly.

Participant Observation

Participant observation was conducted during eleven months of fieldwork. Observations of participants' everyday activities within and between the two research sites provide context for the perspectives elicited through the market survey and participant interviews, and provide insight into how individual farmers, researchers, and technicians negotiate issues of modernity and tradition through their daily agricultural work. Of particular interest is how the conceptions and ideas (of development, modernization, livelihood, etc) articulated through interviews are put into practice; what actors and ideas participants build relationships with and how they manage their network of relationships; and how participants work and interact within and across different spaces. Participant observation in the Amecameca Valley centers on the regional market in the town of Ozumba as the primary site of interaction between the valley's producers, venders, and consumers of maize; and on everyday livelihood practices in homes and field throughout the year. Participant observation in CIMMYT centers on the work routines of individuals and groups of researchers and program officers and included accompanying them while at the research station, in the field, and as they interacted with farmers and extension agents. My observations and ongoing interpretations were recorded in detail through handwritten field notes. For greater detail on the spaces in which these observations took place, and the opportunities to participate myself in participants' livelihood practices, see Chapters 3 and 4, on researcher and extension agent livelihoods, and Chapter 6, on farmer livelihoods.

PART I: THE TEXCOCO VALLEY

Prelude

There are two ways to catch public transportation from Mexico City to Texcoco. If you flag down one of the many little *combis*[5] weaving through heavy traffic, you will squeeze onto a bench seat between fellow passengers and proceed east on clogged 6-lane highways out of the Distrito Federal, through the burgeoning Cuidad Nezahualcóyotl, and onto Carretera 136 North. Because your driver needs to let passengers disembark along the route, and seeks to maintain as full capacity as possible by constantly trolling for new customers to fill any empty seats, you will likely stay in the slowest, right-hand lane the entire journey. After a ride that can take 90 minutes or (much, much) longer – depending on traffic, passenger needs, and the proclivities of your driver – having passed through several densely-populated small cities punctuated by patches of farmland, you call out your stop and pass your fare forward from passenger to passenger. Any change you are owed will be sent back from the driver in the same manner. The trip will cost less than one US dollar.[6]

If, on the other hand, you head to the TAPO[7] bus station, you will buy a ticket in advance, for about 3USD, for a designated seat on one of the *Volcanes*-line large tour buses that leaves the station at set intervals. After making a few stops on the way out of D.F., this bus heads straight for the Autopista Peñón- Texcoco,136D. Unlike the publicly owned and funded carreteras, the autopistas are stretches of highways financed, built, and maintained by state-contracted private

[5] Privately-owned collective transportation – typically hollowed-out Volkswagen buses with bench seating for passengers – that follows set routes through and between towns, with a destination card in the window. They are cheaper and slower than ticketed *autobuses* and provide access to places bypassed by the highways.
[66] All currency conversions using values as of 31 December 2012 according to http://www.exchangerates.org.uk/.
[7] TAPO, Terminal de Autobuses de Pasajeros de Oriente, is Mexico City's bus station for passengers headed east of the city.

companies, who then charge a fee from those who use it. The tolls – 42 pesos (3.25 USD) on the Peñón- Texcoco – are prohibitively expensive for most motorists, resulting in lighter traffic and, at least theoretically, better quality roads with lower accident rates.

Once free from the snarl of Mexico City traffic, vehicles on this tollway zip directly northeast toward Texcoco through the Zona Federal del Lago de Texcoco, the federally-managed zone of Lake Texcoco. The Lago de Texcoco was once a vast body of water and the site of major indigenous empires and cities. For centuries, these urban populations were fed from crops cultivated in the lake using extensive *chinampa* agricultural fields, in which the lake is adapted into a fertile system of integrated canals and islands built up from the lake sediment dredged from these canals. Today, looking out the bus windows as you pass through the Zona Federal del Lago de Texcoco, you will see only stretches of dry land between you and the mountains on the horizon. Beginning in the 17th century, under Spanish colonial rule, a series of flood control projects were implemented to drain water from Lake Texcoco, which culminated in the Deep Drainage System project of 1967.

Now, in the 21st century, the former lake is a landscape of contradictions. Your bus passes a series of storage sheds in the highway median, each with "Parque Ecologico del Lago de Texcoco" (Ecological Park of Lake Texcoco) emblazoned on the side in large blue letters. At about this point in the trip, just past Benito Juarez International Airport, as the Autopista crosses from Mexico City[8] into the municipality of Texcoco, your fellow passengers begin shoving

[8] Technically municipio Nezahualcóyotl, within Mexico City Metropolitan Area.

closed any open bus windows, and a fetid odor quickly becomes too powerful to ignore. The stench is Bordo Poniente[9], one of the world's largest open-air landfills, located in the Ecological Park just south of the autopista. Covering almost 1,500 acres and receiving up to 12,600 tons of waste a day (Godoy 2012), Bordo Poniente was officially closed in early 2012, and ambitious plans to convert the landfill to biogas production and nature restoration have stalled. In the meantime, the 74 million tons of garbage it contains continue to release an estimated 1.2 million tons of carbon into the air each year (Méndez 2016), produce unmeasured amounts of methane, and leach unmonitored toxins into the Lake Texcoco aquifer (Althaus 2012). As I began fieldwork in the region in late 2011, the Frente Único de Pepenadores del Distrito Federal (FUPDF), the union representing 1,500 waste pickers (*pepenadores*) whose livelihoods depend on the landfill, protested the planned shutdown and conversion project. After several rounds of blocking trash deliveries to the Bordo, the pepenadores won concessions from Mexico City Mayor Marcelo Ebrard. The city agreed not to close the separation plant at the Bordo where pepenadores work, which means that, as of early 2012, garbage continues to be trucked into the Bordo, where it is sorted by workers, after which the leftovers are trucked out again to a different landfill.

The smell of the Bordo lingers as your bus continues on the autopista. To the south, on your right- hand side, on the rare day that ozone and fine particulate air pollution subside enough for a clear view, you can see two massive volcanoes looming on the horizon. One is classically-conical, and smoking, while the other is a much more irregular silhouette, fully dormant, and

[9] Built in 1985 in part to receive the rubble from the devastating earthquake, which was exacerbated by "soil liquification" from draining Lake Texcoco.

often covered in snow. We will be heading their direction in the second part of this dissertation. To the north, on your left, lies a tentatively-protected wetlands and migratory bird conservation area[10] and the town of San Salvador Atenco.

This landscape, this landfill-cum-ecological park where waste flows freely but humans must pay a toll to enter, is defined by its many contradictions. It is also a place shaped by contestation. Struggles over power and resources, particularly land, have echoed in the daily rhythms of life in this region for centuries and up to the present day. In 2001, a group of Atenco residents began organizing to resist efforts by the federal government to seize their land and build a new international mega-airport.[11] Comprising mostly *campesinos,* or peasant farmers, from the local *ejido*, or communal territory, this group formed the *Frente del Pueblo en Defensa de La Tierra* (People's Front in Defense of Land, or FPDT). On July 12, 2002, state police confronted *ejidatarios* armed with machetes, leaving more than a dozen civilians wounded. By August, Mexican President Vicente Fox was forced to abandon the airport's construction, advising future governments to heed the "lessons" of Atenco: consult civil society before appropriating land, and respect the "interests and rights of the peasant and indigenous populations who represent our country's identity."[12] However, a few years later, Fox, in collaboration with Enrique Peña Nieto, the newly-elected governor of the State of Mexico, renewed plans for the airport as part of a

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[10] "Lago Texcoco is currently managed by the National Water Commission (CONAGUA), a branch of the Secretary of Environment and Natural Resources (SEMARNAT), as reservoirs and temporary ponds. The area receives annually an average of 150,000 migratory birds that travel through the Central Migratory Flyway. To date, 182 bird species have been identified, among them 30 are shorebirds. The area is a key breeding, wintering, feeding, and resting ground for several species of shorebirds." http://www.whsrn.org/site-profile/lago-texcoco

[11] https://www.citylab.com/transportation/2018/05/the-bumpy-take-off-of-mexico-citys-new-airport/559259/ This project would appropriate 5,400 hectares and impact more than 4,000 families http://www.alasbarricadas.org/noticias/node/35825

[12] https://www.proceso.com.mx/243768/derrotan-los-ejidatarios-a-fox-cancela-el-aeropuerto-en-texcoco

grand regional infrastructure initiative. On May 3, 2006, Fox and Peña Nieto deployed federal and state police forces in riot gear to block some 60 flower vendors from setting up their stalls outside the Texcoco municipal market at the center of town. These flower vendors, all women, were from Atenco and members of the FPDT. As the women refused to disband, more FPDT members joined them, bringing machetes, clubs, Molotov cocktails and bottle rockets, and erecting a barricade across the major highway between Texcoco and Atenco. Police forces swelled into the hundreds, bringing tear gas, night sticks, and submachine guns.[13] That afternoon, dozens of people were injured, and fourteen year-old Javier Cortes Santiago was killed by a bullet wound to the chest. Protesters took eleven police officers hostage overnight, before releasing them to the Red Cross the following morning. On May 4, more than three thousand police officers occupied the town of Atenco, searching homes, making arrests, and confiscating and destroying the cameras of journalists who had arrived to document the event.[14] On one of the residential streets blocked and patrolled by police forces, twenty year-old Alexis Benhumea was shot in the head with a metal tear gas cannister[15]. His father and friends were unable to come out of hiding to seek medical attention for him for over twelve hours, until reporters outside of town coordinated transport to a nearby hospital, where Alexis died of a fractured skull[16]. After a five-month investigation, Mexico's National Human Rights Commission (CNDH), found that the federal and state police had illegally detained 145 individuals inside their homes, and subjected 207 detainees to inhuman, cruel, and unusual punishments. At least eleven women and fifteen men were tortured. Twenty-six detained women were arrested, driven out of town, and raped by

[13] https://www.narconews.com/Issue41/article1761.html
[14] https://web.archive.org/web/20060713121307/http://www.zmag.org/content/showarticle.cfm?ItemID=10216
[15] https://www.narconews.com/Issue41/article1807.html
[16] https://solidarity-us.org/atc/123/p107/

the police who had arrested them.[17] According to Human Rights Watch, the CNDH failed to monitor the government's handling of these abuse allegations after the federal minister of public security rejected their recommendations.[18] At the state level, four public officials were removed from their posts and five more were suspended for ninety days. Victims of torture have received neither compensation nor government admission of wrongdoing.[19] In the summer of 2012, during Mexico's national election season, while I was conducting fieldwork in the region, the FPDT organized marches and demonstrations against Enrique Peña Nieto, who was by that time the presidential candidate for the Institutional Revolutionary Party (PRI). As they marched through the center of Texcoco City, machetes raised high, the campesinos chanted "¡Peña Nieto: Asesino! ¡México sin PRI! ¡Atenco no se olvida! ¡Atenco no se rinde! ¡La tierra no se vende! ¡Se ama y se defiende! ¡Atenco vive! ¡La lucha sigue!" Peña Nieto: Murderer. Mexico without the PRI. Atenco is not forgotten. Atenco does not surrender. The land is not for sale. It is loved and defended. Atenco lives. The struggle continues. On December 1, 2012, Peña Nieto was sworn in as the new president of Mexico.

Months after the 2012 election, many campaign posters have yet to be taken down. Almost every single billboard space for miles along Carretera 136 between Mexico City and Texcoco had been purchased on behalf of PRI candidates. Forty-foot wide campaign posters feature Peña Nieto embracing an ecstatic and much shorter woman in front of what appears to be a thatched roof. The posters read, "My commitment is to you and to all of Mexico: Peña Nieto." Had you

[17] CNDH, *Recomendacion* 38/2006, October 16, 2006, section IV.B.
[18] https://www.hrw.org/report/2008/02/12/mexicos-national-human-rights-commission/critical-assessment
[19] https://www.hrw.org/report/2008/02/12/mexicos-national-human-rights-commission/critical-assessment

travelled instead by the tollway, rather than the public highway, you would see no such political campaign posters, for there are no advertising billboards in the Parque Ecologico.

Once you disembark in Texcoco, whether on the curb from a combi or into the bus station from an autobus, you will then need to catch a *colectivo*[20] for your final leg to the International Maize and Wheat Improvement Center (CIMMYT[21]) on the outskirts of the city. The curbside stop is not marked, except by a gradually-emerging line of waiting passengers. To get there, you walk past the city's zocalo, or central square. This verdant park is next to the municipal market where, in 2006, the women tried to sell their flowers, and where, in 2012, the men and women *macheteros* of the FPDT, marching to Atenco in protest of Peña Nieto, paused to chant their grievances and scrape their machete blades on the street pavement. On a routine day, the zocalo will likely be occupied by shoe shiners, young couples cuddling on benches, and *paleta* vendors with their portable coolers offering refreshments to passersby. On an event day, whether a national holiday or a Coca-Cola-sponsored carnival, both the square and surrounding streets will be impassable. The daily pedestrian crowd is typically thickest in the early mornings. As the sun emerges over the volcanoes, those hustling to offices make their way around those setting up sidewalk shops, and those hand-sweeping up the previous day's mess from the streets.

If you can spy, through the bustle, that your *colectivo* line doesn't yet look long enough to indicate an imminent arrival, this means you might still have time to grab breakfast. The many fresh-juice street carts and taco-*al-pastor* stands along your route seem interchangeable to an

[20] A minibus, larger than the VW bus *combis*, with forward-facing seats and, like *combis*, destination signs in the front windshield. Depending on the route, some drivers expect fares to be paid upon embarking, while others employ a young man to collect fares en route.
[21] Known by the acronym for its title in Spanish, El Centro Internacional de Mejoramiento de Maíz y Trigo.

undiscerning eye. However, it's worth noting that the woman on *Calle Colón* in front of the candy store will add *nopalitos*, spicy parsley, and extra ginger to her blender when you ask for *jugo verde*, and that *Taquería El Güero* has the best *salsa roja* in town. If you tell him so, you'll even get a generous handful of grilled spring onions – sweet and charred to a crisp – thrown in with your tacos to go.

Once aboard the *colectivo*, you have two important tasks. First, keep from spilling and squishing your breakfast on the crowded, bumpy ride. You will have no excuse if you do, for the woman standing next to you is applying pencil eyeliner and hasn't blinded herself yet. Second, keep a lookout for the entrance to the CIMMYT headquarters, so you can call out a request to disembark. If you happen to be significantly less tall than those standing around you, it may be prudent to memorize the particular intersection of overhead powerlines that comes just before your stop.

The CIMMYT guards will let you through the entrance gate, provided your name is on one of their clipboard lists. Most CIMMYT employees drive private vehicles to work, or else are picked up by one of the olive green CIMMYT-repurposed school buses that serve as commuter shuttles. Unless a friendly car pulls over to offer you a ride, it's just over a kilometer walk from the entrance gate to the main building. On your way, you'll pass dozens of hectares of tightly-packed rows of grain. These are the campus's experimental fields where varieties of maize and wheat are bred and tested under different growing conditions. The main offices are in the Norman E. Borlaug Building, named for the Nobel Peace Prize-winning agronomist whose innovative wheat varieties sparked what came to be known as the Green Revolution. In the large entrance hallway of the main building, you are greeted by a larger-than-life bronze statue of Dr. Borlaug himself, field notebook in hand, pencil at the ready. To Borlaug's right, in the corner, is a small ceramic statue, about two feet high, on a pedestal. The caption states that this is Cinteotl, "the Aztec god of maize". To Borlaug's left, on shelves behind glass, are several ears of actual maize. Their color fading, their kernels starting to fall out, these are identified as representative of Mexico's maize landraces, or native varieties. Borlaug's statue gazes straight ahead, out through the glass entrance doors, and seems to be assessing the latest crop of agricultural experiments in the fields before him.

In April of 2011, a large new plaque was hung on the wall of the main entrance hall in the Norman E. Borlaug building, directly across from Borlaug's statue, and paired next to the equally large bronze plaque hung in 1981 to "express gratitude to the Rockefeller Foundation for their valuable help in the development and construction of the CIMMYT headquarters." The new plaque was printed in color, with logos from the Mexican flag, the Governor of the State of Mexico, the national agricultural ministry SAGARPA, CIMMYT, and President Calderón's flashy social development ad campaign "Vivir Mejor" (Live Better). The plaque reads:

> The President of the United States of Mexico presents the Sustainable Modernization of Traditional Agriculture initiative, promoted by the Federal Government and CIMMYT as an innovative mission to achieve food security and sovereignty in Mexico and the world. Bearing honorable witness, the Secretary of SAGARPA and the Governor of the State of Mexico.

This plaque was hung in April of 2011, when the Governor of the State of Mexico was Enrique Peña Nieto, a year and a half before he would become President of the country, and five years after he oversaw the police violence against Atenco.

Methods

In the empirical chapters of Part I, the Texcoco Valley, I will explore the stories of selected CIMMYT extension agents and scientific researchers in detail, one at a time. I use a pseudonym for each interviewee and omit personal details in an attempt to protect their confidentiality. I also edit each interview for length and clarity. The semi-structured livelihood interviews themselves vary significantly in length, depending on the interviewee's schedule and rhetorical inclinations. In each section, the interviewee's words guide the narrative, alternating with my responses, interpretations, and contextual additions. In some instances, I expand on an interviewee's point at greater length, typically to provide context for a point they raise and to flesh out the implications. This is not a linear structure, and many themes are returned to multiple times across the interviews. My intention in structuring the chapter this way is twofold. First, many of the questions at stake in these interviews – How does CIMMYT impact farmers' livelihoods? What kinds of crops and technologies do farmers need? Who sets the terms for development? – are deeply interdependent and simply cannot be understood in isolation. My hope is that, by keeping the threads of this inquiry interwoven, the overall picture will emerge more clearly at the conclusion of the chapter. Second, I see immense value in seeking to maintain the integrity of the interviewee's narrative.

My interviewees are not my data, but rather fellow intellectuals with whom I am in conversation. Though the interviews are limited in form and curated by me, they make arguments and assert epistemologies independent of my own. As with published scholarship and other literature cited here, I engage the ideas in these interviews, critique them, learn from them, identify tensions and unanswered questions. Preserving more of the rhetorical style, sequence, and transitional logic helps us understand what the interviewee is trying to say, as well as a bit about where they are coming from. As a result, each interviewee's section is written as a kind of thick description of the interviews themselves. I make explicit the patterns of social relationships and power I see in evident in these interviews, while providing sufficient context for readers to assess my argument for themselves. In the concluding section of this chapter, I summarize these patterns and the argument that I developed through thick description.

The range of lived experience and varied epistemologies that the interviewees bring to CIMMYT have an important impact on its functioning as a development institution. This impact may initially seem of little consequence, simply a kind of benign variegation to be found in the fabric of any workplace. In fact, many of my interviewees, each exceedingly generous with their time and fully informed of my research interests, expressed surprise that I wanted to discuss their personal stories in such depth. My reasoning is straightforward: in order to better understand the agricultural development effected by this institution, I need to understand who is effecting it and where they come from. Workers in any institution have complicated, even contradictory, interests and agendas which shape their work and, ultimately, their workplace. Even while committing to a shared mission, each may differ greatly in what kind of farming they assume to be realistic, what kind of crops they imagine as desirable, and with what kind of farmers they want to work. These differences may be deemed officially irrelevant as long as each worker is sufficiently loyal to the institution, but I argue that they matter greatly to how development interventions place. CIMMYT as an institution certainly acts to constrain, discipline, and incentivize its employees, but even these norms and regulations are themselves products of earlier phases of negotiation. A political ecology framework allows me to investigate both the structure of a development institution and the agency of the individuals and collectives (both human and otherwise) that are working for, impacted by, and excluded from development projects. I take seriously the power of such institutions situated in hegemonies of global racial capitalism and settler patriarchy, while taking equally seriously the struggles of those who are living their lives, doing their work, and dreaming their dreams under conditions not of their own choosing.

In tackling such dialectics, I must also attend to the front end of social reproduction: if workers are reproducing contradictions and shaping development as it (purportedly) moves forward, how were they themselves produced? This research does not come near to answering such a question, but it does insist on asking it. In my observations of the spaces and practices of agricultural development, I am therefore deeply interested in CIMMYT employees as products of ongoing economic restructuring across scales; the same restructuring in which we are all participants, whether consenting or no, and in which they, as agents of a development institution, are also producers. By studying who is working in CIMMYT, and where they come from, I learn something important about how development can happen. These workers were made available for this work in ways that are personal, and particular to time and place. By conducting a study of their livelihoods – including motivations and decision-making, available resources, networks, and guiding frameworks – I seek to contribute to a fuller explanation of how agricultural development interventions are impacting and, in some ways, producing the Central Highlands region, in relation to socioecologies at other scales. My hope is that this may contribute to the illumination of political openings and ongoing efforts to organize across social difference for justice and wellbeing.

Careful readers will note a significant discrepancy between the data collected and the findings described in this section. In Chapter 3, I explain the dissertation's methodology and the original design of the data collection focused on agricultural researchers and extension agents. In total, I conducted in-depth flexibly-structured livelihood interviews with six CIMMYT scientists (three female, three male) and five MasAgro extension agents (two female, three male). As I transcribed, coded, and reread these interviews, I initially conceived of this Texcoco Valley section as containing eight chapters, each a relatively brief but thick description of a development worker's everyday life. I chose the eight: four women and four men, five of whom worked as research scientists and three who worked as extension agents of various rankings. I knew I would start with the gifted orator and interviewee I call Gabriel. And then, as I wrote, I began, as one often hopes for when writing, to learn a great deal more about what this research had to say.

I knew by then that this was not, as some scholars had hoped,[22] a landscape of convergence or alliance between the renewed investment in regional agricultural development taking place in the

[22] See Eakin et al 2014 for an analysis of the launch of MasAgro in the context of persistent peasant farming in Mexico, in which the authors express hope that the program will serve to support the in-situ conservation of maize agrobiodiversity and the livelihoods of market-oriented smallholders.

Texcoco Valley and the persistent smallholder maize production talking place in the Amecameca Valley. However, as I wrote, I found that the emerging divergence between maize work in these two valleys needed to be explored in greater detail than I had originally anticipated. Through ethnographic engagement with an understudied community – those in charge of interpreting and implementing development– I was encountering a muddiness of subjectivity that felt compelling and important. Both two groups of participants – agricultural extension agents and research scientists – offered me explanations of ongoing agricultural modernization projects that belie the harm that they themselves have witnessed caused by such projects to smallholders and agrobiodiversity. These participants, with advanced training and extensive professional and personal experience with their field sites, were, through our interviews, teaching me about the substance of their work. They were also outlining the living contradictions of uneven agricultural development as they experienced them. If I was to take seriously the perspectives, practices, and aspirations of these development practitioners, while also holding their ideas accountable for the impact of these development interventions, I would need to work past the analytical templates at my disposal. I would need to follow these contradictions through a tangle of thick description and tangents into the political and economic context of modernization interventions.

To do so with all my interviews, or even just the eight I had originally selected, would far exceed the time frame and page length of a dissertation. Moreover, as I realized quite late in the process, it would exceed the scope of this particular inquiry. One of my research findings is that almost none of my CIMMYT-employed participants were directly engaged with smallholder maize farmers in the Central Highland region where they lived and were headquartered. Some of the extension agents worked primarily with small grain (wheat, barley, oats) producers in the region, others did their fieldwork with small-scale maize producers in el Bajio, Oaxaca, or Chiapas. The research scientists often had wide-ranging portfolios of fascinating work, all of which took their attention away from the smallholder maize farmers next door.[23] In order to make headway on the central question of this dissertation – how and why is the fraught relationship between agrobiodiversity and agricultural modernization persisting as it is? – I focused this section on just two interviews. I chose the two participants who worked most directly with maize farmers in the Central Highland region: 1) one of the most experienced research scientists in the institution, who first began working at CIMMYT as an extension agent, and who still lives and farms in the small Central Highlands town where he was born and raised; and 2) the then-manager for the Valles Altos (Central Highlands) MasAgro Maize Hub, charged with administrating agricultural modernization in the region.

What emerges is not a linear deduction, nor even a narrative story arc, but rather an ethno-graph of an absence. Having now written it out, I find that I have illustrated an epistemological erasure, in which agricultural modernization works to shield us from the existence of the kinds of crops and farmers and agricultural imaginaries that lie outside it. What I find most interesting, is that this same work – the insights and lived experiences of development workers – regularly pokes holes in its own premise, and gives us a glimpse of another way.

[23] This was true at the time of our interviews. Since then, several current and former CIMMYT scientists have developed more extensive engagement with maize farmers, including commercially-oriented smallholders, in the Central Highland region.

CHAPTER 3: GABRIEL

Gabriel was born and raised in a town of fewer than 2,000 people in the Mexican state of Tlaxcala, near the border with Hidalgo. He is currently in his 60s and has worked as an extension officer and research assistant with CIMMYT for almost forty years. I began, as I did in all my interviews, by asking: how did you first come to this work? My intention in asking such an open question is to give the interviewee an opportunity, should they want one, to provide their preferred framework for their lived experience. This approach often reveals unexpected and interesting parts of the story that might otherwise have been left out of my limited preconceived frame. As such, it is worth dwelling on the significance of Gabriel's response to my initial question about his work for CIMMYT. Organized and meticulous, as would be any extension officer worth his salt, he began by stating his age and the number of years he has worked for CIMMYT. Next, in a move that I, a grandchild of Midwestern Lutheran farmers, felt I recognized, Gabriel offered a caveat, as if to diffuse any presumption of expert authority implied by my interviewing him: "I am a civil engineer. I didn't study agronomy, nor did I study economics." (These are the fields one might assume would feature in the education background of an agricultural extension agent.) After a few short sentences about his first encounter with some CIMMYT field researchers, he changed tack: "For my entire life, I've worked in the countryside. My family has been *campesina* for my whole life."

Gabriel then proceeded to summarize his family's farm and its influence on his upbringing:

> My uncle was a landholder in the region, he had a lot of land […], more than three hundred hectares. And, so, I was immersed first in agricultural work. I was very spoiled, I was constantly heading out to the fields. For example, when we were the first in the region to buy

> a tractor, I was the first to drive our tractor. On the weekends, in the afternoons, anytime I wasn't in school, and on my vacations.

Here, Gabriel is insisting that his current work as an expert field officer for CIMMYT not be mistaken for something mutually exclusive of or deeply alienated from the work of *campesinos*. In doing so, he clarifies that he is not simply referencing a quaint family history, a colorful childhood that preceded his advancement to development work, but rather that his *campesino* work and identity are an essential part of what he does for his current employer. This constructively set the terms for our interview together, but also stands as a remarkable corrective to development narratives that reign hegemonic within development institutions such as CIMMYT, in which linear Progress marches inexorably toward Modernity, leaving everything else to a dusty Obsolescence. What Gabriel astutely preempts here is a dangerous and common logic that allots no place in society's desired future for peasants or their knowledge and practices. When I ask about his job at CIMMYT, he explains it by foregrounding the family farm. His *campesino* work remains integral to his life and his family, despite not directly providing for their household livelihood. This chapter seeks to trace such contradictions of development, according to which peasant systems are valued and devalued, and their broader implications for agricultural change.

In this small example, one can see how Gabriel's practiced skills as a communicator transformed our interview – rather than merely provide answers to questions asked, he used my initial question as propulsion for an expansive narrative journey. He took every opportunity to teach me about important context for his experience, and built methodically on each of my follow-up questions to make sure I could see how each piece was connected. Like all great teachers, he had more confidence in my project than I did. It was humbling to see how seriously he took my interest in agronomy and other areas beyond my own expertise. His experience and navigation of four decades of Mexican agricultural development sheds new light on some of the contradictions at play, and the interdependent lives at stake.

Joining CIMMYT

Gabriel went to college to study civil engineering and, out of school, got an office job working as an analyst for a Mexican oil company. One day, a few members of CIMMYT's Socio-Economics research team came into his office to buy some maps. They were "doing a study in Valles Altos on barley production. I lent them the maps, and I also lent them my office so the interviewers could work there." He quickly realized they were not as familiar as they needed to be with local agricultural practices.

> …when the CIMMYT team came to the region to do their study, I told them: no, no, here it's not like that. Around here, farmers cultivate their barley this way, they do this, they do that. And so, they [the CIMMYT team] were very interested in me, and asked me if I was an agronomist. I said that no, I wasn't. But I've been around it [agriculture] my whole life. So, they asked me if I wanted to work for CIMMYT. And I told them, well, I would like very much to work with people from many cultures, from many parts of the world, to learn more about conservation agriculture, and, well. That was it.
>
> About thirty days after that, I received a letter inviting me to interview at CIMMYT. They invited me to apply, and I went to apply. I never thought that I would work for CIMMYT, for two reasons. Firstly, I'm not an agronomist, nor an economist, and I thought it wouldn't be possible. Secondly, because of the salary [Gabriel laughs]. I was earning a lot of money with the oil company, and here [at CIMMYT] the pay is very low. But, after I came and talked with the people here, they convinced me. So, I came. And I was very fortunate to work with the people I did.

Gabriel began working with CIMMYT in 1979, at a pivotal moment for agricultural and economic development in Mexico. CIMMYT had just begun formally globalizing its field trials and maize breeding initiatives, establishing regional programs in East Africa, Central America and the Andes, and South Asia between 1977-78 (CIMMYT 2016). At the same time, Mexico's economic infrastructure for maize production was also being reoriented toward global markets. With the election of President de la Madrid in 1982, progressive land redistribution and support for smallholder farmers were replaced with policies of market liberalization and investment in maximizing yield of commodity crops for export. These trends only accelerated in the run-up to the 1994 implementation of the North American Free Trade Agreement (NAFTA), under President Carlos Salinas de Gortari (1988-1994). Salinas imposed limits on credit available through the state-run bank, BanRural, which served ejidatarios who could not use their communal land as collateral for loans from private banks (Biles and Pigozzi 2000), and privatized the publicly-funded institutions, el Programa Nacional de Semillas (PRONASE) and la Industria Mexicana de Fertilizantes (FERTIMEX), which provided publicly funded agricultural inputs such as seeds and fertilizer to Mexican farmers (King 2006; Appendini 2001; Biles and Pigozzi 2000). Salinas also set in motion the eventual elimination of the central institution of state agricultural support, CONASUPO, which provided a national price-fixing mechanism for maize and served as a guaranteed point of sale and distribution of food crops (Appendini 2001). During these decades of the state's discursive withdrawal from Mexico's rural development[24], as CIMMYT was expanding its global field of operation and reorienting away from Mexico in crucial ways, it simultaneously found itself growing in influence relative to the other public development institutions in the country, who were all being starved of resources. CIMMYT's research overall seemed to be disengaging from the particularities of maize

[24] The state was not withdrawing in practice, for state intervention was central to the neoliberal project (discussed below). However, the state was redefining its role, and this required a discursive shift in focus from the power of a protectionist state to that of "free market forces." As a result, state power is systematically obscured (see Hansen and Appendini 1993; Eakin et al 2013).

production in Mexico and Mexican farmers' experiences, while at the same time having a more dominant impact on their livelihoods.

Trajectories of Agricultural Change

I asked Gabriel what he thought about the changes in maize production he had witnessed since 1979. I framed my question in terms of national and regional scale restructuring, such as Mexico's Agarian Reform and NAFTA, but Gabriel directed my attention to global shifts in commercial agricultural production:

> Yes, well, I believe the whole world has felt these changes. But we've also been affected by changes in technology, above all, because new technologies are introduced through official credits or a private bank. And so, the private bank or credit officer from the government have a technological packet, the credit [loan] for a packet of technology.

This shift in how agricultural technologies were marketed and sold accompanied extreme consolidation in agribusiness. In the 1970s, agrichemical companies such as Cargill, Monsanto, and Pfizer began buying up seed companies, a process which has only continued to accelerate since (Kloppenburg 2004). In the 1980s, just after Gabriel began his career at CIMMYT, the consolidation movement swept up emerging biotechnology companies; new genetic modification technologies were acquired by the same "life sciences" companies that now also produced herbicides and seeds. These companies sought to dominate as much of the agricultural sector as possible, and often bundle their products together as a way to increase their market share. As Kloppenburg, writing in 1988 (2004: 246), observes:

> [I]n the last decade [1978-88], the seed has come to be recognized as the ideal vehicle for the delivery of agrichemicals to the field. With the seed industry rapidly coming under the ownership of companies with substantial agrichemical interests, seeds and chemicals have come to be linked in proprietary packages.

Farmers therefore confront an increasingly narrow range of options from consolidated agrobiotechnology firms for what crop varieties they can grow and under what conditions, limits which are often reinforced on the front end by financiers, and on the back end by the companies buying, processing, and marketing a farmer's harvest. These bundled technology packages are unaffordable for many farmers, and contribute to rising rates of attrition in the industry. They also reshape the labor conditions for every farmer, even the relatively privileged, who persists. As Gabriel explains:

> All the farmers, above all, the producers, not only the poor, nor the middle ones, but also the rich ones have had to accept this [bundled] technology because of the lack of resources. Then, if they want to produce, they receive a loan, official [from the government] or from a private bank, but it has included a whole technological package. They [farmers] have accepted [these packages], I think, most of the farmers, who have wheat in Sonora where it is very good, but also those from Sinaloa. With the introduction of the materials [technology packages] we know that they [farmers in Sinaloa] have been producing more corn, they produce 70% of the national corn[25], but also it [bundled technology] is given in other parts [of Mexico]. In Guanajuato, which is the Bajio, and in Valles Altos, it is happening, no? People are producing improved maize varieties, and are looking for opportunities to work through credit [which enables them] to procure not only the seed but also the inputs and especially the technical cooperation. Unfortunately, regarding the technical assistance, we do not have many people trained to give the advice, to provide follow-up, the recommended planting dates, and assist with documentation.

Here, Gabriel illustrates some of the many risks imposed on farmers by these agricultural technologies. Farmers, rich and poor, whose livelihoods depend on producing for certain crop markets, have little choice but to buy seeds and inputs that may not serve their best interests. This is due, in part, to what Gabriel describes as "the lack of resources" accessible to farmers in Mexico at the time. As detailed above, successive government administrations in the 1980s and 90s privatized or diverted most of the resources that had previously supported small scale farming and food systems across the country, including public subsidies for seeds and inputs,

[25] I have been unable to verify this statistic, and wonder if it is primarily true for the winter growing season.

publicly-funded marketing and distribution networks, as well as robust public breeding programs targeting crop varieties to the needs of particular farmers and growing conditions. The government's purpose in restructuring agricultural policy was to facilitate integration into international commodity markets (Keleman 2010). Gabriel's astute observation here is that state reallocation of resources meant, for many farmers, there were suddenly far fewer alternatives to the technologies and technical assistance sold by private companies. And competition within the private sector was dwindling rapidly as well. These emerging consolidations have not, as has been repeatedly predicted, managed to eradicate heterogeneity in Mexican maize production by any means; extensive research has pointed to the continued presence, even dominance in some regions, of maize agrobiodiversity (Perales and Golicher 2014), the creative combinations of agricultural technological regimes with which farmers experiment (Bellon and Hellin 2011), and the persistence of agrobiodiverse smallholder production systems in the face of increasing pressure and hardship (Keleman 2010; Eakin et al 2014). At the same time, economic restructuring is placing these farmers and agrobiodiversity at greater and greater risk.

Waves of government and corporate economic restructuring in the late-20th century, which have continued to this day, yielded a small number of private companies with near-hegemonic control over what a farmer can grow and how. Bundled technology, sold by companies and required by lenders, means that farmers cannot experiment with a given crop variety without also purchasing the potentially expensive chemicals sold with it. Though he does not mention it explicitly here, Gabriel discusses elsewhere at length the constraints imposed on farmers by hybrid maize seeds; companies sell technology packages featuring hybrid, rather than open-pollinated seed, which will only produce well for one generation, thereby forcing the farmer to purchase a new technology package every planting season. As Gabriel emphasizes, not only are these technology packages themselves costly to purchase, but, in the absence of sufficient public extension programs, farmers must often pay for the technical assistance required to effectively use the latest technologies. In his comparison of different regions of the country, Gabriel also alludes to the vicious cycle farmers may find themselves caught up in when they adopt these technologies. Many of these new inputs and innovations function as what agricultural economists call a "technological treadmill"; once a farmer steps on, by adopting a package of technologies and adapting the farm to them, it doesn't stop. The first technology necessitates another and another, increasing risk and competition pressure each cycle (see Cochrane 1958; Levins and Cochrane 1996). Take the example of a pesticide treadmill. First, conditions are set in which the crops depend on pesticide use. These include reducing a plant's own defenses to insects and disease through inbreeding, which is central to hybridization. These crops are then grown in intensive monocropping systems – densely planted fields of a single crop – without the pest-reducing benefits of agroecological diversity, by many farmers in the same region, often season after season. Large, concentrated populations of a single, genetically-simplified species multiple years in a row creates a fertile breeding ground for any organisms that enjoy consuming that particular plant. And so, the farmer applies pesticide, as do all his neighbors growing the same crop (if they are the same hybrid variety, all the plants will also be genetically identical). Eventually, some pests will likely develop resistance to the pesticide, leading to larger and more frequent applications, until eventually a replacement pesticide must be developed and the cycle continues. An herbicide or fertilizer treadmill functions in much the same way, with the agricultural system becoming more and more dependent on a given input. While increasing chemical dependence can mean increasing sales for the agrichemical company (which likely also sells the seed), it can have serious negative consequences for the ecological and farming communities involved.

Furrowing his brow, Gabriel summarized the patterns of technological innovation he has witnessed during his career; "I think there have been advances, but there have also been times when farmers have suffered." He is not alone in this assessment. When viewed in the aggregate, these individual technology treadmills can look like legs of a race to the bottom, with farmers locked in competition against one another. Kloppenburg's explanation of a technological treadmill, building from Cochrane's (1958) conception, illuminates how lucrative the widespread suffering of farmers can be for the agricultural industry:

> The profitability of any operation is largely a function of unit costs of production. New technologies offer a means of reducing these costs. Early adopters of new technologies enjoy windfall innovators' rents, but these disappear as adoption spreads and the cost curves for all operations converge. Because the adoption of new technologies results in increased production, there is a tendency for prices to fall. This merely sets the stage for another round of innovation. Those who fail or are unable to adopt the new technologies suffer economic loss. Marginal producers are continually forced out of business, and their operations are absorbed by more successful operators. The treadmill fosters cannibalistic centralization in farming while simultaneously ensuring a secure and expanding market for the purveyors of new technologies. (Kloppenburg 2004: 35).

These empirical and theoretical patterns remind us that, in a given moment, the farmers who remain are only a fraction of the farmers impacted by the economic policies and structures that currently dominate the agricultural sector. In order to understand our current moment of development, we must also consider the farmers who were marginalized, excluded, displaced, bankrupted, or simply erased from official ledgers along the way.

As he explained the impacts of technological change on Mexico's farmers, Gabriel returned repeatedly to a broader economic context, emphasizing the related consequences of currency devaluations, agrarian reform, and, referencing NAFTA, "these free trade agreements" for Mexico's farmers:

> Because they have had to enter into competition, for example with the United States, we who do not have the technology, we do not have the human resources, the committed technicians, the technicians with the knowledge to take that advice to the field. This has been a major setback especially since [19]94, when the government withdrew sectoral [agricultural development] support[26], withdrew technical assistance, withdrew the funding for rural banks where poor farmers, those with few resources, used to be able to access financing, credit through assistance programs, they [the farmers] were seriously affected. Sonora was a leader of this shift at the national level, where you saw the decrease of collective ejidos. The loss of paternalism caused them [ejidatarios] to not only rent their plots but also to sell them.

Here, Gabriel uses the term *paternalismo* or "paternalism"[27], which in general refers to state oversight of a given social or economic sector. In the context of Gabriel's narrative, the "loss of paternalism" is a precise and stunningly succinct reference to a contentious history of state regulation of land in Mexico over the past 200 years. In 1917, following a revolution itself sparked by a century of unbearably unequal access to and control over land in the post-colonial country, a new Mexican Constitution set forth principles of agrarian reform in Article 27. This article declared all land, water, and mineral rights to be the property of the Mexican people, prohibited private companies from owning large amounts of land, and set forth a mandate for the government to break up large private landholdings and redistribute this land to eligible agrarian communities. By 1988, after sixty years of sporadic redistribution by various administrations,

[26] Here is one instance of several in which Gabriel seems to conflate the different dates of various agarian reform bills and policy changes with the implementation of NAFTA, which took place in 1994. This is not uncommon in areas of Mexico directly affected by the economic restructuring imposed by NAFTA, as well as related policy that preceded or followed from the free trade agreement, not to mention the large scale uprisings in opposition to these policies (see Neil Harvey, etc. on the Zapatistas). For many Mexicans, the political upheaval of 1994 represents broader restructuring that took many years to accomplish, and references to "1994" sometimes denote a range of neoliberal interventions in Mexico's economy during the 1990s.

[27] See Hansen and Appendini 1993 for analysis of Salinas' narrative of modernization vs state paternalism, discursive construction of the peasant (into 3 classifications: economically viable, potential, and non-viable), and shift of blame from state to market when peasants fail.

more than three million households lived in over 28,000 communal landholdings called *ejidos* (Kelly 1994). In 1991, President Salinas initiated a series of modifications to Article 27 of the Constitution and the passage of an Agrarian Law that established a new regulatory framework deemed necessary to attract private investment in agriculture and thereby increase productivity. According to Neil Harvey (1998: 187) the four most significant changes were as follows:

1. Ejidatarios were given new legal rights to purchase, sell, rent, or use as collateral the individual and communal plots that comprise an ejido.
2. Private companies were granted permission to purchase large amounts of land according to legal limits that favored large companies with many shareholders.
3. The new law allows ejidatarios to provide land as "T shares" in a corporate partnership, which means transferring control over communal lands and the resources contained therein to corporate investors.
4. To guarantee security for private property, Article 27's provisions for agrarian communities to petition the government for land redistribution were deleted from the new law.

Among the impacts of these reforms were a dramatic loss of ejidos in parts of Mexico and a reconcentration of land in a few powerful hands. (It is worth noting that this reconcentration has progressed unevenly across the country, and ejidos continue to persist beyond expectations in several regions.) Gabriel gave an example, from his own fieldwork in the state of Sonora, of how this regressive agrarian reform worked to dismantle one community's farming system, including its access to land:

> For example, in Yaqui [a valley in Sonora], now you do not find an ejido collective. The [remaining] ejidos here were large groups [of people], but each one may only have five hectares left. A whole community cannot live on five hectares. The most difficult part is that now they can no longer access credit from those who lend money from private banks as start-up [capital]. They [private lenders] do not accept the title of an ejidatario, it has to be private property to serve as collateral, like a pledge. They [private lenders] expect a liquid guarantee that they [peasants], those without resources, do not have.

Gabriel then connected the experience of Yaqui's ejidatarios with national patterns of land and production consolidation:

> In these first years, and I'm talking at the national level, the ejidos started to rent. And then, to sell. In 1994, with the passage of the [modified] Article 27, [here Gabriel is conflating the date of implementation of NAFTA in 1994 with the passage of constitutional modifications in 1991 and the new Agrarian Laws in 1992, which President Salinas initiated in order to pave the way for NAFTA] farmers began to feel more confident in control of their plot. For example, I'll give you an example. In my town, we are 244 ejidatarios. At this moment, after Article 27, we are twelve. All the rest have sold [their land]. In the census, it appears that we are 244 ejidatarios, but, in reality, we are twelve, nothing more.

I offered that many farmers, from municipalities like Atlauta, Ozumba, Amecameca, Juchitepec, have told me that it's better for them to be ejidatarios in order to receive support for their farming. Gabriel replied that, yes, it was easier to get yearly per-hectare subsidies for production through the government's post-NAFTA Programa de Apoyos Directos al Campo (PROCAMPO). However, he cautioned that it is much harder for ejidatarios than for private landholders to get access to credit. He went on to detail other resources that were harder to access for those with communal land:

> If you are a smallholder and you get an opportunity, for example, to buy a discounted planter, you can get the discount as an individual. I, as an ejidatario, cannot, I have to be in a group, in a rural production association [to buy the planter]. And in those groups, because we do not have the culture, we do not have the education to work in groups, there are always conflicts. And the tractor or the planter that is available, will normally get bought by private hands. Why? because they [the seller] do not know *charla* [dialogue], because there are conflicts, and they sell it to the highest bidder for the most they can get. That is a fact, it is a reality in Mexico.

Here, Gabriel ties the technocratic shifts in rural development assistance programs and government policy to the social relationships through which they operate. With legal and logistical barriers to resource access, come cultural barriers that normalize and reinforce these exclusions. The seller of agricultural inputs, rather than seeing oneself as a stakeholder in the overall wellbeing of one's surrounding agricultural collective, comes to see profit, even at the expense of one's neighbors, as a superseding priority. According to Gabriel's framing, agricultural production is intimately connected to knowledge production. He uses the Spanish verb *charlar*, meaning to chat or have an informal conversation, to identify that which is missing, in his view, from today's network of agricultural stakeholders. In this instance, Gabriel is discussing a lack of dialogue between a machine seller and a farmer in need, but he returns to this theme several times in our interview when discussing relationships between other stakeholders, such as extension agents and seed company technicians, as well as those across lines of social difference, such as age and gender. In each example, Gabriel returns to the theme of dialogue as a decisive factor in development interventions. In his stories, the actors' success or failure often depends on how well they communicated and shared information. Gabriel defines his own role, in working for CIMMYT, as fundamentally about sharing knowledge and talking with farmers. He also frames this as central to the role of the institution in agricultural development more broadly. Throughout our interview, he repeatedly emphasizes that knowledge exchange is central to CIMMYT's mission, as he understands it. Later in this section and this chapter, I will analyze how Gabriel's understanding of CIMMYT's mission differs, in some significant ways, from those of other CIMMYT workers, and from the organization of its programs.

Given the trajectory of dramatic changes in agricultural production taking place since Gabriel first began work as an extension officer, I asked him how the daily activities of his job have changed over the course of his career. To my surprise, he replied that his work duties had been constant until quite recently.

> For more than 25 years, my practice, in truth, hadn't changed. They did change, for example, when we introduced barley, because before we worked more with oxen-drawn plow [yunta] and with human, or manual, labor [fuerza de serhumano]. But with barley, we had to make use of machinery, small tractors. We were modernizing ourselves. But, then for 25 years, it stayed static, everything was the same.

For Gabriel, the change in his work duties came with the advent of MasAgro, the program that made CIMMYT the central node of an alliance of development institutions working on grain production in Mexico, as well as the recipient of tens of millions of dollars in Mexican government funding. As detailed in the intro to this chapter, MasAgro was officially launched in 2011, and was designed as, in part, an expansion of CIMMYT's Conservation Agriculture technician training and certification program, which itself had been officially instituted in 2009. Of course, Gabriel and other CIMMYT workers had been laying the groundwork for both these programs for several years before anything could be officially launched. Speaking in 2012, Gabriel described how his work practices shifted during this time:

> The last five or six years, things have changed. It has changed with the new era of MasAgro. We started with modules in 2008, bringing knowledge to some [Mexican] farmers with whom we had an agreement[28], and from there we started doing conservation agriculture. Why conservation agriculture? Because we had already undertaken several studies on conservation agriculture in Central America. I knew the advantages, but even knowing the advantages, as a farmer, and as a researcher, I wanted to try it. What do the other scientists say? They always say that conservation agriculture is the best, blah blah blah. But you have to test it for yourself as a farmer to really see. What will farmers be able to do? Is it feasible for them to adopt [CA technologies]? For them to adapt and adopt? Or will they not adopt them for some reason? And so, I played the role of referee, but also of a player on the field. I am producing too. I am producing, in the natural conditions of a farmer. I am waiting for the technical recommendations and having discussions with the technician to see if there are products that we are going to apply. And so, yes, my practices had changed.

Here, Gabriel is noting his dual perspective as both an active farmer himself, and an agent of a development institution. This duality goes deeper than simply having sympathy for both constituencies. Gabriel is embedded in a family and community whose livelihoods depend on the

[28] These are farmers working with Asgrow technicians, and growing Monsanto products.

rich collective memory of farming for generations upon generations in the region. These memories and practices substantiate his respect for the expertise of farmers, as well as an appreciation for the reasons they may be skeptical of new technologies or development interventions. At the same time, Gabriel is steeped in the ideological and research paradigms of development institutions, which typically center on positivist science, political and economic liberalism, and growth-oriented agricultural modernization. In practice, Gabriel seeks to attend seriously to both perspectives, but, importantly, he does not equate the positions of a smallholder farmer and a researcher. Through a sport analogy (possibly fútbol, given the near-universal national obsession), he foregrounds the complex power dynamics at play between the practitioner and target beneficiaries of development. Gabriel describes his roles as a researcher and farmer as simultaneously serving as both referee and player in a game. This fascinating choice of analogy immediately conjures the kinds of tension and conflicting interests that might arise. It raises worthwhile questions about how we understand the relationships between different kinds of farmers, development practitioners, and crop markets: which actors are direct competitors? Which have power over others? Which might be playing a different game entirely? Gabriel's analogy also suggests critical awareness on his part of how rules get enforced, whether on the soccer field, or a farm field. A researcher or extension agent does not decide the government policies, corporate strategies, and economic conditions that govern the agricultural industry, and may have, at most, modest influence over technology development and commodity production priorities, but they are charged with enforcement power. Explicitly, they are responsible for marketing and disseminating the latest tools and advice of their employer and partnering institutions. Implicitly, they are responsible for normalizing dominant development narratives and reinforcing the authority of the various private companies, public agencies, and funders that they represent. This fraught responsibility seems to weigh on Gabriel's mind. My question about how his daily activities might have changed over the decades was, for him, also a question about the shifting terrain that he both farms and adjudicates.

Working in Uneven Fields

My follow-up question was about where Gabriel works. I asked him if he gets out to the *campo*, to the farms, often, and he replied:

> Here at CIMMYT, 70% of my time is outside, in the field with the farmers. I am in the field doing continuous monitoring in the modules, giving talks in the [exhibition] events, making records to assess whether [crop] production is sufficient, to see the profitability of the system that we are introducing and we always ask in the modules that the farmer plays a part as witness, and the other part as innovator. We do an analysis to show them [already participating farmers], but also show other actors the advantages of these systems. We have been doing this since 2008, continuously year after year.

2008 is the year CIMMYT began formalizing its Conservation Agriculture program, which channeled more resources to extension work in Mexico (Govaerts & Sayre 2008). The additional resources made it possible for extension agents like Gabriel to spend more of their time on fieldwork and with farmers. Gabriel's characterization of participating farmers as "innovators" is noteworthy here. In Gabriel's interview, he regularly references the agency of farmers in development interventions. He primarily frames this as recognition of farmers' role as active contributors to knowledge exchange and technology development. However, two pieces of context are important to keep in mind as I analyze the narrative framings of farmers later in this section and in subsequent sections with other interviewees:

1) Participatory research has not consistently been a priority of CIMMYT's development work. It is clear that, for some CIMMYT researchers, Gabriel included, farmers have long been viewed as crucial collaborators in many aspects of the research process, from

identifying important questions to evaluating new technologies. In addition, since the 1990s, “participatory research” has come into vogue in the fields of natural resource management and agricultural development, and is increasingly touted by prominent research institutions, including CIMMYT, though the term can be vague and used to refer to a wide range of activities (see Probst et al 2003). Nevertheless, since CIMMYT’s founding, some directors of CIMMYT’s research and extension programs have stated opposition to participatory research on the grounds that it is outside the institution’s jurisdiction, counterproductive to CIMMYT’s objectives, or even in conflict with the pursuit of science. My research provides evidence that this tension, over how and why to engage farmers as agents of change, within CIMMYT is closely connected to broader political struggles over access to and control over resources, over how the economy should be organized and who should benefit. Dominant development narratives are often adept at suffocating questions of politics beneath layer upon layer of assurances that inequality is normal and even valuable, or evading these questions through strict myopic attention to technical details. However, technical logistics fail to adequately explain how CIMMYT approves particular research trajectories, collaborations, participants, and questions. Accepting patterns of entrenched inequality as inevitable requires ignoring who benefits from the exploitation, dispossession, and displacement that maintain them. In order to understand the extent to which CIMMYT invests in participatory research, with whom, and towards what objectives, I must bring competing political interests back into focus.

2) The rhetorical figure of “farmer as innovator” can have punitive consequences, in practice, for actually existing farmers. While often used by development practitioners to praise those farmers who do participate in a given development program, this praise is grounded in particular epistemological assumptions – our expectations about how we think and generate knowledge – that shape not only the research design but also how the researchers interpret the success and impact of the research. According to these assumptions, the principles of conservation agriculture, for example, are objectively an “improvement” on other ways of farming. Particular new technologies may be up for evaluation (and certain farmers’ perspectives may be welcomed as part of the assessment process) but the inherent superiority of the development model overall is not questioned. Therefore, the farmers who adopt these technologies are, by virtue of endorsing the development model, innovative. Likewise, those farmers who do not engage, regardless of the reason, or are overly critical of the development model or institution, regardless of the level of creativity and sophistication in their own approach to farming, are therefore failing to innovate. These epistemological assumptions enable normative language to shift in meaning. “Innovative” ceases to include all farmers who experiment with novel and imaginative approaches to farming, but rather indicates the degree to which a farmer acquiesces to the latest development intervention. The term “traditional,” according to the mission statement of the website homepage of MasAgro (note that MasAgro stands for *The Sustainable Modernization of Traditional Agriculture*), seems to categorize the very target beneficiaries of the program, so named for their long-standing and reform-worthy practices of industrial crop production that waste water and contribute to soil degradation.

> And yet, when I asked a project manager for MasAgro whether the program intended to work with a nearby community of commercial farmers, who grew criollo maize for regional markets, and had expressed to me a keen interest in receiving more extension assistance, I was told that MasAgro was currently working primarily with "advanced" farmers in "high potential areas," whereas the farmers I mentioned were not eligible because they were "very traditional." When a CIMMYT researcher is explaining to me why her institution does not collaborate with researchers from a nearby agricultural university – who, like her, are engaged in active investigations seeking to make agriculture more economically and ecologically sustainable – she summarizes her disagreements with them by saying "they are backwards." These examples illustrate a discursive pattern; CIMMYT leverages its power – political influence, economic weight, and scientific authority – to define itself as modern, and those who offer critiques or competing world views as, by definition, outside of, or behind, modernity and the desirable qualities we associate with being modern. In multiple interviews and casual conversation, with development practitioners from a range of backgrounds and life experiences, I was repeatedly told that a given individual or group in opposition to or critical of CIMMYT's development model, or simply in pursuit of a different mode of agricultural production, was incompatible with modernization. This was not a uniform perspective within CIMMYT by any means, but it was an epistemology that seemed consistently present and significantly influential. In each given instance, such an epistemological frame obscures how a powerful institution contributes to inequality, and shields it from accountability by explaining a community's deprivation and exclusion as the consequence of their own culture. Over time, this rhetorical logic risks permanently constructing certain kinds of farmers, farming practices, and knowledge systems as obsolete.

In Gabriel's words, I do not read anything other than the best of intentions and dedication to farmers' wellbeing. He is genuinely committed to participatory research, he takes farmer's perspectives seriously – indeed, he identifies as a farmer himself – and he has spent a lifetime serving research projects that he believes will better farmers' lives. For these reasons, I consider it especially important to critically examine the discursive and material implications of work done by Gabriel and others like him. My research project seeks to understand CIMMYT's workers and development programs on their own terms, and also, crucially, to unpack how the narratives they reproduce value and devalue the farmers, crops, and farming systems outside their scope.

Clarifying the boundaries of a given project's scope is therefore essential. MasAgro operates through twelve regional extension hubs which, together, cover almost all of Mexico.[29] The Valles Altos region – which includes the high-altitude valleys that comprise the States of Mexico, Hidalgo, Tlaxcala, and Puebla, as well as the Federal District – is divided into two hubs, one for maize and the other for "small cereal grains" such as wheat and barley.

Gabriel is based primarily in the Valles Altos Hub and does the majority of his fieldwork with farmers in this region.

> I work most in Valles Altos, where the project [MasAgro] was born.[30] […] As of yet, we do not go down in the area – I think that bit by bit we're working down to the Chalco area – where we have contacts with farmers that we worked with some fifteen years or more ago. We will be in contact with them to start talking and bring them information in that area. I'm also working, last year I did not, I'm going to return to monitor the Chiapas hub, for the Bajio hub, and the one in Obregon in Sonora. I will continue to work with low-income, middle-income, and high-income farmers, like [those in] Sonora. They [in Sonora] use precision technology.

As Gabriel notes here, his work in different agroecological regions includes wide variation in economic conditions and among participating farmers. In Sonora, part of the Pacifico Norte Hub on Mexico's northern border, farmers manage irrigated, highly mechanized grain production on farms averaging 70 hectares in size, and are able to leverage their political and economic power to secure government subsidies and favorable price contracts from international buyers. In contrast, farmers of the Chiapas Hub, in southern Mexico, are usually growing maize (sometimes intercropped with beans, squash, and/or herbs) on less than 5 hectares of land under rain-fed

[29] MasAgro has a minimal presence in Baja California Sur, is operating only in parts of southwest Chihuahua State and the southwest corner of Coahuila, and is not operating in the states of Neuvo León or Tamaulipas. As of 2017, 4 hubs remain in development (see Camacho-Villa et al 2016).
[30] The Valles Altos Hub is the longest standing extension hub, in operation since 2007, when the Conservation Agriculture program was in its infancy, and the start of MasAgro was three years away.

conditions and with varying use of inputs and equipment, often for a combination of household consumption and local or regional markets, as part of a diversified combination of on-farm and off-farm household income (Camacho-Villa et al 2016).

Gabriel also identified an unevenness to extension work conducted within a given hub – CIMMYT representatives often focus on particular towns in their region, rather than seeking to cover the entire territory. He mentions that there are areas in the Valles Altos Hub, such as the Chalco area, southeast of Mexico City and less than 20 miles due south of Texcoco, where his MasAgro work does not currently take him. I asked where in the State of Mexico he is currently active. Gabriel replied, “We actually work in the State of Mexico close to Toluca [a large city west of Mexico City], and the Temascalcingo area [northwest of D.F.], near the border of Michuacán.” When I asked why these particular places, he explained:

> Because when we made the agreements in 2008, we started doing it with some ASGROW technicians. So, in these areas, the ASGROW stores already had farmers, they set up the farmers' platform, the field platform, where, when the farmers started, they did not know if they wanted a module, or if they wanted a hub, they had no idea of anything, no? We have it in our heads, but we do not have to change it. [By implication, Gabriel means here that CIMMYT employees and ASGROW technicians already saw the advantages of CA, and therefore did not have to adjust their perspective, whereas the farmers who were unfamiliar with CA would have to change their minds after some initial skepticism.] We started little by little to give them knowledge through talks. First, we call them satellites, before modules, the name for them [now] is knowledge modules.

ASGROW is a seed company, based in Mexico, that was purchased from Seminis Inc., a subsidiary of Empresas La Moderna S.A. de C.V. of Mexico, by The Monsanto Company in 1996. By 1999, Asgrow had the highest market share in the country, and continues to dominate the maize seed industry in Mexico (Trejo-Pech et al 2003). In addition to maintaining its seed and implement sales and distribution networks, Asgrow employs technicians to advise farmers who grow their hybrid seed. In October 2008, a delegation from Monsanto-Mexico visited the CIMMYT campus in Texcoco and discussed a joint effort to disseminate conservation agriculture technology in the Valles Altos region.[31] This collaboration formed the basis for what would become the first MasAgro Conservation Agriculture Hub, with Monsanto paying for the pilot program that proceeded MasAgro funding. The first modules in the Estado de Mexico were established in two towns where Asgrow has stores, where farmers using capital-intensive methods of production come to buy Asgrow products, and where Gabriel spent most of his time in the state, as of 2012. All ten of the students comprising CIMMYT's first class of Conservation Agriculture certified technicians were Asgrow employees, who were charged with supervising the CA (soon-to-become MasAgro) modules and promoting the adoption of new technologies among local farmers. I will return later in this chapter to questions of what this private sector partnership might mean for CIMMYT's public service mandate. For the moment, I will focus on the renewed government investment in agricultural research and rural development resulting from this partnership, and the work that it enabled CIMMYT technicians and researchers to do.

Free Trade and Food Security

I asked Gabriel whether he thought that MasAgro represented a new attitude on the part of the government:

> Yes, yes. The federal government, after they ridiculed extension work in [19] 94, there are still programs, such as PROMAF [see Turrent et al 2012; Eakin et al 2014], which have extension agents. But that extension work, over time, becomes only about filling out documents, delivering data, data. And now the federal government is worried, and that is

[31] https://www.cimmyt.org/monsanto-mexico-delegation-visits-el-batan/

> why MasAgro is giving training to technicians nationwide to really provide them with practical tools that they can take to the farmer.

What is the Mexican government so worried about, to use Gabriel's phrasing, that it pivoted to supporting agricultural extension programs? In its promotional pamphlets, website pages, and exhibition events, the Secretary of Agriculture, Livestock and Rural Development (SAGARPA) indicates that national self-sufficiency in grain supply is key among its current worries. Here, "self-sufficiency' is defined in narrow terms as the tonnage of maize produced in Mexico equaling or exceeding the tonnage consumed in Mexico. As many scholars have noted, this exclusive focus on yield leaves out crucial qualitative characteristics of the maize being produced, such as the relative nutritional value, taste, and suitability for the dishes central to local and regional cuisine. In addition, it overlooks questions of access and distribution that determine whether the food produced in Mexico will meet the food needs of the Mexican people. Critics of this model of food security have called for various alternative frameworks (see literatures on feminist food security, food sovereignty, and food justice) that would attend to the relational, interdependent wellbeing of those who farm, those who eat, and the agroecologies at stake.

According to the model of food security employed by SAGARPA, lack of national self-sufficiency in basic grains is the result of lack of productivity on Mexican farms. Yield per hectare is the preferred metric for productivity, and MasAgro, a joint venture of SAGARPA and CIMMYT, promises the conservation agriculture training and technologies with which the country intends to increase yields. "Why CIMMYT?" the pamphlets ask. Because, "following a scientific research program of the Rockefeller Foundation in Mexico, CIMMYT and its most prominent representative in the fight against hunger, the late Nobel Peace laureate Norman

Borlaug, created technologies that allowed Mexico to achieve self-sufficiency in corn and wheat in the seventies," the pamphlets answer (MasAgro 2011). Prominent in the program's list of objectives is "to contribute to Mexico's self-sufficiency through the increase in domestic supply of basic grains," with the stated result that Mexico will "reduce its imports of basic grains." This would indeed be a pendulum shift back from the neoliberal reforms of the 1980s, 1990s, and early 2000s.

In order to understand Gabriel's point about the federal government's shift in attitude that led to MasAgro, I need to consider the logic of state power in the context of economic restructuring and policy regimes. Sweeney et al (2013) identify three main categories of federal agricultural policy that are useful in explaining Mexico's current situation, and emphasize that the state exercises power in relation to global forces, as well as to social mobilization within Mexico:

> In Mexico, agricultural policies have been highly reactive to spikes in social unrest tied to populist movements and constraints imposed by the global economy. Thus even though the policy context is endogenous, it is an essential framework needed to understand changes in maize production since 1980. A natural division of policy history is by presidential office: Portillo (1976-82), de la Madrid (1982-88), Salinas (1988-1994), Zedillo (1994-00), Fox (2000-06), and Calderón (2006-2012). The sexenio is useful because it provides uniform six year divisions and historically each new administration tended to institute new policy initiatives to deliver on campaign promises. For agricultural policy, and the effects on maize in particular, it is easier to focus on three broad policy directions: 1) *protectionist/nationalist* – Portillo and the first years of Madrid, 2) *economic liberalization* – started under Madrid and continued through Fox, and 3) *tortilla crisis response* – Calderón, (Sweeney et al 2013: 79; emphasis in the original).

Before returning to the specifics of the MasAgro program and Gabriel's work on its behalf, I briefly summarize the impacts of these three broad phases of Mexican development policy on the maize sector. I am particularly concerned with the impacts of shifting policy on lower-income consumers and producers, who depend on maize and maize products, like tortillas.

The 2010 MasAgro materials explicitly frame the program as a sequel to Borlaug's Green Revolution of the 1970s, but they also echo some language from that nationalist era of development. Before the imposition of austerity measures in 1982, national self-sufficiency in grain production, along with supports for small-scale grain producers, was a priority pursued by successive administrations, culminating in the ambitious but short-lived (1980-1982) peasant-oriented self-sufficiency program known as the Mexican Food System, or SAM (Sistema Alimentario Mexicano) (see Austin and Esteva 1987).

And then federal development policy shifted dramatically. During the economic liberalization phase, from 1982 through the administration of Vicente Fox (2000-2006), neoliberal reforms did away with the goal of self-sufficiency in favor of policies designed to facilitate flows of cheap food to urban consumers (Fitting 2008). These reforms were also explicitly designed to direct resources to larger commodity farming operations, and away from "less-efficient" smaller and diversified producers (Hansen and Appendini 1993; Eakin 2006). Many of the newly-urbanized consumers had been recently displaced from rural peasant communities, and thereby cut off from their long-standing land base and food systems, as a result of these reforms. Market liberalization policies were successfully manufacturing their own consumers.

In addition to winnowing the nation's farmers, these policies accomplished a major restructuring of Mexico's food system, allowing for dramatic increases in imports, primarily from the United States, of basic dietary staples. From the early 1990s to 2005, maize imports to Mexico from the US increased 413% (Fox and Haight 2010); by 2000, US imports comprised a quarter of all maize consumed in Mexico (Bartra 2004). These imports escalated for two primary reasons: 1) The Mexican government did not enforce tariff-rate quotas for maize included in the NAFTA agreement, which would have severely slowed or halted imports of US maize; and 2) the US was dumping heavily-subsidized maize on the Mexican market. The WTO definition of "dumping" is the exportation of a product at a price below the cost to produce it. From 1997-2005, the United States exported maize to Mexico at a price that averaged 19% below production costs. Fox and Haight (2010: 169) calculate that, as a direct result of price drops caused by US dumping, Mexican maize producers have lost more than "$11 billion since 1990, with the highest losses in 1993, and in 1999 and 2000 when dumping margins exceeded 30%." This dumping of US maize had an even more disproportionate impact on Mexican markets because of another quirk in the NAFTA agreement: yellow and white maize were treated as one single commodity, even though, as Nadal (2000: 16) writes:

> It is important to note that the corn varieties produced in the United States and in Mexico are not strictly the same commodity. The US is the largest producer of yellow corn, normally used as animal feed. On the other hand, Mexico is one of the largest producers of white corn varieties that have a finer texture and higher flour content, making them more suitable for direct human consumption. White corn prices are, on average, 25% above the prices for yellow corn.

Both "yellow" and "white" corn, as their internationally-traded commodity abstractions are known, are broad categorizations for a range of dent varieties bred for specific industrial uses. Kernel color is not inherently a distinguishing feature of different maize varieties. Color is a genetic trait that can vary wildly within a given variety of maize, and even on a single ear of open-pollinated maize, wherein each kernel is an individual fruit of the *Zea mays* plant capable of producing a genetically-unique organism. For example, the Chalqueño landrace that dominates much of the Valles Altos region is often seen in a minimum of five different colors, including red, blue, white, "dove," and a bright yellow (though the yellow color fell out of favor with Mexican farmers following NAFTA, and it takes great skill and effort to produce ears of all one color, as oppose to mottled; see Farmer Chapter for details). However, commodity futures markets tend to be disinterested in the nuances of biological reproduction, or social reproduction for that matter, and thus, in the macroeconomic picture, “yellow corn” refers to the dominant maize type grown in and exported from the US, and “white corn” refers to the dominant maize type grown for industrial processing in Mexico. In both cases, farmers may cultivate any number of varieties, but they will overwhelming be hybrid, as opposed to criollo or farmer-bred varieties, as industrial buyers strongly prefer hybrids (Keleman and García Rañó 2011). The Mexican agricultural census likewise distinguishes between yellow and white maize, with the additional category of “maíz forrajero,” grown to be shredded into fodder for livestock (INEGI 2017). These broad categories fail to account for the heterogeneity and range of diverse maize cultivation in both countries, a far more significant data gap in Mexico, where a far greater percentage of the population depends on small-scale production for their subsistence and livelihood. Later in this chapter, I will discuss the Mexican government’s attempt to count the production of what it calls “specialty maize varieties,” and the lack of quality data that persists.

Incomplete accounting notwithstanding, SAGARPA records show that, during the post-NAFTA transition period (1997-2005), the production of white maize in Mexico increased by 50%. This dramatic increase was produced despite the simultaneous flood of US maize into Mexico, the severe price drops, and the billions of dollars in losses for Mexican farmers detailed above (Fox and Haight 2010). It calls into question the government’s implication that Mexican food insecurity is caused by a lack of productivity. Such evidence also suggests a more complex story than dominant narratives about this phase of economic liberalization have pressured us to assume.

Throughout the run up to NAFTA, its implementation, and its aftermath, there have been well-organized oppositions, rigorous critiques, and compelling arguments for alternative ways to organize our social and economic lives. Many of the mobilizations that have sustained their work to this day are informed by peasant and indigenous knowledge systems and managed, at least in part, by those whose diverse livelihood practices have weathered centuries of colonial and imperial restructuring (see La Via Campesina, La Otra Campaña, Zapatista Women communicados). Some critiques of NAFTA, however, remained disconnected from the lived experiences and everyday lives of those who would be most severely impacted, even if these critiques express deep concern for the wellbeing of smallholder farmers and poor communities in Mexico. This may be part of the reason that a certain strand of antiglobalization discourse and a certain strand of free market evangelism, for all their mutual antipathy, share a core assumption about the social groups they purport to be trying to save. Anti-globalization movements assumed that Mexican smallholder maize farmers would be driven from the countryside by NAFTA, and saw this as an injustice (see James 1994). Pro-globalization analysts and policymakers assumed that Mexican smallholder maize farmers would be driven from the countryside by NAFTA, and saw this as progress (Wood 1993). According to both narratives, the campesino is obsolete. This is a common feature of many critiques of hegemonic ideas – even the opposition accepts the premise (Peet 2009). As Loker writes:

> the prevailing development model sees campesinos as antimodern – the antithesis of development--not as human beings whose needs require attention. If the rest of the modernization program is followed, their needs will somehow be taken care of, almost in

> passing, as a by-product of development of other sectors of the economy (industry, capital-intensive export agriculture). This seems true whether we are talking about the modernization paradigm of the 1950s or the neoliberal development paradigm of the 1990s (structural adjustment, export-led growth, comparative advantage). Campesinos are seen as having a comparative advantage of zero with no constructive role in the national economy or the global division of labor. Campesinos simply do not fit into the predominant development paradigm, yet: there they are!

In defining campesinos as outside of development, the state abdicates responsibility for their wellbeing, and for any detrimental impacts the state's development policy may have on them. Some opposition to neoliberal development has followed suit, reinforcing the idea of campesinos and indigenous communities as Other, in need of rescue from extinction, but without an active role in deciding the trajectory of social change. To the surprise of both standpoints, however, these communities keep refusing to disappear. Loker's exclamation rings perhaps as true today as it did in the mid-90s: Campesinos – there they are!

Extensive literatures elsewhere document the oppression, exploitation, and abandonment that development, for all its promises and contradictions, has visited on peasants and the poor around the world (see Kautsky 1988; Brass 2002; McMichael 2008; Peluso and Lund 2011). Of primary importance to this section, and to my research more broadly, are the intersecting narratives of 1) the role of campesinos in Mexico's future, and 2) the role of state power. I argue that the consistency with which campesinos are deemed obsolete, despite their persistence through generations of regime change and policy shifts, has served to grant the state a measure of impunity. It allows us to forget that the state is implicated in the deprivation and disenfranchisement experienced by this sector of society, and in the ongoing extraction of value from campesino labor that subsidizes state development programs to this day. This is part of a broad narrative pattern in which the neoliberal state denies wielding its power in key moments and seeks to naturalize the inequality that results. The following paragraphs summarize maize production dynamics during the economic liberalization policy phase.

NAFTA was designed to favor larger-scale commodity crop farming operations over smaller-scale diversified producers, which it did quite successfully (Fox and Haight 2010; Keleman 2010). In spite of myriad hardships since the 1990s, including disadvantageous policy shifts, the dismantling of public infrastructure, financial crises, and climate variation, smallholders did not generally abandon maize farming (Eakin et al 2014). Several studies demonstrate that in parts of south-central Mexico, including Mexico State, the amount of land devoted to maize cultivation actually expanded under NAFTA (de Janvry et al. 1997; Nadal 2000). For many marginalized Mexican farmers, this represents an expanded livelihood strategy in which some family members do off-farm work, often migrating to cities or other countries, and this remittance income helps the family afford needed agricultural inputs, while small-scale maize production offers a hope of more stability and control over household subsistence in the face of a volatile global economy (Hewitt de Alcántara 1994; Fitting 2008).

New technologies, public benefits for commercial producers, and government investment in infrastructure have produced higher maize yields in targeted regions in northern Mexico. Irrigation infrastructure, in particular, has enabled intensive cultivation in areas otherwise poorly suited to maize. Sweeney et al (2013) document that, though the irrigated sector continues to constitute a small share of total land area planted in maize, increasing yields in this sector constitute a growing share of national output each year. In 1980, “only 25% of maize production used irrigation and by 2006, it had risen to approximately 45% of production," (Sweeney et al 2013: 82). State intervention and investment was crucial to this expansion. As Alcantara (1973: 29-30) observed:

> the agricultural policy of Mexican governments during the 1940s and 1950s consistently discriminated against the land reform sector on the grounds that it could not be sufficiently 'productive' (a fallacy, for census data shows that in 1940 ejidos were actually slightly more productive than large private properties), while encouraging private commercial farms through massive public investment in rural infrastructure, credit, and mechanization. Between 1941 and 1952, for example, 18 percent of the entire federal budget, and 90 percent of the agricultural budget, was spent on large irrigation projects which transformed a few northern states (notably Sonora, Baja California, Tamaulipas, and Sinaloa) into commercial cases. By far the greatest part of these new irrigation districts was sold as private property – often to the families of prominent politicians and businessmen, as well as to employees of federal government agencies. Thus the balance of economic power in the principal centers of commercial agriculture, which had begun to be modified in favor of the ejido sector under Cardenas, was definitively shifted toward the private sector. This can be graphically illustrated in the case of Sonora, where in 1940, 40 percent of the farm land of the state was held in ejidos. Ten years later, that figure had dropped to only 17 percent, not because the number of ejidatarios had declined, but because newly created farmland had been delivered to large private landowners.

In terms of commodity maize production, no state was transformed more dramatically by these drivers than Sinaloa, which, according to national statistics (SIAP), went from producing 2.16% of national white maize harvest in 1990, to producing more than a quarter of all white maize in the country in 2009, a sixteen-fold increase in yield (Eakin et al 2013).

The expectation among analysts and policymakers has been, for decades, that neoliberal restructuring would consolidate the maize industry among large-scale commercial producers, leading to widespread abandonment of small-scale commercial farming (de Janvry, Chiriboga, et al., 1995; Rello & Pérez, 2010). However, the latter sector is, thus far, persisting (Sweeney et al 2013; Eakin et al 2014).

Small scale cultivation, which is almost entirely on rain-fed, or unirrigated, land, includes subsistence and commercial production, with many households producing maize both for household consumption and for sale each year. Scholarly analysis regularly stumbles over the diverse economic topography of maize farming in Mexico, and therefore often has an awkward time discussing “commercial” versus “non-commercial” production, a tension which is central to my research and which will be discussed at length at several points in each chapter. For this and other reasons, small scale maize production for subsistence and for regional, local, or “specialty” markets is most likely to be underestimated by official sources (see Keleman and Hellin 2009). Nevertheless, what data we have indicates that small scale production is a significant contributor to the national maize supply. As Turrent Fernández et al (2012: 7) write:

> Eight million hectares are planted with maize in Mexico yearly. Of these, 1.5 million hectares are irrigated while the majority – 6.5 million hectares – are rain-fed. The rain-fed land tends to be farmed by smaller scale producers using more traditional farming methods, though this is a heterogeneous group. Collectively, their production still accounts for the majority of Mexico’s maize production.

Trends for rain-fed maize production vary by region. In some areas of the country, including Mexico State, the land area devoted to rain-fed maize has been declining slightly since 1980. In others, such as Chiapas or Tlaxcala, production appears stable. There are also areas, such as the industrial rain-fed production in the state of Jalisco, where more land is currently being devoted to this sector each year (Sweeney et al 2013). States dominated by rain-fed cultivation are consistently among the top producers of maize in the country; the states of Sinaloa and Michoacán are heavily invested in irrigation, and are the first and fifth in annual production, respectively, whereas the states of Jalisco, Mexico, and Chiapas are overwhelmingly non-irrigated, and are second, third, and fourth, respectively (Sweeney et al 2013).

Due to dramatic production increases from 1997-2005, Mexico was fully self-sufficient in maize for human consumption, even while it was increasingly reliant on imports of yellow maize for livestock feed (Fox and Haight 2010). Some of this increased production was due to higher yields in states like Sonora and Sinaloa that received disproportionate funding from the state. However, production increased significantly in many rain-fed areas as well. According to the 2017 National Agricultural Survey, 42% of the combined total yields of yellow and white maize grown in Mexico were grown on rain-fed, or non-irrigated, land. Rain-fed land constitutes a significant majority of land area devoted to maize cultivation: 57% of hectares planted in yellow maize and 75% of hectares planted in white maize (INEGI 2017).[32] Research indicates that farmers have persisted in growing the maize varieties prized for culinary uses but rejected by maize processing industries; some studies indicate that 70-80% of all maize fields in the country may be planted in criollo varieties (Aquino 1998, 245; Turrent 2005), while others estimate that criollos may constitute closer to 50% of the total area of maize production (Ortega-Paczka 1999). As mentioned above, we do not have reliable data nor adequate metrics for counting the diverse kinds of maize grown in heterogeneous cultivation systems for a multitude of markets as well as non-market purposes. However, the data we have, which is likely to underestimate the kinds of maize production marginalized by global commodity markets, demonstrate that precisely these modes of production have made essential contributions to the country's national supply. Despite economic liberalization policy designed to eliminate the smallholder maize sector, these farming systems have persisted (Eakin et al 2014). Without these farming systems, deemed "non-viable" by modernization theory,[33] Mexico would not have had enough maize to feed itself.

[32]Author's calculations based on INEGI data.
[33] See Hansen and Appendini (1993) on Salinas' discursive shift

By examining the role of the state during this phase of economic liberalization, we can identify three key assumptions that undergird development policy: 1) the market, not the state, chooses winners and losers; 2) smallholders are inefficient and will be driven out of the maize sector; 3) campesinos will be freed from the land and chose to abandon farming. We can also recognize contradictory empirical trends that persist in the face of such policies. So-called “free-markets” require extensive state involvement to facilitate and secure private gains. As Eakin et al conclude, in their study of Sinaloa’s “maize boom” since the 1990s, “the resulting ‘neoliberal landscape’ has been more engineered by public-sector intervention than by free market forces,” (2013: 46-7).

This awareness of the highly influential and obscured role of the state in managing market forces is helpful in a critical reading of how crisis came to Mexico’s tortilla industry in 2007, and who benefited from it.

A Tortilla War

It is a shibboleth of neoliberalism that free markets will raise the living standards of everyone (or at least enough of us). That development has always been uneven did not deter proponents of free trade from promising that NAFTA would bring cheap food and benefit Mexican consumers. From the perspective of the urban Mexican consumer, the government’s shift from “producer-centered” to “consumer-centered” policies was successful, for some time, at funneling cheap food into cities. Yet, as discussed above, the cheaper yellow maize imported from the US is not an equivalent substitute for the white maize grown in Mexico. Yellow maize does not therefore tend to displace white maize directly, because it cannot be used for the same foods as white maize. Most Mexican consumers reject yellow corn as inferior in quality, and many consider it unfit for human consumption. Yellow maize can, however, displace white maize consumption indirectly: cheaper imported maize is used as animal feed, which lowers the price of industrially-produced meat and dairy. Combined with cultural pressures and the prestige of diets perceived as higher class, cheaper prices push an increasingly urban population away from a criollo maize, beans, and vegetable diet to a processed wheat products- and meat-based diet (Fox and Haight 2010).

Consumers in rural areas, where the negative impacts of economic restructuring hit hardest, did not necessarily encounter the same lower food prices as their urban counterparts. As Fox and Haight (2010: 37) explain:

> According to standard economic theory, if Mexico had a single, competitive national corn market that "cleared," translating import prices consistently throughout the country, net rural corn consumers – that is, landless farmworkers and subsistence producers – should benefit from cheaper imports. Yet this does not appear to have happened. First, the relationship between cheaper imported yellow corn and rural consumer prices is not clear, since rural consumers continue to have such a strong preference for Mexican white corn. After all, Mexican consumers are well aware that imported yellow corn is animal feed. Second, lower imported corn prices at the border do not necessarily translate into lower prices in remote rural consumer markets, because of imperfect, fragmented markets and high transportation costs.

Cheap food, therefore, was not distributed evenly. In addition, cheap food was not reliable. Contrary to standard economic theory (again), falling maize prices did not consistently yield lower prices for maize-based food products in Mexico. Take, for example, tortillas, which are made almost entirely from maize. In a country where maize provides 33.6% of daily calories for an average consumer (and an even larger share of the diet for poor and rural Mexicans) and the range of maize-based dishes is so vast, tortillas[34] account for as much as 39% of all maize consumed by humans (Keleman and García Rañó 2011). Between 1995 and 1999, the price of maize in global commodity markets dropped by half (from about 800 pesos/metric ton to about 400 pesos/metric ton), but the average price of tortillas rose more than three-fold (from 0.50 pesos/kilo to about 1.75 pesos/kilo) (OXFAM 2003)[35]. About a decade later, the situation hit a breaking point. Between July 2006 and January 2007, the average price of tortillas rose 72% (Keleman and García Rañó 2011); consumers in Mexico City paid over 10 pesos per kilo of tortillas, while prices in the rural "interior" of the country reached prices of 12-15 pesos per kilo (Posada et al 2007). Keleman and García Rañó (2011: 557) calculate that the higher price meant that "the cost of a kilo of tortillas was equivalent to approximately twenty per cent of the daily minimum wage." A kilo of tortillas contains approximately 1,200 calories, or sixty percent of the daily caloric intake for an individual adult, and is the amount of tortillas consumed each day by the average rural Mexican (The Economist 2007). Many poor families, dependent on a single wage earner, could no longer afford their daily sustenance.

In what many international observers dubbed Mexico's "tortilla crisis", and the more power-attentive national news outlets called a "tortilla war" (see Navarro 2007), the public took to the streets in protest, the central bank warned of inflation risks, and the freshly-inaugurated President Felipe Calderón, having preached free-market values throughout his campaign (The Economist

[34] Keleman and García Rañó 2011 state "tortillas (and their variants)" for this statistic. There is not a specific source for this statement, though the 39% would equal Table 2's entries for "traditional rural tortillas," fresh masa industry, and harina processing industry. It is unclear whether "variants" also include tlayudas, tlacoyos, quesadillas, and other masa-based dishes that overlap with a tortilla press stage.
[35] This report has details on Cargill and ADM manipulating NAFTA negotiations, revolving door of lobbyists, and manipulation of free trade & WTO to protect monopoly.

2006), scrambled to save his presidency by instituting a voluntary pact with some large retailers[36] to cap the price of maize flour (harina)[37] and tortillas (Keleman and García Rañó 2011).

The 2007 “tortilla crisis,” resulted from a convergence of several factors. Expanded ethanol processing and ethanol fuel mandates increased demand for maize in the United States. Even more consequentially, it raised the expectation of increased demand in the future which, in food markets where as much as 80% of all trades are by speculators, can create sudden and extreme volatility. These trades are most often in futures contracts, which are one of the oldest forms of investment in commodities. Historically, futures contracts were a way to manage the uncertainty of growing crops by guaranteeing a market for the producer and a stable price for the buyer. As Levitt (2011) writes:

> [A] buyer of maize, such as a corn processing company, could protect itself against maize prices going up in future years by buying a corn futures contract to guarantee itself a stable price. This is known as hedging.

However, the financial sector has been radically restructured in recent years. Lenient regulation has allowed investment firms to create new financial instruments that bet on the price changes in food futures contracts. This incentivizes investors to take advantage of any change (or perceived change) in commodity prices, potentially turning a small price shift into a wild price fluctuation, and a stable food market into a dangerously unstable one. Interest in food commodities markets has also grown exponentially during this time. Basic food staples are extremely appealing to

[36] 19 retailers, including Walmart and Gruma, representing about 10% of the retail sector for maize flour and tortillas (Keleman and García Rañó 2011).
[37] This price cap favored masa harina over fresh masa and tortillas nixtamal, see below on the “first tortilla war.”

investors, because there will always be demand for them. If a monopolistic seller is charging too much, he is largely immune from a so-called “market correction”; consumers cannot simply choose not to eat. Levitt (2011) explains that, since the turn of the 21st century:

> there has been a surge in interest in buying and selling these futures contracts from people with no interest or connection to agriculture or the food sector. These investors are known as speculators.
>
> Speculators do not have any commercial interest in the commodity they are trading - unlike the corn processing company they are not looking to take delivery of any maize any time soon. Their only ambition is to make a profit from the changing prices over the lifetime of these food futures contracts.

Speculators make short-term trades in search of short-term profits, which can magnify a commodity price trend exponentially, beyond any relation to the material status of the commodity in question. And so, in 2006, as a record volume of maize – 21.9 million tons – was produced in Mexico, and record volumes of maize – 7.3 million tons of yellow and 254,000 tons of white – were imported into Mexico, financial traders bet on future prices as though they were anticipating scarcity in maize markets, and drove the price sky high (de Ita 2007).

While extreme volatility is often fueled by speculators who may have never been near a grain silo, some investors profiting from the spike in maize prices are closely tied to the grain itself. Of all the stakeholders in Mexican tortilla commodity chains, the only clear winners amidst the chaos of 2007 seemed to be the industrial-scale intermediaries and the harina (dehydrated maize flour) industry (Keleman and García Rañó 2011). These industrial players buy and sell the physical grain commodity, while simultaneously trading in financial products derived from the commodity. For the handful of companies that dominate the maize market in Mexico, such a situation presents clear opportunities to influence the market to their advantage.

Some of these opportunities are illegal. In 2015, the Commodities Futures Trading Commission fined Cargill $500,000 for executing "wash trades" (simultaneously buying and selling the same financial instrument to create misleading activity in the market) between 2010 and 2014 (Micik 2015). If my calculations are correct (words for numbers get awkward at this scale), this fine is four ten-thousandths of a percent of Cargill's sales from the year the fine was leveraged. In 2015, Cargill made one hundred twenty billion three hundred ninety-three million dollars in revenue (Cargill 2015). The following year, Cargill's in-house trading firm, Cargill Risk Management, was recognized for excellence as a leader in global commodities markets, winning the 2016 Energy Risk Award for best agricultural commodities house (Risk.net 2016).

Many other opportunities for market manipulation are not considered illegal, or at least are not targeted for enforcement. In 2007, some Mexican lawmakers, financial officials, and peasant organizations accused the largest tortilla and maize flour distributors of hoarding supplies to drive prices up further (McKinley 2007). Cargill was reported to have bought 600,000 tons of maize in Sinaloa in 2006 (see Navarro 2007), and yet, in early 2007, following the winter harvest, Cargill did not return to Sinaloa to buy maize as it normally does, which industry analysts caution may indicate that Cargill might already had inventories of corn in their possession (de Ita 2007). Official export records cannot account for the record volumes of maize that were harvested and sold in Sinaloa that year, further suggesting that the largest intermediaries were warehousing their maize in anticipation of higher prices in the future. The largest firms would even have been spared much of the cost of this large-scale storage, thanks to the Ministry of Agriculture's subsidy program for the purchase, storage, handling, freight, shipping and export of maize, which was aimed almost exclusively at the largest intermediaries (de Ita 2007). By the end of 2006, these industrial intermediaries were claiming low inventories, raising prices, and participating in speculation on future price increases. Maize that was purchased in April 2006 for 1,450 pesos/ton was sold in December for 3,200 pesos/ton, a 36.2% increase from the sale price in July. Maize flour increased by 31% over the same period while, as mentioned above, tortilla prices increased 72% in Mexico City, with even higher spikes in some rural areas (Keleman and García Rañó 2011).

President Calderón's response – a voluntary price cap – lacked enforcement mechanisms and failed to regulate price manipulation. It brought the price of tortillas down slightly in some areas, though at the expense of Mexico's maize farmers, by allowing imports of cheaper US maize above established quotas. Tortilla prices remained high in many rural areas, where tortillerias using fresh masa dough have to buy maize daily, limiting their ability to negotiate price, and small household tortilla producers face a terrible feedback loop in which consumer demand depresses due to high prices, but the tortilleria is the family's household income so they have to raise prices to protect their livelihood, which further depresses demand (Keleman and García Rañó 2011).

Along with Cargill, there was at least one other clear beneficiary of Calderón's intervention. Archer Daniels Midland (ADM) holds a position, as does Cargill, as one of the four corporations that control nearly all of the global trade in grains.[38] ADM has successfully leveraged political

[38] Known as the ABCD group for the alphabetic convenience of their initials, ADM, Bunge, Cargill and (Louis) Dreyfus, account for between 75% and 90% of the global grain trade, according to estimates. Figures cannot be given with confidence, however, because two of the companies are privately owned and do not give out market

influence into a business model subsidized by public resources and secured by government regulation. Since the late 1970s, ADM has lobbied and financed US politicians to institute direct-payment subsidies to corn farmers[39] and a strict quota on imported sugar – which enabled its high-fructose corn syrup to dominate the US sweetener sector – and, later, to impose a domestic ethanol fuel mandate, a steep tariff on imported ethanol, and tax exemptions for domestic ethanol production – which, together with subsidies and protections for corn production, have made ADM the largest ethanol producer by far, controlling a third of the market. Following NAFTA's implementation, ADM carried its state-sponsored business model south of the US-Mexico border, where its influence in the maize industry has grown rapidly. When the 2007 tortilla crisis erupted, ADM was well-poised to capitalize on the disaster facing so many Mexican maize producers and consumers. As Philpott (2007) explains,

> Indeed, the same company responsible for rigging up the U.S. corn-based ethanol market is also profiting handsomely from soaring tortilla prices. Archer Daniels Midland, the leading U.S. ethanol maker and the world's biggest grain buyer, owns a 27 percent stake in Gruma, Mexico's dominant tortilla maker. ADM also owns a 40 percent share in a joint venture with Gruma to mill and refine wheat — meaning that when Mexican consumers are forced by high tortilla prices to switch to white bread, Gruma and ADM still win.

Beyond passing judgement on the behavior of individual politicians or corporations, it is crucial to scrutinize the institutions that govern political and economic conditions, and to consider where public resources are invested. As the above examples make clear, private businesses are struggling for monopoly control over resources and public officials are weighing in decisively on the outcomes of these struggles.

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shares. https://www.theguardian.com/global-development/poverty-matters/2011/jun/02/abcd-food-giants-dominate-trade

[39] After grain prices soared in 1973 (ADM CEO is credited with convincing Nixon to send US corn to Soviet Union, generating whole new market and demand for corn) price floor subsidies were replaced with direct payment subsidies, which encourage farmers to stay in corn and produce more and more while allowing much greater price volatility. https://grist.org/article/adm1/

When Mexican journalists write of a “tortilla war”, they are critiquing the free market framing of the tortilla crisis as a phenomenological event arising from the autonomous behavior of freely-trading economic actors. They are calling attention to the role of state power. In a commodity war, as in a conventional war, the state seeks to enforce a monopoly control on violence. Under neoliberalism, economic violence against the public - rising consumer prices, food shortages, nutritional deprivation – takes place with the permission, if not direct backing, of public officials.

Luis Hernández Navarro, opinion editor of *La Jornada*, argues that the cruel spike in prices in 2007 was the second of Mexico’s tortilla wars. The first tortilla war occurred under the Carlos Salinas de Gortari’s administration (1988-1994), when the state monopoly, Conasupo was dismantled and control over Mexico’s maize market was transferred to private monopolies under three transnational companies – Cargill-Continental, ADM-Maseca and Minsa-Arancia-Corn Products International (de Ita 2007). The Salinas administration also worked to restructure the tortilla commodity chain, concentrating power in the hands of a single company with close ties to the government (Philpott 2006). In the late 1980s, a small corn-flour manufacturer called Maseca was struggling to compete with traditional *masa*. Masa, a fresh maize dough, has, for millennia, been made through a process known by a Hispanicized version of a Nahuatl term: *nixtamalización*. *Nixtamal* involves boiling the hardy criollo maize kernels whole in water and calcium hydroxide. The calcium hydroxide, known as “cal” in Mexican Spanish and “lime” in English, is simply ground limestone rock, which is plentiful across much of the volcanic highlands that comprise Mexico and Guatemala.[40] Once cooked, the whole kernels are simply

[40] “There is no precise date for when the technology was developed, but the earliest evidence of nixtamalization is found in Guatamala’s southern coast, with equipment dating from 1200-1500BCE,” https://www.tortillerianixtamal.com/what-is-nixtamal

drained and ground to produce the fresh masa dough. Tortillas made from masa nixtamal are nutritionally far superior to those made from refined dehydrated maize flour, known as "masa harina," in several ways; the whole grain provides dietary fiber, and nixtamalization alters the chemistry of crucial antioxidents and minerals, improving the bioavailabilty (our bodies' ability to digest) of niacin, amino acids, calcium, and proteins (Wacher 2003).

Tortillas nixtamal are also indisputably more flavorful than tortillas from masa harina. When Maseca tried to promote its flour as a modern, more efficient base for tortilla production, the market rejected it; consumers overwhelmingly preferred the taste and texture of tortillas nixtamal (DePalma 1996). This did not ultimately pose a problem for Maseca's owner, Roberto González Barrera, a close friend of Carlos Salinas, who had just won the presidency on a platform of free market capitalism.[41] Carlos' brother, Raul Salinas, was in charge of Conasupo and, before dismantling the program, Raul leveraged federal tortilla subsidies on Maseca's behalf, selling them grain at lower prices and protecting them from competition with price caps on tortillas. In 1990, Conasupo and Maseca signed an agreement which froze the amount of maize that would be distributed to producers of tortillas nixtamal, and mandated that all growth in the tortilla market would be supplied by masa harina. In 1994, federal subsidies totaled 43 percent of Maseca's net revenues (DePalma 1996). At the time, the only other producer of masa harina besides Maseca was the government program, Miconsa; by the end of Salinas' term, Miconsa had been run into the ground. Meanwhile, Maseca was selling tortilla producers equipment with

[41] Under neoliberalism, the state regulates markets to ensure that capital flows freely. "Free markets" does not mean producers and consumers are free to make choices that serve their interests… (Harvey 2004). I.e. this is not illegal, and not even truly 'corrupt', this is how neoliberal markets are designed to function, despite the misleading sales pitch.

which to convert from fresh masa production to masa harina production. Writing in 1996, the New York Times reported:

> Those [tortilla producers] who refused were punished by the Government, which sent them the worst corn and strictly limited the amount of grain the shops received. Hundreds of shops have gone out of business.

By 2007, 49% of tortillas in Mexico were made with masa harina, and Maseca's parent company, the Grupo Industrial Maseca, known as Gruma, controlled 73% of this market (de Ita 2007).

During both these tortilla wars, Mexicans were nonconsensual investors in a food system that seemed to keep stretching their labor and wages more thinly. With such extreme market concentration, consumers have few options to avoid the companies capitalizing on their exploitation.[42]

In this more complex story, then, we can better understand how both the economic liberalization that was sold as free trade, and the consolidation of maize distribution and processing that was packaged as national protectionism in times of "crisis," align with the neoliberal project. Both policy directions brought new forms of risk to bear on Mexican consumers and producers of maize, while dramatically increasing the inequality between large-scale and small-scale Mexican producers. We can see that the disproportionate harm of both trajectories has come to bear on those whose livelihoods and subsistence depend on the maize in fields, markets, and homes that

[42] Monsanto tried, in 2011, to explain Mexico's "lack of self sufficiency" "crisis" as a result of refusing to use its transgenic maize varieties (Acedo 2011).

the state considers marginal to its national project. We may also notice that what the state deems important is essential in order to understand agricultural change in neoliberal times. After all, the neoliberal project, however helter skelter in practice, is in theory fundamentally about leveraging state power to secure the consolidated accumulation of capital by political and economic powerbrokers (see Harvey 2004). National policy in recent decades has engineered a Mexico increasingly dependent on the United States and the Mexican State of Sinaloa for its most economically, politically, and culturally important crop, with ramifications about which we have barely begun to inquire. Some longtime scholars of Mexican maize production hope that MasAgro might signal a significant change in national policy, and help to reverse the emerging decline in land area devoted to rain-fed maize (Sweeney et al 2013). By launching MasAgro in terms of national self-sufficiency in maize, the Mexican government has indeed expressed concern over at least one vulnerability of its agricultural sector. The program also deploys language that seems to echo previous peasant-centered agrarian reform programs, and imply support for the places, people, and kinds of maize most at risk under neoliberalism. And yet, it remains unclear to what degree this surge in federal investment in agricultural extension and development constitutes a shift away from neoliberal priorities. Gabriel observes that MasAgro is fueled by renewed worry within the government. The program's impact may hinge on whose wellbeing it is that haunts them.

Participatory Knowledge Production

When considering the government's agenda behind MasAgro, as Gabriel encourages us to do, I found it helpful to keep in mind the political economy context of Mexico's maize sector. Such context is often missing from the government's descriptions of its own policies. For example, the promotional materials for MasAgro do not engage the legacy of social and economic restructuring for maize production. Instead, they retell a technology-centered story that has been repeated at the advent of successive agricultural modernization programs around the world (CITE). (Here is the technical solution to a narrowly-conceived problem! When structural inequality persists, and is perhaps exacerbated by our intervention, we will develop a new technical solution to an equally narrow conception of the problem!) In this case, the story of MasAgro emphasizes its line of succession, framing new development interventions as a sequel to Borlaug's Green Revolution. By leaving out the context of these two phases of Mexican agricultural policy, and that of the more than half century between them, storytellers can elide the contradictions of maize farming and economic development, a few of which are described above. These omissions tend to serve a political purpose, obscuring evidence that would contradict the justification for preferred policies or question the legitimacy of the administration pushing them. At the same time, some contradictions remain visible, and help to flesh out our understanding of the people at work behind a given policy.

Take, for example, the technologies at stake in MasAgro's vision of agricultural modernization. At times, materials from the program center this vision on so-called "improved" maize varieties – hybrid lines developed by CIMMYT and commercially produced by private seed companies – as part of a technology package administered by a certified technician (CIMMYT 2011). Such a model accords neatly with that of Norman Borlaug and what has come to be seen as the standard Green Revolution approach. And yet, even within publication issues with titles such as "CIMMYT Contributes to Mexican Food Security with Improved Seed," (ENLACE 2014), there are stories of MasAgro components that exceed this approach. Some seem to merely expand the scope of CIMMYT's commitments to a hybrid seed-centered capital-intensive model of agricultural development: the International Maize Yield Consortium (IMIC) component of MasAgro provides support for small-scale private seed companies in Mexico by facilitating access to CIMMYT's precommercial maize varieties, helping them to develop commercialization and marketing strategies, and facilitating connections to government funding sources (CIMMYT 2012). Other components tack in what seems to be a different direction: CIMMYT technicians, through the MasAgro program, are collaborating with smallholder resource-poor farmers in Guatemala to improve their farmer-bred (open pollinated) maize, conserve soil fertility and water, and diversify their cropping and animal husbandry systems (ENLACE 2014).

These contradictions in MasAgro's guiding logic remain unresolved, and I will explore some ways in which they are displaced later in this chapter. Among other impacts, these cracks and contradictions provide ventilation for those at work within the program. Though I may see some of Gabriel's ambitions and motivations as undermined by the structure of the institution he works for, they nevertheless seem to have enough oxygen to sustain themselves. In fact, in Gabriel's telling, his career trajectory has a coherence and fairly consistent focus, in defiance of surrounding ideological debates and political vicissitudes. Gabriel's start at CIMMYT was under the mentorship of Norman Borlaug, the institution's founding father figure:

> [A] lot of my work was involved with Dr. Norman Borlaug, in Sonora. When I met him, and started this work, I learned a lot about the technical side of agronomy. I was already quite familiar with the social side of the research; I knew how to do interviews, and I was familiar with farm work. And, so, to work with Dr. Borlaug is something that will stay with me the rest of my life. When I talked with him, I learned so much, but I also realized that this work, the social science with farmers, this is really what I wanted to do with my life.

Gabriel was able to continue specializing in field work and participatory research for most of his career:

> Since I entered CIMMYT in 1979, I have always been working with farmers. Always with farmers here in Mexico and in Central America. I worked in countries like Honduras, El Salvador, and Nicaragua. So I was always working with smallholders. I believe smaller farmers than where you work in Chalco. And I was primarily involved in projects on maize, maize production, and the production of wheat.

With the advent of the Conservation Agriculture program, later incorporated into MasAgro, Gabriel's responsibilities shifted to include more training of technicians themselves:

> These days, we have very large programs to train technicians in conservation agriculture, and I work to help train them. I take them to the field, to do diagnostics, to do analyses, and I look for the sites where we'll conduct interviews. We first do informal interviews to develop a questionnaire, and then we administer the questionnaire, collect the data, and then conduct the analysis. Initially, we did this by hand, of course, because we didn't have computers. Later, I think we were the first to get a computer in CIMMYT, and we worked with analysis programs.

Because of the organizational structure of MasAgro, and its emphasis on knowledge exchange between technicians, researchers, and farmers, Gabriel was able to blend his training of technicians and managing of MasAgro experimental platforms with his longstanding commitment to research with smallholder farmers. Basic scientific inquiry now had the added angle of seeking to promote MasAgro and recruit farmers to participate:

> We continued working with smallholder farmers, through the Maize and Wheat Programs. We worked to understand farmer knowledge. Why farmer knowledge? Because we were asking for parcels from them to conduct experiments. And we divided the technicians into groups to work with different parcels. We divided them into those from Asia, Africa, and South America, by culture, and by language. But, ultimately, we were all working together.

Gabriel focuses heavily on the importance of knowledge exchange throughout our interview. Farmer knowledge is a key focus of interest for him as a researcher. Knowledge is also a crucial tool that he, as a CIMMYT technician, provides to farmers:

> I have learned all these tools, because I have worked with researchers, well, of various specialties, but also from many universities. I worked for 6 years with people from Stanford, doing several projects, mainly in Cuidad Obregon in Sonora. I went to Stanford and I learned everything. So, I have worked with many students, but also with researchers like Wally Falcon, who is a researcher and the head of the agricultural economics program there. Rose Naylor, …[pause] we were involved in the projects. So, always learning from them.

Gabriel then turned his narrative frame to include me, and my research, in his story:

> Since you are here, you can not only be a socio-economist, you have to learn from the different actors, so that when you go to the field, you try to have the best to be able to assist the farmers, but also to contribute to the researchers for the different projects you have. This is my method, right? Learn from Emma. After I learn from Emma, I want to take her knowledge to share with other researchers but also with other farmers.

This is Gabriel's method indeed. He soaks up interdisciplinary knowledge at every opportunity, studiously considering the potential contributions of department chairs and graduate students alike, all while remaining securely moored to the needs and realities of farmers in his home region. He repeatedly emphasizes knowledge as an exchange of mutual understanding, rather than simply a unilateral transfer of discreet data or instruments from technician to farmer. He explains his perspective as inherited from his own training, which he is able to pass down to the technicians he now trains himself:

> I went to Iowa in the nineties and took a course on extension work, which helped me a lot. […] In Iowa, I took an English course, but also an extension course, and the person who taught it also knew Spanish very well, so he taught the course in English but also helped me in Spanish. And so, I took this course that was really helpful, and now when we are talking with some people, we are telling the technicians: first, when you go to the field, you must know where you are, listen to the farmer, to what he is doing, and then you propose the technology. If the farmers are interested, we suggest try a part of the plot. And [emphasize] that we do not give seeds. We do not give, we do not give anything. But we do give knowledge. We train them, and we teach them to produce under this system.

These are somewhat uncommon dictates. "Know where you are." So much of economic and development policy has been guided by an assumption that free market reforms are universally applicable.[43] “Listen to the farmer.” The fundamental premise of scientific realism is that only the technical experts, who have analyzed variables under controlled experimental conditions, can speak to the truth; farmers have mere anecdote and speculation to contribute (Beck 1992). Gabriel’s approach, in contrast, attends to the particulars of place and the value of participatory knowledge production. The technician isn’t the only expert authority, and the farmer’s interests must shape the advising process. In Gabriel’s view, this means that technicians must look for the right farmers to participate in MasAgro:

> So, we look for innovators, we look for committed people. Why committed? Because it is a farmer who, once empowered [*encapacitado*], are those who are giving knowledge to their neighbors. And there, that is a strong relationship, because farmers believe more in another farmer who is innovative, and believe less in the technician. Because the technicians have sometimes gone only to sell products and earn [money] from the farmers. And so farmers believe less.

Here, Gabriel mixes the language of individual responsibility (innovators, committed people), with the language of empowerment (at least according to my translation). While the former typically buttresses arguments that blame the poor for their own suffering (or the poor farmer for their own exclusion from a support program), the latter has proliferated in recent development approaches that, at a minimum, acknowledge historical forces behind existing inequality and seek to put resources in the hands of those without (Martinez et al 2021). He also brings a critical reflexivity to his work as a technician. His description of the technician’s relationship to the farmer goes far beyond the profit-driven transaction commonly seen in the extension work conducted by a seed company’s technicians. For Gabriel, there is a serious practical flaw to this kind of extension work. He cautions technicians against wielding exclusive authority or serving

[43] The IMF and World Bank are one-stop-shops for restructuring perscriptions. When researching “market-based” land reform WB project in Mexico in 2006, I found documents with “Nigeria” as the listed country name. Other researchers have found IMF documents with wrong country name in a seeming “copy and paste” error: https://www.politicalresearch.org/2004/07/06/the-roots-of-corporate-globalization-in-imfworld-bank-structural-adjustment-policies/

only their employer's interests, because their enterprise will not succeed. Farmers, their clients, will not believe them.

Gabriel decenters the role of the technician further, framing MasAgro's interventions as merely the beginning of a knowledge exchange process that should snowball from farmer to farmer:

> With this part of extension, we are betting that there is more transfer [of technology] from producer to producer than from technician to producer. But we take advantage of the situation; we work with the producer and the technician. The two precede together to send the knowledge to other producers.

Gabriel acknowledges that MasAgro's approach is not a universal favorite, for it amounts to more work for the technicians in many ways, and challenges some of the industry's precedents:

> The [government] technician received these practical tools in the university, but has already forgotten them, and they are not updated. So, what we really need is to update those tools, be trained to use them, have them [readily accessible] that day, so that you bring that knowledge to the farmer. I think we [CIMMYT agents] have everything we need, and we are making progress little by little. We have very committed technicians, we have technicians who do not like that change [MasAgro] because it is a commitment to work more, to bring knowledge there [to farmers], but we are also saying that, over time, this will improve the farmer's standard of living.

As Gabriel argues that the new, "updated" MasAgro model will succeed, he emphasizes the new method of extension work as much as the new content. Conservation Agriculture – the suite of environmentally-responsive cultivation techniques, resource-conserving precision machines, and hybrid seed-centered technology packages, as well as the banner headline of MasAgro's program – is only alluded to here as the "knowledge" that technicians are responsible for keeping up-to-date and bringing to the farmer. Gabriel indirectly endorses CA, but also emphasizes that the quality of social relationships among farmers and technicians is decisive:

> When you win the confidence of the farmer, then you have won. Each time [harvest], more money, the farmer takes that extra money he earns, he wants to take a little bit to pay you because you bring him knowledge. I'm telling you because I'm already asking the farmers: Now, with the profitability that you have, after that you still want to pay for technical assistance? And believe me, the farmers are telling me: Yes, if the technician has it [training and knowledge] here, he teaches me, he helps me, then I believe that, what I am earning. I can pay him a part.

The farmers in Gabriel's hypothetical example are paying a technician to assist them in augmenting their existing profitability, which indicates these farmers are likely engaged in growing seed purchased as part of a technology package from a seed company, and selling the harvested grain through contracts to an industrial intermediary. For such farmers, Gabriel argues that an investment in technical assistance of the sort that MasAgro-trained technicians provide is well worth the cost. Implicit in this argument is that these participating, innovative, committed farmers also have access to credit in order to have sufficient capital to invest in technical assistance.

Gabriel frames such an investment as delivering returns beyond a single harvest season. He sees farmers as playing a central role in ongoing knowledge production:

> So, it is difficult, because of the culture of the technician, but I think we are achieving interesting things, positive things, training the technicians and bringing knowledge there [to the field]. Now, what we are ... I am strongly proposing that we train innovative farmers. Farmers with a lot of experience. Why do I tell you? Because we give them a diploma, as certified farmers with different technologies. Because they feel proud and commit to give talks, to give knowledge to other farmers. This is what we are missing. I am truly hoping that we will have it at some point.

Gabriel leaves ambiguous what cultural dynamics he sees as unproductive. However, over the course of his interview, he repeatedly frames the dialogic process between farmers, technicians, and researchers – the heart of agricultural improvement, from his perspective – as a countercultural move. For this reason, I read his statement above as making a grounded case for participatory research in which the dignity and agency of farmers are centered. It is worth dwelling on his discreet insistence that pride and technical expertise are not a competitive advantage that one individual holds above another, but rather are resources that redound to collective benefit the more they are exchanged. To the degree that Gabriel's position here is in conflict with both current hegemonic theories about how economies should be organized, and the market structures into which these farmers seek to sell their commodity grain, it is all the more interesting to consider.

Gender and Extension Work

In keeping with his counterculture sensibilities, Gabriel expressed a keen interest in recruiting younger Mexicans to the training programs. He sees them as less resistant to the new approach, and perhaps less possessive of their skills and knowledge:

> The other advantage is that we are approaching many students, young people who still do not have much of a work method yet, and whom you can still train as true technicians, committed to sharing knowledge.

I asked Gabriel if he works with many women. I asked specifically about both female farmers and female technicians, though Gabriel, in his response here, focuses on women as farmers:

> Here, there aren't many women [farmers]. We have some women in D.F., where above all there is one woman. She is getting old, she is seventy-six. But very interested in the CA system. She sees the advantages, she has seen them after two years of sowing, and she wants to continue with this system. In the areas in Oaxaca and Chiapas, this is where there are more women.

I asked Gabriel why there were more women farmers in these southern states:

> Because there is more migration. Where you see migration, women are left in charge of the farm. In Valles Altos, that does not happen. Doesn't happen.

Gabriel's answer references the context of gendered divisions of labor and migration across North America, which results in men from poorer Mexican states, particularly those in the south of the country, leaving their family's farm to work in the industrial fields, orchards, and factories of northern Mexico, the United States, and Canada (CITE). Mexico State and much of the Valles Altos region have experienced far lower rates of male labor out-migration than surrounding states, like Puebla and Morelos, or southern states, like Oaxaca and Chiapas (CITE). In regions where significant numbers of men are leaving the farms for work elsewhere, such gendered patterns of migration have produced what some analysts describe as a "feminization of agriculture." Women, who were traditionally excluded from work in the fields, must now take over male duties such as plowing, planting, weeding, and harvesting. However, despite the prevalence of this narrative, even among some migrant-sending farming communities, the departure of male farmers does not necessarily mean women simply assume men's roles in addition to their own. More often, there are complex repercussions for women's work responsibilities and decision-making power, as well as for gender ideologies of women's subordination. Radal et al caution against oversimplification of this trend, arguing that, "[i]n the smallholder sector in Latin America, where a male-dominated family farming system is accompanied by strong gender norms against women's field labour participation, it is critical to distinguish, at the very least, between participation in labour and in management," (2012: 116). Gender ideologies are enforced through institutions and social relationships at many scales, and it is common for women who step outside the bounds of their inherited subordinate role to do so at great social cost.

Mexico is no exception to the broader regional (and global) trend of patriarchal norms, and it is in this context that Gabriel emphasizes the advantages he sees to working with women farmers. Following his explanation that he works in areas, such as Valles Altos, with lower rates of male out-migration and female management of farms, he asserts the following:

> But if there are women [farmers], it is a fact that we want to work with women, because through women, when we already trust them, and they receive us well, then that there is not that problem that the farmer gets upset because they talk with the wife or the mother of the house [after they talk with us]. The woman, we talked with her about the soil conditions, the advantages of being a conservation farmer, how the texture of the soil is improving, how the organic material will improve, as through time we have earthworms [signs of good soil health]. And the woman in this sense [Gabriel snaps his fingers] seizes the idea. And then she talks with her husband. Sometimes the husband does not want to, or half does care, half does not care. But when the woman participates, the woman makes him see a lot of interesting things, and I think we have very good farmers who offered commitments not because of people from CIMMYT, or because of outside technicians. Because they were convinced by their wives.

In Gabriel's remarkable narrative turn here, women are framed as a key decision maker in the farming household, and as potentially more powerful in shaping the success of CIMMYT programs than the institution's trained experts. I will continue exploring women's roles in household decision making in the next chapter. In the follow chapter, Chapter 4, I will engage in greater detail the ways in which CIMMYT navigates gendered narratives of agricultural knowledge and work.

Meanings of Modernization

Up to this point, Gabriel had given me such rich descriptions of his work for MasAgro, from his perspective. He had returned many times to farmer livelihoods and farmer knowledge, but he hadn't made mention of the MasAgro program's stated objectives, such as increasing crop yields, stabilizing consumer grain prices, national self-sufficiency in grain production, or conserving water and chemical inputs. So, I asked Gabriel if he could describe for me the ultimate goals of the MasAgro program, and I specifically mentioned that I had read about intended outcomes such as raising yields, and adapting to climate change. Gabriel responded by recentering dialogue with farmers in relation to the broader project:

> Right, well, we do have a lot [of objectives]. The commitment is to talk with the farmers. They [my supervisors] do not ask me here [at CIMMYT to do this], but everyone, always, the people, the group that works with me, I am always asking that we talk to the farmers about their needs, about the loss of the soil, about the changing climate. We are not going to see rain as we had been, suddenly lots of rain, suddenly frost, suddenly other disasters [siniestros]. But, also, I am always saying, and in my talks I always like to say: raise awareness with all farmers, the women and the men who show up [asistir].

This is Gabriel’s first acknowledgement, in my presence, that his goals as a researcher and extension agent are not always perfectly aligned with those of his institution. He proceeds by justifying his focus on the heterogeneous perspectives of farmers according to common overarching concerns of the international agricultural development community:

> At this moment, we are one hundred and fifteen million inhabitants, in Mexico. Only one hundred million agricultural hectares. But with the construction of houses, the construction of roads, and the loss of soils, in 10 years, we will not have one hundred million agricultural hectares, we will have less. But we are going to have a population of perhaps one hundred and fifty million inhabitants. And if now we cannot feed ourselves, in 10 years we will be dying of hunger, fighting for food. And the only way to be able to do something, at this moment with government support, the interest to increase food, is to look for different options.

Gabriel then cautions that meeting ambitious development goals will require a flexible, inclusive approach:

> And some farmers say: But I want to do it with my native corn. Let's try. Do not stay outside [the program], let's try. If it works, then we [CIMMYT technicians] learn too. We have an experience, but only you decide. We tell you that you can see lodging problems, you can control the weeds [and] you will have to use pesticide. If we [technicians] do [advise pesticide use], then according to the [certification] board, it is no longer conservation agriculture. But there is still the option. You can apply fertilizers, you can do other practices,

> other new technologies that till the soil, it depends on you. What it offers you, conservation agriculture, is that you improve your soil. In five years.

Here, Gabriel frames conservation agriculture, not as a rigid protocol, but as a set of guiding principles that may need to be adjusted to suit the particular conditions and needs of different farmers. In doing so, he again validates the differing farmer perspectives he has encountered. His next statement reminds us that, to put such an attitude into practice can involve logistical challenges:

> I, in my case, like to give myself reminders. When I'm visiting the farmers, suddenly, my watch tells me that I have some time before seeing the next farmer, and so I take them to see the modules that produce these characteristics. So that they understand. And not only so that they see it, but also so that they talk with the farmers who own these modules.

For Gabriel, a creative approach to his farm visit schedule, guided by an imperative to cultivate as many conversations as possible, makes a substantive difference. It has also allowed him to maintain some continuity in his relationships to farmers in his home region throughout his CIMMYT career:

> For me, I always liked what we've done since the eighties to bring farmers, farmers from the State of Mexico to the State of Tlaxcala, those from the State of Tlaxcala, we took them to Hidalgo, and those from Hidalgo, we went on a bit of a run to bring a group of these farmers to Sonora, looking for resources of the state government, from IFAD [the International Fund for Agricultural Development, an international financial institution], so that they could acquire another level of precision, additional knowledge, and, above all, so that they could talk farmer to farmer. This is, for me, where there is a lot of technology transfer.

Gabriel advocates putting farmers from different states in contact with one another. Specifically, he describes coordinating in-person visits of farmers from states with low government investment to states with much higher government investment, in the hopes of facilitating greater access to resources. Though he explains this approach as one he has sought to practice his entire career, he also frames the current moment, and the MasAgro program, as an unprecedented opportunity to achieve ambitious levels of knowledge exchange and resource distribution:

> As you go, you give, and you give. You saw this at a visit with us when we went to a group of international technicians in conservation agriculture. And so, everything we do, we do with farmers. I like to participate a lot. I like to participate a lot with the municipal authorities as well, who are the decision makers. And make focus groups to convey – to learn, but also to convey - knowledge. This is what we can do with MasAgro. I do not know where we are going to arrive. I hope, expect, we will achieve very positive things. Why? Because for the first time in history, there are farmers around here who finally know what CIMMYT is. They always hear of it, but they could not … [pause] they did not have access. A lot of information, but very few researchers could go to the fields, and now they can. Since 2008.

2008 was the first year of CIMMYT's emerging Conservation Agriculture training program, which set the stage for MasAgro. In Gabriel's view, this current phase of development programs has unique potential to make CIMMYT a positive and influential presence in Mexican agricultural production and in the lives of farmers on the margins of the industrial sector. Importantly, he sees CIMMYT's work as a deeply reflexive endeavor, in which engagement with outside criticism, as well as critical self-reflection, is essential:

> Every week I will make a program where I will be in a given state, and the farmers will visit. In this program, a researcher like you who comes, Mexican or international, and if you are interested in knowing: what we do with farmers, how is monitoring, what do farmers think, what do they say? Well, I think we have to participate. We have a line [of inquiry] there, a questionnaire that we apply, but we are always open to taking observations from others that tell us how to improve. There people say that: I have experience in another country and what we did there was this. But we take it and analyze and try to start with that information to know what farmers say. We are always open.

It is perhaps a sign of Gabriel's ability to practice the critical self-reflection he advocates that, over the course of our interview, he develops a measured degree of ambivalence regarding his own work. Much of the time, he frames his devotion to participatory research, service to smallholder farmers, and embrace of a diversity of farming practices and farmer perspectives, as an unwavering approach, even a hallmark of CIMMYT's mission inherited directly from Borlaug himself. And yet, at certain moments, Gabriel brings contravening observations into our conversation. Several times, he highlighted tensions between the work he was trying to do and the larger institutional agenda. And, near the end of the interview, he expressed profound worry for the future of the agricultural crop that so many Mexicans hold most dear: criollo maize.

Criollo maize varieties are inextricably entangled in questions of power and the future of agriculture in Mexico: Who controls the reproduction of the seed? Who decides what crops are valuable and desirable? What kinds of social, ecological, and economic difference will agricultural policy permit? These questions are central to my research project and I will return to them in each chapter. For now, I focus on criollos as a site of contestation that brings into higher relief some of the tensions at play in Gabriel's work. In the following paragraphs, I have compiled the portions of our interview in which Gabriel dwells on criollos in relation to CIMMYT and agricultural development. He brought them up many times throughout the course of our conversation. These excerpts represent a reoccurring theme from early in the interview through the end, where he asks me if I, in my research, see evidence of a future for criollo maize in Mexico. More than any other topic, criollo maize helps reveal tensions between Gabriel's own priorities for his work, and the conditions he has to work with.

Criollo, Hybrid, and Transgenic Maize

The first time Gabriel delved into the complexities of criollo maize and farmer decision-making, he related this issue to my own research. Knowing of my keen interest and ongoing field work in the Amecameca Valley, he begins telling me of his experience in the region, decades before MasAgro:

> I was working in the Amecameca Valley with small farmers. This program was introduced in the late 1980s, I believe, and early 1990s. The focus was on Conservation Agriculture, and on zero tillage and minimal tillage. We began, as well, to bring [maize varieties] from CIMMYT that were lower in height, varieties that were open-pollinated.

Open-pollinated varieties (OPVs) are advantageous to farmers because, unlike hybrid varieties, OPVs breed true year after year, which allows farmers to save seed from their harvest, select for the traits they value most, and plant this seed the following season. In contrast, hybrid varieties will only produce well for a single generation, so farmers cannot expect good results from saved seed, and must buy hybrid seed each planting season. Gabriel also describes these varieties from CIMMYT as "lower in height," by which he means that they didn't grow as tall as the local farmer-bred, or *criollo,* varieties, which can grow to over nine or ten feet in height. Domesticated maize, unlike wild grasses, tends to have small, fairly weak root systems relative to the weight of its stalks, leaves, and ears. This means that taller plants are at greater risk of lodging, or falling over, before they have finished maturing, resulting in crop loss. Gabriel and other workers in the CIMMYT extension program had assumed that these characteristics would be seen as a desirable advantage by maize farmers in Amecameca.

> But the farmers there already had a good yield. They were happy, because their maize was not falling to the ground [lodging] much. The farmers were interested in varieties that had this resistance to lodging, but they wanted maize with the same characteristics as their own criollo varieties. Characteristics like the flavor of the tortillas, characteristics like the flavor of elotes [fresh sweet corn], characteristics like the useable forage, because horses, cows, bulls, they don't eat the residue, the rastrojo [stover; leftover leaves and stalks] from hybrid maize, but they do readily eat stover from criollo maize varieties. In addition, in this region, as you know, farmers benefit enormously from the ojas, the totomoxtle [maize husks] for processing tamales. And when these farmers saw that our maize would not offer these characteristics, after two years [of experimenting with the "improved" varieties], no one wanted to plant the maize that we brought from CIMMYT. And so, because of the conditions of the program, and decisions within CIMMYT, we didn't continue working in this region after that.
>
> There wasn't much to do there. Well, we could have worked with the farmers on their [criollo maize] varieties but, at that time, CIMMYT was dedicated to promoting the adoption

> of its own varieties to farmers with few resources. Where we really succeeded was with wheat production. Because, here in CIMMYT, we have varieties that are well adapted and that farmers have adopted all across the country. With excellent yield, excellent resistance to diseases and pests. This is how farmers adopted varieties from CIMMYT.

Here, Gabriel highlights a conflict between the target goals of CIMMYT's extension program and the needs of farmers in the Amecameca region. These farmers were receptive to extension officers and potentially interested in their assistance with agronomic challenges such as pest management or lodging prevention. However, CIMMYT extension was not prepared to assist farmers who wanted to keep their own varieties, rather than adopt varieties designed and produced by CIMMYT. The goal of CIMMYT extension at the time was to promote the adoption of new varieties. This ended up limiting the range of communities with which they worked.

> We worked in the Amecameca/Chalco region for, more or less, six years. Then, after this program to deliver new resources ended, we didn't work there any longer. I did return a few times to reconnect with farmers in the region, because I was working closely with farmers in Sonora, and I brought some farmers from Central Mexico to Obregón so that they could see other kinds of production systems. Some of these farmers were very interested in applying these techniques in the Chalco region. They were all from Juchitepec and Tenango del Aire. This is where farmers in the region began introducing systems of planting in beds, not conservation agriculture, but in beds nonetheless. Yes, it is difficult for farmers with certain soils in the [Chalco] region. When the rains come, the beds start to disappear, because of the particular characteristics of the soils there.

Recounting this cycle – of embarking on a project in one region, working there for several years, watching it come to a close, and moving on to another project – seemed to trouble Gabriel. A little later in our conversation, he contextualized his limited work in Amecameca within the broader trajectory of his work with CIMMYT. As he mentions elsewhere in the interview, the current moment, and mandates of Conservation Agriculture, feel like an opportunity to achieve some of his longstanding goals of serving farmers directly:

> We at CIMMYT began working in Tlaxcala in the late 1970s, throughout the 1980s, and afterwards, we arrived in this region of Amecameca. And so, yes, I have worked with small-scale producers. However, I must confess, that in the history of CIMMYT, during the time

> that I've worked for CIMMYT, this is the first time that I have conducted social research [estudios sociales]. Because, I've always asked: why are we soliciting information, soliciting more information, analyzing it, developing a paper? We then have publications, but we don't have anything for the farmer. And, after, these twenty plus years in CIMMYT, finally! [Gabriel's face cracks into a smile] I am so happy to work with... well, I work in Socio-Economics, but supporting the Conservation Agriculture program. Because, we are bringing knowledge, we are providing training and greater capacity for the farmers, and we are training/empowering [capacitando] the technicians, which is a fundamentally important tool for them to bring knowledge to the farmers. And so, I get to help them learn, but I also analyze the information that they are generating in order to see whether what we are doing is cost-effective for the farmers to improve their livelihoods [medios de vida], or are we doing nothing? And I, in particular, I am very pleased, because, yes, we see results with those farmers with whom we work through Conservation Agriculture.

However, unlike elsewhere in our interview, Gabriel segues here, from the abstract aspirations of improving farmers lives, to the concrete and fraught question of what participating farmers will grow. I did not interject or otherwise prompt this train of thought directly, though it likely makes a difference that Gabriel knows of my deep interest in criollo maize and campesino farming practices. The paragraph below follows directly from the one above, without interruption, and seems to reflect a longstanding preoccupation of Gabriel's:

> We are introducing, yet again, improved varieties, maize, in this case, where it is true that we are taking away from the farmer the possibility of continuing to live by producing criollo varieties of maize, for the characteristics for subsistence and feeding the family. But, at the same time, I think that we are also really helping these farmers, because, for example, in the region where I am producing, where my family lives, the yield for [criollo] maize there is one and a half to two tons [per hectare], in a very good year. But the cost of production is very high. There isn't enough manpower – neither within the family nor for hire – to do the manual labor [labores culturales] required to plant [criollo] maize. In addition, with the maize varieties that grow very tall, with conservation agriculture, we see a lot of lodging, because they do not have a good anchoring [buena claje], they don't have a great enough quantity of roots that go deep enough, and so, we have tried conservation agriculture with criollo maize, and we don't have good success with criollos.

In quick succession, Gabriel enumerates some of the key complicating factors in small-scale maize production, including yield and cost of production; how much manual labor is required, and how much is available; and how well cultivation practices are suited to a particular crop.

Unlike many agronomic analysts, who dismiss criollos as inferior (often citing lodging), Gabriel leaves ambiguous what he deems to be the cause of the apparent incompatibility between criollo maize varieties and conservation agriculture techniques.

He is clearly uncomfortable with the thought that his work for CIMMYT is undermining the cultivation of criollo maize. I was struck by his blunt language. He states, without euphemism, that “it is true that we are taking away from the farmer the possibility of continuing to live by producing criollo varieties of maize.” He then summarizes the purpose of criollos as “for the characteristics for subsistence and feeding the family,” and it is important to note his careful phrasing here. He does not say that these farmers, who grow criollo maize, are subsistence farmers. Instead, he says that this criollo maize, which is grown by these farmers, has characteristics valued for feeding the family. In fact, he implies that these farmers are commercially-oriented to some degree, because CIMMYT programs are successfully encouraging them to replace criollo maize varieties with hybrids that are poorly suited to subsistence use, and emphatically preferred by industrial buyers.

In his choice of language, Gabriel seems to be deliberately skirting a widespread assumption among development practitioners, including several other CIMMYT researchers, that criollo maize is for subsistence production and household consumption, while “improved” hybrid maize is for commercial production. The corollary is that farmers who grow criollo maize are, by definition, not commercial farmers. I will explore the politics of these assumptions more fully later in this chapter, and the empirical evidence that refutes them in the next chapter. For now, I will mark them as contested but extremely common assumptions that have undergirded agricultural development since the professionalization of plant breeding in the early twentieth century (see Kloppenburg 2004).

Gabriel next raises one particular dimension of the politics of criollo maize: the perceived existential threat of biotechnology. This fear has mobilized Mexicans around the country in defense of native maize populations. It has also fomented significant confusion on the technical, ecological, and political distinctions between different kinds of plant breeding technologies. Gabriel describes his neighbor's reaction to the first time he started growing non-criollo varieties:

> As of 2009, I have been doing a conservation agriculture module with my family. Our first year was 2008 to 2009, and I began to introduce hybrid maize. The people were frightened of hybrid maize. Everyone thought that this maize, they all said: Es un trangenico! Es un transgenico! [It's transgenic!]

"Transgenic" or, in Spanish, "transgenico" is a more precise term for what is commonly known in the English-speaking world as "genetically-modified" or "genetically-engineered". The latter two terms can broadly reference any organism produced through the manipulation of its genetic material by humans, including by millenia-old practices of selective breeding. In contrast, a transgenic organism is specifically one into whose genome exogenous genetic material has been introduced, often, though not exclusively, by deliberate human intervention. The biological mechanism for transmitting DNA between unrelated organisms is called "horizontal", or "lateral", gene transfer. Horizontal gene transfer is opposed to "vertical" gene transfer, in which genetic material is passed from parent to offspring through reproduction.

This process of genome transformation, transgenesis, was first identified in bacteria in 1928 (Austin 2001). Scientists first produced transgenic mice in the mid-1970s (Constantini 2001), and the first transgenic plants in the mid-1980s (Heldt 2011). Given our species' misbegotten habit of insisting that the world segregate itself into the "natural" and the "artificial," we have tended to conflate the fact that humans have induced some instances of transgenesis with the delusion that only humans can induce transgenesis. Textbooks on genetic engineering credulously differentiate transgenic crops from "wild" plants as though they are mutually exclusive (see Heldt 2011). Students of biology may therefore be confused to learn that horizontal gene transfer (HGT) has been a feature of all three domains of life – Bacteria, Archaea, and Eukaryota (which includes everything from plants to slime molds to us) – since the beginning of evolutionary time (Soucy et al 2015). Recent microbial ecological research indicates the "promiscuity" of gene transfer between bacteria and eukaryotes may be much higher than previously thought (Owens 2014). Many scientific publications, at least those engaging an audience presumed to be familiar with this facet of evolutionary biology, make a useful distinction between "artificial" HGT – induced by human scientists in a lab – and "natural" HGT – not induced by human scientists in a lab (see Heldt 2011; Lacroix 2003; Gelvin 2003). However, many more scientific publications routinely drown this technical distinction in an ocean of normative and ideological assumptions.

In the following paragraphs, before returning to the specifics of transgenic maize in Mexico, I will unpack a prominent and emblematic example to illustrate how scientific discourse can be used to undermine, rather than inform, rigorous public debate on the politics of transgenic crops. In 2015, a collection of molecular biologists and crop geneticists published their genuinely fascinating study, evidence of an ancient T-DNA transfer by bacteria to the domesticated sweet potato, in one of the world's leading scientific journals, the Proceedings of the National Academy of Sciences, under the title, "Sweet Potato: a naturally transgenic food crop". As researchers are often encouraged to do, the authors conclude their study with a discussion of the broader implications of their research. In this case, they hope their findings can ameliorate the public's misunderstanding of transgenic crops:

> *Agrobacterium*-mediated transformation has been the method of choice for the development of genetically modified crops. Despite their cultivation on more than 170 million ha, the growth and consumption of transgenic crops still faces societal opposition. This has impeded their use in efforts to contribute to a more sustainable agricultural future. Our data reveal that T-DNA integration, the interruption of an *F-box* gene, and the subsequent fixation of foreign T-DNA into the sweet potato genome occurred during the evolution and domestication of this crop, which is one of the world's most consumed foods. This finding could influence the public's current perception that transgenic crops are "unnatural," (Kyndt et al 2015).

While the authors' article title arguably features the term "natural" in a defensible way, to mean that the genetic transformation of these sweet potatoes was not induced by humans in a lab, their conclusion risks rendering that term entirely meaningless. They themselves confuse their readers with muddy and inconsistent language, while simultaneously blaming an obtuse public for misappropriating the idea of "natural." If, as the authors seem to be advocating, "natural" and "unnatural" (or "artificial") should no longer distinguish the bacteria-induced horizontal gene transfer to sweet potatoes, which occurred without human intervention[44], from the introduction of glyphosate pesticide resistance, obtained from bacteria, into patented Roundup Ready crop varieties by Monsanto scientists, then what on earth are those terms supposed to mean? The authors seem to be trying to collapse the distinction between the two – plants that we have learned are safe to eat during millennia of co-evolution, on the one hand, and commodity crops that are being modified and marketed according to the needs of a company's quarterly earnings

[44] Though it is worth noting that this specific transgene seems to persist only in the domesticated form of the crop, possibly raising questions about how natural and social selection may have played a role in its genetic success.

reports, on the other – simply because some of the plants in question share a bacterial mechanism for genome transformation.

Any productive conversation about the potential risks and rewards of biotechnology must make claims that are based on evidence. The authors above, along with many others, draw on substantial evidence to argue that the transfer of exogenous DNA into a food crop, with or without human interference, does not automatically render that crop dangerous to eat.[45] However, just because these authors are experts in genetics, does not mean that genetics is the only expertise required. Just because some plant genomes were altered 8,000 years ago by the same bacteria used to produce transgenic crops in a lab today, does not mean that the "genetically modified" crops currently grown on "more than 170 million ha" are the cultural, political, nutritional, economic, or ecological equivalents of the plants that were on that land before them.

The authors' assertions above rely on slippery use of terms, passive tense, and conflation to avoid central empirical facts. In the case of the commercial transgenic crops cultivated today, *Agrobacterium*-mediated genetic transformation wasn't a method chosen by divine providence, evolutionary selection, democratic deliberation, or public consensus. It was the choice of transnational corporations who use their patented transgenes to secure even greater control over

[45] I would argue we also need much more rigorous research into the comprehensive human health impacts of eating crops with specific transgenic modifications, as well as genomic simplification from hybridization, and the resulting changes in pesticide applications, for example. There is substantial evidence that glyphosate crops increase pesticide use which results in higher risks to agricultural workers, and higher presence of pesticide residue in food (see Benbrook 2016).

the profits of global agricultural production. In addition, societal opposition to the cultivation of transgenic crops on large stretches of the world's agricultural land is taking place in the context of escalating economic inequality, political violence, land grabs, farmer suicides, and lack of transparency in industrial food systems, all of which predate, but also compound existing misunderstandings and misrepresentations of genetic science.

Much of the global public does lack a basic understanding of a great deal of scientific knowledge, including that which relates to transgenics. Some advocacy groups and nongovernmental organizations have seized on these misunderstandings as a political opportunity, inflaming public fears of "Frakenfoods" and "genetic contamination," though many also ground concerns about transgenic crops in extensive lived experience and scientific evidence (see Villa 2014). Opposition to transgenics is rarely an isolated stance. Often demands for "GMO labelling" serve as a means to mobilize opposition to everything from corporate control of food systems to lack of government regulation of chemicals and biotechnology. Allied economic and political powerbrokers tend to use consumer fears of transgenic ingredients as a red herring to deflect critiques of the broader political economy of biotechnology.

Scientists like the authors above bear great responsibility for the intractable confusion over what transgenic crops are, who currently benefits from them, and whether they could have any role to play in a collective agricultural future that is just and sustainable. They fall into the trap of using the concept of "natural" uncritically, as a stand-in for sweeping claims that anything designated natural is therefore good and safe. They also demonstrate a deeply irresponsible inclination to make claims well beyond the scope of their data. Many scholars have worked to organize the kind of rigorous, evidenced-based debate on crop biotechnology that should inform responsible policymaking (see Kaplan and Winklerprins 2017). In addition to clarifying the technical dimension of crop breeding and genetics, such a debate must take seriously the solid, historical reasons why so much of the public distrusts the biotech industry, as well as those politicians and scientists who champion them. It must also assess a given technology in its ecological, political, and even technical context. For example, though horizontal gene transfer could theoretically be engineered into any type of maize one fancies, agricultural industrialists have exclusively prioritized hybrid maize as the substrate for their patented transgenes. The transgenic maize varieties that dominate U.S. corn fields are not open-pollinated; the exogenous genes are inserted into inbred hybrid varieties. From the companies' perspective, the hybrid's refusal to be productively replanted by farmers serves as a biological enforcement of private property rights to the seed, reinforcing the legal actions required for enforcing proprietary rights to the transgene (Kloppenburg 2004). This fact – that available transgenic maize varieties are, in current commercial practice, also hybrids – is obscured in many debates over the impacts of transgenic technology on environmental or human health. Next, I will turn to the material and discursive presence of transgenic maize in Mexico, which drove Gabriel's neighbors to exclaim in horror at the thought he might have introduced some to their town.

In recent years, scholars interested in tensions between the United States and Mexico over agricultural development have increasingly turned their attention to prominent debates over transgenic maize. This reflects, in large part, the dominance that transgenic maize has assumed, in terms of US production and policy, since the commercial planting of transgenic maize in the country first began in 1995. According to the US Department of Agriculture, 96% of US corn planted in 2020 was genetically engineered. Of the total US corn acreage planted in 2020: 5.2% was Bt maize, containing traits derived from the Bacillus thuringiensis bacterium that cause the altered plants to produce insecticides; 8.3% was HT or ‘herbicide tolerant’ maize, developed to survive application of specific herbicides that previously would have destroyed the crop along with the targeted weeds; and 86.5% contained both Bt and HT (stacked) traits (USDA 2020).

McAfee, who has spent years studying the dynamics of the debate between the two countries, argues that “having placed its bets on transgenic technologies, the US government has worked zealously to convince publics and prime ministers that genetically engineered crops and products are safe, superior, and the solution to virtually all agricultural challenges,” (McAfee 2008: 151). The US Departments of Agriculture and Commerce, in their fervent promotion of transgenic technologies, have extolled the ability of future generations of crops to solve the ecological challenges of food production and alleviate hunger and rural poverty. Since the late 1990s, these agencies, backed by the six or so transnational corporations that currently dominate international agribusiness markets, have made the purported superiority of transgenic crops a central feature of their long-standing push for the liberalization of food trade and the global enforcement of intellectual property rights to agricultural technologies.

Mexican authorities have exhibited great ambivalence toward the deregulation of transgenic maize. In 1998, they placed a de facto moratorium on the commercial cultivation of transgenic maize, citing concerns that it would likely cross-pollinate with native varieties and thereby transfer genetically engineered traits, with consequences that we do not yet fully understand. Risk of gene flow to non-transgenic maize is especially concerning in Mexico, the place of origin for maize and a global center of the species' biodiversity. In 2009, this ban was modified granting 196 permits to three international biotech corporations – Monsanto, Dow AgroSciences, and DuPont's Pioneer Hi-Bred – for experimental cultivations of transgenic maize in northern Mexico. In 2012, these three were joined by the seed and agrochemical conglomerate Syngenta, and together the four companies submitted seventy new applications for permits to plant transgenic maize, fourteen of which were for commercial cultivation on almost 6 million hectares. However, the biotech giants are currently stalled in their efforts to expand transgenic cultivation; a decade-long concerted opposition movement expanded dramatically in late 2012, just as I was completing my fieldwork for this dissertation; farmers' groups, environmentalists, artists, and prominent intellectuals mobilizing to hold workshops, public forums, and demonstrations in many Mexican states and countries around the world to demand a moratorium on the planting of transgenic maize in Mexico (Ribeiro 2014). Under the Peña-Nieto administration, legal and political battles raged. While international private interests have put immense pressure on the Mexican government to facilitate investment in the development of transgenic crops in the country, opposition from indigenous, peasant, and activist groups has continued to, in the words of the United States' Foreign Agricultural Service, "stymied" the efforts of biotechnology companies (USDA 2018). In February of 2013, the Bill & Melinda Gates Foundation and the Carlos Slim Foundation opened a Biosciences Complex within the CIMMYT headquarters (CIMMYT 2013) which explicitly would allow for the development of transgenic maize and wheat (USDA 2018). However, in September of the same year, the XII District Court in Mexico City suspended the issuance of permits for the cultivation of transgenic maize, both experimental planting for research and technology development, and commercial cultivation for sale to the public (Riberio 2021). Collective civil action and campaigns against transgenic maize in Mexico persisted until in 2020, the national Senate passed a "Federal Law for the Promotion and Protection of Native Maize," to prevent the "intellectual plundering" of maize genetic resources. Morena party Senator Ana Lilia Rivera, one of the bill's sponsors, stated to Mexico News Daily (2020) that the law was one step in addressing "the debt that [Mexico] still has with indigenous communities since the implementation of the North American Free Trade Agreement in 1994." On December 31, 2020, Mexican President Andres Manuel Lopez Obrador (elected 2018) issued an executive order to phase out all agricultural use of the herbicide glyphosate and all transgenic maize for human consumption[46] in Mexico by 2024.

Gabriel knows this context well, and reassured his neighbors that he had not violated any ban with the varieties he introduced to his farm, telling them, "Well, no, it's not transgenic maize, it is hybrid maize, like you find in the market, that's being produced in many parts of the country already." He explains to me:

> It was a variety from Asgrow [a Monsanto subsidiary], and, in this year, severe drought was a major problem, it was an atypical year. My neighbors planted criollo maize, and when their maize had reached a height of 20cm, my maize was only 10cm, and so all the farmers around were saying: this new system doesn't work! This new system doesn't work! For I had all the soil inundated with crop residue, all of the coverage [of crop residue] from the previous year was on there. The rain cycle came, and my crops were getting higher and higher, while the others' crops were tiring, and, about 60 days after planting, then came the drought, and all was drought for about 45 days. My neighbors' criollo maize had died. And the maize that I had in the module resisted [drought], resisted, resisted, because of the soil management, the crop residue, that had maintained the humidity of the soil. At the end of the growing season,

[46] Though the language in the decree in its Official Register is somewhat ambiguous, Mexico has already begun withholding import permits for transgenic maize from the United States, and seems potentially headed toward a ban on transgenic grain for animal feed, as well as human consumption. reuters.com/business/environment/mexico-stalling-gmo-corn-permits-ahead-ban-says-top-farm-lobby-2021-06-10/

> the others had a yield of 800 kilos to 1,200 kilograms per hectare. Whereas I had a yield of 6,300 kg per hectare. My cost of production in 2009 was 4,800 pesos per hectare, and the cost of production for my neighbors, because I did interviews with them, their cost of production was more than 5,000 pesos.

In his example, Gabriel emphasizes the conservation agriculture cultivation techniques – such as minimal soil disturbance and maintaining soil cover through crop residue – as making the difference between his harvest yield and that of his neighbors. His astute emphasis on soil management serves as a helpful reminder that, contrary to the claims of some unscrupulous seed vendors, the variety of maize is not the sole determinant of yield.[47] As Gabriel mentioned previously, some farmers, like those in Amecameca, conducted their own experiments to compare hybrid varieties with criollo varieties and decided to eschew the hybrids, in part because they were able to harvest products beyond the grain, such as husks and forage, from fields planted in criollos. In the next chapter, I will explore the politics of measuring crop yield in greater detail.

I asked Gabriel why there was such a difference in production costs between his farm and his neighbors'. He replied:

> Because of management, the agronomic management that you apply to the crops. While they had to prepare the soil, hacer un barbecho [break up the topsoil, leaving it exposed to the sun for up to 30 days, during which time larvae and eggs of pests die], one or two sweeps through [the field], then comes their planting [cavo de siembra], by machine or manually. After this, comes the application of fertilizers, but also comes the manual maintenance work [labores culturales], wherein one passes with a hoe, removing weeds and putting soil on the [base of the] plants so the wind doesn't topple them. So, one does three passes – a first weeding, a

[47] The Green Revolution required a massive structural mobilization of state and private-sector resources (Jennings 1988), Agroecology (Holt-Gimenez and Altieri 2013), There may be a significant gap between a commercial variety's intrinsic yield – the maximum potential, the highest yield possible under ideal growing conditions – and its operational yield – what is achieved in a farmer's field when a crop is exposed to pests and environmental stresses such as drought (Gurian-Sherman 2009) A comparison of yield potential would require including these factors, along with the long-term social and environmental harm of chemical and fossil-fuel intensive production systems.

> second weeding, and a third to pack earth around the plants – and the harvest is also done by hand. The cost of production for harvest goes up a lot for criollo maize. Because you need to pay for labor. You have to cut, then amogotar [stand the cut maize stalks upright on their ends in groups leaning into one another, which allow the stalks to dry in the field. In Mexican Spanish, these bundles are call "mogotes". In American English, they are known as "shocks", and the process as "shocking" the corn.], then you have to pizcar [Hispanicized Nahuatl word for harvest], degrain, the cost of production is very high. And the cost of production in conservation agriculture: first, the first year, you prepare the soil. You can do an aggressive preparation of the soil. You can plow, hoe, as you please. But, after the second year, you don't have to do anything. Or, you just have to re-form the beds. And, if the beds are well-formed, you don't have to do anything. The cost of the planting, the cost of the seed, the cost of the fertilizer, and the cost of the herbicide, because you use herbicide, immediately after planting. But, after this, you don't do anything until the plants are at least 40cm tall, we do a second application of fertilizer. Because hybrid maize asks for, improved maize asks for more nourishment. Also because of the population size, because criollo maize varieties have populations of 28-35,000 plants per hectare. And the population of hybrid maize varieties, in Valles Altos, goes up to 60-70,000 plants per hectare. And so, in order to achieve a good yield, we have to increase the nutrients, the food, especially nitrogen. There's also the harvest, but the cost of the harvest is much lower, because you're using machinery. And so, the cost of production is much, much lower, while the yield potential is much higher.

As Gabriel vividly describes, the cultivation of criollo maize is very labor intensive, from planting, through the growing season, to harvesting and post-harvest processing. There are several reasons why criollo farmers rarely use machinery. One reason is that the machines are not designed for their maize – the kinds of criollo seeds that dominate the Valles Altos region are often too large and irregular for mechanized planters, and their large size and elongated shape makes them especially susceptible to cracking, bruising, and other damage during mechanized harvesting, shelling (crushing the maize ears to release the kernels), cleaning (sifting the kernels from the chaff and broken cob pieces), and grading (separating kernels by size, shape, and density by passing them through screens and holes) (see Ajayi 2006). Another reason that many farmers who grow criollo maize – which they can save, rather than buy, each year – also do their field work by hand is that they cannot afford to buy or rent these expensive machines. Gabriel does not include the cost of the machines in his production cost comparison.

Here, I will also point out a theme that will reemerge at several points throughout this chapter: the metrics of sustainability. Gabriel represents a program called The Sustainable Modernization of Traditional Agriculture (MasAgro), which centers on a model of Conservation Agriculture that likewise defines itself as “sustainable.” This concept is, of course, often a relative one; a given approach is sustainable in contrast to the other, less sustainable ones. It is worth noting that, when a farmer transitions from growing criollo maize according to longstanding campesino practices, to growing hybrid maize according to conservation agriculture methods, this is a transition that requires increased agrochemical use. Hybrids are designed to be grown under highly controlled conditions and tend to be less capable of competing with other plants for light and nutrients, hence the dependency on herbicide applications. They also require multiple applications of chemical fertilizer during the growing season. As Gabriel mentions, this is partly due to the agronomic needs of hybrid varieties, and partly due to the density at which they are designed to be planted. Growing maize, a particularly nitrogen-hungry crop, intensively for successive generation can deplete nutrients in the soil, one of the conditions referred to as “soil exhaustion.” Conservation and “precision agriculture” models advocate that fertilizer applications be applied according to exacting calculations and using machinery that can deliver the chemicals directly to each plant, rather than spray them over an entire field. However, when fossil fuel-based energy is cheap, it is far more cost effective to synthesize chemicals in fossil fuel-powered factories and apply them to crops in excessive quantities. For many farmers, big and small alike, it feels prohibitively expensive to be precise.

Agronomists for intensive maize cultivation systems tend to advise aggressive nitrogen fertilization so as to achieve maximum yield. Kansas-based Farm Journal Media field agronomist

Ken Ferrie likened nitrogen in a maize plant to gasoline in a vehicle engine – enough fuel, and the crop growth will never slow down, but a lack of nitrogen will cause the crop to stall. “You want to keep enough nitrogen available during all corn growth stages so crop growth never slows down. Corn that’s nitrogen deficient at the beginning of the growing season gives up yield potential,” he says. “Nitrogen-deficient corn in the late reproductive stages costs actual yield,” (Brooks 2018). This has been an increasingly common attitude since the Green Revolution, which exported fertilizer-responsive crop varieties and intensive industrial cropping systems around the world.

Whether this is considered a sustainable approach is another matter. 120 million tons of synthetic nitrogen is applied to the world’s agricultural fields each year, and more than half of that is calculated to wash off and into local watersheds, where excess nitrogen stimulates explosions of plant and algal growth. These “blooms” eventually rot and consume all available oxygen, leaving local aquatic and marine life to suffocate. The Gulf of Mexico is only one of many bodies of water that has a regular “dead zone,” caused by nitrogen runoff down the Mississippi River from the grain fields of the Midwestern United States. This dead zone continues to get larger each year. In 2018, it extended for 8,800 square miles (Pearce 2018).

Increasing nitrogen fertilizer while simultaneously reducing biodiversity in an agroecosystem, as agricultural intensification does, also creates an ideal environment for ballooning populations of the phytophageous insects which feed on crops like maize (Zhao et al 2015).

This agricultural model mirrors the capitalist economic model it was designed to serve. Growth for the sake of growth, without end. Social and environmental costs are externalities. Crises are opportunities. Minimizing tillage, as conservation agriculture does, is certainly a positive move, but it not clear that this challenges, or even mitigates, the "laws of motion" of a capitalist system. Unlike ecological nutrient cycles, circulating capital has a growth requirement, and behaves less like a cycle than a "spiral in constant expansion," (Harvey 2017). Even under conservation agriculture this creates an unforgiving technological treadmill. As Jason Moore (2010: 405) explains, the social and environmental harms of intensive production are a logical outcome when agricultural systems are restructured for the sake of capital:

> [S]oil exhaustion is 'fixed' through rising capitalization in the form of fertilizers, while fertilizers themselves work only for so long before provoking pest invasions, escalating pesticide use, which creates new resistances, and so forth. The upshot is that the rising capitalization of nature creates a world-historical situation of rising production costs stemming from the degradation of the conditions of production. Rising socio-ecological exhaustion and rising capitalization are two sides of the same coin.

Capitalization causes a crisis in the agricultural system, which creates an opportunity for more capital-intensive inputs to "solve" the first crisis, which leads to more crises, and more opportunities for capital circulations to expand. In the thick of the US Corn Belt, where expensive new transgenic drought-tolerant and herbicide-tolerant crops are selling themselves as the solution to the climate change and chemical resistance caused by their predecessors, this agricultural system can seem hegemonic. It can feel impossible to imagine a way out. In the Mexican Central Highlands, however, capitalization is being considered piecemeal, as farmers and technicians weigh each new technique or seed variety against the diverse alternatives that persist across the region. Capitalist agriculture-as-totalizing-hegemony is prevalent in narrative form, but remarkably rare in practice.

Gabriel went on to explain that, even after the impressive demonstration of drought tolerance, his neighbors remained suspicious of his new maize variety. He and other CIMMYT workers found that many farmers in the region became warier of commercially-sold seed after the national transgenic ban was modified in 2009 to allow select companies to cultivate transgenic maize.

> And, so, in Valles Altos, after 2009, farmers didn't want to eat this type of maize. Always out of fear, because they didn't know it was a hybrid. We passed through, and held various conversations, but folks were still afraid. Of trangenics. Because of the information coming from newspapers.

I asked Gabriel if farmers with whom he works continue to express anxiety about transgenic maize:

> Yes, the majority of them, the majority do. Here it occurs [transgenic maize] because many people have migrated to the United States, and bring seeds back in their clothing, when they return home, they bring seeds with them. And so that's why they were asking if those were transgenic maize [plants], because when they return and plant the seed, they say that, they plant the seeds and the plants emerge and grow, but they have no ears. If there aren't ears, then it's transgenic. But I'm saying: no, not necessarily. It could be transgenic, but it could also be hybrid. The maize doesn't produce because the conditions where they get the seed are at sea-level, at 100-500 meters above sea level, and here we are at 2,500 meters above sea level, so the maize emerges, grows, but doesn't produce. And so, bit by bit, we've been eradicating this idea among producers, and I'm now able to tell you that, this year, the maize that we're planting in the region, in the states of Tlaxcala, Puebla, Estado de Mexico, and Hidalgo, 70% is hybrid maize.

For some within CIMMYT, and certainly among CIMMYT's industry and government partners, this rate of farmer adoption of hybrid seeds is seen as an unalloyed success. For Gabriel, his work to convince farmers of the merits of hybrids comes at a painful cost:

> The criollos have been lost: last year, almost 100% of the maize was criollos, 95% of the maize was criollos. And, this year, we have calculated that about 70% of the maize planted must be hybrids. We are asking all of the farmers who planted hybrids to evaluate the characteristics of the maize. Every woman of the house says that they don't like the tortillas [made from hybrids], not to feed to their children or their husband. And so, what we are recommending is that, if you have 2 hectares to plant [maize], save half a hectare to cultivate criollo maize for your own consumption, and seed the remaining hectare and a half in a commercial manner [en una forma commercial para el mercado] for the market, where you're

> going to get a better yield with which you will be able to provide great wellbeing to your family. This is, I believe, the best idea for the farmers.

Here we see some slippage between an empirical fact – that industrial processors and intermediaries expect and are currently organized around the standardization of hybrid maize – and a normative assumption – that farmers seeking to participate in commercial markets should necessarily grow hybrid maize. As we will see in the next chapter, there is not a single uniform maize market in Mexico, but rather a diverse array of commercial maize markets, including ones that have been organized around criollo maize and smallholder farmers since long before CIMMYT existed, and which continue to support many farmer livelihoods to this day. There is notable tension between the practice described above, in which hybrid maize is normalized as inevitable, and Gabriel's statement earlier, in which he highlights the flexibility of the MasAgro model: "And some farmers say: But I want to do it with my native corn. Let's try. Do not stay outside [the program], let's try."

Gabriel's own farming practices do not resolve this tension. He explains that he applies the same advice to his family's farm that he gives to other farmers:

> I personally love criollo maize! But I cultivate, as others do, a small section of land with criollos, for their quality characteristics, for my own consumption and that of my family. We all [in my town] say that we plant a quarter hectare, half a hectare, in criollos, and three, five, ten hectares in hybrid maize. These are the conditions.

I am struck by Gabriel's choice of words when describing how he and his fellow farmers grapple with such fraught choices. *Estas son las condiciones.* These are the conditions. Even as he explains his own advocacy for hybrids, and accepts that the commercially-oriented farmers with whom he works have practically no alternative to hybrid seed, he avoids committing to the narrative of hybrid varieties' inherent superiority. Those who don't regularly spend time perusing agribusiness product catalogues, reading textbooks on agricultural biotechnology and development, or chatting with the farmers and extension agents who work in the industrial maize sector, may not appreciate how unusual this is. One can find professional critics of industrial production, including hybrid seeds, quite easily (CITE). And one can hardly avoid if one tries the lavishly funded scientific and trade publications preaching the faith of "improved" varieties (CITE). One can even find rigorous examples of each, grounded in extensive evidence and experimental trails (though the funding, institutional support, news coverage, and research bias is stacked overwhelmingly in favor of the hybrids) (CITE). However, it is easiest to dismiss hybrid maize and the cultivation systems it requires, if, like me, you aren't trying to make a living by selling maize. It is not at all easy to stake your family's livelihood to producing hybrid maize, and still maintain a critical awareness of the structures in which you are doing so. Gabriel's perspective, steeped in the social and technical complexities of how we grow maize and for what purposes, reminds us that farmers are not making livelihood decisions under conditions of their own choosing.

Gabriel's next thought connects these structural conditions with the CIMMYT programs that help to shape them:

> I see that, with these programs like MasAgro, and the need to address a lack of food, […] when the farmers start to be familiar [with the program], they are going to sacrifice the characteristics that they prefer for consumption, those of criollo maize, in order to cultivate more hybrid maize, for it gives them a resource with which to live.

This observation raises a multitude of questions. Where is food lacking, and what is preventing it from getting there? Why is this seeming lack of food pressuring farmers to stop growing the kinds of maize that are most nutritious and delicious? How did we end up with agricultural conditions in which farmers have better hope of making a living by growing maize they don't want to eat?

Such questions are certainly not answered by the trends of agricultural change under global capitalism. To paraphrase Patel and Moore (2017), our current food regime promises cheap food, but cheap food guarantees neither that people are fed, nor that they are fed well. Gabriel describes what these global trends look like in southern Mexico:

> This is what has come to pass in La Frailesca, in Chiapas, where we [CIMMYT researchers] first started working in 1991. When we first started our study there, 90% of farmers were growing exclusively criollo maize. When we returned, ten years later, the criollos had disappeared. In this moment, 95% of farmers were growing hybrid maize, and about 10% were growing other varieties, about 3% in criollos and 7% in open-pollinated [improved] varieties.[48]
>
> When we asked farmers: what happened with the criollos? The criollos that one desires in order to make food, all those dishes for which criollos are well suited? We asked them if the hybrids served these uses well, and they responded that, yes, the hybrids worked alright. They didn't have the same flavor, but they did work to make the maize-based dishes that they are accustomed to.

Keeping in mind the Amecameca farmers, who stuck with criollo maize varieties after finding they didn't get the husks and forage they needed from hybrid maize, I asked whether these farmers from Chiapas found that hybrids produced the maize products they needed beyond the grain. Gabriel replied:

> No, in Chiapas, they tend not to use the rastrojo [stover] to feed animals; they primarily rely on pasture. It's much wetter there. However, in regions like Amecameca, I know farmers who have tried using hybrids, and they get great yields: 7-7.5 tons of grain per hectare. But, we did a study, Emma. This was in 1996. We did a study with some farmers in the region, and we saw... the analysis that we did showed that famers earned more from the sale of the maize husks than from the grain. And so, this is one of the qualities for which is it very difficult, for farmers in this [Valles Altos] region, to change from criollos to hybrids, or to an

[48] See Hellin 2012 on this region, MASECA is the dominant purchaser here.

> improved variety. They would require a hybrid with the same characteristics [as criollos] with regards to the husks.

I asked Gabriel why the industrial maize sector prefers hybrids so firmly over criollos:

> Look, the sale of hybrids, in the mill industry... [pauses] I was interviewing some mill operators in Oaxaca, and these industrialists commented to me that: yes, the advantages of criollos are excellent, for consumption. But for those in business, criollos do not yield as large a quantity of tortillas, per kilo of raw grain, as compared to hybrids. Apparently, according to the data, as I remember, [criollos] yield a kilo [of tortillas] per 100 grams of grain, while 100 grams of hybrid maize yields more than a kilo and a half [of tortillas]. And this is the performance that industrialists are looking for.

In the recently published studies I have found, several criollo varieties of maize yield as much, if not more tortillas per kg of grain than hybrid varieties (Guzmán-Maldonado et al 2015). In a 2011 analysis, landrace (criollo) varieties of maize from the State of Mexico were compared with white hybrid varieties provide by CIMMYT. After growing and processing all varieties under controlled conditions, the researchers found that landraces produced an average of 1.40 kg of tortillas per kg of grain, compared to 1.38 kg of tortillas per kg of white hybrid grain (Guzmán-Maldonado et al 2015). Though landraces clearly yield plenty of tortillas, the authors do note that many of the landrace varieties tested do not meet industry standards for shelf life – tortillas from landrace maize tend to dry out, discolor, and become stale more quickly than those made from hybrid maize. This shorter shelf life is thought to be a result of the high content of phenolic compounds in landrace maize, compounds which, in food science parlance, are "closely associated with the sensory and nutritional quality of fresh and processed plant foods," (Ho et al 1992: 2). Phenolic compounds are, among other qualities, good sources of antioxidants, and many have been shown to have inhibitory effects on carcinogenesis (the formation of cancer cells) (ibid).

From Gabriel's description, it is unknown whether the industrialists who told him that criollo maize fails to yield sufficient tortillas were drawing from empirical assessments that could be put into conversation with Guzmán-Maldonado et al's 2015 study. It is also possible that perceptions about farmer-bred varieties and their place, or lack thereof, in a modern food system are contributing to erroneous assumptions about what kinds of maize are practical and desirable.

I asked Gabriel whether farmers had discussed their feelings about controlling the reproduction of the seed, which they can do with open-pollinated varieties, but not with hybrids, which must be purchased every planting season. He replied that they had:

> [F]armers who, as I said, have started to grow hybrids, one of their complaints is just that. They want to be able to recycle seed from their harvest, not have to buy new seed each cycle. We have mentioned to them that, with this new MasAgro program, where they are able to work closely with CIMMYT, we will be talking with the programs located in their region, to see, under this agreement, whether they can reproduce seeds from open-pollinated varieties, or even hybrids, maybe synthetic hybrids, where the farmers might take on the role of seed producer [semillero] for a cycle or two.

If farmers were enabled to guide plant breeding and take on leadership roles in producing seeds, and if these seeds were then an open-source technology – accessible to the public, who can use, reproduce, and tinker with it as they see fit – then such an initiative would be one step toward the transformative institution of seed sovereignty that peasant organizations such as La Via Campesina (1996; 2009) and Navdana (2021) have been demanding (see also Kloppenburg 2010; 2014). However, I was not able to find additional information on this aspect of the MasAgro program coming into practice.

Gabriel went on to describe the compromises that some farmers are forced to make, when they choose to invest in hybrid seeds and stake their farm to producing hybrid maize, but cannot afford the price of the commercial seeds every planting season:

> In this region [Valles Altos], farmers don't do this, but in Chiapas, where farmers have fewer resources, they don't buy seed every year. They might buy seed one year, and then plant directly from their harvest, and it might only produce 25% of the original yield, but it does grow. And some others mix them: they buy a bag of seed, and mix it with another bag [of seed] from their own harvest. Well, we know nothing's going to happen. Every year, you're going to see a decrease in production.

Gabriel mentions that there are government programs to assist with the cost of seed (which only apply to purchasing hybrid varieties, and could not be applied to, say, purchasing criollo seeds from a fellow farmer) but continues with an example that suggests these government supports are insufficient or inaccessible to many farmers in need:

> [F]armers, fewer in this Valles Altos region, but there are some who, when the price of seed is very expensive, mix a bag of purchased hybrids [hybridos de bolsa] with seeds from their harvest of hybrids. And, we ask them: why do you do this? You're going to lower your yield. And they tell us that they don't want to, but they have to plant 5 hectares, and they don't have the money to buy five bags of seed. So, they buy three bags, and then degrain their harvested maize, and mix in enough seed so that they can plant their entire 5 hectares.

I offered that many farmers with whom I've spoken describe a chronic lack of transparency in the market for hybrid seeds. Some have encountered technicians and company representatives who heavily promote specific hybrid seeds, but leave the farmers confused as to how and why these hybrid varieties will not breed true in the ways that their criollo varieties always have. Other farmers have indicated to me that the hybrid kernels sold at local third party agricultural supply stores are not always the first-generation seeds, like those sold by seed companies, but may include the harvested kernels as well, and may be ambiguously labelled. Unlike criollo kernels – which can be put to use either as grain or as seed, depending on the user – hybrid kernels must be distinguished by the seller as one or the other. Without transparent marketing and technical guidance, these smallholder farmers might lose their harvest before learning the difference.

MasAgro and the Future of Mexican Maize

I then asked Gabriel about MasAgro's large budget, and CIMMYT's mandate to support all farmers, especially poor and small-scale farmers, in the whole country, from every region. Given his own descriptions of the MasAgro hubs, it seemed as though farmers like those in Amecameca were being excluded. Gabriel replied:

> Look, I believe that the potential is lower, that these places [like Amecameca] are where it goes down. Why does it go down? Because there are already mejoradores ["improvers," seed companies and plant breeders] and there are already farmers who are looking to obtain what they are producing, with those characteristics. And it's certain that one will see hybrids, because, for example, you can find even hybrids that are blue in color, or black, that were not in the market.

Gabriel's logic is a little hard to follow here, but he seems to be explaining that there are service providers that can step in to fill the gaps in CIMMYT's extension networks. This question of the relative "potential" of places to participate in MasAgro is a reoccurring theme among some of my interviewees from CIMMYT, and will be further explored later in this chapter.

Gabriel continued, and evoked an expanded notion of the MasAgro program, from that of a discreet set of participant networks actively coordinating with CIMMYT employees, to that of a vision for the future of agriculture in Mexico. Under the latter, even those communities who are growing non-CIMMYT crops and turning to non-CIMMYT sources for technical assistance will be influenced indirectly by the conservation agriculture model:

> And so, under the mandates of CIMMYT's MasAgro program, I believe that, in some regions, there are farmers who will need to hire a specialist that can work with them to improve their crops, and try to find materials [germplasm] that are adapted to the region and which have the characteristics that they are looking for. I think that this is going to benefit, in reality, the country. Why? Because, for example, because of Conservation Agriculture.

Here, Gabriel is articulating a structural understanding of CIMMYT's ability to shape the conditions of production at the national scale. From this perspective, conservation agriculture techniques have the potential to improve conventional soil management, thereby improving soil fertility and minimizing erosion:

> We have soil loss, every cycle, due to the impact of the rain, moving and moving the soil, we have cascades of soil, you can see some gullies in about half of the plots. And we in Conservation Agriculture are reconstructing the soil.

By way of example, Gabriel describes the conservation agriculture module he started on his family's farm:

> The module that I mentioned to you is on a slope. A steep slope. I had not wanted to cultivate this land, my parent's land, because the soil was compacted. Because, every time, there had been soil loss. And, after five years, it was like the other farmers envied the module. Over there, various areas of extension had emerged and they [the farmers] had gone, had seen them, had questioned and learned, and they now intended to adopt these practices in their own farms. And so, I believe that the important thing here is to work ethically, to bring knowledge to the farmers. And tell them, not only about the advantages, but also about the disadvantages. In the case of maize, you must tell the farmer that [the hybrid varieties] produce a greater yield, but this requires spending more for fertilizers that many farmers are not accustomed to using, and for herbicide that, likewise, many farmers know of but don't use for maize.[49] Also, you must tell them that, to plant hybrid maize, one must work with terms of credit in order to have access to inputs, and also enter into a contract with the businesses in order to get future prices. So that one secures access to a market and the purchase of one's maize. Farmers are sometimes frightened by this aspect, because they must pay for technical assistance, and they must pay for agricultural insurance. They question why they can't plant their maize in the traditional way. However, the culture is changing, bit by

[49] This is likely because many farmers adopt a different commodity grain crop before switching from criollo to hybrid maize. Wheat and barley would be "improved" seeds that need higher levels of herbicide and fertilizer applied, and farmers with criollo maize will not think of these chemicals as necessarily applicable to maize, since criollo maize does not need them.

> bit, for the farmer, and I think they are interested in taking risks. They take risks when they see results. This is the idea behind our modules.

Gabriel's train of thought here takes him from an appreciation of CIMMYT's national influence, and the environmental benefits he hopes will result, to empathy for farmers who see these changes coming, see themselves being asked to trust more of their livelihood to market managers and gatekeepers, and are afraid. Over the course of his career, he has seen CIMMYT shift the landscape of maize production in Mexico. In the current moment, CIMMYT is wielding immense resources with which to do so. The narrative he develops suggests that Gabriel may well be thinking about what the growth of MasAgro means for those farmers who opt out, or are left out, of support programs. His experience also reminds us to consider the social and ecological consequences of the many farmers who, guided by MasAgro's model, do change what they grow and how.

As Gabriel next describes the recruitment process, in which MasAgro introduces farmers to the products available for implementing conservation agriculture methods, we can start to see the filtering effect of institutional logistics. Farmers are brought to MasAgro modules, where they can see for themselves how specific crop varieties fared under a conservation agriculture system. At these events, are the company representatives selling the technology packages designed for this system. Farmers who don't fit this model, and the critical questions they may pose to the CA approach, are sifted out – by self-selection or otherwise – at each stage, from event invitation to sales pitch to the moment they decide whether to risk some of their land and labor on this new model. Gabriel describes how he seeks to assist farmers in this process:

> With these modules, we can train technicians, and train farmers. And so, when the events are held, the [technology] fairs, the farmers come, as well as other actors: the seed distributors,

> machinery distributors, and they also present on what they offer in the market, and we make recommendations to the farmers: This seeder, this isn't going to work for you. This type of maize hasn't been tried in this region. You have to put forth materials that are already known. And, if you want to offer other materials, well, we ask that someone who wants to sell a new variety of maize must let us have four lines, which we will plant there, and when we hold a field event, another fair, we invite farmers to come familiarize themselves with different kinds of maize. This does not cost the farmer; it costs the seller. And, if this kind of maize grows well, the famer will want to buy it. But, if it doesn't grow well, the farmer is not going to be fooled, he is going to see that, in order to produce well, he should not buy this maize.

From this description, there seem to be many cracks through which different kinds of farmers and maize can fall, especially for a program that explicitly purports to be compatible with the heterogeneity of Mexican maize farming. I asked Gabriel if he thought that diverse cultural practices, and small maize markets could continue to exist in a context of modernization. He replied:

> Yes, I am sure of it. In fact, [modernization] will provide opportunities for small farmers. But not on an individual basis, one has to be in an association of rural production where 10, 15, 20 farmers work grouped together. An ejido, or other kind of rural association. They are going to produce their own criollo varieties of maize. There needs to be improvement that takes place in the field, participatory breeding. For example, lower the height of the ears. Teach the farmers which ones are the healthiest plants, and when to do the seed selection. Don't do it at the harvest [once the maize has been cut down], but rather do it in the field. Make a little list or something, and mark the best plants: plants that have two ears, plants with the strongest stature, with many leaves. This is what we want to teach the farmers. And when they know these things, they are going to begin to increase their yield. But, they are also going to be producing maize like el azul [blue], el rojito [red], el amarillo [yellow] criollo, como el blanco [white], and we must find niches in the market where they can offer these products. There are people in Mexico City, in the same villages [where the maize is produced] who want to buy this type of tortillas, or maize for making homemade tortillas. It doesn't matter if the price is higher.

Missing from this answer is the astute appreciation Gabriel expressed earlier of CIMMYT's power to change the conditions of production in ways that direct resources away from the kinds of farming practices, technical assistance, and maize varieties he describes above. At the same time, Gabriel is drawing from a lifetime of observing criollo maize and campesino farmers persisting in ways that scholars have found difficult to predict or explain (CITE).

He offers an illustration, from his own neighborhood, of the presence that criollo maize has in towns across the Valles Altos region:

> I'll give you an example: in my town, my family has a mill, a tortilleria, where they produce tortillas from hybrid maize. The cost of the tortillas is $10.50 [pesos per kilo]. However, in the next intersection, on the next block, there's another tortilleria where they make tortillas from criollo maize, and where the tortilla is artisanal, the woman is going to make it herself [by hand as opposed to by machine]. And it's yellow maize, or blue maize, or white maize. And so, people come to buy tortillas at 14, 15, up to 16 pesos per kilo. Listen, there are market niches for them. The question is to look for them.

Here, Gabriel draws on language common in agricultural economics about the competitive advantage that marginalized ingredients can have in what economists call "the market" (and political economists call a cheap food regime) if these ingredients are sold up the "value chain," as more expensive processed goods, and to a higher-end consumer (see "Organic Sprouted Ancient Maize Flake cereal at Whole Foods).[50] Gabriel continues:

> Look for different channels that will lead us to produce [criollos], but also to commercialize them. Don't sell the grain. Better to teach them to make value added products. Like this: set up a tortilleria where you offer these kinds of products, and where people go to buy them.[51]

Gabriel's next phrase re-emphasizes his confidence that criollos can survive, while also reinforcing the dichotomy between them and modernity:

> I am certain that yes, there are, the two: MasAgro, the modernization of the countryside, while caring for criollos, yes, it is possible to do.

I was interested to better understand Gabriel's view of this tension, and offered that it can be difficult, in the global market, to balance producing for quantity versus quality. He rejected my

[50] https://www.wholefoodsmarket.com/product/one-degree-organic-foods-sprouted-ancient-maize-flakes-b00fl6m4um Last accessed September 7, 2020.

[51] Many important normative assertions here: open-pollinated maize is subordinate (niche) and patented hybrids should remain dominant; even open-pollinated varieties should not be sold as kernels (here called "grain"), which is how seeds are exchanged between farmers, but only as a value-added food product, thereby reinforcing the enclosure of the seed; these "niche" products should continue to be undercut by the cheap food regime, in which subsidized commodified tortillas are presented to consumers as costing significantly less.

premise, and I anticipated his next story might follow the value-chain idea, and demonstrate how criollos could be scaled-up. Gabriel, however, took us in a direction I had not anticipated.

Fetishes of Maize

Gabriel's next story revealed the deeper implications of how we value different kinds of maize and the people and places who produce it. Drawing from his fieldwork in the southern Mexican state of Oaxaca, he connects themes of state violence, economic restructuring, and commodification that also arose in his discussions of working with maize farmers in northern and central Mexico. Together, these stories illustrate the cruel unevenness of agricultural modernization in the country.

He begins his story by framing our conceptualizations of maize in the context of international market exchange:

> This is sometimes a myth, but yes, it is possible to produce maize[52] and look for value-added for local products. For example, in 2010, there was a study, in various parts of Oaxaca, where they produce principally criollo maize. There is little hybrid maize in these regions. There is a myth that only with particular types of criollo maize from Oaxaca's Valles Centrales is it possible to make the tlayuda [a large, crispy tortilla typically served with a thin layer of refried beans, lard, bits of meat, avocado, salsa, and cheese on top]. But we found that these regions were not producing much maize, and yet they continued making the tlayuda; selling them in the local market and also sending them to the United States. And so, I asked: where are you buying the maize? The criollo maize used to make tlayudas was not being grown here because of diseases, pests, and drought. Where is this supply coming from that makes

[52] Here, Gabriel's phrase "produce maize" seems a short-hand reference to hybrid maize (as opposed to "local products" i.e. criollo maize) thereby reinforcing a default centrality of hybrid varieties, capital-intensive production, and centralized industrial processing. This raises but fails to address the question of why this kind of production is deemed inevitable and essential for Mexico's food system.

> possible a secure market for continuing to export and sell in major ports like Acapulco, Puerto Escondido, Veracruz? The tlayuda arrives, the tostada arrives.
>
> The farmers told me [that] they don't sell it [maize for tlayudas]. Well, where does it come from? [Farmers:] The intermediaries sell it.
>
> They [farmers] do not sell it, but where does it come from? The [local] intermediaries do not sell it. So, I followed the trail of clues [*la pista*] and found some intermediaries who told me: Well, the maize, see what happens is, if I sell the bags that I get from Sinaloa, no one buys them. So, I took that same maize and put it in the bags of the [local Oaxaca] region and with that, the farmers buy my maize.
>
> That maize is hybrid maize that they produce in Sinaloa, and it is very good to produce the tlayuda. And so, the farmers, the tlayuda producers, continue making their tlayudas without knowing where the maize is really from.

To summarize: Gabriel participated in a research project on the small-scale artisanal production of tortillas for talyudas in the state of Oaxaca. When a tlayuda maker buys maize, and when her customers buy tlayudas, they are expecting to buy local criollo maize. But maize intermediaries want to sell their cheaper, hybrid maize from Sinaloa. No one in Oaxaca wants that maize, so the intermediaries repackage their wares to misleadingly pass off their Sinaloan hybrid maize as Oaxacan criollo maize.

I am left with many unanswered questions. The tlayudas I've encountered in recent years are exclusively made with white maize – did this precede the bait-and-switch supply chain, or has tlayuda color homogenized as a result of the influx of white Sinaloan hybrid maize? Given that hybrid maize sells for a lower price than criollo maize, who is capturing the price difference? Are intermediaries selling their misleading maize for the criollo price? Or are they making inroads into the Oaxacan maize market by undercutting the criollo price? Who is truly being fooled by this maize? When I think of the difference between tortillas made from criollos and hybrids, even when both are nixtamal and made by hand, there is no comparison in taste and texture, and I am certainly less of an expert than a Oaxacan maize farmer. Are local farmers being displaced by this Sinaloan maize, so that tlayuda producers are becoming more alienated from local criollo maize? Are tlayuda producers knowingly passing along the deception to their unsuspecting customers?

In Oaxaca, the market for criollo maize is markedly different from many other parts of Mexico, given the intensity of the tourist industry demand for specific flavors and ingredients indigenous to the region. In the tianguis of Mexico's rural Central Highland region, the overwhelming majority of those seeking to buy criollo maize, and everyone selling it, is a campesino – even if you don't currently grow criollo maize yourself, you are immersed in a community that has been doing so since time immemorial. In the busy tourist-oriented street markets of Oaxaca, the social relations of maize production become less intelligible. Here, you are not producing and consuming criollo maize because you are campesino, you are seeking out criollo maize because you want to consume *lo campesino* [that which is campesino]. Use value is subverted by exchange value, and criollo maize is supplanted by hybrid maize.

The indigenous-majority state of Oaxaca is internationally renowned for its cultural commodities, which center on indigeneity in all its textile and culinary forms. As Gabriel illustrates, and tourism advertisements proclaim, Oaxaca can be seen as a place of exotic authenticity. If you, cosmopolitan consumer of means, want to taste the world during lunch today, try a tlayuda. If you want a real tlayuda, buy it from Oaxaca. The indigeneity is the commodity here, as much as the tortilla itself.

In September 2017, a featured writer for the website "In the Know Traveler" posted an essay entitled "Oaxaca: It's All About the Tortillas." Next to a photo of herself at the tortilleria closest to her Airbnb (she is behind the counter-service window, where she has joined the proprietor, who she calls a "Mayan woman"[53], for the photo op), the author begins, "I like the art galleries, the black pottery, and the cold beer by the zocolo, but for me, the best part about Oaxaca is the tortillas." She tells us of her relief in "escaping" her job and the "bitter winter" to "the throb of life in Mexico," and her success in exercising her "fledgling Spanish," but the bulk of her essay is devoted to a step-by-step description of walking to, buying, carrying, and eating these tortillas. To close the essay, she writes, "I've had many great Mexican meals in my life, but whenever I have a really good corn tortilla, I'll always remember Oaxaca, where they were perfect."[54] I can't stop wondering whose corn she was eating.

Other researchers corroborate Gabriel's observation of industrially-produced maize from elsewhere being sold as Oaxacan criollo maize. McAfee (2003) found that the Oaxacan farmers she interviewed complained that grain buyers only buy white criollo maize from local farmers, which they then mix with cheap imported white US maize and sell as "local." This is in a region

[53] There are sixteen formally registered indigenous communities in Oaxaca, the largest of which are Zapotec and Mixtec. None of Oaxaca's indigenous groups are "Mayan," a term which encompasses many distinct populations with their own culture and historical identities. Mayan city-states, trade networks, cultural practices, and languages have historically extended from what is now the state of Chiapas, across the Yucatán Peninsula, through Guatemala, El Salvador, Belize, and Western Honduras. This travel blogger is likely making an erroneous assumption about the identity and heritage of the tortilleria proprietor in Oaxaca City.

[54] https://intheknowtraveler.com/oaxaca-its-all-about-the-tortillas/ Last accessed April 3, 2020.

where criollo maize often comes in a wide range of colors, making it challenging and very labor-intensive to produce ears of open-pollinated maize that are purely a single color. (Hybrid seeds are all genetically identical and grown in monocultures on a large scale, so that the genetically identical plants pollinate each other, producing all ears of a single color more automatically). Such deceptive supply-chain management by grain buyers exacerbates the displacement pressure on smallholder farmers and criollo maize, while maintaining just enough cultural infrastructure from which to extract value. Farmers reported to McAfee that they were being offered 30-40% less for their maize from these buyers, a price which would no longer cover their cost of production.

And so, in order to market Oaxacan tlayudas to upscale consumers as a specialty product that is worth extra money in a cheap food regime, subsidized industrially-produced hybrid maize from Sinaloa and transgenic white maize from the United States is mixed with criollo white maize from Oaxacan smallholder farms, labelled as local, and sold to those craving authenticity. It's quite possible that you are eating this counterfeit maize as a tlayuda on the streets of Oaxaca City's historic center, or in a fancy restaurant in Mexico City. With international capitalists involved, you may even find it in New York City. Your local Whole Foods will sell you "heirloom corn tortillas grown in Oaxaca, Mexico" which, if you read the company's autobiography, you might mistake for a postcolonial Holy Grail:

> In 2014, we set out on an earnest search for a corn tortilla with exceptional flavor and integrity. Our quest took us to Oaxaca, Mexico, where we met farmers whose families have been cultivating traditional maize for centuries. It was there that we experienced our first perfect, true tortilla. […] We soon started collaborating with these farming communities while sharing their heirloom corn with top restaurants around the world, and Masienda was born. […] [We] offer the most flavorful, nutritious and real ingredients possible. We believe

> that the best-tasting food is achieved through a relentless support of agricultural biodiversity, sustainability and independent farmers.[55]

We don't know whether these "heirloom" tortillas include bags full of transgenic grain from Iowa. We do know that the maize intermediaries encountered by Gabriel, the grain buyers described in McAfee's interviews, and Masienda's team of award-winning chefs and corporate executives selling Oaxacan tortillas to "top restaurants around the world" are all trafficking in the same fetish.

A capitalist commodity chain is never transparent, even when one kind of maize isn't being deceptively substituted for another. As David Harvey, following Marx, explains, ignorance is necessary for capital to keep flowing smoothly: "The exchange of commodities for money is real enough, yet it conceals our social relationships with others behind a mere thing – the money form itself," (1982: 17). What appears to a consumer (or an economist) as the objective character of a product – say, that tortillas from Oaxaca have an inherent nutritional, cultural, or even ethical superiority – is actually a complex set of social relationships. I will spend much of the following two chapters considering these social relationships, as well as the social meanings of maize, in much greater detail. For now, it is helpful to keep in mind Marx's concept of the "fetishism" of commodities, which he uses to name the problematic relationship between the value of a commodity and its representation in money form. It is fetishism which allows exchange value to uncouple from use value, for price to disconnect from value, and for the consumer not to notice the "qualitative inconsistency" in the products they are buying (*Capital* Vol. 1: 102).

[55] https://www.masienda.com/about Last accessed April 3, 2020.

Consumers paying for expensive tortillas at Whole Foods are told that they are buying, not only the most delicious and nutritious tortillas, but also independence for farmers, and integrity for themselves. No need to investigate working conditions or environmental impacts along their supply chain, when these tortillas come pre-packaged with "relentless support" for agricultural biodiversity and sustainability. Some of this fetish value may trickle down to other specialty markets, where a wider range of consumers will be able to afford the prestige and moral high ground that comes with heirloom maize, because their "Oaxacan" tortillas are actually made with US corn. More people can participate in the exchange of a commodity fetishism. This seems to be what the CEO is, perhaps inadvertently, saying when he vaunts that "The whole reason we're launching Masienda Bodega is to democratize the access to landrace corns."[56] However, many campesinos and workers in Oaxaca disagree that neoliberal consumerism has improved the functioning of democracy.

The public school teachers of Oaxaca's Section 22 of the national teachers' union, Coordinadora Nacional de Trabajadores de la Educación (CNTE)[57], have a tradition of annual strikes, in which they usher in the school year with a protest, demanding better for them and their students than persistent poverty wages, perennially rising school fees, and revanchist neoliberal reforms. In June of 2006, when the teachers set up their camp in Oaxaca City's zocalo, PRI governor Ulises Ruiz responded by sending in the state police. As police tried to evict the teachers' camp using

[56] https://civileats.com/2017/10/27/ancient-corn-is-coming-to-whole-foods-but-remains-out-of-reach-in-mexico/ Last accessed April 3, 2020.
[57] A dissenting union that has split off from the conservative PRI-dominated official national teachers union.

batons, tear gas, and helicopter support, the strike swelled to a popular uprising. A coalition of labor, student, campesino, indigenous, and leftist organizations formed The Popular Assembly of the Peoples of Oaxaca (APPO), and added a new demand to the list: remove the governor from office. The Mexican Constitution states that: "if an executive is incapable of maintaining a state of governability, new elections must be held," and, after APPO members elected a central Coordinating Committee, "Oaxacans set out to prove just how ungovernable they are," (redemma 2009). APPO members occupied state radio, shut down the city, and set up blockades on the roads to Mexico City and the international airport. Schools remained closed. A women's march took over the state-owned television station, startling the rest of Mexico with broadcast programming that was run by women, featuring women, and denouncing the government with detailed allegations of its crimes against its citizens' right to life.[58]

The governor fled. For months, Ruiz "governed" Oaxaca from a hotel room in Mexico City while the numbers of those calling for his removal grew. He responded with violence. Seventeen hundred state police were deployed to clear the streets. APPO members were murdered, kidnapped, disappeared, assaulted, raped. Police and military officers in masks and street clothes started cruising the city streets at night in the back of pickup trucks, shooting their guns. Sometimes they shot in the air. Sometimes they shot at civilians. On October 27, they killed four people, one of whom was a journalist from New York City. International media started paying attention. The US Ambassador to Mexico called for law and order. President Vicente Fox sent federal troops in tanks to "retake the city."[59] Part of the urgency was the need to quell the

[58] https://libcom.org/history/looking-back-oaxaca-rebellion
[59] https://www.nytimes.com/2006/10/30/world/americas/30mexico.html

uprising before President-elect Felipe Calderón's inauguration in December. Many international observers considered the 2006 election to be confirmation of Mexico's ability to move beyond the PRI's seventy-two years of one-party rule – calling it a "consolidation" of democracy in Mexico.[60] Many Mexicans, particularly in the southern states, considered it a blatant fraud. Fox, Calderón, and Ruiz all needed to suppress the latter voice in order to affirm the former. As Wright, quoting Mexican writer and cultural critic, Carlos Monsiváis, puts it: "the Mexican government has committed 'barbaric human rights abuses' in the name of democracy," (Wright 2008: 201).[61]

And, in neoliberal times, democracy means commerce. For months, during the rebellion, Oaxaca City was nearly unrecognizable, and some powerful observers found the loss of commercial opportunity to be more upsetting than the loss of civil rights. International media focused their lamentations on the disruption of tourist activity. In August, the *New York Times* coverage reported their perspective on what was at stake:

> [T]he once jewel-like center of Oaxaca is a mess. Protesters have stolen buses and used pickup trucks to block streets, along with rocks, barbed wire and ropes. Graffiti declaring Mr. Ruiz an assassin defaces most of the buildings. Tents and tarps shelter protesters, who burn tires and garbage at night, keeping an eye out for the police. The city's once-prosperous tourism industry is gasping for air. More than 1,000 hotel workers have been laid off, and tourists have canceled reservations well into 2007. The hotel and motel association estimates that the industry has lost $150 million in the last three months, not to mention the embarrassing cancellation of the *Guelaguetza* cultural festival here.[62]

[60] Consolidating Mexico's Democracy
The 2006 Presidential Campaign in Comparative Perspective
edited by Jorge I. Domínguez, Chappell Lawson, and Alejandro Moreno, Johns Hopkins University Press, 2009.
[61] https://www.jornada.com.mx/2007/01/21/index.php?section=opinion&article=005a1pol
[62] https://www.nytimes.com/2006/08/24/world/americas/24mexico.html

On October 30, as heavily armed federal troops moved into the city, the *Times* quoted relieved business owners, and added its own racialized language to help its readers differentiate the good Oaxaca from the bad:

> As troops advanced, some people came out of their homes to applaud their arrival, and what they hoped was the end of the lawlessness that had taken over Oaxaca. "Thank you for coming to the rescue of our city," said Teófilo Rodríguez, 56, a businessman. Oaxaca, a six-hour drive southeast of Mexico City[63], is known for its colonial charm, with centuries-old architecture and a distinct regional cuisine. But on Sunday it more closely resembled an urban jungle.[64]

In mid-December, the federal troops – having stormed the city, occupied it for weeks, arrested hundreds, and intimidated APPO members into either flight or silence – withdrew and handed a subdued capital back to the governor, who returned to Oaxaca. Those businesses that were able, reopened, and tourists began trickling back. Hundreds of local police were stationed on every block of the tourist zone to ensure that the people of Oaxaca would not disrupt the consumption of it.

Ten years later, the streets of Oaxaca were ablaze again. A militarized landscape had become routine in the decade since the 2006 rebellion, with federal troops periodically joining local and state police in a violent show of force against a teacher's rally or political march (Magana 2011). In June of 2016, photos show a war zone once more: police launching tear gas and shooting at civilians, who are throwing stones and fleeing; cars burning; many of the more than 170 wounded still in hiding, afraid to seek medical attention. [65] Twelve people were reported killed.[66]

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[63] Google Maps says this is a 6 hour drive. However, in a 1960s VW Beetle that needs to be stopped with the hood up every two hours to let the engine cool off, the drive from Mexico City to Oaxaca City, which requires ascending 5,236 meters and descending 5,898 meters, took us over 13 hours.
[64] https://www.nytimes.com/2006/10/30/world/americas/30mexico.html
[65] https://www.citylab.com/equity/2016/06/oaxaca-violence-police-clashes-protesters-violence/489224/
[66] https://nacla.org/news/2016/06/28/life-after-massacre-view-oaxaca

Many of the demonstrators were again from Section 22 of the national teachers' union, this time protesting education reforms, and facing down the military, both imposed on them by PRI-party President Enrique Peña Nieto. This was ten years, almost to the month, after then-Governor Peña Nieto had sent troops into Atenco, and Governor Ruiz had sent troops into Oaxaca City.

However, the 2016 rebellion represents a movement displaced. Fortified (and gentrified) Oaxaca City is no longer the site of contestation. This rebellion took place in the largely indigenous (Mixtec, or Ñuu Savi) town of Asunción Nochixtlán, where federal police had attempted to evict the *tianguis* on market day, when thousands of regional residents visit the town to buy and sell their wares (many of which are the very homegrown ingredients that are then sold, for higher prices to higher-end clientele, in Oaxaca City). Nochixtlán is strategically-located on a major highway between Mexico City and Oaxaca City, and it was town residents who led the blockading of this economic thoroughfare.[67]

As the police and military attacked, they peppered their hail of tear gas and bullets with racial slurs.[68] They mocked Oaxacans as Other and inferior, cursing them to surrender: ''¡Pinches oaxacos, ríndanse!'' They called the demonstrators whores, ''¡Putos huarachudos!'' the obscenity (puto) modified by a derogatory adjective (huarachudo) that means an uncultured, unmannered, indigent Indian. "Huarachudos" comes from the word "huaraches," a Hispanicized version of the Purépecha term kwarachi, which names a pre-Colombian leather sandal that remains popular among rural communities across Mexico (not to mention among the hippie- and

[67] https://nacla.org/news/2016/06/28/life-after-massacre-view-oaxaca
[68] https://www.jornada.com.mx/2016/06/24/politica/005n1pol

hipster-inclined across North and South America). The soldiers shouted at the locals, pointing their guns: ‘‘¡Viejas chapulineras, váyanse a hacer tortillas!’’ Old women! (using a term for a woman who sells fried grasshoppers, a popular snack and quesadilla condiment). Go home and make tortillas!

Some in the state of Oaxaca voiced support for the use of force against the demonstrators in Nochixtlán. “We need to work in peace,” Fabiola Calvo, president of the Consejo del Centro Histórico para Comerciantes (the Merchant Council of the Historical Center), an organization of service providers in the tourist zone of Oaxaca City, told journalist Natalie Delgadillo on June 28, 2016, one week after the police killed as many as twelve civilians. “We are in a very critical situation. We have small businesses. We are in a very deep economic crisis. Businesses are closing, people can no longer pay salaries. It is very important to urge the three branches of government to restore the rule of law.”[69]

When the United Nations Human Rights Council finds that the “militarization of public security”, “extrajudicial killings by security officers”, and “impunity remain serious challenges in Mexico,” (UNHCR 2016)[70], it is worth asking: what does the law protect in Oaxaca? On many of the blocks where local police now stand guard, real estate values increased thirty-fold from 1988 to 2008, and continue to appreciate at rates of 20-25% each year. The 1992 reform of Article 22 of the Constitution, which “has not yet triggered widespread *rural* dispossession,” (Mutersbaugh 2008: 209; emphasis in the original), has proven an effective instrument for

[69] https://www.citylab.com/equity/2016/06/oaxaca-violence-police-clashes-protesters-violence/489224/
[70] the Special Rapporteur’s full follow-up report on Mexico: http://ap.ohchr.org/documents/dpage_e.aspx?si=A/HRC/32/39/Add.2

privatizing urban and coastal land, particularly in areas that appeal to the US and Canadian expatriate markets. As Mutersbaugh (2008: 209) explains:

> The Sam's Club, auto dealerships, shopping malls and Mormon temple arrayed along Oaxaca's airport road, the proliferating trophy homes in the Oaxacan foothills, the new government center rising in Cuilapan, all are built on land previously held by ejidos or indigenous communes, some as recently as the year 2000.

Foreign investors should "act now," says the owner of the real estate firm Real Estate Oaxaca, and "should only consider purchasing privately owned property, which is becoming increasingly available as communal land holdings, or edijal, are converted." Interviewed by a journalist in 2008, a Toronto transplant, who runs a Bed and Breakfast near Oaxaca City's Centro Histórico, notes approvingly that investment in infrastructure had increased dramatically in recent years. "It seems like since the conclusion of the 2006 unrest, government is more intent upon fixing, remodeling, repairing and growing," he observed, "If 2006 didn't put a damper on land and house values, nothing I can anticipate for the future will adversely impact [them]."[71]

"Value," Marx writes, "does not stalk about with a label describing what it is."[72] Rising rents and floods of tourist dollars do more to conceal the state of health of a city than to disclose it, leaving us oblivious to the social meaning of the value being produced. What we cannot see when we buy a delicious tortilla, or read about the robustness of the Oaxacan real estate market, are the social relationships being destroyed in order to create new opportunities for investment. Privatization of land and the influx of speculative capital increase the divide "between rich and poor, between those who live on rents from spiraling housing prices, appropriation of public

[71] http://www.banderasnews.com/0804/re-oaxacare.htm
[72] Karl Marx. Capital Volume One ; Part I: Commodities and Money; Chapter One: Commodities; SECTION 4

property, and tourist-oriented boutiques, and those who must pay those rents, scraping out a living hawking handicrafts, pizza, and often their own bodies," (Mutersbaugh 2008: 208-9). We may think we are supporting, even honoring, Oaxaca's indigenous communities when we visit the capital city and relish the local cuisine. However, as Mutersbaugh explains, we are extorting them:

> Tourists come to purchase indigenous handicrafts, food, and spectacles such as regional dance and *calenda* street processions, largely unmindful of the perverse effect of tourism in fueling sharp increases in housing and living costs and an avaricious appropriation of public spaces to private ends. […] Under these conditions, the working poor who sustain Oaxaca's vital soul find themselves squeezed for cheap labor and pressed to the margins, confronted in their daily struggle to survive by a private opulence built of riches diverted from their commonweal. (Mutersbaugh 2008: 209).

If the poor and marginalized express their grievances and demand redress from the state, they endanger what Mutersbaugh calls "this dynamic of accumulation through privatization." When it became clear, in the summer of 2006, that "the longer the strike, the greater the loss in property values, the state moved aggressively, and violently, to protect privatization. (Mutersbaugh 2008: 205).

This is a pattern of spatial restructuring seen around the world during the late 20th and early 21st centuries. Neil Smith (1996) describes gentrification as a central feature of a neoliberal "policy of revenge" in which the state and private capital mobilize to "retake the urban frontier" from the poor and other marginalized social groups. Under this revanchist logic, the city is transformed from a place that belongs to the people (who claim their right to public space, as well as other political rights), into an investment that must be protected from the people.

The government's grant of impunity and legitimacy to violence – violence against those marked by their ethnicity, gender, class, and resource base – dovetails with its neoliberal polices – policies that have successfully consolidated wealth and power, exacerbating existing inequalities. Anyone who contemplates speaking out or taking to the streets is made well aware of the consequences for doing so. In the aftermath of the 2006 Oaxaca rebellion, Wright (2008: 202) observes:

> That the country did not erupt in protest over the government's use of force is due to numerous factors, such as fear of reprisal and economic exhaustion. It also indicates the success of neoliberal policies in further marginalizing the indigenous communities in Mexico which have long suffered from endemic racism and the worst poverty rates in the country.

Inequality is the kinetic energy of neoliberalism: it keeps increasing as more force is brought to bear and, as long as the whole thing stays in motion, can be put to work when needed. In Mexico, state violence gathers energy across great temporal and spatial distances. Racial hierarchies first set in motion centuries ago are kept in circulation. These days, the world's most privileged classes are flown in to be leveraged against the country's most disenfranchised. Both Oaxaca's market value and the means to enforce it rely on colonial infrastructure that, as Martin (2008: 222), echoing Smith (1996), explains, makes possible vengeful urban policy:

> As individuals attached to the tourist sector will assert, "Oaxaca lives off her image". Indeed, contemporary tourism has reproduced with a vengeance a nostalgic dream of the orders and cultures represented by the lettered city. […] In the colonial romance of the city, furthermore, the wealthy buy continuous access to a certain kind of indigenous cultural presence—most notably in food cultures, artisan production, dance, and music—thereby staking out a clear cultural and social order that consistently gestures towards forms of colonial rule. Alongside this urban colonial dream, the continued absolute negation of, and outright hostility towards, the political, socioeconomic, and cultural realities of the majority of Oaxaca's peoples endure.

Gabriel references this "image" of Oaxaca when he says above that "there is a myth that only with particular types of criollo maize from Oaxaca's Valles Centrales is it possible to make the tlayuda.” He is most directly puncturing the romantic notion that there is something uniquely magical about the maize endemic to Oaxaca. In Gabriel’s usage, a myth is a widely held but false belief. Based on his observations, it is false that good tlayudas can only be made with Oaxacan criollo maize, because he has watched industrially-produced Sonoran hybrid maize be used to produce flavorful tlayudas that sell very well. Setting aside what we know about the deceptive tactics behind this particular commodity chain, the nutritional and environmental differences of criollo and hybrid maize systems, and the impact that the Sonoran maize industry has had on small scale farmers across the country, Gabriel makes a narrowly-conceived but sound point: “This is sometimes a myth, but yes, it is possible to produce maize and look for value-added for local products.” A tortilla is not some pure perfection, crystallized out of ethereal indigeneity. It is a straightforward combination of ingredients, made glorious by skilled hands and, I would argue, the richness imparted by generations of ecological, genetic, and social interactions that tend to make plants tasty. It would not stand to argue, and Gabriel is not arguing, that the kind of maize involved makes no difference in the quality of the tortilla. He is reminding us that agricultural and culinary innovation does not happen in a vacuum. In fact, it never has, as evidenced by the fact that maize farmers in Mexico have been experimenting with and exchanging maize varieties for millennia, and making delicious tortillas all the while.

At the same time, we must map out the travels of this myth that Gabriel mentions, because it organizes a great deal of our political and economic practice. A myth is not a politically neutral misconception. As Wright (2006: 3), following Asad (2003:28), puts it, a myth is “a socially useful lie” that influences social behavior by naturalizing and normalizing hierarchies of power. “In consequence, myths are vehicles for foreclosing discussions of politics as they use fantastic characters and situations that depict hierarchical relationships broadly believed to have bearing on 'real life' without having to explain these relationships," (Wright 2006: 3-4). The myth that Gabriel encounters in Oaxaca has echoes of the myth of the Ecologically Noble Savage,[73] according to which indigenous peoples are inherently harmonious with their environment, conservationists by nature, and thus are morally superior to nonindigenous peoples while simultaneously incompatible with modernity. In context, of course, indigeneity is itself a colonial construction, environmental exploitation is a highly profitable capitalist enterprise, and this myth serves as a powerful tool for deflecting disruptive inquiry.

If the ecologically noble maize is produced by savages, then we won't question the need for an entrepreneur from the United States to manage the tortilla commodity chain, nor share of the profits he keeps. If indigenous people are always, by definition, disappearing, if not extinct already, then those of us descended from settlers can treasure our heirloom tortillas without feeling accountable to the living human beings who grew that maize this season. And, if indigeneity means rare and isolated, then we won't make connections between the "unrest" in Oaxaca and the state-sanctioned racial, gender, and class violence everywhere else.

Moreover, as a myth of global capitalism, indigeneity is structured by inherent contradictions. Following Wright's (2006) analysis of the paradoxes of the myth of the disposable Third World woman, we can parse these contradictions. We hear, on the one hand, how the indigenous Oaxacan produces maize that is unmatched in its flavor and environmental virtue. On the other

[73] Redford 1991 *The Ecologically Noble Savage*; Hames 2007

hand, we hear of these dangerous, threatening masses who turn the charming streets of Oaxaca City into an "urban jungle" and scare the tourists away. One is memorialized on Masienda's website while the other is targeted for eradication. The myth framework explains how indigeneity can produce such value through its own destruction. Tortillas from "indigenous" maize are reified as the human relations – democracy, sustainability, health, culture – currently under siege by the same international market that will sell you the tortillas. If the marginalized don't cooperate, and instead demand actual democracy, watch that same tortilla come shooting back as a racial slur. ''¡Viejas chapulineras, váyanse a hacer tortillas!'' Old women, go make tortillas!

And we are not to find this strange. The myth is a disciplinary device, "patrolling the bounds" of normativity (Wright 2006: 5), just as the police patrol Oaxaca. Any indigenous, rural, or poor people who, despite being defined as disappearing, refuses to accept the conditions of their own displacement, are understood, according to the myth, as abnormal. As Wright explains, the myth summons into existence its normalized subject, "who reaffirms explicit relations of power and hierarchy," (2006: 5). Inside the tourist zone, indigeneity is a precious commodity to be bought and sold. Outside, it is a target for hatred and invective, punctuated by bullets.

If you're talking about maize in modern Mexico and you're not talking about state violence, you're describing only the fetish, and not the social meaning of maize. This, at least, is the framework I find most helpful in piecing together the strange and seemingly paradoxical logics of commodification. But I wanted to understand, as best I could, the framework that Gabriel finds useful. And so, I asked, once again, whether criollos have a place in the Conservation Agriculture program. I mentioned that none of the MasAgro documents I read had mentioned in-situ (on-farm) biodiversity. They emphasized the principle of working with small farmers, and discussed the biodiversity preserved ex-situ in CIMMYT's gene bank, but I didn't see how they connected the two concepts to make room for the farmers who maintain diverse maize varieties on their farms. His response seemed to frame criollo production as auxiliary to the country's primary maize production, a side project for farmers and a reservoir of germplasm for the rest of us:

> I know the topics [included] within MasAgro, but what I want to say, along with the technicians that we are certifying, regarding maize areas where the criollos are producing, if they [the farmers] already are interested and share our concerns, is to try to reproduce the criollo materials, not to lose them. The farmers are growing their capacity here in the hybrids, but we would like to see the farmers continue producing the criollos in a small part of their plot. This is what we are doing today in Oaxaca and in Chiapas. There, the hybrids are entering the flattest parts, closer to the cities, and in the highest parts of the mountains are the criollos, which are acriollado, adapted to the conditions, this is how they [the farmers] continue to produce [criollo varieties].

Gabriel's reply leaves my question largely unanswered, but seems to confirm the larger paradox. Mainstream agricultural support programs do not easily accommodate criollo maize varieties, and the dominant commodity market discourages their production. Nevertheless, they are a precious global heirloom. This seems to place a great burden on those farmers, and the few extension agents and field researchers, who are doing the work to maintain criollo varieties. Who will be held responsible for endangering them?

Family and the Home Farm

I asked Gabriel, as I do every interviewee, if he had any questions for me. He continued with the topic of criollo maize, and asked me:

> What do you think about those farmers in Chalco? Do they want to continue maintaining their traditional[74] agriculture, the cultural management of their maize varieties, or are they thinking it might be preferable to adopt other cultivars, more profitable ones? Or produce a hybrid, giving up their cultural traditions and husks for tamales? What is your impression? What do you think?

I described the vibrant persistence of criollos and many traditional agricultural systems in the farming communities with which I work. I explained that many of these farmers are commercial farmers who, rather than selling into an industrial commodity chain, sell their criollo maize in a regional tianguis, or street market. In these markets, maize is valued differently, and farmers see criollos as the more profitable maize. Gabriel, no doubt familiar with many of the places I describe, encourages my train of thought with a, "yes, yes," and nod of his head.

I say that many of the farmers with whom I've worked are experimenting with new technology, but they don't seem to have a lot of trust in the government or institutions like SAGARPA or private companies. They also don't know much about CIMMYT. Sometimes they work with technicians and engineers from nearby universities (Chapingo or El Colegio Posgraduados), but on tree fruit, not on maize. I tell Gabriel that, this isn't the central focus of my research, but it

[74] Here, Gabriel is using "traditional" in a long-standing usage to mean smaller-scale, less resource intensive, less commercially-oriented, and often criollo-cultivating farmers. (Sweeney et al 2013 even use "traditional" to mean "not commercial," which raises questions about why they don't say "subsistence," is this acknowledging that "commercial" might have a blinkered understanding of what kinds of markets are out there). But MasAgro explicitly uses "traditional" to mean what literature typically calls "conventional" farming, that is, industrial large-scale commodity production that is deemed less sustainable or "conservation" minded…

seems as though for the most vulnerable farmers, those with the fewest resources, it is really important to maintain control over the seed and the market, over relations of sale.

Gabriel interjects: "…relations of production, with their criollos."

I nod and continue, saying that this system of production with criollos seems to be their security against political changes, a form of risk management. Gabriel nods emphatically and says he understands me perfectly:

> Si, entiendo, entiendo perfecto. Yeah, this is what sometimes worries me, no? We have also found [MasAgro] farmers who produced only criollo maize five years ago and did not have much chance to introduce new technologies, and now, when I ask about the advantages MasAgro has given them, these farmers say: no, I only see front, not back, I do not turn around, I do not go back to do what I did. [Gabriel:] And why do not you do it? Why? [Farmers:] Because I am already able to have a better income so that my children go to school. So that I can buy shoes, pants for me, for my wife, for my children. And, before this, the maize that we sowed was only for consumption and we sold little, but we sold it in the stores, to change it for oil, to change it for butter, for beans or for rice. And not now. Now he feels like, as a farmer from the state of Mexico told me: Now, I sell all my maize, and I have resources, to buy my neighbors' beans, one hundred kilos, two hundred kilos. Another type of criollo maize… If I grow a hybrid, then I buy criollo from my neighbors who continue to plant criollo, and at prices that are sometimes lower or more comfortable.

In Gabriel's telling, criollos are the kind of maize grown by those with the fewest options. If possible, a maize farmer will choose to jump on the economic treadmill, to replace his criollo maize with the hybrid maize that industrial buyers want. This farmer can then benefit from the relative disadvantage of his neighbors who presumably could not afford the input capital required to grow hybrids, and therefore who continue selling criollos which, as marginal commodities, can now be bought at a depreciated price. Perhaps sensing the race to the bottom he describes, Gabriel returns to worry:

> So, there are people who do not want to know what they had before. But I'm worried about that, no, because I love the criollo maize culture. But I also know that those who produce criollo maize, if you are a farmer with five hectares, you cannot live producing only six tons [of grain] a year. But if you are a producer with five hectares using the new technology, and that gives you five tons per hectare, you have 25 tons [total], no longer only six or five tons, and you are more profitable. And these tools give you economic solvency with which to invest in new technologies, but also to provide a better standard of living to your family.

Thinking of some young farmers I had met selling criollos in the tianguis, who had come back to Amecameca after working in the United States and Canada for some years, and knowing of recently escalating tensions around the United States' H-2A agricultural migrant worker visa program,[75] I asked Gabriel if he saw many families returning to a campesino life after living in another city or country. He replied:

> Yes, this is true, but they are few, very few, because the ejido land has been sold. There are ejidos that are rented for 10, 15 years. Why? Because the young people, when there was no profitability in a rural life, rented their ejido parcels and moved to the United States. Now, they are returning, but they have nowhere to farm.

Gabriel has four children, who, as of 2012, ranged in age from 26 to 35 years old. I asked him if they worked in agriculture:

> They did, they worked in agriculture. They know a lot about the countryside, about agriculture. However, the oldest works in civil engineering. The other three work for an American company, but in Puebla. The eldest [of these three] is studying automotive mechanics, for diesel. They sell power generators, to Telmex, to Televisa, to the big companies, and they sell to many countries in Central America. They [the generators] all come from Miami to Mexico. In Mexico, they are stored in the offices to be marketed. And, so, the eldest of my kids is a manager, and he is going to continue his coursework in Miami, but he is also going to Ireland. Many [Mexicans] study there, in Ireland. And the other three work here.
>
> So, they are no longer in the field, no longer in agriculture, but, on weekends, Saturdays and Sundays, they are with me. And I love producing, growing things, working on the farm, but sometimes I have to do interviews in far away parts of the country. And, on their vacations, they come with me.

[75] https://www.mcclatchydc.com/news/politics-government/article24729139.html

I asked Gabriel if his children encountered many farmers closer to their ages on these far-flung interviews:

> The past two years, they have been integrating. In 2010, 90% of our farmers were above 55 years old. It was worrying. Because in five years, more elders and less produce. And now, 2011-2012, we have many young farmers. Children of the old farmers who have returned from the United States or the big cities, and are joining agricultural production. This, personally, makes me happy, because I know that someone is going to continue with this agricultural link.

I commiserated, explaining that the farming population in my country continues to get older and older. Gabriel replied:

> I believe it's the same here, for more than 50 years. But here, in the northeast, as in the southeast, there are young people coming back, because they do not have much chance to enter the US. There is a lot of competition in employment, and with many people from Central America as well, from other countries, China, everywhere, and so young people return [to Mexico]. I had a son spend three years in the United States. And then, suddenly, one day, he told me Papa: First year, everything's great, I'm really happy; Second year, I'm no longer doing well; Third year, it would be better for me to return to Mexico. Because right now I work only to get by, the rent is expensive, food is expensive, and so I'd better return to Mexico.
>
> He was in Iowa, and he was in Santa Rita, California. In Iowa, he was on a contract for a seed company, working on crossing maize varieties. In California, he worked for a company that assembled airplane seats. He had a secure job, and earned well, but he decided he was not sorry to leave. [Son:] My wife and my children are in Mexico, and I'm here, sending money to Mexico. What I spend here, I cannot spare, so it would be better to come back.
>
> And he came back and seems much younger since he got back! He lives in Puebla.

We seemed to have arrived at the conclusion of our interview, and so I thanked Gabriel for his generosity and time. I told him what a pleasure it was to talk with such passionate members of the CIMMYT community. Gabriel, professional catalyst that he is, couldn't resist turning a compliment into a teachable moment, and immediately responded:

> Many people have asked me why I have spent so much time with CIMMYT. For this, because my school in agriculture has been the farmers, the researchers of many cultures, many nationalities that are here, and I had the chance to work with them, to talk, learn, share my experiences and they also share with me. So, this is how I got informed. As I say again, I

> am not an economist, nor am I an agronomist, but at this point I think I am more economist, more agronomist than many agronomists! Learning from all of the farmers, I like to listen to them and then give observations to them. I'm never arriving and then telling them things, no. First, I learn from them and then if I have something to give. If I do not have anything, I leave, and I try to ask other colleagues: What can we give as useful information? These are the logistics that I am always applying with farmers. And since you always have the opportunity to go out into the field, to learn, to know, this is for me, it's what I like.

As he has emphasized from the very beginning of our interview, Gabriel is not an agronomist, and he is not an economist, though he is often asked to do the work of both. Existing in this liminal space seems to allow him to see the horizon, maintaining peripheral awareness of the contradictions that remain unreconciled, and keeping his eye on the end game:

> This is what I always tell my wife: I do not build houses, I do not build buildings, but I build the way, I build lives. Through the information that I bring to the experts and, working with them, we build lives. We build farmers that we train so that they are growing and giving a better standard of living to their families. That's what I do.

CHAPTER 4: LILIAN

Lilian was born to a family of agriculturalists and ranchers in the state of Sinaloa, located in northwestern Mexico, bordered by the state of Sonora to the north, and the Gulf of California to the west. She is currently in her 40s and was recently hired as part of the MasAgro expansion. At the time of our interview, she had been working for CIMMYT for one year, as head of the Valles Altos Hub. To describe her job as demanding is an understatement. When not in the field, Lilian can be seen hustling back and forth on CIMMYT's campus from one meeting to the next. She was, however, able to make time for a thirty-minute interview with me. In contrast to Gabriel's expansive storytelling, Lilian's responses to my questions tend to be minimalist and efficient, crystal clear without widening the scope. You can tell immediately that her job requires managing the duties and expectations of not only her team of technicians and office staff, but also collaborating research and extension actors, partnering government agencies, and an array of allied stakeholders in the region.

Joining CIMMYT

I began with my standard initial question: how did you first come to this work? Lilian replied with a swift summary of her current position:

> Here, we are working in Conservation Agriculture, and my principal focus is planning and organizing and executing the actions of Conservation Agriculture and of MasAgro that are taking place here in Valles Altos, which comprises the states of Hidalgo, Tlaxcala, Puebla, the State of Mexico, and D.F.

As Manager of the Valles Altos Hub, Lilian is responsible for overseeing her team members, who operate out of the CIMMYT headquarters office and travel to field sites across the states included in their region. Without editorializing, Lilian moved on to walk me through her formal training:

> I'm a biologist, but I have a Masters and doctoral credits in ecology. I studied in Baja California, and began working in the ocean with marine mammals. I worked with manatees, and then I went to do my Masters, and worked with dolphins. Then I began my doctoral degree, and I had to stop halfway through, but I was working on the genetics of dolphin populations.

I did not press Lilian to elaborate on why she left her doctoral program without finishing the degree, though I did marvel aloud at the opportunity to study marine ecology in such a wondrous place. The Gulf of California lies between the Mexican states of Sinaloa, where Lilian grew up, and Baja California, where she went to school. An alternate title "Sea of Cortés" persists in both English and Spanish. This title – bestowed by sixteenth-century Spanish explorer Francisco de Ulloa, in honor of his patron, conquistador Hernán Cortés – is a vestige of the two centuries during which Spain believed the Baja California peninsula to be an island, and the gulf to be a strait (Solnit 2013; Miller 2018). Failures of colonial interpretation notwithstanding, the gulf is a uniquely biodiverse ecosystem and understandably fascinating to students of ecology, as extolled by an edited volume on the subject:

> One cannot visit the Gulf of California (Sea of Cortez) without recognizing its remarkable and singular nature. […] The accumulation of species diversity since the Gulf's opening ~5.6 million years ago has produced one of the most biologically rich marine regions on earth. […] Its 6,000 *recorded* animal species is [sic] estimated to represent about 70 percent of the *actual* (total) faunal diversity lurking in its rich waters. So productive are the Gulf's waters that about half of Mexico's total fisheries production comes from the region. […] More than 500,000 tons of seafood are taken from the Gulf annually, and this figure does not include the wasted by-catch (which would probably double, triple, or quadruple that tonnage), (Brusca 1973: 1, emphasis in the original).

Lilian smiled warmly at my undisguised awe for her region of study, but did not take the opportunity to go into farther detail, instead moving on to describe what followed after she left her doctoral program:

> Afterwards, I returned to Sinaloa and, as I was unemployed, the Sinaloa state government invited me to work in a livestock operation. At this ranch, I worked with cattle and began teaching this seminar. They taught artificial insemination, and I had to contact local producers of forage. This began my experience with technology transfer and with agriculture.

In moving from Baja California back to Sinaloa, Lilian's work took her from one of the country's most productive bodies of water, to one of its most productive agricultural regions. However, the modes of production differ profoundly. Whereas the marine life in the Gulf is a product of ecological diversity – a harbor for some of the endemic species, species richness, and associated traditional knowledge that make Mexico one of the most "mega-diverse" countries on Earth – the crop harvests in Sinaloa have been accomplished by seeking to eliminate all but a few chosen species from the landscape through a highly controlled, input-intensive model of monocropping. As Eakin et al (2014: 31) explain, "Sinaloa's geography has long been considered ideal for intensive agriculture," with abundant surface water and a sub-humid climate making production possible year-round in the state's coastal plain. Beginning in the 1930s and 40s, public and private investment in hydraulic irrigation infrastructure enabled large-scale vegetable production. By the 1960s, Sinaloan producers of irrigated commodity vegetables had become serious competition for those in the United States. It was not until the 1990s, however, that producers began devoting precious irrigated fields in Sinaloa's central plains to maize production. For most of the twentieth century, maize was a marginal crop in the state, grown primarily for subsistence in rain fed conditions. Then, between 1990 and 1992, the land area planted in commodity white maize nearly doubled, and continued to increase dramatically throughout the 1990s (Eakin et al 2014: 32). As discussed in Gabriel's interview in the previous section of this chapter, Sinaloa has since become a dominant player in Mexico's national maize market, producing nearly a quarter of the country's annual maize supply.

This transformation of Sinaloan agriculture, including the state's new and disproportionate influence on the conditions of commodity maize production nationwide, represents a restructuring of not only what farmers are growing, where, and how, but of the very role of government itself. The 1990s witnessed a transnational movement to redefine the relationship between the public and private sectors and the responsibility of the state to civil society through complex processes of "re-regulation" (Snyder 1999, 2001; Martin 2005; Radcliffe 2005) known as neoliberalization. In Sinaloa, neoliberal reforms directed federal resources to subsidize the infrastructure, fuel, experimental trials, and futures contracts needed for large-scale capital-intensive mechanized maize production.

Eakin et al (2014) sought to understand Sinaloa's shift into maize and its implications through interviews with a wide range of actors in the region, including: officials from state and federal maize programs; representatives of commercial seed and agrichemical companies; agricultural financiers; academics; extension agents and agronomists from both public and private institutions; and individual farmers. The researchers found that particular discourses – of private initiative and innovation at various scales – dominated to such an extent that their interviewees consistently employed them to explain Sinaloa's maize boom. However, these discourses were often in conflict with empirical observations, made by the same interviewees, of how the maize boom had actually taken place:

> While actors in the region narrate the impressive response of growers in terms of opportunity, ingenuity and entrepreneurship, combined with 'perfect' infrastructural and biophysical conditions, the interviewees also provided evidence that the resulting 'neoliberal landscape' has been more engineered by public-sector intervention than by free market forces (Eakin et al 2014: 46-7).

Without an interventionist government pouring public money into infrastructure, and subsidy programs targeting capital-intensive mechanized agriculture (see Appendini 2012), there would not be an irrigated maize sector in Sinaloa today. Maize farmers in the state have consolidated their considerable economic and political leverage, organizing one of the most powerful growers associations in the country with which to lobby the state and federal governments and maintain control of a disproportionate share of public resources. As Eakin et al (2014:45) explain: "Sinaloan maize farmers have benefited in the neoliberal era, in part because they have been active participants in maintaining and cultivating the public sector as a critical buffer and intermediary in their engagement with the markets." One of the most crucial mechanisms for the state's buffering role on behalf of Sinaloan maize growers was a publicly-funded organization known as Fundación Produce:

> In the early 1990s, a prominent farmer and politician in the state recounted how the Fundación Produce (Production Foundation) was established as a liaison between government and growers, and as a means of ensuring that state policy favoured the interests of farmers[76]. Fundación Produce not only proved to be an effective mechanism for research and education for commercial growers, but also became an influential organization in state and federal policy development. Fundación Produce now has branches throughout Mexico, (Eakin et al 2014: 37).

It was this quasi-public organization to which Lilian was eventually recruited, following her return to Sinaloa:

> I was working [with the state government] about two and a half years, and then they invited me to work with the Fundación Produce Sinaloa, which is the coordinator of the northern region of the state, and there I worked, again, managing, and coordinated as well, projects on the transference of technology, and I had three experimental fields, where we validated, principally, the plant materials of maize, safflower, soybeans, and cotton.

[76] Though many involved think of FP as favoring the interests of "farmers," it is designed to favor an exclusive mode of capital-intensive farming, to the primary benefit of investors in this industry, as well as a select set of participating farmers. This extreme unevenness is obscured by discourses of improvement and by conflating the competing interests of different groups of maize farmers.

As Lilian illustrates, one of the key responsibilities of Fundación Produce was to conduct experimental seed trials to assess the strengths of competing seed varieties.[77] Before neoliberal reforms, it was the role of public institutions such as INIFAP to develop seed varieties best suited for particular environments and farmer needs, and to produce these seeds at scale for distribution. Under neoliberalism, the state has largely withdrawn from this role, leaving an opening for private seed companies to sell patented varieties in their stead. Public and non-profit institutions like INIFAP and CIMMYT still do much of the basic research required to develop new breeding technologies, identify promising germplasm, even breed specific lines. These materials are then made freely available to the "public," including private seed companies who can carry the technology the final yard to production at a large enough scale for sale and distribution, or even insert a proprietary gene into the variety. Public institutions also take on labor-intensive work on the back end of seed development. Farmers are rightly skeptical of new varieties and want to see them proofed under local conditions before risking their own livelihood on them. And so, Fundación Produce takes the latest commercial varieties, conducts extensive annual seed trials in Sinaloa, and showcases the results to growers' associations.

These seed trials, though they run on public funds and labor, often help to obscure the role of public institutions in technology development; they highlight crop varieties by brand name, giving sole credit to the company that carried the technology over the finish line. In addition, the trials reinforce a severely narrowed vision of what viable agricultural production can look like. As Eakin et al (2014: 45) note: "[b]y not factoring soil management, irrigation management and nutrient management into the production equation, the seed trials promote an obsession with

[77] Post-Green Revolution, varieties are assessed almost exclusively in terms of yield.

achieving high yields through seed selection and chemical inputs, irrespective of cost and the natural capacity of the resource base." This distortion of assessment science can influence not only the selection of particular seed varieties over others, but also the training of scientists and the shape of their relationships with farmers.

Lilian frames her experience with Fundación Produce as formative:

> And so, this is how I got my start, my experience in agriculture. So, now I have about six years' experience in agriculture.

I didn't question her framing here. Lilian's explanation made good sense thus far: her training in applied biology transitioned from marine ecological conservation to agricultural production as a result of the opportunity to work for the Sinaloa government. And so, I found it jarring when Lilian made an unprompted swerve in her narrative and mentioned that she had, in fact, grown up in a family of agriculturalists. She described her family's operation in Sinaloa:

> We cultivated maize and beans and sorghum. We had irrigation. We also had dairy cows. Now we don't have them anymore; we have a shop that makes cheese, from milk that we buy. And, my brother has about 95 pigs that he feeds with the leftover whey and nopales. We have a little bit of land where we also plant nopales. It's hotter there, in Sinaloa, and the farmers have extension systems that are much bigger than those here [in Valles Altos]. My brother manages my mother's ranch, and my sister is a housewife, she's married and has children.

Here, Lilian doesn't specify the acreage of her family's farm, but clearly describes a substantial operation ranging from bulk grain and legume production to value-added products such as cheese and pork. The *nopales* she mentions are nopal, or Opuntia, cacti, often known as "prickly pear" cactus in the United States. There are approximately one hundred and fourteen known species of nopales endemic to Mexico, and the flat paddles of the cactus are sliced and stewed or pickled as a condiment and side dish across much of the country (FAO 2017). *Nopalitos* can be found sold as a vegetable for human consumption in many Mexican street markets, where a vendor can usually be seen passing the time by cleaning (cutting off the spines) and slicing nopal paddles with expert flicks of her butcher knife. Each step of processing raises the price that she can ask for her nopalitos. In northern Mexico, as commercial livestock production has expanded, farmed nopales (see Chavez-Moreno 2009)[78] have offered an alternative source of animal feed to many producers, including Lilian's family.

Gendered Access to Agricultural Livelihoods

It is worth dwelling for a moment on the significance of the gendered dynamics that emerge from Lilian's descriptions of her family. She states, and leaves as self-explanatory, that her brother took over management of the extended family's ranch, while her sister managed the household of her own immediate family. Such gendered divisions of labor, with their drastically different social valuation and economic compensation, are central to the structure of global capitalism (Wright 2006). The commercialization of agriculture, a foundational feature of global capitalist restructuring, has undermined women's role in farming in countries around the world, often excluding women from managerial positions and from accessing land, credit, or the extension services that support commodity crop production, while simultaneously devaluing women's knowledge and the subsistence, medicinal, and ceremonial crops that women cultivate (Howard 2003).

[78] Farmed nopales are most often of the species Opuntia ficus-indica or Opuntia matudae although the pads of almost all Opuntia species are edible. The other part of the nopal cactus that is edible is the fruit called the tuna in Spanish, and the "prickly pear" in English.

Even where women make substantial and expanding contributions to agriculture, they remain the "invisible farmers," undervalued and overlooked (see Sachs 1983). This paradoxical idea drives dominant assumptions about a woman's place in commercial agricultural operations. It is this paradox that organizes Lilian's description of a farm in Sinaloa, Mexico's epicenter of capitalist agricultural restructuring: she begins in the first person plural – this is a farm where both daughters and sons are interested in agricultural careers, where "we" all helped cultivate maize and care for dairy cows – and she concludes in the masculine singular – "my brother has," "my brother manages."

Though women are systematically disadvantaged by governing institutions, their agency, both within and outside these systems, must not be overlooked if we are to understand how agriculture and development take place, much less if we seek to change their trajectory. Underneath broad patterns of gendered exclusion and devaluation are the complex particulars of everyday lives and decision-making. I can recognize the evidence that men tend to dominate commercial agriculture in Mexico, and around the world (see Chambers and Momsen 2007), while knowing that this doesn't predetermine every aspect of Lilian's relationship to agriculture. Structural inequality shapes the conditions of our daily experiences: it makes some choices more dangerous for us and increases our disproportionate risk. But women have long been doing the majority of farmwork, and doing so under punishing conditions. They have continued to maintain knowledge systems and crop diversity, pursue access to and control over the resources claimed by patriarchy, and collaborate with men even as they face troubling gendered expectations and divisions of labor.

Lilian clearly grew up highly engaged in her agricultural surroundings. She speaks with precision and clarity in describing, not only of the interrelated crop cultivation and animal husbandry of her own family's operation, but of its reliance on Sinaloa's state-funded infrastructure, including, as Lilian points out, one of the largest and most well-funded agricultural extension programs in the country. Her interest in resource management surely informed her pursuit of a Masters degree and PhD in the natural sciences. Though she chooses to leave unstated the nuances of her circumstance and motivation, I know that these institutions – industrial agriculture, graduate school, STEM fields – have long served to marginalize women and their ideas. I can therefore appreciate her academic achievements, which have enabled her to secure management positions on multiple large agricultural projects, while situating them in a context that continues to perpetuate gendered inequality.

I do not have insight into how, why, or to what extent Lilian was excluded from her family's ranch operations when she was growing up and developing her academic and professional interests. However, I take seriously the lived experience that she chose to make explicit in our interview: that, despite being raised by a family of ranchers and farmers in an intensely agricultural region, an upbringing that qualified her brother to eventually take over managing the family farm, it was not until after Lilian left home, secured formal education, and was offered work by her home state's government that she got her "start," her "experience in agriculture."

The seeming contradiction of Lilian's experience fits a pattern of gendered social relations that we will see develop over the course of other interviews in this chapter. Uneven access to professional opportunities, knowledge production, and authority has implications for what development institutions label “women’s empowerment,” which can be more precisely analyzed as gendered power relations at multiple social scales, from the household to the global. Moreover, these power dynamics structure how farming, development, and even knowledge production (about farming and development) take place. When some children, according to their gender, are excluded from participating in and inheriting the family farm, this shapes the future of farming itself. How is this related to the increasing rates of women being trained and certified as agricultural extension officers and researchers in Mexico? What kinds of farming, and crops, are privileged by these extension and research programs? What does this mean for the farming practices, knowledge systems, and crops that are outside the scope of such projects? These questions drive my analysis, throughout this chapter, of gendered social relations and their impact on maize diversity.

Hub Valles Altos

Following the brief mention above of her work for the State of Sinaloa and her family’s farm, Lilian began describing her current work:

> I have been working with CIMMYT for one year. Why the Valles Altos hub? Well, I was invited to work here in CIMMYT, and I took the offer, well, because is it a recognized international center, which brings much greater labor security than other places.

Lilian’s frankness is illuminating here. Her merit of an invitation to work at CIMMYT is not in question, and it is revealing that she chooses to frame the driver of her career change in terms of the conditions of labor. So much of agricultural development tends to be explained in terms of aspirational goals. A development institution hires a bunch of new practitioners. Why? Because we are going to feed a hungry world. Beneath this surface justification, we can see the institutional need to reproduce itself and, under capitalism, expand. We hired a bunch of new people because a multi-billionaire gave us some millions of dollars, in a grant named after him, to build a research wing, also named after him, and to fill it with workers. These are the moral and material catalysts for development interventions.

But, when we focus on the justifications that institutions give for continuing their work, we often fail to consider where the workers themselves are coming from. Why do development, from a worker's perspective? Why, in Lilian's case, move from working to conserve marine biodiversity to producing high-yield commodity crops? Why move from a state program in Sinaloa to a global research institute in Mexico's Central Highlands? The centers of concentrated wealth and power are, sometimes, for some people, relatively more secure places to work. Development is labor-intensive. It could not happen without enlisting armies – some military, some civilian – of human beings to conduct the research, extension work, and outreach that it takes to put policy into practice. And this work must be, directly or indirectly, serving the existential purpose of development institutions: in the words of James Ferguson, "to build a case for why they need more money to do the next project, and why the next project is going to turn out differently from the previous one."[79][80] For this reason, a development worker's individual skills and interests must be understood as serving not only a given development project's internal goals (i.e.

[79]From Antipolitics to Post-Neoliberalism: A Conversation with James Ferguson. Humanity: An International Journal of Human Rights, Humanitarianism, and Development, Volume 5, Number 2, Summer 2014, pp. 247-259 https://muse-jhu-edu.proxy.lib.umich.edu/article/549311/pdf

[80] I'm thinking of development as enclosure here (see Sevilla-Buitrago 2015) In this way, development functions as an enclosure of agricultural space. Farmers are alienated from the farm fields as spaces of communal knowledge and crop production, and those who aren't displaced from farming entirely are rendered subjects of development. Development projects intervene in spaces of production and social reproduction, reorganize social relationships, and commandeer processes of subjectification until we can no longer imagine an alternative.

increasing crop yields), but also the overarching goal of legitimizing the concept of development intervention.

This approach helps make sense of development projects that may seem at first to be set up for failure. When we observe that a development institution has systematically misconstrued a “less-developed” place, or has marshalled resources that are clearly ill-suited to serve the needs of its targeted beneficiaries, we must step back to ask ourselves: what technical work is this development project accomplishing, and what are its effects?

In Lilian’s case, her skills and interests might not, at first, seem to be an obvious fit with the job she was hired to do for MasAgro. She was brought in to manage the Hub Valles Altos Maíz, which encompasses the Central Highland region. (This hub serves the region’s maize farmers, while the Hub Valles Altos Granos Pequeños focuses on a concentration of “small grain” producers who grow wheat and barley in portions of the states of Hidalgo and Tlaxcala.) This hub actually predates the existence of the MasAgro program; the Hub Valles Altos, along with the Hub Pacífico Norte, were first established in 2007 to conduct Conservation Agriculture (CA) trials, which set a precedent for future funding requests and subsequently expanded into MasAgro. The Texcoco CIMMYT campus is located in the Valles Altos region, and some of its most experienced researchers and extension officers managed these first CA trials. None of them were hired to manage the hub once it was part of the MasAgro launch. Lilian has a lifetime of experience working with farmers in Sinaloa – one of the states constituting the Pacífico Norte region – and her most recent work experience involved collaborating closely with the private agricultural services and grower organizations that are now key hub partners and allied stakeholders. Lilian was not hired to work with the Hub Pacífico Norte.

There are many reasons for these seemingly incongruous management hires. Some of them are rooted in chronic dismissal by outside experts of the viability of the kind of peasant economies, smallholder farming, and farmer-bred crop varieties, despite the persistence with which these practices have supported livelihoods and food systems in the Central Highland region for millennia. If one assumes such agricultural heterogeneity is destined to disappear, then there is little need to hire a hub manager who specializes in engaging it. Other reasons stem from the powerful agribusiness interests who benefit from extension models that promote farmer adoption of their products. No matter the official objectives of the development intervention, if public institutions are partnering with private for-profit companies, the latter will pursue their own existential purpose, and there's no profit to be made from communities simply feeding themselves from open source seeds they grow themselves.

But perhaps the most immediate reason for hiring a specialist in large-scale industrialized commodity production to manage a region of small scale peasant producers is also the most banal: a new manager must be able to produce "results," evidence of success and steady progress that will satisfy existing funders as well as solicit future funding. CIMMYT owes annual, quarterly, and even weekly reports on MasAgro initiatives. In the age of MasAgro, Fridays at CIMMYT are frazzled, and, during my fieldwork, I came to assume that I should give up on any interviews I might have scheduled for a Friday. On Fridays, all researchers and extension managers were consumed by meetings, which always ran late, in which they struggled to produce new reports on the progress made during the week. These reports needed to demonstrate growth, above all else – increased numbers of technicians certified, expanded areas of extension, rising rates of technology adoption by farmers. Anything that complicates this growth is undermining the success of the program, and threatening the financial future of CIMMYT itself.

In theory, the job of a hub manager is to foster "agricultural innovation" in a "heterogeneous and changing context" in response to the "different agro-ecological and socio-economic conditions" of a particular region (Camacho-Villa et al 2016). In practice, the job of a hub manager is to facilitate increases in the production of certified technicians, technology-oriented farmers, and commodity crop-yielding acreage. Even, or especially, in a deviant region like Valles Altos, where dominant modes of farming are organized around sustenance rather than capitalist expansion, this is a job for which Lilian is supremely qualified.

As Lilian explains, she was deeply unfamiliar with the Valles Altos region when she was hired to take over management of the Hub Valles Altos. She describes being taken aback at the contrast between farming practices in Valles Altos and those in her home state:

> This region is very different [from the north]. It left a great impact on me, when I first arrived, because the agriculture in Sinaloa is a very technified [tecnificado][81] form of agriculture. It's a high-production form of agriculture. And so, here, the production in zones like D.F. or Tlaxcala, really caught my attention. Here, the parcels of land are very small. There are also some like this in Hidalgo, but to a lesser degree. And, planting still occurs by

[81] I find this is a useful and insightful phrasing here from Lilian, as opposed to the euphemisms we often rely on in English ("modernized"), and the narrow focus of instruments and inputs (mechanized, chemical-intensive). "Technified" captures not only the techniques particular to capitalist agriculture, but also the divisions of labor and professionalization (industrialization) of technical expertise.

> hand, I didn't realize that they still planted by hand. They plant by hand, and with criollo varieties. And so, this was really striking to me, the level of production here, but also the producers here, no? That produce for subsistence. While, in Sinaloa, it's a business for producers.

In the Pacífico Norte region, growers manage an average of 70 hectares of irrigated commodity crops. These farms are highly-mechanized and input intensive, and growers are a highly-organized collective, which enables them to negotiate government subsidies and stable prices in international markets (Camacho-Villa et al 2016). In contrast, the Valles Altos region has an average farm size of less than 5 hectares, the smallest average for any region in the country (INEGI 2000). Unlike in Sinaloa, where practically all maize growers produce for export-oriented commodity maize markets (Eakin et al 2018), the Valles Altos region is highly heterogeneous, with maize farmers growing under both rainfed and irrigated conditions, with varying degrees of technology and input use, for a wide range of household and commercial purposes (Camacho-Villa et al 2016).

Peasant Maize in Neoliberal Times

Here, it is important to engage critically with the language applied to farmers' maize-based livelihoods. Categories that may appear neutral and merely descriptive are politically fraught and a contentious feature of the history of agricultural development in Mexico. Agriculture has been at the heart of political struggle for Mexico's entire history as a colony and a country. Farmer discourses of who they are and what they do have, at times, competed with the state's discursive construction of them and, at other times, complemented state discourse (Hansen and Appendini 1999). Following a revolution waged in the name of a landless population, the Mexican state reemerged in 1919 with a constitutional responsibility to redistribute land. For most of the twentieth century, despite fluctuating economic regimes, this redistributed communal property – *ejidos* – and the peasant communities who lived and worked on it – *campesinos* – provided a framework for negotiating the state's obligation to society. However, in recent decades, the state has leveraged this discursive interdependency against the peasantry, reconstructing their reliance on public resources as a failure to compete in a global market, and reframing peasant livelihoods as nonviable in an era of economic liberalization.

Hansen and Appendini (1993: 86), writing at the dawn of the North American Free Trade Agreement, observed that the previous decade of global neoliberal restructuring and national structural adjustment had yielded important shifts in Mexican institutional discourse:

> [I]t seems that both the state as well as the peasantry were relating to a discourse that underlined the identity of the peasant as an agricultural producer. The state sought to 'modernize' this producer and the peasant sought to retain and negotiate access to public resources that had supported him as such. Both discourses remained within what Kearney (1996)[82] would call a concept of the peasantry constructed within a modernist and dualist perspective with distinctive notions of space and time. The complex and changing identity of the so-called 'peasant' – part-time farmer, wageworker, artisan, merchant, informal urban self-employed and transnational migrant – are constructing new identities within the trends of globalization. What matters here is that these diversities may open up for [sic] new types of social and political associations at the local level, and to the construction of hybrid (peasant) identities that incorporate a variety of the changes that mould people in an agricultural sector under rapid transformation[.]

When peasants are discursively narrowed to agricultural producers, and ranked in a hierarchy of those who produce for a global capitalist market, several new narratives are made possible. The struggles of campesino communities can now be blamed on the inherent "inefficiency" of peasant production, absolving the state of responsibility for redistributing access to resources.

[82] Kearney, M. 1996. *Reconceptualizing the Peasantry: Anthropology in Global Perspective*. Boulder: Westview Press.

The gendered, racial, classed, regional, and indigenous grievances of different campesino communities are more easily deflected when individual producers can each be blamed for failing to exercise “rational” choices in a “free” market. The dynamics of peasant livelihood practices, even peasant crop varieties, can be written off as backwards, as failing to move forward in time, as incompatible with a modernist future. When Lilian looks at the agricultural landscape of central Mexico, where *ejidos* and campesinos have maintained a significant presence, she doesn’t see farmers making complex and carefully reasoned decisions under conditions not of their own choosing. She sees temporal anomaly: “planting still occurs by hand, I didn’t realize that they still planted by hand. They plant by hand, and with criollo varieties.”

While modernist discursive innovations have shifted the normative assumptions about what peasants should be farming and how, they have also interfered profoundly with our reading of what peasant are already doing. A peasant is narrowed to an agricultural producer, and agricultural production is viewed through a capitalist lens. Within this frame, the purpose of farming is to produce commodities for a capitalist market, which presents a challenge when seeking to categorize heterogeneous farmers and their complex social, economic, and ecological relationships to farming.

Peasant farmers, as Hansen and Appendini (1993) explain, have responded to global economic restructuring by cobbling together more and more diverse livelihood practices, so that members of a household who identify as “campesino” may well provide for themselves through a range of work on and off the farm, including some for wages.[83] At the same time, peasant household economies retain a dual economic character that has historically distinguished them from other forms of farming, including more thoroughly capitalist operations. As Ellis (2003: 8) explains: “The peasant unit of production is both a family and an enterprise; it simultaneously engages in both consumption and production.” Peasant farmers grow crops for their use value, in addition to their exchange value, and many sell at least some of their harvest every year.

However, this empirical reality does not fit neatly within the categories that constitute a modernized, capitalist epistemology, wherein peasants are considered obsolete to the point that they regularly go unnamed in scientific studies of agriculture, including in regions dominated by peasant agriculture. Development institutions and researchers find themselves employing language that often obscures how agricultural production is taking place. The FAO, so committed to avoiding the class politics of the peasantry, resorts to lumping together smallholder communities with some of the largest US farming corporations under the concept of “family farming,” (Garner and de la O Campos 2014). Even researchers comfortable with naming smallholder farmers as “peasants” can find that their metrics fail to account for household livelihood structure. Eakin et al (2014 [1]), for example, foreground the heterogeneous, “semi-subsistence” characteristics of Mexican campesinos, and explicitly critique the normative assumptions of capitalist development. But, when it comes time to document which smallholder farmers are producing maize commercially, the researchers categorize farmers, not according to their actual engagement with markets, but according to exogenous expectations of viable scale. Rather than asking “which farmers sell their maize,” they instead ask, “which farmers are

[83] See Cindi Katz 2004 on time-space expansion

producing sufficient maize to participate in markets today," (Eakin et al 2014: 140). Farmers are classified as "sellers" only if their annual harvest was more than 1.25 times a calculated estimate of the kilograms of maize "required" to meet the consumption "needs" of each adult and child in their household (see De Janvry et al 1995). As the researchers acknowledge, this methodology results in classification that systematically erases certain smallholder market practices from the scientific record: "Those households that were selling maize, but producing less than 1.25 times their expected consumption, were thus classified as non-sellers, resulting in the possibility that some households will report selling maize although they do not have a surplus," (Eakin et al 2014 [1]: 140).

This slippage from description to imposition proliferates, often with far less transparency than offered by Eakin et al (2014[1]), across development studies and other scientific fields, as maize producers are automatically defined as "subsistence" farmers if they don't have enough land, or don't grow enough, or don't grow "modern" maize varieties, or participate in markets that aren't considered "formal" enough (see Arslan & Taylor 2009; and more…). These discourses work to discipline us all, especially those who are contracted to realize the project of modernization. When Lilian looks at the maize farmers of Valles Altos, she doesn't recognize a business enterprise, like those she grew up surrounded by in Sinaloa. She doesn't see the multifaceted on- and off-farm livelihood strategies of local households. She doesn't see the dual-economic production of a campesino maize farm. She doesn't see the regional markets where many of these farmers sell large portions of their maize harvest every year (discussed in detail in the following chapter). She sees, and is startled by, the low productivity, the subsistence.

Having highlighted the contrast she sees between Sinaloa and Valles Altos, Lilian turns to describing her active projects in the Valles Altos Hub:

> Right now, in the hub, what we are doing is, principally, the Sustainable Development with the Producer component, another component of MasAgro. It's the transference of technology[84]. And the way in which we transfer technology is through the establishment of platforms where the technology is generated. We are establishing modules with producers where we show the technology to be transferred to the rest of the producers in the region. And, afterwards, we generate the areas of extension.

In translating Lilian's interview, I included a literal translation of the name she used for the MasAgro component. In its Spanish-language publications, CIMMYT refers to this component as *Desarrollo Sustentable con el Productor*, "Sustainable Development with the Producer." In its English-language publications, CIMMYT names this component for the phrase that was supposedly among Norman Borlaug's last words before his death in 2009: Take it to the Farmer.[85]

Take it to the Farmer

In CIMMYT materials promoting MasAgro, the hubs are lauded as "nodes of innovation." In their 2011-2012 annual report, a text box asks "What is a Hub?" and answers:

> It is a system of investigation (Experimental Platform), implementation (Module), and diffusion (Areas of Extension) to improve agricultural practice, in which the producer is the principal promoter, through work with technicians, scientists, universities, private initiatives, businesses, and government officials.

[84] See Camacho-Villa et al 2016 – many in CIMMYT work to envision extension work that fosters heterogeneous and participatory innovation with farmers. Recent publications even argue that this is what MasAgro is accomplishing. However, the hub managers themselves have a different sense of their own role, and the structural demands on them don't allow much room for the messy iterative process described in this 2016 publication.
[85] https://www.cimmyt.org/news/public-policy-and-borlaugs-final-instruction-take-it-to-the-farmer/

In 2012, the year of my interview with Lilian, CIMMYT deployed a few different graphics to illustrate these three primary components of the hub model. At its most simplified, the model is represented by shapes in a fractal diagram. Lilian drew this on my notepad while explaining the different parts of the model to me. She first drew a large circle and labelled it “Experimental Platform.” Medium-sized circles connected to the large one at the center; these are “Modules.” Small circles, in turn, connect to the medium ones, which Lilian labelled “Areas of Extension.” Her drawing mirrors an illustration published in a MasAgro infographic which explains the TTF (Take it to the Farmer) strategy (see Figure 3). Like Lilian’s sketch, the published graphic features the Experimental Platform most prominently, representing it as the largest circle and in the brightest color, with the Module and Extension circles progressively smaller and more faded. In the infographic, the hub is defined as a means of transferring knowledge and technology to producers, and this transfer is represented by numbered arrows: First, knowledge and technology are transferred from Experimental Platform to Module. Second, “leading producers” from the modules promote these technologies out to Areas of Extension. Third, this knowledge and technology is applied to extension areas. Fourth, feedback is transferred from Areas of Extension to Modules, and from Modules to Experimental Platforms. The technologies in question include postharvest techniques, “improved” seed, machinery, and application of agrichemicals.

Most CIMMYT publications and slide presentations that I encountered during this period tended to feature an alternative graphic, one that decenters the Experimental Platform somewhat. Here, the Experimental Platform, Module, and Extension Area circles are the same size, and all three are connected by lines, not arrows, to each other, forming the shape of a peace sign behind them (see Figure 4). The Experimental Platform circle is at the top. The implied the subordinate status of Modules and Extension Areas is reinforced by other aspects of the illustrated diagram.

This diagram – which has undergone subtle revisions in the years since it first appeared, and which remains a staple favorite when explaining MasAgro's Take It to the Farmer Initiative – represents the human actors at work in each "node of innovation" with illustrated human heads. I found this a striking contrast to many of CIMMYT's other illustrated diagrams, not to mention the majority of agronomic textbooks I've encountered, which tend to portray depopulated fields at various stages, with an occasional activity rendered as a field with machinery at work (see Figure 3). The humanized TTF diagram even goes beyond silhouettes to depict faces with particularized facial features. However, the racialized, classed, and gendered logics of the depictions chosen in this case are troubling. The figure of "Investigador" (Researcher), featured only in the Experimental Platform, has a long, narrow, pale pink-white face; neat haircut with tidy part; thick-lensed glasses; and collared lab coat. The figure of "Técnico" (Technician), featured in both the Experimental Platform and Module, has ruddier white skin, a thick square face, close-cropped red-brown hair, an orange trucker hat and a buttoned-up collared shirt. The figure of "Productor" (Producer) is represented by a few different faces, the default of which is has a large round head with noticeably browner skin, the shadow of unshaven beard stubble, shaggy black hair hanging in his eyes, a wide-brimmed hat, and a collarless shirt that leaves his chest exposed. This representation of Productor appears 3 times in this diagram of a hub: Twice in the Area of Extension circle (once very small and once again as the largest face in the entire diagram) and once next to the Técnico in the Module circle. There are two other very small faces in depicted in the Area of Extension: 1) a narrow-faced Productor with a large black mustache, wide-brimmed hat, collared shirt, and brown jacket; and 2) an oval-faced Productor turned to a ¾ view with light skin, drastically long and thin nose and neck, pink lipstick, stylized eyelashes, styled bangs and long black hair gathered into a ponytail with a bright red scrunchie, a hat with an upturned brim that looks to be a Fedora, and a pink shirt with a wide, white scalloped collar. As you may be able to deduce, this last Productor represents a woman. She is, in fact, the only apparent representation of a woman in the diagram; all other figures appear to be emphatically gendered male.

This diagram implies a hierarchy of knowledge production behind the TTF initiative which, combined with the use of racialized and gendered illustrations, reinforces exclusionary ideas of what kind of people can do what kind of agricultural work. Those in positions of authority in this diagram have all the features of white masculinity, with those on the receiving end of the knowledge and technology transfer bearing all the features that, in a racist postcolonial space, are coded as poor and indigenous: darker skin, rounder face, untidy appearance. There are no women depicted among the researchers or agricultural technicians, and there are almost no women depicted among the producers. Almost, and the caricature who was included embodies every hallmark of white femininity the illustrator could conceivably graft onto such a small drawing.

What does it mean, that this visual representation is among the most common introductions that CIMMYT provides to their Take it to the Farmer program? This diagram is featured in pamphlets, journal articles, and slide presentations. TTF is the central component of MasAgro that engages farmers and extension agents directly, and MasAgro is the Mexican government’s flagship investment in rural development and sustainable agriculture. It is not an incidental depiction, nor is the vision it presents inconsequential. Given its distinct prominence, I engage it seriously, as a representation of how the state's agricultural intervention is intended to operate.

This diagram certainly does not invent the racial and gendered dynamics of agricultural research and extension. Dominant degree-granting institutions, scientific research programs, and funding agencies were originally designed to exclude anyone who wasn't white, male, and wealthy, and they continue to afford exclusionary privileges (Shahjahan and Edwards 2021). A farmer participating in CIMMYT's programming is indeed more likely to be resource-poor and lower income than farmers who can pay for private extension services and, in Mexico, as in much of the world, those with the fewest resources are disproportionately communities of color and indigenous.[86] And yet, these illustrated faces are not a neutral reflection of the Mexican agricultural landscape. In a country continuing to struggle with racist hatred and violence, where indigenous activists are killed for exercising their civil rights (Davidson 2019)[87], where authorities are more likely to blame a woman for her own murder if she is working outside the home (Wright 2006), and where peasant communities seeking to retain control of their land continue to face federal tanks and soldiers (FAO 1999)[88], it is not a neutral move by the state to mark people according to their social differences.

[86] CIMMYT's programs are mandated to serve the most marginalized farmers, though they are shifting to a more privatized model of agricultural extension. As my interviewees consistently explain, they also cannot serve the most resource poor and marginalized farmers, but rather have to seek participants with a greater aptitude for risk (and an interest in input-intensive commodity crops?)
[87] https://latinamericareports.com/indigenous-activists-killed-in-guerrero-mexico/1968/
[88] https://fas.org/asmp/library/reports/Chiapas.html

And yet, the modern state, following its own existential logic, governs through the categorization and assessment of bodies.[89] The diagram is more than a product of existing intersectional inequalities and prejudices. It is an instrument of state power. It has agency as it moves through the world, contributing to the reproduction of gendered, racial and classed hierarchies and to the imposition of disciplinary norms. White, male, higher income and wealthier people with formal degrees are normalized as the experts on how agricultural systems should be organized, on how to farm well. Moreover, anyone brown, indigenous, poor, or female who disagrees, who claims the authority to critique MasAgro, who prefers a different agricultural model, is abnormal, deviant, in need of reform. Such established categories exercise normalizing influence over a population by making access to public services and resources, like MasAgro, contingent upon compliance.

The MasAgro Hub diagram makes explicit the normative hierarchies at work in agricultural development interventions, thereby helping us to recognize tensions at play in the everyday decision-making of workers involved in every aspect of the MasAgro project, from scientific research, to agricultural extension, to farming. It should prompt us to consider those farmers who work outside of the hub networks: in what ways might they encounter and be impacted by state disciplinary power? It also allows us to visualize the normative abstractions that those working within the MasAgro program must grapple with on a daily basis. These coercive categories are active even when they are left visually implicit – as in the simplified Hub diagram of circles that Lilian drew in my notebook – or left unspoken.

[89] Foucault, *Discipline and Punish*

Managing Maize Modernization

In the remainder of Lilian's interview, she focuses on the details of her fieldwork as Hub Manager, as well as the work she assigns to her team of agricultural technicians, the majority of whom are female. As I contemplate and unpack her words, I remain aware that she is represented by a vision of agricultural development that has no place for her.

As Lilian describes the Valles Altos hub, she highlights concepts of capitalist modernization, which we have seen before, in Gabriel's interview:

> Here in Valles Altos, we have about seventy-six modules, nine extension platforms, and we're in the process of registering areas of extension. The modules are established with producers who are innovators, with producers who have land parcels in sites that we believe will have an impact. The modules are simply located where we can place them. And, impact, meaning they will impact the adoption of technology. For example, if we establish a module, we know that it's going to impact so many hectares. You want to get as many producers as possible to adopt the technology. And so, this is how we're working here in my hub.

In Lilian's description, we see the resurfacing of a concept that was central to Gabriel's understanding of the normative boundaries of MasAgro: innovation. Both interviews present the circular argument that MasAgro works with innovative farmers, who are known to be innovative through virtue of their participation in MasAgro. However, Lilian articulates additional dimensions to the concept of "innovator". As Hub Manager, perhaps the single most influential enforcer of governing norms in the Valles Altos region, she understands an innovator to be a farmer who will effect the growth in capitalist consumption and production, which, as outlined earlier in this chapter, justifies the entire development intervention. Lilian explains that innovators are producers who will "have an impact," meaning convince new producers, "as many as possible," to adopt the technologies that MasAgro is promoting. Though these technologies include some open-source techniques – such as a harvesting method designed to improve soil conservation, which involves leaving "residue," or unused plant material, in the field as a protective cover layer[90] – most are proprietary. The private companies participating in MasAgro range from local retail seed distributors to vertically-integrated transnational conglomerates selling everything from patented hybrid crop varieties to farming machinery. The hub model establishes its modules by appointing a farmer deemed most likely to recruit the greatest number of fellow farmers to give up their previous way of doing things, and buy the latest products from agricultural companies.

Lilian goes on to describe her hub's collaboration with public and private entities. First, she explains that, under MasAgro, CIMMYT functions as an agricultural development contractor for state governments:

> Our collaborations are one important component of our work. So, we are not collaborating with the state governments. We collaborate with SAGARPA and with their delegations in each state. And so, how you deliver, how you work to bring results, becomes very important. We have signed agreements with the states; the state governor signs with CIMMYT and SAGARPA, and it's a contract of collaboration wherein all the politicians are aligned with MasAgro. This is significant, because then, when there are producers who want to innovate, implement some new technology, like Conservation Agriculture, the government supports them. So, MasAgro is not intended as a substitute for any other program, it is to strengthen

[90] As discussed elsewhere in this dissertation, the stalks, leaves, and husks leftover from harvesting hybrid maize are considered a waste product in industrial production systems. However, in peasant systems centered on criollo maize, these are not byproducts, but rather valuable secondary products that can be used and sold as animal feed and tamale wrappers. Historically, maize farmers in Mexico maintained soil health through minimal tillage, nonchemical fertilizers, and intercropping. To this day, much of the maize farming in Mexico does not comport with the assumptions underlying MasAgro's analysis of the threats and solutions to soil conservation.

> the programs that the government already has in place. MasAgro does not give money to the producer, nor subsidies. MasAgro supports the generation of technology and transfers it to the producer. Basic capacitation, no?

Here, Lilian distinguishes MasAgro from the programs of the 1970s and 1980s, during Mexico's nationalist phase of agricultural development (see summary in Gabriel section), in which subsidies and services were provided directly to small scale producers. She distinguishes MasAgro, as well, from the recent and current programs that offer direct subsidies to the largest farms and to intermediary industries (see summary of Sinaloan agriculture and the tortilla industry in Gabriel section). In Lilian's description, MasAgro's function is to use government funding to support the production and adoption of agricultural technologies. These technologies include: a conservation agriculture approach of zero tillage, residue retention, and crop rotation; "improved" seed varieties; "precision" machinery; methods for post-harvest storage of grains; and market data. While farmers may adopt some of these technologies simply by adjusting their techniques, MasAgro's approach often favors the products sold by private companies and the commodity markets in which private companies buy grain harvests. This is, in part, an outcome of MasAgro's public-private partnership model. Within MasAgro, CIMMYT envisions itself as a liaison between farmers, agribusinesses, and grain buyers. However, most Mexican maize farmers do not farm in a manner compatible with many such inputs, nor do they necessarily produce the kind of maize compatible with global commodity markets. Though reliable national data is currently lacking, previous research suggests that, at the very least, a significant portion, if not a sizeable majority, of Mexican maize farmers produce at a small scale for their own household's consumption and for diverse informal markets[91]. This kind of farming relies on the genetic diversity of *criollo* maize varieties maintained over millennia as a staple source of food, a

[91] de Janvry, Sadoulet, & de Anda, 1995

source of income and livelihood safety net, and a material basis for the religious, culinary, and cultural practices central to daily life across the country[92]. Through MasAgro, CIMMYT and partnering agencies are directing public resources away from most maize farmers, away from the kind of maize farming that nourishes social reproduction, particularly in marginalized communities, and toward capital-intensive maize production. As Lilian explains, “MasAgro does not give money to the producer, nor subsidies. MasAgro supports the generation of technology,” much of which is produced for a profit by companies at various scales, and then MasAgro “transfers [the technology] to the producer.” The program appears to be designed to subsidize private companies that supply and are supplied by the farm, while being careful to avoid providing resources directly to the farmer.

Lilian goes on to detail some of the mechanisms by which MasAgro supports the generation and transfer of technology. She begins by discussing MasAgro’s technician certification program:

> We have a program for the capacitation of technicians. We certify technicians in Conservation Agriculture. Each year, there is a call, a selection process for, principally, agronomic engineers. They are trained over the course of one year. At the end of the year, if they pass their exams and everything, the technicians are certified by CIMMYT. But they are not employees of CIMMYT, so much as employees of government agencies, or other institutions that do extension work or do technology transfer. A technician has the responsibility to establish a module with an innovative producer and provide technical extension within three years.

As discussed in Gabriel’s section, the technician certification program was first launched in 2009 as a pilot program by CIMMYT and Asgrow Seed Company, a Monsanto subsidiary. This initial collaboration integrated the training of Asgrow technicians with field trials to compare the

[92] Bellon, 1996; Bellon & Brush, 1994; Perales, Benz, & Brush, 2005

growth of four hybrid maize varieties provided by Asgrow. This hybrid maize was grown under two different cultivation systems: CIMMYT and Asgrow called the first system "conventional" or "traditional" agriculture, and the second "sustainable" or "conservation" agriculture. Under "conventional" agriculture, the soil is tilled, or plowed, regularly, causing severe disturbance to soil ecology, and the crop residue, or leftover stalks and leaves, is removed, leaving the soil bare after harvest. A "conservation" agriculture approach involves minimal to zero tillage, and the crop residue is left to provide soil cover in between harvests. The soil cover can reduce weed growth, nutrient loss, and soil erosion. CIMMYT researchers found that grain yields were substantially higher in the conservation agricultural plots than in the conventional ones, both under these controlled experiment trials, as well as in comparative trials conducted by local farmers. From these findings, MasAgro states that Conservation Agriculture is a model for "sustainable farming practices" which enable farmers to "increase their productivity, reduce costs and protect the environment."[93]

It is crucial to keep in mind the farming systems that are excluded from this comparison. Both systems in the CIMMYT-Asgrow trial include only Asgrow hybrid seeds (the farmer trials may have included a wider range of seed, though many of these farmers are also advised by Asgrow technicians, whose job requires selling Asgrow products). Both systems are highly capital intensive, involving the use of expensive chemical applications and machinery, in addition to the cost of hybrid seed. Moreover, both systems are monocultures, in which the field is planted exclusively in a single crop (in the case of hybrid seed, each plant is also a genetic identical to

[93] https://globalagriculturalproductivity.org/cimmyts-game-changing-partnership-with-mexican-smallholder-farmers/

the others). Though the conservation agriculture system advocates crop rotation[94] – in which farmers alternate crops in a given field every few planting seasons, planting maize one year, then perhaps soybeans or wheat the next – it tends to remain focused on monocultures. By contrast, Mexican maize farmers have historically grown maize in polycultures. The *milpa* system features, at its most basic, maize planted among beans, squash, and *quelites* (edible greens and herbs), an agroecological combination that maintains soil fertility while minimizing crop loss[95]. Whether planted in poly- or mono-cultures, most Mexican farmers cultivate *criollo* maize varieties, rather than hybrids. This is emphatically the case in the Valles Altos region. According to Mexico's national agricultural research agency, ICAMEX (Instituto de Investigación y Capacitación Agropecuaria, Agrícola y Forestal del Estado de México), seventy percent of the land devoted to maize cultivation in the State of Mexico is planted in criollo maize (de la Cruz 2013).

Why is the Valles Altos Hub – the founding hub of MasAgro, a program subtitled "The Sustainable Modernization of Traditional Agriculture" – defining capital-intensive industrialized commodity maize production as "traditional" and "conventional" agriculture, when the overwhelming majority of maize farmers in the region have never grown maize this way? Why

94 Many MasAgro publications refer to "multicropping" as standard practice in conservation agriculture. This term is defined as growing more than one crop in the same field in one year. Since most regions of Mexico have multiple growing seasons a year, multicropping can be achieved through crop rotation – planting a field in only one crop at a time but alternating crops each season – or through intercropping – planting a field with multiple crops at the same time. Unlike the *milpa* system, in which squash grows in between maize plants and bean vines use the maize stalk as a trellis, industrialized intercropping often features many rows of a single crop, with a small number of rows planted in an alternative crop that serves to deter pests or reduce soil erosion. Industrialized agriculture relies on machinery that cannot function in the irregular heterogeneity of a milpa field. Phillips S.H., Thomas G.W. (1984) Multicropping. In: Phillips R.E., Phillips S.H. (eds) *No-Tillage Agriculture*. Springer, Boston, MA

95 LINARES MAZARI, Edelmira, Robert Bye Boettler, "Las especies subutilizadas de la milpa", Revista Digital Universitaria, 1 de mayo de 2015, Vol. 16, Núm. 5. Disponible en Internet: <http://www.revista.unam.mx/vol.16/num5/art35/index.html> ISSN: 1607-6079.

are its experimental trials not assessing the sustainability of MasAgro's Conservation Agriculture model against the soil health, costs, and (multi-crop) productivity of the diversified criollo maize systems that constitute most of the maize farms in the hub region?

Self-reproduction explains part of MasAgro's trajectory. In a global political economy organized according to the needs of capital, food is defined as a commodity, national food security is measured by total calories produced, and farmer success is measured in grain yield per hectare. For a development institution, these assumptions pave the path of least resistance toward renewed funding.

This is not to say that CIMMYT takes no interest in criollo maize. MasAgro Biodiversidad (Biodiversity) is the component of MasAgro dedicated to research on diverse grain varieties, including maize. Unlike Take it to the Farmer, Biodiversidad does not conduct participatory research with farmers who, in this case, are responsible for maintaining genetically diverse maize varieties. Instead, MasAgro Biodiversidad collects these maize varieties, analyzes their genotypes, and "indentif[ies] new genes of interest for maize breeding programs" [96] with the goal of developing hybrid maize breeding lines that contain the desirable criollo genes.

In the years since the program's launch, MasAgro has expressed occasional interest in the maize diversity being maintained *in situ* around the country, though published articles go to elaborate

[96] https://www.cimmyt.org/projects/masagro-biodiversidad/

measures to emphasize that criollo maize farming is a marginal practice. As part of a collaborative experimental program with milpa farmers in three states where criollo maize is widely cultivated – Oaxaca, Michoacán, and the State of Mexico – government and CIMMYT publications describe criollo maize as a “niche” product, citing national data to claim that criollo maize amounts to a miniscule percentage of total maize yields in the country.[97] Such claims are based on slanted data: maize production for subsistence and informal markets is less likely to be tallied accurately in a government census; and national total yields that combine Sinaloa’s industrial production with smallholder harvests obscure both how dominant criollo maize is in some regions, and how central it is to livelihoods and food systems around the country. However unfounded, framing criollo maize as on the verge of disappearing does serve the broader justification for this small MasAgro side project: “With this joint initiative [between CIMMYT and Mexico’s Ministry of Agriculture and Development], the MasAgro program seeks to revitalize the mipla.” They argue that the productivity of native maize has been lost due to the “persistence of inadequate practices,” that native maize cultivation “is being abandoned,” and that this initiative will “protect native maize,” “rescue the milpa,” and “ultimately maintain the genetic diversity of seeds and cultivated plants.”[98]

Contrary to this narrative, results from case study research finds that the Mexican smallholder sector has not widely abandoned maize farming, and that “these farmers not only persist, but also demonstrate a vitality and dynamism that could represent an opportunity for Mexico’s maize

[97] Secretaría de Agricultura y Desarrollo Rural 2019 https://masagro.mx/es/inicio/41-boletines/boletines-2019/184-maices-nativos-clave-para-erradicar-el-hambre-y-mejorar-la-nutricion-en-el-pais-agricultura-cimmyt
[98] https://masagro.mx/es/inicio/41-boletines/boletines-2019/184-maices-nativos-clave-para-erradicar-el-hambre-y-mejorar-la-nutricion-en-el-pais-agricultura-cimmyt

future," (Eakin et al 2014: 137-8).[99] Genetically diverse maize is being maintained through the dedication and creativity of smallholder producers and peasant communities around the country, despite "several decades of policy designed to eliminate the smallholder producer," (Eakin et al 2014: 137). These policies have dismantled public infrastructure for smallholders, redirected support to large-scale capitalist farming operations, and prioritized economic liberalization for commodity grains.

Though MasAgro's promotional rhetoric initially suggested a commitment to supporting heterogeneous smallholder maize producers (see Eakin et al 2014: 151), the program seems organized in ways that actively contribute to the displacement pressure faced by these farmers. The premise of MasAgro's experimental trials erases the enduring existence, vitality, and value of diverse peasant maize systems. When the program does engage these systems, it frequently distorts the current state of genetically-diverse maize farming and misrepresents the role of government policies and development institutions, which have aggressively discouraged farmer-bred varieties and undermined smallholder production for decades.

One organizational feature of MasAgro that renders viable engagement with heterogeneous maize systems less likely is its public-private partnership model. MasAgro provides support, services, and resources (from teaching and research materials, to maize germplasm) to private seed companies and agribusinesses. In many hub components, much of the decision-making is delegated to certified technicians who, as Lilian explains, work for the agencies with which

[99] Hallie Eakin, Hugo Perales, Kirsten Appendini and Stuart Sweeney 2014 Selling Maize in Mexico: The Persistence of Peasant Farming in an Era of Global Markets *Development and Change* 45(1): 133–155.

MasAgro partners. These technicians – some of whom work for public agencies, though most appear to be employed by private companies – are responsible for recruiting farmers, guiding their farming practices, and recommending technology. Technicians who work for private companies have a clear mandate to promote their brand and sell their products. It is hard to see the incentive for these technicians to engage farmers seeking support for farmer-bred maize varieties and low-input farming systems.

The Valles Altos Hub partners with different agricultural agencies in different states. Lilian's description of different partnering agencies helps to explain how MasAgro's organizational structure functions to homogenize its modules and areas of extension, even in a region as heterogenous as Valles Altos:

> There are a number of agencies. For example, in Puebla, there is COPAC [Consejo Poblano de Agricultura y Conservación]. In the State of Mexico, we work with a lot of farmers in Toluca. In Hidalgo, we have the greatest impact with Monsanto. And part of innovating, aside from Conservation Agriculture, is also handling improved varieties, or hybrids, that can guarantee a better yield. In Hidalgo is where the most modules have seeds from Monsanto. This is not because we at MasAgro are promoting their products, no. This is not our role. But, there are seed companies and Monsanto distributors that are working very hard in order to promote the adoption of these technologies. And, some of the modules with producers that we have in Hidalgo buy Monsanto seeds.

As Gabriel explains in his interview (see pp97-98 in Chapter 3 of this dissertation), MasAgro works with farmers near Toluca, because the city has a high concentration of Asgrow suppliers and technicians. Asgrow is a subsidiary of Monsanto and was the founding private partner of MasAgro. In both the State of Mexico and Hidalgo, MasAgro's role is to facilitate on behalf of Monsanto representatives as they, in Lilian's words, work very hard to promote the adoption, or sale, of their hybrid maize seeds. In a region where the majority of maize farmers, for complex and dynamic reasons, persist in planting criollo maize varieties, MasAgro's private partnerships seem designed to either exclude most farmers, or to displace the farming systems central to regional ecosystems, cultural practices, and livelihoods. As the largest government investment in small(er) scale farming in a generation, MasAgro also appears to serve, in part, as a hefty public subsidy of agribusiness profits.

At least, this is the logic that is most apparent to me. I ask Lilian if she can explain to me, in her own words, what the ultimate objectives of MasAgro are. She responds:

> Look, among the objectives is the establishment of the modules, no? Each year, we establish modules based in the regions where we currently have little impact, and that are based, of course, in the goals. But, we focus primarily in the establishment of platforms and modules here in Valles Altos. This is part of the objectives of MasAgro, in general.

This is a more pragmatic and illuminating answer than I had expected. Rather than the platitudinous list of objectives – solving hunger and poverty and climate change – that adorn MasAgro promotional materials, Lilian answers on the terms by which she manages her hub. From a managerial standpoint, the purpose of the program is to expand the program. The logistics of the program are organized such that her team establishes experimental platforms, which lead partnering technicians to establish modules, which lead "innovative" local farmers to establish areas of extension. Growth for the sake of growth, without end.

As Lilian continues explaining her understanding of MasAgro's objectives, she conveys the degree to which logistical concerns can eclipse concerns for the implications of MasAgro's expansion, and leave little time for critical questions regarding the impact of MasAgro on farmers, farming practices, and maize varieties outside the scope of partnering agencies. For the first, and perhaps only, time in our interview, Lilian's thoughts sound slightly harried, her syntax a bit more prone to revision as she speaks:

> In this hub, we already have enough modules. We could perhaps bring a module to an area where we aren't currently working, but my focus is on the establishment of extension areas, so that, at the end of the story, it is the decision of each producer, because they have seen their neighbor's functional module. My idea is this, to focus more on areas of extension. The platforms are where we generate new technologies, and they must be based at institutions. But they must also be located in the region where the technologies will be applied. Therefore, each platform is different, because each platform will tend, or has to resolve the problems that surround it. So, the platform that we have in Tlaxcala is very different from the one in Puebla, and is very different from the one in UAM Xochimilco. Each one will be very different, because it has to attack the problems there in the region.

Lilian is clearly triangulating ongoing debates within MasAgro over best tactics for expansion in the region, and I wasn't able to read much into her train of thought here. However, her subsequent example of a place-specific agricultural issue was one I recognized immediately:

> Of the states that we have, Hidalgo, is also the state with the most irrigation. The irrigation is with aguas negras [effluent sewage water from Mexico City], and so they have good production, the land performs well, and, yeah, we have great yields. They say they're going to start treating the sewage, but we're waiting to see what they do [laughs].

The State of Hidalgo, like the State of Sinaloa, is the recipient of large-scale, publicly-funded irrigation. However, unlike Sinaloa, Hidalgo's irrigation is not a sophisticated network requested by farmers to bring potable water to their crop fields. Shortly after the 1910 Revolution, as the population of greater Mexico City began to boom, city officials began sending "aguas negras" ("black waters," or untreated sewage) north, over the mountains and out of the valley, through low-tech gravity-operated canals and into the rivers and reservoirs of the semi-arid Mezquital Valley, traditionally inhabited by the indigenous Otomi people.[100] For more than 100 years, the storm runoff, industrial wastewater, and toilet contents for most of the Valley of Mexico's

[100] Blackwell, Rebecca. April 25, 2017. "Wastewater Farming to Cease in Hidalgo: Local Farmers Fear New Water Treatment Plant Will Kill Wastewater Farming." https://www.eluniversal.com.mx/articulo/english/2017/04/25/wastewater-farming-cease-hidalgo

twenty-one million inhabitants[101] has been applied directly to more than 90,000 hectares in the State of Hidalgo, bringing with it innumerable health hazards and a publicly funded source of fertilizer-rich irrigation.[102] In collaboration with MasAgro, Mezquital farmers were growing commodity maize and oats and seeing record grain yields.[103]

As of my interview with Lilian, Mexican authorities who had pledged that construction of a massive water treatment plant would be completed before 2012, had awarded a 900 million USD contract to a consortium led by the Spanish company ACCIONA Agua and revised their assessments; they now promised the plant would be up and running by 2015.[104] In 2017, ACCIONA Agua opened Atotonilco, claiming it to be the largest waste water treatment plant in the world.[105] Also in 2017, ACCIONA Agua was awarded the DuPont Water Company of the Year Award for "the most significant contribution to the development of the international water sector." In the words of the awards committee: "no one did more [than ACCIONA] to promote the case for private water last year."[106] Mezquital farmers have expressed concerns that they will be unable to afford payments for the newly treated and privatized irrigation water, in addition to chemical fertilizer to replace the wastewater nutrients they will now no longer receive.[107] MasAgro-certified technicians working in Hidalgo have seized on this moment of transition as an opportunity to expand their farmer networks and promote Conservation Agriculture practices.

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[101] "The World's Cities in 2016". United Nations. 2016. p. 11.
[102] Romero-Alvarez, H.:The Mezquital Valley, Mexico, in:UNESCO, WHO, UNEP: Helmer, P.; Hespanhol, I. (Editors):Water Pollution Control: A Guide to the Use of Water Quality Management Principles, May 2003
[103] https://www.cimmyt.org/news/aguas-negras-an-agricultural-revolutions-buds-in-mexico/
[104] https://janetjarman.com/portfolio/view/aguas-negras
[105] https://www.acciona-agua.com/pressroom/in-depth/2018/july/atotonilco-wwtp-m%C3%A9xico-the-world-s-largest-wastewater-treatment-plant-celebrates-its-first-year-in-operation/
[106]https://globalwaterawards.com/water-company-of-the-year-2017/
[107] https://www.eluniversal.com.mx/articulo/english/2017/04/25/wastewater-farming-cease-hidalgo

Near the time of my interview with Lilian, CIMMYT was interviewing technicians working in Hidalgo to promote MasAgro's recent expansion in the region:

> According to Fermín Hernández Méndez, a graduate of CIMMYT's conservation agriculture-certification course and a technician with the Mexican subsidiary of Monsanto, ASGROW seed company, […] "In Hidalgo, conservation agriculture is a revolution," said Hernández, "Farmers are adopting the practice because they know that a change is coming – a change that is most likely going to strain their soils."[108]

The restructuring of maize production in Hidalgo since 2012 is simultaneously two interdependent and conflicting stories: the first, a tale of cleaning up toxic water, bringing extension services to poor farmers, and promoting soil conservation; the second, a plan by some of the largest corporations in the world, in coordination with the Mexican government, to devote public resources to the privatization of water, fertilizer, and agricultural extension services. These two stories contradict one another. Both projects employ some of the same people, people who are well-intentioned and good at their jobs. This is how development happens.

I asked Lilian how the Valles Altos Hub gained new producer participants. She clarified that she and her team did not establish modules and extension areas directly:

> The certified technicians contact producers, CIMMYT does not establish modules, they are independent. Rather, the established modules are based in the technician who is certified by CIMMYT. In order to be certified, one has to establish a module with a producer. The selection of a producer is done by the technician. We could not have modules without certified technicians, because CIMMYT cannot provide technical assistance. We can't, we don't have sufficient personnel to provide it.

[108] https://www.cimmyt.org/news/aguas-negras-an-agricultural-revolutions-buds-in-mexico/

Certified technicians are responsible for recruiting the farmers they see as most the most desirable consumers for their employing agency. As Lilian continued explaining, this tends to exclude large categories of farmers:

> It's much more difficult to work with smallholders or with producers who are very poor. But this is what MasAgro focuses on. It's complicated, because, if many habits need to be changed, many technicians even have to have special machinery adapted to the system. So, there is a barrier to this kind of change, no? These farmers have some thirty years using one method, and they're not going to change because, [adopts the voice of a farmer] "Well, my father did it this way, my grandfather did it this way. Now, how we manage is fine." They have to modernize.

Here we see an emphatic version of the assumptions that underlie agricultural modernization: if farmers are excluded from development interventions to "improve" agriculture, they are to blame for failing to improve themselves. What Lilian describes as "complicated" is the incompatibility of CIMMYT's mandate to serve the most resource-poor and marginalized farmers, and its obligation to reinforce capitalist agricultural systems that offer no place to such farmers. Unable to resolve such a deep contradiction, Lilian displaces it by focusing on the presumed close-mindedness of poor farmers:

> [Modernization is] to update yourself. Before, you had a telephone like this [gestures in the shape of a huge antique dial phone], and now you've modernized yourself, you have one with buttons or a touchscreen, no? This is modernization. In this case, it is about technology. The traditional way is fine, we just have to modernize it. You have to see the way that will cost less, have greater yields, and, well, seize the technology.

If technology is benign, new technology inherently better than that which existed previously, and modernization inevitable, then development institutions are not responsible for their role in shaping the trajectory of agricultural change, let alone responsible for any negative impacts to the vulnerable populations they seek to serve.

Lilian, knowing my particular interest in criollo maize systems, extends her argument to the case of farmers who grow these maize varieties:

> This [conservation agriculture] system is for everyone. Those who plant criollos, if they don't want to change, the idea is that they adopt a variety that produces better and more stable yields. It's complicated to get stable yields. For the producer who refuses to make this change of seed type, what we are trying to do, as well, is the selection of his seed; in a given parcel, there are stubby plants, there are tall plants with big ears, or tiny ears, and he will select the seed to try to achieve more standardization in cultivation, so as to have plants more or less of the same size and be more productive. The idea is to improve the plant material that one has.

In this somewhat tortured passage, I see Lilian genuinely grappling with the implications for criollo maize farmers of MasAgro's hybrid maize-centered model of agriculture. Her training has exclusively centered on modes of agricultural production in which grain yields per hectare are the absolute highest priority. The Conservation Agriculture goals of soil conservation and cost reduction are all secondary, they are simply means to the ultimate end of reliably increasing yields. Nowhere in modernization theory is the consideration that some farmers may have a different set of priorities, or that different agricultural systems might produce benefits and value beyond grain tonnage per unit of land. If farmers resist the path to which MasAgro is committed, it must be because these farmers simply don't want to change. If farmers express different ideas about what a "better" maize variety is, if they have different priorities, then they are refusing to improve.

Managing Everyday Life

As we neared the end of our interview time, I asked Lilian if she could help me better understand her daily routine. She obliged, providing some details of the workload she encounters every day:

> Normally, I arrive in the office, check my messages, head out, and typically I have a lot of meetings. Meetings with government officials, meetings with producers, or meetings with my own team to systematize the tracking of the modules, no? We make forms to document the history of each module. So, I arrive at eight in the morning, and get done at who knows what hour [laughs]. Normally, I get done around six at night. Normally, this is what we do, no? The expenses, the outputs from the guys, we program tomorrow's activities, make sure they've finished the previous program, and then, well, you go out to the fields, where we evaluate the parcels that we have within the certification program, and we do a routine monitoring of what the engineers do each week.

In Lilian's everyday lived experience, we catch a glimpse of the livelihood pressures on those working within development institutions. Most scientific attention is paid to the livelihood pressures of those who are intended beneficiaries of development interventions: the farmers who bear most of the economic risks of food production and must juggle the costs of production with their household needs and the social meanings of maize. Scant attention is typically paid to development workers themselves: what decisions do they navigate on a daily basis, and how do these decisions shape development itself?

From Lilian's description, it seems as though each and every work day is a gauntlet of assessments. She and her team must track the progress of each hub component; improve this tracking process by "systemizing" it; meet with producers to demonstrate the progress they can achieve through MasAgro; document that this progress justifies program expenses; meet with government officials to demonstrate that MasAgro's progress is worthy of further funding; plan the next stage of progress and progress-monitoring; and do it all again the next day. This is not a schedule that allows for much critical thinking or reconsideration of the current trajectory.

As my final question to Lilian, I broached a subject about which I was very keen to hear her thoughts, though I wasn't sure whether she'd be keen to share them. I asked her how gender affected her work as manager of the Valles Altos Hub. Lilian replied:

> The majority of producers are men. Though, it's not a question of work, because almost everyone on my team is a woman. The engineers are [women], who spend all their time in the fields. At first, this was difficult, because they [the producers] didn't accept them. And they [the female engineers] are young, as well. These two factors work against them: youth and gender, no? But, fortunately, they are very capable engineers, and they have demonstrated to the producers that they know how to work as well as a man. So, it's very funny, now they [the farmers] talk about and look for the female engineers: "I'd like you to send me [Victoria] to help me with this". So, yes, it takes a lot of work, but once you've proven yourself, now it's very easy.

When Lilian states "it's not a question of work," I believe she was responding to how I framed my question to her. I think she was arguing that the work of her team would proceed regardless of the given gender dynamics, since her team comprised almost exclusively women. Farmers in the hub region had no option but to work with the female engineers. As Lilian breezily references how difficult it was to try to serve farmers who couldn't accept expertise from a woman, I couldn't stop thinking back to the MasAgro Hub diagram with its gendered caricatured humans. There is no room for a woman researcher, manager, or engineer in this diagram.

In our interview, Lilian doesn't take the time to consider why female engineers are seen as unacceptable, as abnormal. She is quite convincing when she claims that "it's very easy" to exist as a woman in agricultural development, as long as you've "proven yourself" first. She leans back in her chair, at her management desk, having taken one half hour out of a busy day to tell me how well the Valles Altos Hub is running. And tomorrow, she'll come into the office and set about proving herself all over again.

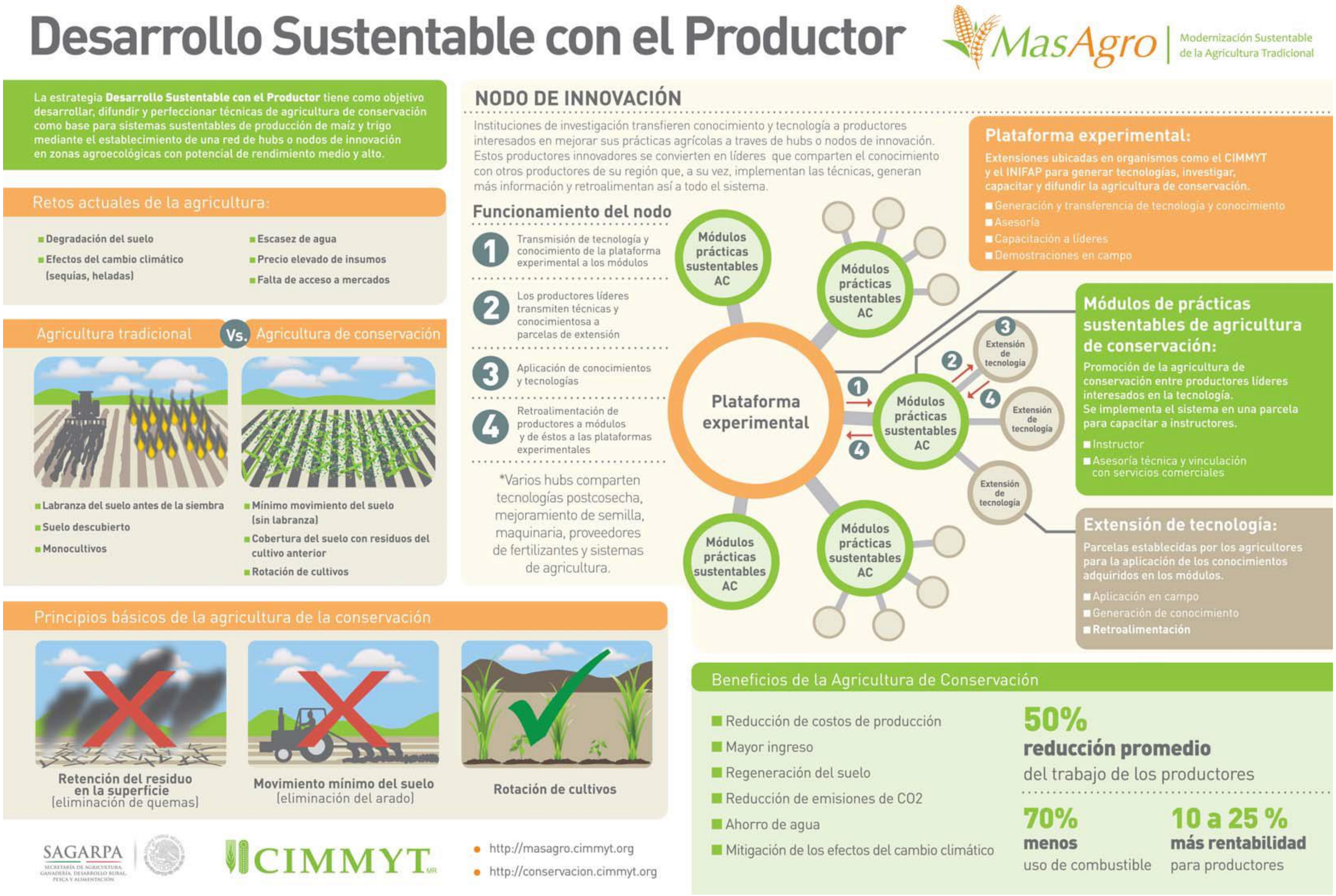

Figure 3: Diagram of the Take it to the Farmer component of MasAgro, 2012

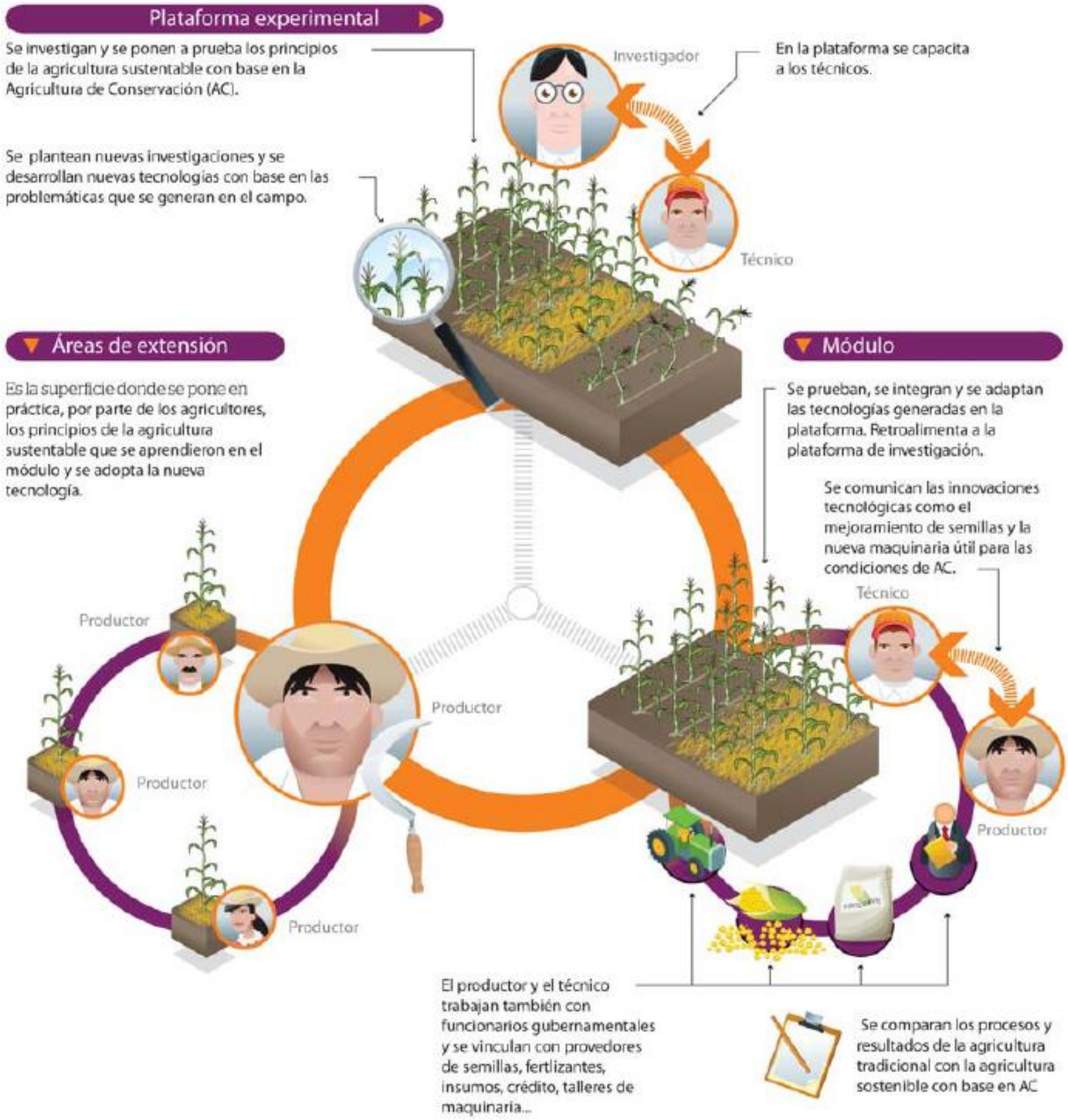

Figure 4: Diagram of Participatory Research Hub Structure, MasAgro 2011-2012 Informe de Actividades, p 24

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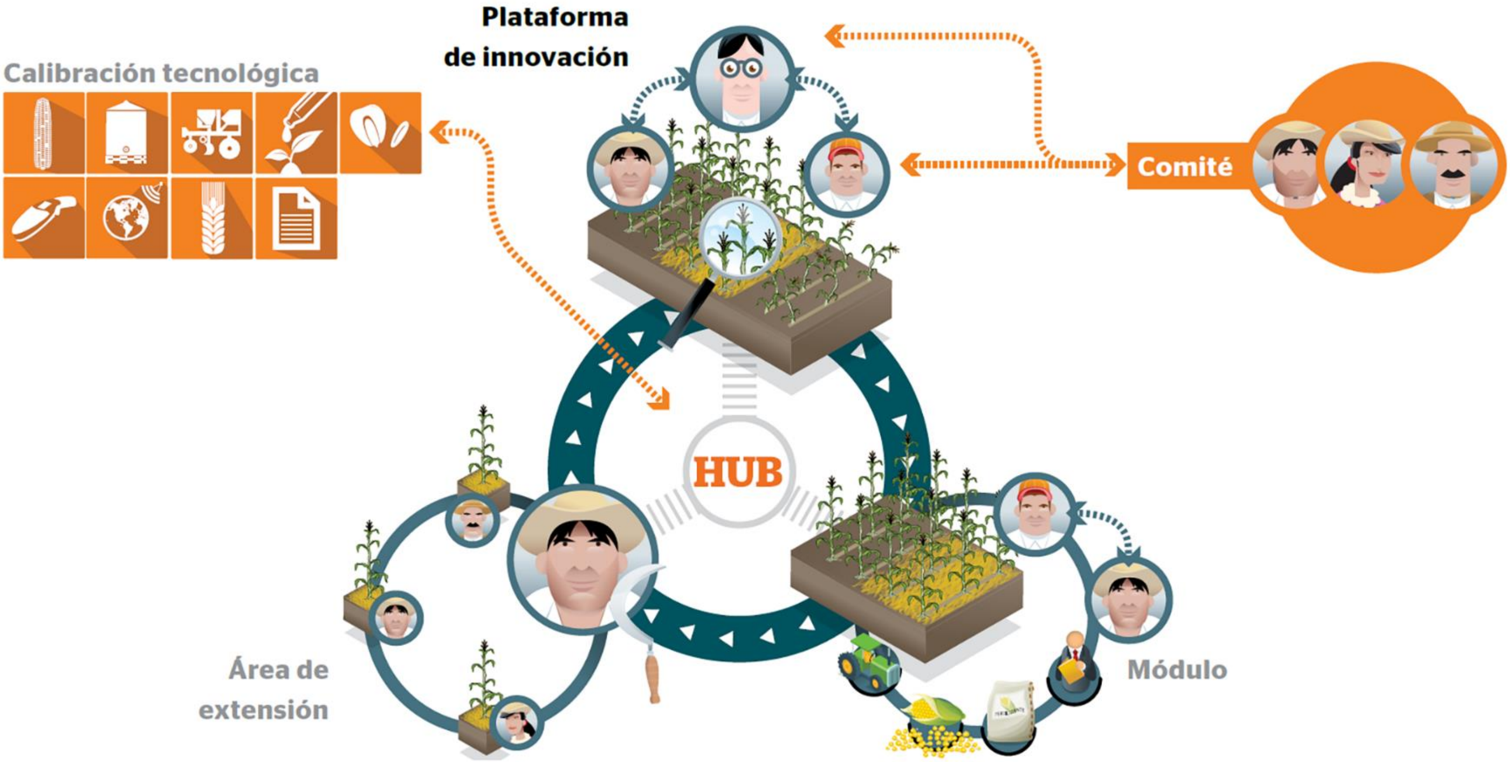

Figure 5: Diagram of Participatory Research Hub Structure, CIMMYT presentation 2015

PART II: THE AMECAMECA VALLEY

Prelude

On that rare early morning when the air is clear enough, you can stand on the CIMMYT campus, outside of the city of Texcoco, and see the Iztaccíhuatl and Popocatepetl volcanoes. With the rising sun behind them, their silhouettes puncture the horizon, marking the southeastern boundary of the vast Basin of Mexico (Figure 1). Popocatepetl (5500 m/18,045 ft) and Iztaccíhuatl (5220 m/17,126 ft) are Mexico's second and third highest peaks, respectively, surpassed only by their neighbor to the east, Pico de Orizaba (5610 m/18,406 ft), also known by its Nahuatl name, Citlaltépetl.[109] All three volcanoes are part of the Trans-Mexican Volcanic Belt, the country's tallest mountain range, which runs latitudinally across central Mexico and forms a roughly 60 mile-wide unique ecoregion of high-altitude valleys and pine-oak forests.[110] Nestled in the western foothills of Popocatepetl and Iztaccíhuatl rests the Valley of Amecameca.[111] During the time of the Aztec Empire – an alliance of three Nahua *altepetl*, or city-states, including that of Texcoco – the Chalco-Amecameca Valley[112] produced the most tribute in the form of food, principally maize, of all tributaries (Shroeder 1991: 32). Moctezuma's list of tributes required three to six times more maize from this province than from any other (Anderson and Barlow 1943). In the centuries since, as the great lakes were drained, the deep friable sedimentary soils of Amecameca continued to yield surpluses of *criollo* maize

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[109] Ferrari, Luca; Esquivel, Teresa; Manea, Vlad; Manea, Marina (2012). "The dynamic history of the Trans-Mexican Volcanic Belt and the Mexico subduction zone". Tectonophysics. 522-523: 122–149.
[110] Nixon, K.C. 1993. El género Quercus en México. In: Ramamoorthy, T.P., Bye, R., Lot, A. & Fa, J. (Eds). Diversidad Biológica de México. Orígenes y Distribución. Instituto de Biología, UNAM. pp. 435-448.
[111] Here, I'm following Perales Rivera's (1998: 56) nomenclature, using the term Amecameca to refer to the portion of the Valley of Chalco under consideration.
[112]My use of the present-day "Valley of Amecameca" corresponds generally to the portions of the Nahua altepetl Chalco that were primarily devoted to surplus agricultural production. The tributary province of Chalco was divided into four sub-altepetl of Tlalmanalco/Tlacochcalco, Amaquemecan, Tenanco Texopalco Tepopolla and Chimalhuacan-Chalco. (Schroeder, Susan.1991. Chimalpahin & the Kingdoms of Chalco. Tucson: University of Arizona Press. P 97)

with which to feed a rapidly growing Mexico City, and Texcoco emerged as the global epicenter of maize modernization. Though the present-day cities of Texcoco and Amecameca are a mere 40 km (25 mi) apart, what connects them to one another, in many ways, are their political and ecological differences. As I learned, over the course of my research here, travelling between the two valleys is complicated by their very interdependency. Not to mention the traffic.

There is no direct route to get from one to the other (Figure 2). Commuting from Amecameca to Texcoco by public transportation requires careful strategic planning. Many of your best options are illegible at first, marked nowhere on the maps and signs, because outsiders are almost never in need of such a route. It may take much trial and error. You will get yourself stranded in six lanes of stopped traffic for more hours than you can count. Take every opportunity to watch and listen to the kind strangers travelling with you. Once they start to appreciate the extent of what you don’t understand, they will teach you.

You’ll learn, slowly, that each different brand of collective vehicle, each different parking spot along the street, even the different methods of picking up passengers – whether the little bus rolls along trolling for passengers or waits in one spot, whether the driver calls to you, honks at you, or sits silently – combines to form a detailed code of precisely where and how they will travel. Many of the buses before you have the same destination banner displayed in their windshield. The code is what you need to differentiate the ones that will easily get you to work on time from the ones that will cause you to miss the work day entirely.

As it turns out, the simplest route to Texcoco from Amecameca[113] begins on a darkened corner of the latter city's central square, two blocks from the main throng of buses. Here, a fleet of white Mercedes Sprinter vans waits quietly as a line of passengers forms. Getting in line between 5:45 am and 5:55 am will minimize your wait while still assuring there are seats available. As soon as there are enough people in line, the first van opens, eleven lucky commuters fill every open seat, the doors close, and you're off. Whereas other buses charge you less if you travel a shorter distance, here your fare is the same no matter your stop. Charging full fare for each passenger means your van can afford to take the fastest route without needing to fill a seat after each passenger disembarks. Full fare in 2012 was fifteen pesos, which was just under one USD at the time.

Since you are trying to get north from the Amecameca Valley to the Texcoco Valley (see Figures 1 and 2), you will have to make a transfer, from the bus headed west into Mexico City, to one headed back east out of the Valley of Mexico. Your stop does not have a formal marking, nor is it officially named. Just before you reach the Mexico City boundary, there is a small collection of candy and magazine vendors gathered in the two-foot space between the highway lane and cement guard rail. You exit the idling van, still in its lane of traffic, and, along with your fellow commuters, hop the guardrail, shimmy down the steep bank, following a well-worn dirt path, hustle behind the loading docks and across the parking lot of a Bodega Aurrera[114] to the shoulder of another highway, where you can catch a bus to Texcoco. Traffic is much slower here so, if you scan the oncoming vehicles and don't see the one you need, you should have time to grab

[113] Provided you can pay a slightly higher fare, and do not need to carry bulky wares with you.
[114] A Walmart subsidiary supermarket.

breakfast from one of the many vendors serving steaming hot food along the sidewalk. The woman third from the corner, under a dark blue tarp, has the richest *chileatole*, brimming with epazote and green chiles.

From there, it's a straight shot on Carretera 136 North to Texcoco, where you can catch your ride to CIMMYT. You should arrive by 8:45 am.

On your trip from Amecameca to Texcoco, travelling on the right side of the road places you on the inside of the loop, making it possible to walk from the first leg to the second quickly and without dangerous road crossings. When travelling from Texcoco to Amecameca, however, you have no such option. Here, the right side of the road places you on the outside of your loop. More than two dozen lanes of high-speed traffic stand between where you exit a ride from Texcoco and where you can catch one towards Amecameca. There are bright yellow public footbridges – pedestrian crossings raised atop three steep flights of stairs – along the highway at regular intervals, but the snarl of highways intersecting here, at the boundary of Mexico City, means that you must scale and descend several footbridges to find the roadside where traffic is headed west toward Amecameca. Once here, you will find that the only *combis* going where you need that pass with any regular frequency are ones that will also spend hours upon hours wiggling through the inner city streets of Chalco and Tlalmanalco before arriving in Amecameca. After some weeks of this, you may begin to consider other options.

Just before my field research began, in 2010, companies contracted by the Mexican government had completed construction of the eastern stretch of the *Circuito Exterior Mexiquense*, an outer loop of toll roads around greater Mexico City. Anyone in a private vehicle willing and able to pay the tolls could now drive from Texcoco to the nearby town of Montecillo and take this *autopista* to Chalco, bypassing Mexico City traffic entirely, before switching to the unrestricted highway toward Amecameca.

Though this stretch of *autopista* was officially listed as completed in 2009, construction of the entrance and exit ramps through which to access the toll road continued well into 2013. For the duration of my fieldwork, from summer of 2010 to the fall of 2012, traffic unlucky enough to be taking the unrestricted highways past Chalco was routed through the middle of the active construction zone. Lanes disappeared, heavy digging equipment loomed, potholes the size of *vochitos*[115] opened up in the bare earth, and buses slowed to a crawl, whipping their passengers back and forth as they navigated the uneven ground.

Eventually, you will find that your best option for public transportation from Texcoco to Amecameca is to take commercial tour buses into Mexico City and back out again. You can take the ADO (Autobuses de Oriente, or Eastern Buses) line from downtown Texcoco to the TAPO (Terminal de Autobuses de Pasajeros de Oriente, or Eastern Passenger Bus Terminal). From there, the Volcanes bus line will take you directly from the TAPO to the downtown Amecameca station. These bus tickets will cost you about two and half USD each.

[115] Classic Volkswagen Beetles

Before you leave the CIMMYT campus, take a look due south. If the morning air is crystal clear, and you can easily see the snow-capped volcanoes, beware. This breathtaking sight is an ominous sign for the air quality to come. It indicates that an atmospheric inversion has formed overnight; a layer of cold air has descended over the Valley of Mexico, and is now trapped there by a layer of warm air above it. As the more than twenty million inhabitants of Greater Mexico City go about their day, the pollution they produce will be trapped under this inversion layer, which acts like a lid on the valley (Thurston 2017). By the time you leave CIMMYT at the end of the work day, visibility will have plummeted. As your bus heads from Texcoco into Mexico City, the air will start to sting your eyes and lungs. If you are asthmatic, as I am, be prepared for breathing to become quite difficult.

Happily, the air quality will improve again as you ascend out of the Valley of Mexico toward Amecameca. Whereas both Texcoco and Mexico City are at about 2,240 meters (7,350 ft) above sea level, the city of Amecameca sits at an altitude of 2,480 m (8,140 ft). You will feel the air grow markedly colder as you leave the Federal District. The urban landscape starts to open up. Dense city streets give way to smaller buildings spread farther apart. More brush appears along the highway. Backyard maize plots grow larger and larger, until full open fields emerge between industrial buildings and residential clusters. As you round a turn outside Tlalmanalco, the incline of the highway increases dramatically, and flat farm fields are replaced by a scrub ecosystem thick with pines and evergreen oaks. Sixty-five percent of the Tlalmanalco municipality is forested.[116] As you emerge from under an overpass and between two wooded hills, the city of Tlalmanalco sprawls down the slope to your left, a field of maize covers the land to your right, and Iztaccíhuatl and Popocatepetl tower on the horizon in front of you. For the next seven kilometers or so, maize fields extend away from the road on both sides until they reach the tree-covered hills to your right and the tree-covered volcanic foothills to your left. From May to October, these fields will be dark green, full of ever-taller stalks of maize. By December, the stalks will have dried to a golden brown and been arranged in conical *mogotes* or shocks that echo the shape of Popocatepetl behind them. During planting season in the spring, you'll see farmers preparing the soil. In my almost-daily commutes on this route, I never once saw a tractor in these particular fields, though I did see farmers tilling their soil with animal-drawn plows – often with a pair of oxen, and once with a single mule.

Suddenly, the agrarian landscape shifts to solid masses of concrete buildings on both sides. The road is now lined by a raised sidewalk with a bright yellow curb. You've reached the city of Amecameca. It is a few blocks' walk from the bus station to the zocalo, or central square, where raised flower beds shape the brick walkways and flowering trees shade the park benches. On the southwest corner of the square, sits the Palacio Municipal de Amecameca de Juarez, or City Hall. Facing the Palacio from across the square, is the red and white-steepled Parroquia de la Asunción, the most photographed of the thirty-some odd churches in central Amecameca. Directly to the east, beneath the Iztaccíhuatl and Popocatepetl skyline, is the covered municipal market, where locals can buy fruits and vegetables, handmade tortillas and tlacoyos, cheeses,

[116] Enciclopedia de los Municipios de México, ESTADO DE MÉXICO, TLALMANALCO. https://web.archive.org/web/20070528124528/http://www.e-local.gob.mx/work/templates/enciclo/mexico/mpios/15103a.htm

dried herbs, and freshly butchered meat seven days a week. Most of these vendors import their wares – tropical fruits from Veracruz, cheeses from Chihuahua, etc – though the woman from whom I bought blue maize tlacoyos every week sources maize from her extended family's production in the municipality.

Every Sunday, the central square converts into a rest stop and attraction for regional tourists on their way back to Mexico City from a weekend in Cuautla and Cuernavaca. This is Amecameca's weekly *tianguis*[117], or municipal street market. Carnival rides are packed into the open space of the zocalo. Vendors squeeze together, selling every snack imaginable, from cotton candy and churros to chicharrones and chile-slathered jicama sticks. The guys with wheelbarrows full of mangos compete with one another to see who can one-handed peel and partition a mango-on-a-stick with a machete the quickest. Whereas on a weekday, sunbathing street dogs are the primary occupants of a given block behind the covered market, on a Sunday, these blocks are clogged with food vendors selling: smoked fish; hot dogs; steamed ham and pineapple pizza, drizzled with mayonnaise and a sweet ketchup sauce; and towers upon towers of candied fruits. Along the main streets, the vendor's stalls feature postcards, toys, scarves, and clothes – everything from Oaxacan-style dresses to bikinis to wool Baja hoodies. In the evening, the tourists leave to finish their drives home, the vendors pack up and leave as well, and the street dogs rummage through the heaps of garbage left behind. On Monday mornings, when I

[117] *Tianguis* is a Hispanicized version of the Nahuatl term for market: *tianquiztli*. The word *tianguis* persists in vernacular Mexican Spanish as a term for an open-air, periodic street market, of the sort that might be called *un mercadillo* in Spain (and urban Mexico) or a kind of "flea market" in the United States. While some *tianguis* in Mexico are newer in origin, many contemporary *tianguis* have been held on the same site since before the sixteenth century (see descriptions of *tianquiztli* in López de Gómara, Francisco (1552/2006). *Historia de la conquista de México*, cap. LXXIX, p.114, México: Porrúa. ISBN 970-07-0721-4).

would walk to the square to catch a 5:45am bus, the city cleaning crews would still be hard at work.

The Amecameca *tianguis* operates according to logics of entertainment. The market opens at a leisurely pace; streets won't truly start to bustle until late in the morning, as traffic from Morelos starts to arrive. Visiting tourists are tempted with varying flavors of exoticness and indulgence. On this afternoon in Central Mexico, we are promised a sampling of somewhere enchantingly far away, though a New Yorker might not recognize what passes for pizza here, and a Zapotec might look askance at the embroidered blouses.

By contrast, there is a different *tianguis* farther south in the Amecameca Valley that is more centered on quotidian diversity, where locals go to buy weekly groceries, and to sell what they grow in their home farms and gardens. To get there from Amecameca City, walk south to where the two-lane highway 115 heads out of town. If it's predawn on a Tuesday, each little combi zooming along will likely have OZUMBA blazoned on a sign in its windshield. You have no fathomable reason to be there at that hour unless you, too, are headed to Ozumba, so one eyebrow twitch from you is all it will take for a combi to pull over and sling the passenger door open. You will squeeze onto a bench seat, slam the door shut, and speed away. Though it is too dark to see them, you will hurtle past tall pine trees, expansive maize fields, a few ecotourism ventures, and an incongruous and perpetually empty German restaurant. If the sun has started to lighten the sky, you may be able to see, on your left, a silhouetted Popocatepetl, the active of the two volcanoes, gently smoking away. Once you reach the Ozumba city limits, you will exit the highway and continue south, down a hill, past the Universidad y Colegio Alzate de Ozumba (a mixed high school and university campus), toward the city center. The *tianguis* extends for many blocks (Figures 3 and 4) but, if you are most interested in the sections for regional produce, grains, and seed exchange, as I am, you'll want to disembark on the very north end of the market scene. Conveniently enough, your combi will have to take a sharp right where the main street becomes blocked with market stalls. All you need to do is pass seven pesos to your driver, and ask: "Me deja en donde da la vuelta, por favor," ("Please drop me off where you take the turn.")

Methods

When I first began reconnaissance work in the Amecameca Valley in 2010, I did not anticipate that my study of maize farmer livelihoods in the region would come to center on a market. In fact, I was entirely ignorant that a maize market the likes of Ozumba played such an important role in my research area. I knew, from the work of Mexican maize ecologists (see Perales Rivera 1998), that this region featured a provocatively strong presence of farmer-bred *criollo* maize varieties. I also knew that many of these farming households relied on the income from selling their *criollo* maize, either to the intermediaries (*coyotes*) who travel from town to town buying the harvests of smallholders, or in various regional markets (Perales Rivera 1998: 126-7). However, as I began introducing myself to field researchers and smallholder farmers in the region, and explaining my interest in maize diversity and farmer networks, more and more people began giving me the same advice: you need to get to Ozumba on market day.

And so I did. I attended the Ozumba *tianguis* almost every Tuesday (the more popular of the two market days) from January through November 2012, and developed it into my primary research hub for maize farmer recruitment. In focusing on the farmers and maize in this market, I do not assume them to provide a representative sample of the maize diversity, networks, or markets in the region more generally. To what degree the dynamics I observed in Ozumba reflect broader agricultural trends is beyond the scope of this research. My hope is that future research builds on this modest market study, and the questions it raises about the social, ecological, and economic diversity of maize in Central Mexico.

As a central site of my fieldwork in the region, the Ozumba *tianguis* serves four important purposes. First, the *tianguis* provided me, as a researcher, access to a wide range of small-scale maize farmers from communities across the Amecameca Valley. Travelling between small towns in this mountainous region requires long bus rides and multiple route connections with unpredictable arrival times. Most of us, myself and my research participants, had sporadic cell phone access at best. Trying to schedule meetings with farmers where they live risked a serious imposition on their time, or a missed opportunity for conversation after much schlepping, or both. By contrast, since farmers were already planning on convening weekly in Ozumba, I was able to observe market practices for hours without interrupting their business, and to coordinate surveys at their convenience. A structured livelihood survey format allowed me to solicit information about farmers' livelihood practices through discreet questions, which could easily be paused if a potential customer approached, and picked up again when the participant's attention was free. The Ozumba market's weekly concentration of farmers made possible more sustained access to a pool of research participants from all eleven municipalities[118] in the Amecameca Valley than would have been possible had I been recruiting them in their home towns.

Second, the *tianguis* offered a window into the complex relationships between farmers and their maize that extend beyond the farm field and the home. Many maize farmers in the region, particularly those invested in *criollo* varieties, are involved in seed selection and exchange, post-harvest processing, sale, and marketing of their maize. The *tianguis*, as a site for such practices, seems to interrupt, in some ways, the social processes that reproduce gendered segregation and divisions of labor in other spaces. Whereas the planting, plowing, weeding, harvesting, and other labor that takes place in the field tend, in this region, to be considered men's work, and the elaborate steps involved in cooking maize in the home are performed almost exclusively by women, the livelihood practices of the Ozumba maize market often involve all members of a farming household working together in the same space. In the *tianguis*, various realms of gendered expertise converge. As discussed in more detail below, this has interesting implications for how authority and power are wielded and by whom. Gender shapes the dynamics of market exchange here, and women's authority in marketing maize, and negotiating terms of sale, itself shapes local and regional understandings of the usefulness and value of maize agrobiodiversity.

[118] Amecameca, Atlautla, Ayapango, Cocotitlán, Ecatzingo, Juchitepec, Ozumba, Temamatla, Tenango del Aire, Tepetlixpa, Tlalmanalco. My definition of the Amecameca Valley corresponds to the State of México's regional divisions, with one exception: under the SECAMPO (formally SEDAGRO) divisions, Valle de Chalco and the city of Chalco are also included under the Amecameca region. I exclude these because these densely urbanized areas are socially and economically distinct in several important ways, in addition to being physically in a distinct high-altitude valley.

Third, this market study contributes to a small, but growing body of research on the livelihood practices of commercially-oriented *criollo* maize farmers in Mexico. Markets for farmer-bred crop varieties remain an understudied area in the literature on in-situ conservation of agrobiodiversity (Keleman and Hellin 2009), and the Ozumba *tianguis* is understudied in the literature on maize diversity in the Amecameca Valley (see Perales 1998), despite being widely known throughout the rural eastern Highlands as a central hub of *criollo* maize exchange (R. Ortega P. and F. Castillo G., personal communication, 2011).[119]

Fourth and finally, the Ozumba *tianguis* case study raises timely questions about what kinds of agricultural practices are possible and desirable. I began this research at the advent of the MasAgro project, which launched in 2011. MasAgro represents the most substantial investment by the Mexican government in national grain production that the country has seen in generations. The program also takes an assertive normative position on the terms of sustainable agriculture amid ongoing international debate, arguing that its model of research, extension, and cultivation will improve environmental conservation, national food security, and the livelihoods of marginalized farmers. Before I began immersive fieldwork, I and others (see Eakin et al 2014) anticipated that the stated goals of MasAgro might make the program's operatives keenly interested in precisely the kind of low-input farming and biodiverse local food networks that currently thrive in the Amecameca Valley. I though it perhaps likely that MasAgro's Conservation Agriculture extension program would reach out to the very maize farmers with whom I was working: commercial producers, yet growing primarily for regional human

[119] Add a sentence about research on "specialty markets" and niche products not studying regional peasant markets?

consumption, and conveniently located just the next valley over from CIMMYT's central campus. I found, instead, that MasAgro was oriented away from the Amecameca Valley and the kinds of farmers and maize that live here. This market study of maize in Ozumba seeks to better understand the range of maize produced for sale in the region, and what role both the maize and the market play in the livelihoods of the farmers responsible for them. This chapter, together with previous chapters on the livelihoods of those who work within MasAgro, speaks to the political and ecological implications of regional trajectories of agricultural change: what does it mean if the modernization being produced in the Texcoco Valley is unsupportive of, or in conflict with, the diversification being produced in the Amecameca Valley?

Following three months of reconnaissance research in the region during the summer of 2010 and winter of 2011, I conducted eleven months of data collection in the Ozumba *tianguis* in 2012. Three different methods were used: a) a representative market survey of all the farmers selling maize in the Ozumba market on a single day in April 2012 that elicited information on the types of maize being sold, where the farmers got the seed they planted, where the maize was grown, and at what price it was being sold; b) 21 structured livelihood surveys with maize farmers, both male and female, often including husband and wife pairs; and c) participant observation, in which maize farmer practices and interactions were documented, while selling their harvest in the market, while working in their fields and gardens, and while working, playing, and resting in their homes.

I first visited the *tianguis* in January of 2012, and attended it almost every week thereafter for the next eleven months. The first few weeks were devoted to walking through each section of the market, getting familiar with its rhythms and organization, buying my groceries, dawdling over each new product, and chatting with vendors. During this time, I met a young woman whom I'll call Sabina[120], who was close to me in age and was deeply curious about my work. She had grown up in the *tianguis*, playing on the sidelines while her mother sold fruit and vegetables from their home garden, and later helping to care for her younger siblings and manage some sales. Sabina became my paid research assistant for the first phase of data collection in the market, which centered on structured market surveys with members of maize farming households who were at the market selling maize. Her intimate knowledge of the *tianguis* and her enthusiasm for the task of conducting the survey were of great value; she was able to introduce me to people who would likely not have been as forthcoming had I, a stranger, approached them on my own. We conducted many structured livelihood surveys in tandem, sitting with farmers in the market as they sold their maize, following a series of twenty-five questions I outlined beforehand (see Appendix). We often took turns asking questions, and I would occasionally repeat an earlier question, with slight rephrasing, later in the survey. The questions that Sabina had in her notebook were the same I had in mine, but the answers she received were often different in subtle ways. Sometimes, she elicited more information, because farmers were more relaxed and talkative with someone they knew. At other times, Sabina's presence seemed to limit the amount of detail in farmers' responses. There appeared to be moments when farmers felt no need to explain something that Sabina would clearly already know, though I might remain wholly ignorant as a result. In addition, Sabina's manner as a

[120] I use pseudonyms for all research participants, in accordance with IRB #38028.

researcher changed over the course of our work together. As she became more confident and familiar with the questions, she became more stern with our participants. She began intervening early in their responses if their thoughts seemed to wander, demanding quick and brief answers to every question. Often this was exactly the opposite of my goals as an ethnographer – I tend to learn the most from answers that come from an unexpected point of view, or ones that revise the premise of the question as I asked it. But I hesitated to correct Sabina, or even to presume that my approach was more "correct." I'm sure her approach was more reliable for making sure we got an answer to every question from every farmer, whereas I was liable to be riveted by whatever our participant said, regardless of whether it answered the question I'd asked. Our work together ended after a few weeks, when Sabina landed a much-coveted job at a shoe store in D.F. and was no longer available to spend every Tuesday exploring Ozumba with me.

As I became increasingly familiar with the *tianguis*, I learned more about the temporal and spatial organization of its maize sector. Unlike many other crops, which are available only during their peak harvest season, maize tends to store quite well and is sold in Ozumba year-round. It does vary significantly in quantity, quality, and price from season to season, but maize remains in demand every month, particularly as grain for household or commercial food production. Moreover, in this market, there are several factors that seem to keep fluctuations in maize prices relatively small throughout the year, which are discussed in more detail in the sections below. It is worth noting that this perception, shared by myself and those who buy and sell maize in the tianguis, is based on close but informal observations. More extensive and rigorous analysis of diverse economic practices in criollo maize markets is beyond the scope of this dissertation, though I hope my research emphasizes the serious need for such future research.

Maize Varieties

Maize varieties were identified according to five types of germplasm – hybrids, recycled hybrids, open-pollinated improved varieties (OPVs), and creolized varieties– following the criteria described by Bellon *et al* (2006). However, only hybrids, recycled hybrids, and landrace varieties were found to be present in the Amecameca Valley. Following local usage, the word *criollo* will hereon be used to refer to landrace varieties, the locally-adapted maize populations resulting from many generations of farmer selection and management.

These locally-adapted, genetically-diverse varieties are known in regional vernacular as *criollos*. *Criollo* translates literally to “creole”, which indicates a product of mixed lineage. There is a heated debate among Mexican maize scholars and those active in Mexico’s many different maize conservation and food sovereignty movements as to whether such maize should be referred to as *criollo* or as “native” maize (Turrent et al 2012).

One important concern in this debate is to confront any imperialist implication that would credit Europeans for this national food staple and reservoir of cultural and biological wealth that was originally domesticated in Mexico. Indeed, the term has direct colonial connotations: *criollo* was an elite racial category in the Spanish colonial caste system, referring to whites of pure (or almost pure) Spanish descent who were born in the colonies.[121] In other words, it referred to a

[121] In the racial hierarchy of the Spanish colonial caste system, c*riollos* were an elite group just beneath the elite European-born *peninsulares*, with more rights and power than mixed-race *mestizos* and *mulatos*, or indigenous and Black African populations (Carrera 2003).

Spaniard raised on Mexican soil. Obviously, this is not the story of origin of *Zea mays* which was domesticated as early as 10,000 years ago from wild teosinte species in central Mexico and the highlands of Guatemala (Jones and Hyps 2008).

However, I argue that the term *criollo* should not be analyzed exclusively according to its colonial usage. The term comes from the Spanish verb *criar* – meaning to breed or raise, or to produce or create – and is used colloquially in Central Mexico to mean "locally raised" or "homegrown." In Mexican street markets, peasant women and men sell *criollo* maize, *criollo* avocados, *criollo* pecans, all of which are their own household variety. In these spaces, *criollo* is an indication of superior quality, because the vendor is staking her personal reputation on the maize seed she is selling.

Criollo is also an expression of a provocative form of indigeneity, and herein lies its political importance. Unlike "native," which would make legitimacy contingent upon the achievement of some pristine historical state, *criollo* aspires to authenticity through grounded intermingling. In the vernacular usage of Mexican *campesinos*, creolization evokes a process of experimentation and diversification in place. It hails a form of value defined, not by racial purity or some fetish of the past, but by adaptation and heterogeneity. Creolization is therefore a process with radical political and economic implications: in an era of heightened volatility and uncertainty, perhaps the most successful risk-management strategies will be ones that decentralize control, rupture established normative categories, and relinquish power across lines of difference, both social and biological.

In this dissertation, I follow the lead of the farmers who breed and cultivate these varieties. Without purporting to resolve important debates about language and representation, I will use the terms provided to me by my participants for the farmer-bred open-pollinated maize varieties present in the Ozumba *tianguis*.

Market Survey

While some local crops, such as homegrown avocados or *chayote*, are sold in lower volumes and scattered throughout the *tianguis*, maize is largely concentrated in a designated five-block section.[122] The spatial distribution of maize vendors remains quite constant during the year as well; each individual, couple, or family has a stretch of sidewalk approximately three meters long that they occupy every Tuesday (the market is also held on Fridays, but this day is much less popular for both vendors and consumers, especially those of perishable goods). As of 2016, each vendor paid the Ozumba municipality two pesos (less than 0.30 USD) per linear meter per market day for the length of sidewalk or street on which they displayed their wares[123]. Almost all of the maize vendors with whom I spoke told me that they typically sell maize in Ozumba all year long, and I did run into the same families each time I attended the market, for the most part,

[122] There are some exceptions: since vendors selling crops from their own fields and garden will include small piles of whatever they have to sell that day, there are occasional small piles of maize for sale elsewhere, just as there are some small piles of other products for sale in the designated maize section.

[123] Some local property owners have pushed the municipality to raise the charge for tianguis vendors. Some of this pushback takes the form of those who work in the formal market expressing contempt for those who work in informal markets https://reporterosenmovimiento.com/2016/02/23/comentario-tianguistas-de-ozumba-afectan-calles-y-negocios-que-si-pagan-impuestos/ In 2016, the Ozumba Municipal President proposed raising the daily charge per linear meter to eight pesos https://reporterosenmovimiento.com/2016/01/26/le-quieren-aumentar-300-el-cobro-de-piso-a-tianguista-de-ozumba/

though there was often fluctuation in which family members were present, depending on their other work and social obligations.

These aspects of spatial and temporal constancy, and the small size of the maize section of the *tianguis*, mean that a limited market survey can potentially yield valuable insight into market characteristics. Following a much-simplified version of established methods for surveying the ethnobotany of markets (Cunningham 2001), I conducted a single survey of the five-blocks devoted primarily to maize, as well as the adjoining alley dedicated primarily to the sale of maize husks, or *ojas*, for use as *tamal* wrappers. I counted every maize vendor, recording for each: 1) the type of maize being sold; 2) the origin of the seed; 3) the town where the maize had been grown; and 4) the sale price. The survey took place on a Tuesday morning, the weekly peak of activity, in early April, which vendors reported was the annual peak sale period of maize seed for planting. While this survey does not assess annual variation in price or varietal availability, it does provide a detailed illustration of the patterns of farmers' preferences and perceptions that emerge from my observations and data from the longer livelihood surveys and interviews. Both producers and consumers identify particular valued traits with certain maize varieties, and prices in the *tianguis* are negotiated accordingly.

The survey did not record the gender of maize vendors since, as with many homegrown products, maize is most often sold by rotating family members who may each be present sporadically, or as a group. Asking for an individual to self-identify as the designated vendor would potentially yield more information about local responses to outsiders than about maize market practices. The question of gendered divisions of labor is more rigorously addressed through ethnographic methods and discussed in Chapter 7.

Structured Livelihood Surveys

All livelihood interview participants were recruited at the Ozumba tianguis. Following two months of regular attendance at the tianguis – during which time I bought my groceries, familiarized myself with the weekly routine and dynamics of the street market, and conducted the four-question market survey (see Market Chapter) – I began inviting maize farmer vendors to participate in a more extensive livelihood interview focused on household characteristics, agricultural assets, maize production, household maize consumption, and maize sales, with particular emphasis on the maize varieties planted. This structured livelihood interview consisted of twenty-five questions about household characteristics, resource access, and maize production practices (see Appendix). A total of twenty-one households accepted my invitation to participate in the structured interview. In five instances, a married couple was representing their household at the Ozumba tianguis and both members participated in the interview; for these interviews, I counted both female and male maize vendors, rather than excluding one or subsuming them into a single head of household. These twenty-one household livelihood interviews comprise twenty-six individual participants, including twelve women and fourteen men. The women range in age from 42-78 years old, with an average age of 62. The men range in age from 24-76 years old, with an average age of 51.

These participant households represent eleven towns from across the sub-valleys that constitute the Amecameca Valley. In this context, theirs seems to be, in an important sense, a place-based livelihood: of the twenty-six participating individuals, all but three (one married couple and one unmarried man) are currently living and farming maize in the same town in which they were born.

While interview participants were all active maize vendors in Ozumba, and the tianguis served as my central site of participant recruitment, my observations of household livelihood practices were able to include a more complete picture of those involved in the work of producing, processing, and preparing maize in the context of everyday life. This participatory observation component of the research was conducted on farms and in homes, in addition to the tianguis, and thereby included additional research participants who were not necessarily involved directly in their household’s tianguis activities nor in my structured livelihood interview.

Participant Observation

I deliberately recruited participants for the livelihood interviews. However, my interviewees arguably recruited me for the participatory observation, and took an active role in shaping the design of this component of my data collection. As a result, I was able to participate in activities and observe spaces that I could not have anticipated on my own. Interview participants would regularly invite me to visit them on their farms and in their homes. Such invitations occasionally arose during the interviews themselves, as the farmers noted my rapt attention to their descriptions of particular maize varieties and farming practices. At other times, farmers would differentiate their role as host from the interview process, inviting me to a family meal or special occasion as I greeted them in the market. Three families in particular reciprocated an interest in the research project itself – they were as curious about my work as I was about theirs. These three families each proposed and planned multiple visits for me to their workspaces – farm fields, gardens, and homes – at moments they deemed crucial for my understanding of the annual maize farming cycle. These included plowing and planting, a celebratory harvest cookout held out among the maize fields, the post-harvest maize processing and sorting, and a mid-winter tamale feast. In each of the three families, it was the female maize vendor, the family matriarch, who initiated these visits. One woman invited me to a Sunday meal at her home shortly after my research began and, while I was there, proposed that I come back again when they were planting the maize. Another woman began planning a tour for me of her house and family farm fields from the first time we met in the Ozumba tianguis, and brought it up each time I saw her during my weekly tianguis visits until we found a date that worked for us both. A third woman, with whom I had sat and chatted every week for months, took it upon herself to ask detailed, meticulous questions about my research goals and methods. She then spent the remaining nine months of my fieldwork period collaborating with her mother-in-law to curate a series of visits for me that featured what they felt were key activities in which I needed to participate in order to understand their household's maize production. These activities included planting, post-planting plowing, several celebrations to mark different stages of the harvest season, post-harvest processing sessions, and important holidays that, as she put it, "are about maize too."

This participant-driven component adds immense value to the research project. I was able to learn, not only about the annual arc of maize-centered household livelihood practices, but also about the subtended gendered social relations. To understand how maize is produced in the Amecameca Valley, I need to consider, not only who is doing what work, but also whose decision-making is shaping the production process. That is, I need to pay attention to power. As this chapter will demonstrate, the persistence of criollo maize is fundamentally a co-production of knowledge and crops, in which the social meanings and the value of maize are alive in the hands of farmers.

CHAPTER 5: THE OZUMBA MAIZE MARKET

Every Tuesday and Friday throughout the year, the narrow, otherwise sleepy streets of Ozumba[124] are transformed by the commotion and congestion of the *tianguis*, or municipal street market[125]. Vendors journey here from the neighboring states of Morelos, Puebla, Tlaxcala, from Mexico City, and from the twenty municipalities that constitute the State of Mexico. The market officially opens for set up at midnight. First to arrive are women selling homegrown medicinal and culinary herbs, flowers, and other wilt-prone delicates. By five in the morning, in the chilly, blue-black darkness, before sunlight has begun to peek over the volcanoes looming to the east, these women have settled their children, still sleeping and blanket-swaddled, and arranged their aromatic wares in towering stacks along the walkway. By noon, if all goes well, they will have sold out and be in a *combi* on their way back home to make dinner for their families. Other merchants trickle in as the sun rises and the morning warms. The narrow blocks begin to crowd with a kaleidoscopic bustle of women and men buying, selling, and bartering everything imaginable. The Ozumba *tianguis* brings together people from communities across the region to buy and sell all manner of household and farming necessities, from clothing, hardware appliances, and school supplies, to live rabbits, turkeys and draft animals. It features many of the myriad products available at street markets throughout the country, including kitchen appliances, knock-off Ray Ban aviators, pirated DVDs, dried chiles, fresh cheeses and used furniture. In addition, it serves as a market for products one cannot find anywhere else, including hundreds of varieties of local herbs, dozens of local varieties of beans, a vast array of seasonal wild edible

[124] In the current draft, I have used the true names for towns and municipalities. However, I will strongly consider assigning pseudonyms for all place names below the scale of the Amecameca Valley.
[125] “el tianguis de Ozumba es como un puerto lejos del mar, en donde la gente casi siempre encontrará los productos que busca”. José Manuel Martínez Torres Monografía Municipal de Ozumba, Gobierno del Estado de México, Toluca, 1986. (as quoted in GARCÍA DAVISH, F., “Ozumba de Alzate, un puerto lejos del mar”, en Tiempo libre, (1988), p 4)

mushrooms[126], handmade glazed ceramic cookware from local clay, and a combination set of pumice stone and volcanic ash harvested from nearby quarries and favored for pot-scouring. Over recent decades, this market has also ascended in primacy as a site for the exchange of *criollo* maize seed among farmers from throughout the Central Highlands. Today, the Ozumba market is the most prominent regional site of maize exchange. Multiple blocks of the crowded *tianguis* are set aside for maize and maize products. For many small scale commercially-oriented maize farmers in the region, this is the primary market for their annual harvest.

Ask any *campesino* in the eastern Central Highlands where to find *criollo* maize, and they will likely send you to a five-block stretch of the Ozumba *tianguis*. This section of the market is devoted to maize seed and grain. Elsewhere in Ozumba, as in the region at large, maize is ubiquitous on market days; most prepared foods, from *esquites*[127] to *quesadillas*, feature maize as a primary ingredient and are sold on every corner. However, for those seeking maize in its raw state, these five blocks in Ozumba offer a unique space, one not found in the other numerous weekly markets in towns elsewhere in the region. While vendors of many products in this tianguis are exclusively retailers – selling the fruit grown or clothes made by someone else – the maize vendors in this market are all primary producers as well, selling their own maize, which they sometimes supplement with that of other farmers in their town. Vendor after vendor lines the Avenida Juarez (Juarez Avenue) to sell their maize. Kernels are sorted by type and quality

[126] Jesús Pérez-Moreno, Magdalena Martínez-Reyes, Angélica Yescas-Pérez, Adriana Delgado-Alvarado, Beatriz Xoconostle-Cázares 2008. "Wild Mushroom Markets in Central Mexico and a Case Study at Ozumba". Economic Botany (Special Mushroom Issue) 62 (3): 425–436. “The economic value of wild mushrooms in some regions of Mexico appears to contribute to the maintenance of traditional ethnobiological knowledge, generally observed to be in overall decline”

[127] Fresh corn kernels boiled in salted water, then sautéed with onions, chile pequin, and epazote, and served to order dressed with a combination of lime juice, chile powder, mayonnaise, and crumbled queso fresco.

and displayed in piles on leftover fertilizer bags, or sometimes on large wooden-framed mesh sieves, so as to separate the chaff and display a cleaner product. Many vendors also sell small quantities of beans, wheat, or other homegrown items. Beans are typically criollo – most often large, purple ayocote, a native of the area – while wheat is exclusively hybrid wheat grown from commercial seed.

To an outsider, this scene may appear at first glance to have emerged fresh from a Diego Rivera mural of indigenous daily routines in Prehispanic times.[128] And, indeed, many features of the Ozumba *tianguis* – from the Nahuatl names for places and products, to the rhythms of barter and exchange, to the varieties of maize themselves – can trace their origins to this very region centuries, if not millennia, ago. The market itself has been held in these same streets since at least the early seventeenth century (García Davish 1988). However, this market and surrounding highland valleys are part of a highly porous system. Local change has taken place here in intimate relation to the violence of colonial conquest, agrarian revolution, state terror, and global economic restructuring. The maize varieties developed here have sustained the Aztec empires of Tenochtitlan and Chalco, provided a subsistence base for the lower classes of indigenous, campesino, and worker populations, and served as reservoirs of genetic material for harvest by agribusiness corporations. They have also served as a relatively reliable resource base for rural livelihoods when other options are unpredictable, out of reach, or otherwise undesirable. Some of the farmers growing maize to sell in the Ozumba *tianguis* have attempted, and failed, to make a satisfying living through wage employment, perhaps in a local factory or retail store. Many told

[128] D. Rivera, *El Tianguis de Tlatelolco, 1519* (Mexico City: Palacio Nacional 1942) (fresco mural), viewed by author 16 July 2012.

me stories of having tried, in recent years, to earn money through seasonal migrant labor on farms in Ontario, or New Jersey, or Kentucky, until fickle politicians in the US and Canada rescinded those policies that had previously generated labor contracts. Crop diversity provides a degree of stability and certainty for farming households that can mitigate some of the harshest consequences of volatile political and economic conditions (CITE). However, the maintenance of *criollo* maize is also highly resource and labor intensive, albeit in different ways than the cultivation of hybrid maize; the most impoverished and stressed households are not typically successful in making a living or fully subsisting from *criollo* maize farming (Zimmerer 1996). The cultivation of *criollo* maize is therefore not a last resort when there are no other options available. It is, rather, an investment in a particular set of socio-ecological relations, ones grounded in a history of agrarian and postcolonial survival, and an ethic of familial care and collaboration.

In this chapter, I investigate working relations of the Ozumba *tianguis* in order to better understand why commercial maize farming households in the Amecameca Valley continue to invest primarily in *criollo* varieties. I begin with a discussion of the methods of data collection used, describing how the limited market survey is situated within a broader ethnographic project. I then discuss survey results, particularly the clear dominance of *criollo* varieties of maize over hybrid varieties in the market, a pattern which reflects the dominance of *criollos* more broadly among maize populations in the Amecameca Valley.[129] The following chapter integrates findings from the market survey with data collected through a combination of extended, flexibly-

[129] Perales 1993

structured interviews and participatory observations in the market, detailing farmer valued traits and the perceived benefits of particular maize varieties. Finally, this chapter concludes with a discussion of the implications of these findings for the politics of agricultural development and crop biodiversity conservation.

The Dominance of *Criollo* Maize

As I helped a woman whom I'll call Berta clean *nopales*, her youngest daughter dozing in my lap, I took note of the ubiquitous presence of maize in this vibrant market scene. We were ostensibly sitting in the herbs and flowers section of the market at the time, and yet maize was everywhere I looked. Immediately to our right, a woman was making blue-corn tortillas at rapid-fire pace to serve in great stacks alongside steaming bowls of *pancita*, or *mole de panza* (tripe soup), a local breakfast favorite. In the chilly morning hours, vendors warm themselves with a hearty breakfast of *atole* (corn porridge), *tamales* (corn dumplings often filled with pork and spicy salsa, wrapped in corn husks, and steamed), or breakfast tacos, tortillas filled with rice and hardboiled egg. During Lent, these taco vendors offer *romeritos*[130] *con mole y camarónes*, a rich taco filling of greens in a sauce thick with spices, chiles, and dried shrimp. Down at the end of the alley, a farmer in overalls hawked fresh *elotes* (corn on the cob) out of the back of his pickup truck.

[130] *Romeritos* means "little rosemary" and was described by those who sold *tacos de romeritos* simply as "romero la verdura, no la hierba" or "rosemary the vegetable, not the herb." *Romeritos* look a bit like a succulent rosemary stalk, but are not biologically related. *Romerito*, scientific name Suaeda *torreyan*, is one of the many *quelites* or wild herbs and vegetables central to regional cuisine. It is an evergreen shrub that grows readily in the marshy areas still remaining south of Mexico City. When cooked, the fleshy leaves burst with salty flavor.

When I asked Berta what maize varieties her family had planted last season, the answer came instantly: “why, *criollos*!” she exclaimed with a laugh. Those around us smiled quietly as though mine were an amusingly naïve question. Berta went on to list the advantages of *criollo* maize, as she perceived them. It grows much better in the frost-prone high-altitude valley, having been bred to local conditions for generations, and often has better resistance to local pests. *Criollos* can be harvested, de-husked, and de-grained by hand. Hybrids, on the other hand, are too tough and one needs access to a machine to degrain them. *Criollo* maize stalks can be fed to the family’s animals, whereas the cows, horses, and even mules refuse to eat the tough stalks of hybrid plants. Many local humans consider hybrids to be inedible as well. Large-scale commercial corn flour processing facilities prefer to work with hybrid grain because of its uniform kernel size and texture. However, in this region, I regularly heard folks refer to store bought tortillas, produced from hybrid maize, as *tortillas de olote*; the joke is that they taste as though they were made from *olotes,* or corn cobs, instead of kernels. And hybrid maize is unsuitable for the more than 600 distinct culinary dishes across the country designed around the taste and texture of local *criollo* varieties.

Berta’s strong preference for *criollo* maize resonates with the consensus among almost all of the farmers selling their maize in the designated maize section of the *tianguis*. Like Berta, these farmers perceive *criollo* maize varieties to be far superior in flavor and texture to hybrid maize. Unlike Berta, who makes money in the market by selling fresh produce from her household garden, these farmers depend on selling their maize harvests as part of their household income, and they judge *criollos* to be more profitable and marketable than hybrids as well.

The Ozumba *tianguis* shows near-complete (95%) dominance by *criollo* varieties of maize (Perales et al 2003). The market survey documented 137 farmers selling their maize in the *tianguis*. Unlike vendors of many other crops – such as tropical fruit, bulk dried chiles, or fresh vegetables – who are strictly retailers and import their wares from other regions of Mexico, those selling maize in Ozumba are also maize farmers themselves. They typically cultivate several hectares of maize, the bulk of which is set aside for sale, with some reserved for household consumption. These farmers will often purchase the maize harvests of other farmers in their town, which they use to supplement their own harvest and sell in the *tianguis.*

On the day of the survey, 131 of a total 137 farmers were selling *criollo* maize varieties. Twelve farmers sold hybrid maize, six of whom sold exclusively hybrids, while the other five sold both hybrid and *criollo* maize. There were also 56 vendors selling maize husks, 34 of whom sold exclusively husks in the designated alley. These 34 women (all husk vendors were female) primarily worked in the *tianguis* as retailers, whereas the 22 vendors selling both maize kernels and husks were maize farmers selling their own crop, as well as the harvests of others from their town.

Of the 131 farmers selling *criollo* maize varieties, almost all of them (129) sold *criollos* in various colors belonging to the *Chalqueño* landrace. The other landrace represented was *Cacahuacintle*, which was sold by a total of 34 farmers. 32 farmers sold both *Chalqueño* and *Cacahuacintle* varieties of maize. Both landraces are known to have been cultivated for thousands of years in Mexico’s central highlands (see Anderson and Cutler 1942; Anderson

1946; Wellhausen *et al.* 1951). A 1995 survey of maize populations in the Amecameca Valley found almost complete dominance by white varieties belonging to the *Chalqueño* landrace, with very small populations of other colors of *Chalqueño* (blue, red, yellow, xitocle) and white *Cacahuacintle* (Perales 1998). While *criollos* have retained the dominance recorded two decades ago, the patterns of which *criollo* varieties are selected has shifted in some significant ways, at least according to the sample represented by the Ozumba tianguis. White *Chalqueño* maize is the most common maize variety represented in the *tianguis,* but the representation of blue *Chalqueño* and white *Cacahuacintle* is dramatically higher here in 2012 than in the region, as measured by the 1995 survey. Farmers selling maize in Ozumba described a surge in recent years in the popularity of blue maize for tortilla- and tlacoyo-making. In addition, *Cacahuacintle* has become increasingly popular in the past decade, both for making *masa* (dough for tortillas, tamales, etc) and for use in pozole, according to these farmers, and is known for its delicate texture and sweet taste.

Geography of Maize Diversity

All of the maize varieties represented in the Ozumba *tianguis* are adapted to the region. The *Chalqueño* race is thought to have been among the modern incipient races, a combination of *Conico* and *Tuxpeño,* that was present by the time of the Spanish Conquest in 1519 (Wellhausen *et al.* 1951; Sanders *et al.* 1979). *Cacahuacintle* is classified with the pre-Colombian tropical races and thought to have originated in central or South America, though its Nahuatl name and high-altitude distribution suggest that the introduction was not recent (Anderson 1946). In the past decade, agricultural research institutions in central Mexico have produced several hybrid varieties specifically for the high-altitude valleys of this region and devoted great resources to disseminating them to agricultural extension programs and local input stores. It is probable that these are the hybrid varieties purchased by local farmers and found in the *tianguis*.

The distribution of different maize varieties is highly uneven across the Amecameca Valley. The market survey included the question "where did you grow this maize?" which had been designed after reconnaissance work verified that most, if not all, vendors of maize in the *tianguis* were selling maize that they had grown themselves. This was particularly true in April, which was still early in the post-harvest season, before farmers had begun to run out of their own stores of maize and to turn to maize purchased from others (which would most likely come from others in their home town). None of the 137 maize vendors corrected the premise of the question when asked, and typically responded with a variation on the answer "I grew it in [town name]" or "We're from [town name]." These answers reinforced the pattern observed previously that maize vendors in the *tianguis* sell maize harvested from the same town where they live themselves.

Of the seventeen towns represented in the market survey, five towns constituted 74% of maize vendors present: San Juan Tehiuxtitlan, Juchitepec, Tepetlixpa, Cuijingo, and Ozumba. These five towns are well-situated to yield a high number of commercially-oriented maize farmers, in that they are an accessible distance, by decent roads, to the *tianguis* and have a higher economic base than other towns, such as San Diego Huehuecalco, but they are still heavily invested in small-scale farming, unlike the more urbanized and larger city of Amecameca. These five towns are also the only locations where those farmers selling in the *tianguis* were growing hybrid maize. In the other twelve towns, farmers selling in the *tianguis* grew exclusively criollo varieties. Juchitepec and Ozumba, the two towns with the highest number of hybrid maize vendors, are the two primary sites, outside of the SEDAGRO office in Ayapango, where diverse agricultural inputs including hybrid seeds are sold. This pattern is crucial to understanding the persistence of criollo maize varieties. Criollo maize is not grown in isolation, and it is not an option of last resort. Maize farmers are choosing to invest in criollo maize in the presence of other viable options, often doing so during or after careful consideration of hybrid varieties, either by experimenting with it themselves or observing a neighbor doing so.

Gendered Dynamics of Labor and Authority

All members of a given maize farming household tend to contribute to the time- and labor-intensive process of selling maize. As discussed in the Methods section above, this contrasts with other maize-centered livelihood practices in this region such as planting and plowing[131], which are typically considered men's work, or tamale and tortilla making[132], which are typically considered women's work. The tianguis offers an opportunity to study the gendered relations and divisions of labor involved in maize livelihoods in the region beyond the spaces of farm field and home. Rather than investigate these dynamics through direct questioning, such as interviews and surveys, which elicit the perspectives and intentions that farmers are conscious of and willing to discuss with a researcher, I chose to consider them through ethnographic observation. By

[131] There is no strict taboo against women in the maize fields, rather it is considered men's responsibility to take care of planting, plowing, harvesting, etc. In nearby regions, with heavier male outmigration, women take over field work.

[132] Tortilla making by hand or individual press, for household consumption or for sale, is women's work, whereas every worker in a tortilla shop where tortillas were made in bulk by a machine was male.

studying the everyday practices of farmers *in situ* in the market, I am better positioned to understand the context in which farmers make their livelihood decisions. I am able to appreciate the nuance, complexity, and contradictions of individual practices as they unfold over time, and I am more open to unexpected possibilities than when I establish questions and parameters in advance. Ethnographic observation allows particular practices to come into higher relief, to be visible as re-negotiations of power and place.

In addition to the post-harvest processing, storage, and packaging that takes place over many weeks at home, on market day itself, families have a full day of labor ahead of them, only part of which takes place at the tianguis in Ozumba. Transportation must be arranged, which typically involves borrowing, renting, or sharing a pickup truck or comparable cargo vehicle. Small scale producers bring their own products to Ozumba from their home, which is sometimes several hours away by road, and usually can't afford the commercial transportation accessible to professional vendors. For smallholders, large bags of maize kernels are among the heaviest and bulkiest products they must bring to market that, unlike donkeys, cows, and ponies, are unable to load themselves into vans. Male household members and friends of the family are typically tasked with loading, driving, and unloading the maize, then ferrying the sacks of kernels to their vendor site in the maize section of the tianguis. A few of these men who own their own hand truck (the heavy duty two-wheeled upright platform with handle and ledge) will then rent out their labor and, while their families sell the household maize, spend much of the market day shuttling improbable loads through dense crowds on behalf of any customer or vendor in need. If you happen to be in one of the dense tianguis crowds and hear behind you a cry of "¡Golpe!

¡Golpe! ¡Golpe!”[133], move aside as best and as quickly as you can, for one of these men with his hand truck is coming through, most likely at speed.

Whereas some products sold in the tianguis seem clearly associated with male or female labor – I’ve only ever seen barbacoa (pit-roasted mutton) prepared by men here, and licuados (milkshakes blended to order) by women, for example – most products are sold through intricate and cacophonous marketing practices that defy conventional gender binaries. In the maize section, both men and women of all ages can be found tending their household’s vendor site. Nevertheless, over the course of a market day, some patterns of gendered divisions of labor start to emerge.

Even when men and women come together to the tianguis to sell their maize, gendered activities during the market day tend to place women at their maize vendor site for long, uninterrupted stretches, while leaving men more mobile throughout the tianguis. While men unload and park the transport vehicle, women set up the vendor site and keep watch. Men are more likely to leave the maize section to sit and eat breakfast at a *pancita* bar in the covered market, whereas women tend to stay at their maize vendor site and grab a tamale and white roll from a passing food cart. Maize sales are combined with child care duties: women take charge of their young children, grandchildren, nieces and nephews, keeping them fed and occupied at the maize vendor site. Only for an emergency bathroom run will women leave their vendor site to accompany the child

[133] “Golpe” means a blow or knock.

in need, their other children remaining under the careful watch of the women in neighboring vendor sites. Both men and women regularly take on odd jobs during the market day, in addition to selling maize, though these odd jobs have a gendered geography: whereas men offer to assist shoppers with heavy purchases for a fee, and traverse the entire tianguis with their hand truck for hours at a time, women will stay at the maize vendor site, cleaning and trimming produce from their home garden to sell in small piles alongside their maize, or weaving sturdy plastic tote bags to sell. Men's greater mobility during the market day means that they are less often in charge of supervising maize sales, which requires constant sustained attention. Some men take the occasional opportunity to rest a bit after a grueling morning of work, before the packing up and journey back home in the afternoon. I regularly saw men pausing in a shady spot to take a nap. I never, ever saw a woman napping in the tianguis.

These practices, added together, mean that, in any given moment, significantly more women than men are stationed at the piles of maize available for sale. Women are primarily present for the long market days, which means they are the household members who primarily decide what prices to ask that day, who assess how customers are reacting to their maize quality and their asking prices compared to those of their neighboring vendors, who pay their vendor fee to the municipal rep as he makes his rounds, and who explain to customers the value and advantages of their maize. Women are the default managers of selling maize in the Ozumba tianguis. Though the labor of selling maize is shared in many ways across genders, women maintain their authority to negotiate terms of trade through extensive observation of other vendors and consumers in the maize section of the tianguis.

This authority in the market influences other stages of maize processing and decision-making within maize farming households. As household experts on cooking with maize, and as the household member (in heterosexual couple-headed households) most directly engaged in soliciting consumer preferences, women acquire a preponderance of the knowledge necessary to make key judgments when deciding which varieties to invest in planting next season, when selecting particular kernels to save as seed for her household's planting in the coming year, and when separating kernels from a single variety into different quality categories. Most of this labor takes place at home following the maize harvest, sometimes over the course of months, as a household gradually processes its stored maize. For a commercially-oriented maize-farming household, such as those with whom I worked in the tianguis, these decisions must take consumer perspectives and behavior into account, in addition to the household's own subsistence needs and preferences.

I joined a number of these households, in homes scattered across a wide geography of small towns in the greater Amecameca Valley, as they worked to process their maize. This work was often set aside for Sundays, which were observed as a day for staying at home with family, if not as a day of rest. We usually set up shop in the interior courtyard of the family's home, where the light is best, arranging piles of maize ears, tubs for unsorted kernels, and repurposed fertilizer or other sturdy bags for sorted kernels, in circles around us. Every available family member joined in, especially for the task of degraining the ears of maize. Unlike hybrid maize varieties, which must be degrained by a specialized machine, criollo maize varieties can be degrained by hand. Criollo kernels are much longer and more tapered than hybrid kernels. With the heel of your hand, you can exert enough force on the top of the kernels to pop them out of their sockets and off the cob, one row at a time. Children as young as toddlers in these maize farming households practice the skills with which to assist their parents in degraining, often competing with one another to see who can degrain the most ears. It took me many weeks of degraining to come close to their competency, and for the deep purple bruises to fade from the heels of my hands.

Even such focused labor was interrupted regularly with other dimensions of household life. An extended family member would drop by, take a seat in the circle, and share the stories of everyday dramas from that week. An inquisitive kitten or house dog would tiptoe past numerous reprimands to see what we were up to. A child would get fussy and be whisked away for a nap. A daughter-in-law would walk out from the kitchen, scoop up a pail of the maize kernels designated as quality grain (as opposed to set aside for seed), and set it to boil in pot with a chunk of limestone. Once it had boiled for several hours, she would drain the maize, and either grind it into fresh *masa* dough using a hand grinder clamped to a table edge, or take the pail of cooked maize down the street to the neighborhood mill.

One prominent family in a town known for its unparalleled quality blue *Chalqueño* maize, owned their own motorized grinder, and served as their neighborhood's maize grain mill. Whenever a neighbor was ready to make tortillas for a family meal, she would bring her cooked maize grain to their gate, knock, and a family member would hop up to answer. Freshly cooked and drained maize kernels have absorbed precisely the right amount of water for fresh *masa* dough for tortillas (additional lard is often added for tamale dough). The cooked maize kernels are poured into the motorized grinder, and the moist dough that comes out is packed back into the same pail, then returned to the customer in exchange for a few pesos. As we degrained and sorted maize kernels in the family's courtyard, most of the midday interruptions were women requesting the maize grinder's services. As the afternoon progressed, however, the knocks at the door were increasingly likely to indicate requests for *pulque*. Among this family's myriad sources of supplemental income was a small *pulque* business. They only sold on Sundays, out of their front gate, while the family was home and working in the courtyard just inside. On Saturdays, a family member, usually the husband, would collect fresh *aguamiel*, the sap from maguey cacti growing on the borders of the family's maize fields. This *aguamiel* was then "seeded" with some of last week's pulque, and left to ferment overnight. In the cool nights of the highlands, the pulque fermentation slows, but a warm sunny day rapidly accelerates the conversion of sugars into alcohol. If consumed in the morning, the pulque was light and sweet and slightly tangy. By early afternoon, when most customers stopped by, it was quite a bit stronger, like a sour beer. Customers would pass their container through a small door in the family's central front gate to be filled. Most brought a translucent plastic jug, though several teenagers bore handsome double-spouted glazed carafes with clay cups for spout caps, traditional redware of the kind I'd seen in the ceramics section of the Ozumba tianguis. Once filled, the jug was passed back in exchange for eighteen pesos, about one USD at the time. The pulque would continue to ferment and strengthen as it was enjoyed over the course of the afternoon. The family might consume some leftovers together that evening, but any pulque remaining by Monday morning was considered too fermented to drink, and would be left as pulque "seed" for the following weekend.

Though every household member participated in the degraining and sorting process, women served as key decision-makers for saving seed and separating grain into quality categories. As everyone sat in a circle together, the female head of household would tactfully direct her husband, children, and others as to which varieties were the highest priority for next season's planting, which seed to set aside for the household's farm, and which categories to apply to the kernels that would be taken to sell in Ozumba.

Such matriarchal power dynamics have implications for women's everyday lives in these maize-farming households. They also likely have implications for the region's agrodiversity. It matters that those involved, perhaps even those at the center, of making decisions regarding how maize is selected and sold, will also be the ones cooking the maize for everyone to eat with every meal and snack of the day. Their expertise and responsibilities may mean they value maize varieties differently than the rest of us. These women have preferences, for themselves and their families, that, in this particular maize economy, translate into the value system by which maize is produced, marketed, and consumed. Any farm field is a reflection of particular power relations that are at once social and ecological. When we consider the landscape of Mexico's Central Highlands, and the criollo maize varieties that thrive here, we would do well to recognize the full community of minds who deemed this agroecosystem worth the upkeep.

In addition to their influence over maize varietal selection and marketing, women in these commercially-oriented criollo maize-producing households also control a significant portion of decision-making regarding the weekly household budget. In the tianguis, women are the household members primarily responsible for interacting with customers, and for accepting customer cash payments and providing any necessary change. Toward the end of the market day, these women typically leave any children with the oldest remaining family member – sometimes an eldest daughter, sometimes their husband – and head out into the rest of the market to do their weekly shopping with the money earned from selling maize that day.

The structure of the market space, and of the economic relations that take place here, have deeply gendered implications. It matters who is responsible for child care, who gets a nap when they need one, or who takes charge of grocery money, and these divisions of labor and power are always being negotiated in every economy. The Ozumba tianguis may also offer market access to an unusually wide array of maize producers. Before I began immersive research here, I imagined that a regional peasant market might well be more accessible than global commodity markets are for lower-income and resource-poor farmers. However, the economic practices of one research participant of mine suggested gendered opportunities in this market that I had not imagined.

There was one maize-farming family with whom I became especially close. They were easily the most prodigious farmers – of criollo maize, but also countless species of garden produce and herbs – in their town, which was itself one of the most well-represented in the maize section of the tianguis. This family was headed by a profoundly kind and gregarious woman I'll call Magda who always asked after the wellbeing of my own family, and sought to address the scandal of my being away from them for so long by having me over for family meals several times a month during my research period. Every member of her family, often four generations of which was present at the tianguis, responded with gracious enthusiasm to my litany of questions about everything from the grammatical nuances of colloquial phrases to the ingredients in their heirloom mole recipe. Her youngest nephew and I would exchange language lessons by teaching one another our favorite song lyrics. I spent a disproportionate amount of time with Magda's family, often stopping by at the end of a long market day to sit and catch up. They always had large piles of several maize varieties, including some of the most high-quality blue and white Chalqueño maize at the market, and took up one of the longest vendor spaces, about four meters of sidewalk, in one of the most central blocks of the maize section, on Benito Juarez Avenue. And, sitting just to their right, in a much smaller vendor site, were always the same two women.

These women were from the same town as Magda's family. They were both slight of build and grey-haired, with matching French braids. They both adored the little flavored gelatin and pudding molds sold out of a delicate metal-framed glass case shaped like a birdcage by a lady with burgundy hair, who carried them through the streets of the tianguis crying "*¡Gelatina! ¡Gelatina!*" The two grey-haired women always encouraged me to join them in a *gelatina*, and would treat me to one if I declined to buy one for myself. They always displayed two varieties of maize for sale, Cacahuacintle and white Chalqueño, and had kernels of high quality, though a bit smaller than those of their neighboring vendor. I never did see whether they had assistance carrying the bags of maize from their transportation to their vendor site, though I've certainly seen smaller women wielding heavier cargo on their backs across the market each week. They always listened and smiled as I chattered away with Magda's grandchildren. When it came time for me to conduct livelihood surveys with maize farmers in the tianguis, and I had finished talking with Magda and her husband[134], I asked the woman sitting closest to Magda if she would like to participate in the survey as well. To my delight, she nodded and smiled. Most of the survey – questions about planting decisions, farming equipment, field size, etc – proceeded as normal. However, when I asked questions about household size and membership, she didn't answer, simply smiled and demurred instead. It quickly felt invasive to ask about her household. During one of the first household questions, she had exchanged a glance with her tianguis companion seated next to her. Without inferring anything from this exchange, I decided to not finish the household portion of the livelihood survey and to not request a separate survey with the second woman. I simply thanked the first woman for her generosity and time.

I do not know why this woman seemed uncomfortable with the questions about her household, nor do I have any interest in speculating. She was the first and only participant to react in this way, and I was more than happy to dispense with any questions she chose not to answer. I am exceedingly grateful for her willingness to engage in the survey as she did, for she helped illuminate a dimension of the tianguis that I would have otherwise failed to appreciate. In this particular market, at least in the maize section, it is normal, even expected, that women, including women unaccompanied by men, are in charge of the maize, of the vendor site, of the terms of exchange, of conducting sales, and of the proceeds. This is, to put it mildly, not the norm in all markets. Capitalist institutions, following from European colonialism, work very

[134] It was common for both husband and wife to participate in the livelihood survey. In fact, if I knew that both typically came to the market, I made an effort to conduct their survey when both were present at their maize vendor site. In these cases, I deliberately addressed my questions to them together, making eye contact with each and speaking in the second person plural. I left it up to them how they preferred to respond. In the majority of cases, I found that the husband was often the first to speak, and his wife tended to interrupt, or chime in afterward with a correction, affirmation, or clarification.

hard to maintain heteronormative and patriarchal relations according to which labor can be apportioned and profit extracted. In twenty-first century Mexico, women are expected to be subordinate members of legally-recognized male-headed households, themselves ineligible for land title and many of the public benefits and economic privileges derived therefrom (see Deere and León 2001a).

These two grey-haired women came to the Ozumba tianguis every Tuesday. They socialized with their neighboring vendors, and their customers. They sold their criollo maize. For all I know, their partnership didn't necessarily extend beyond keeping one another company on market days. However, their example made it possible for me to imagine that a non-heteronormative couple might be able to participate fully in the maize section of the tianguis, without some of the barriers found in other modes of commercial maize production. Women are often excluded from holding private land title, which private banks require as collateral for any loan with which to buy agricultural inputs, such as hybrid seed, chemicals, and machinery. Women are also restricted in their ability to register as members of their local *ejido*, Mexico's postrevolutionary system of communal land tenure. According to national agrarian law, women can only register as *ejidatarias* if they can demonstrate they are the household's sole economic provider, which in practice can be difficult to do (Deere and León 2001a; Hausermann 2014). As Hausermann (2014: 787) explains, though Mexican women play "significant roles in agricultural and social (re)production," they make up a small fraction of registered *ejido* members, and "[b]y extension, local leadership positions requiring ejidatario status are dominated by men." Government programs, such as agricultural credit and extension, or participatory research with farmers, which are the primary alternative to private banking services and technical assistance from seed and agrichemical companies, are also tied to official ejido status, and therefore largely unavailable to women.

In addition to excluding women from access to or control over agricultural resources, Mexico's "long history of masculinist agrarian law," (Hausermann 2014: 785) serves to define rural women exclusively in terms of their subservient relationship to a male head of household. Through discourses, laws, and governing practices, dominant social institutions construct women's agricultural work as "no more than supplementary to men's," (Radal 2011: 32; see also Sachs 1996). Not only does this constructed dependency privilege masculinized work and ideas over others, it effectively mandates that women enter into agricultural and economic practices as members of a heterosexual couple.

As an "informal" market, with much less government oversight and regulation than formal commodity markets, the Ozumba tianguis may be accommodating of diverse social and economic formations. This is not to say that local control, deregulation, or noncapitalist economies are inherently more inclined toward gender equity or women's empowerment. Far from it, as extensive research has demonstrated (Deere and León 2001b; Trauger, Sachs, et al 2010; Hausermann 2014; MORE). However, much as nonhuman nature can resist commodification despite neoliberal interventions (Robbins and Luginbuhl 2007), intimate human-maize relationships at the center of the Ozumba tianguis seem to demonstrate some resistance to patriarchal heteronormativity despite decades, if not centuries, of masculinist economic restructuring.

Actors need not be intentional in their resistance, nor sentient, for that matter, to accomplish this kind of resistance (see also Gilmore recently?). Without having conducted the necessary research, I cannot speak to the perspectives on these issues held by farmers selling their maize in the Ozumba tianguis. What I can describe are patterns of gendered divisions of labor and decision-making with women consistently in positions of authority. Spaces of economic activity, upon which the daily sustenance and livelihoods of thousands of households across the region depend, that are defined by the utter banality of female management. Maize varieties that are not produced by inbreeding “male” and “female” parent lines (Bittman and Kowalenko 2004), but rather by managing the genetic richness of a flagrantly hermaphroditic plant as it co-evolves with a dynamic agroecosystem. In the maize section of the Ozumba tianguis, I encountered openings for a far wider array of sexual politics than I expected. I also witnessed a degree of authority and autonomy, across intersecting lines of socioecological difference, that I haven’t seen in other spaces of agricultural production.

My observations yielded far more questions than this dissertation can begin to answer. More extensive research, using a variety of methods, is needed to understand the gendered dynamics of labor, livelihood, and maize diversity in this region. However, my observations over many months in the Ozumba tianguis, and in the spaces of social reproduction that undergird it, suggest that the gendered divisions of labor, of authority, and of knowledge production among these households may be different than those of a broader industrial agricultural landscape. I observed clear and persistent patterns of access to and control over resources that centered female agency. This research raises important questions about the relationship between gendered social hierarchies, the conservation of open-pollinated farmer-bred crop germplasm, and diverse economic practices.

Farmer Valued Traits

Productivity and Yield

As noted by maize producers in Oaxaca and Chiapas (Bellon et al 2006), farmers in the Amecameca region exercise multiple concepts of yield that do not necessarily correlate with one another. A few farmers I surveyed discussed the yield of different maize varieties in terms of tonnage per hectare. However, most did not measure their harvest by weight, either in total or in marketable units, and were unable to estimate their own yield in such terms. When asked about the maize varieties they cultivated, most farmers discussed comparative productivity in terms of ear size and kernel size.

In this region, traditional approaches to spacing and planting maize have been developed over the course of millennia, and farmers tend not to significantly modify their method when using different maize varieties. Those who choose to plant hybrid maize often space the seeds as they do *criollo* seeds. Farmers plant by hand and on foot, typically dropping 4 maize seeds into holes spaced approximately 3-4 feet apart. This spacing is tailored to the growing requirements of traditional maize varieties, and also allows many farmers to cultivate beans, squash, and other vine crops in among their maize plants. Only one farmer participant planted his hybrid seeds closer together than he did his *criollo* seeds; the others were largely unfamiliar with the intensive cultivation systems for which the hybrid seeds available to them had been designed.

Within local maize cultivation systems, which feature little variation in planting density, farmers' evaluation of ear size and kernel size provides an approximate measure of the yield of a given variety. The *criollo* maize grown in the region produces ears that are longer with much larger kernels than those of available hybrids, and is thus deemed to "give" or produce more. Ear and kernel size also significantly increase the overall profitability of the maize harvest, as discussed in more detail in the following sections. However, in-depth conversations revealed that higher yield is not necessarily a top-priority trait in farmer seed and varietal selection as compared to other quality characteristics.

Maize Quality

Farmers in the Amecameca region place great importance on certain characteristics of the maize plant itself, particularly: resistance to pests and diseases; tolerance of local environmental conditions, including high altitude, early frost, and sporadic rainfall, and; to a lesser extent, resistance to lodging. Participants reported that lodging was not a widespread problem and not a primary cause of crop loss in the region. Though the Amecameca Valley is dominated by only a few landraces, the agronomic vitality of particular maize varieties is locally specific in the variable highland environmental conditions. It is important to highlight that, for local farmers, a particular maize variety's ability to "grow well" in a given environment is not judged exclusively, or even primarily, in terms of yield; most often, a variety's strengths and weaknesses were described in terms of quality characteristics that would determine the marketability and profitability of a farmer's harvest. These characteristics include ear size, kernel size and color purity, and resistance to physical damage from insects, weather, and post-harvest processing.

White and yellow *criollo* varieties are considered by farmers to be the "toughest" and most durable types of maize, more capable of resisting damage from frost, periodic drought, pests, and disease. White maize is the most common and widely-adapted type by far among farmers in the region. Yellow maize is considered well suited to a wide range of local climates, but has declined significantly in popularity in the past decade, notably since the 1994 implementation of NAFTA and subsequent increased importation of cattle-grade yellow corn from the United States. According to local informants, yellow maize has since gathered a reputation as better suited for animal feed than human consumption.

Blue and red varieties are described as "softer" and more "delicate" than white and yellow maize; they are considered capable of growing very well in local environments, but as being more susceptible to visible kernel damage from pests and disease, which would reduce its market value.

Farmers describe *Cacahuacintle* or pozolero maize as doing better in "tierra caliente" – niche environments of the highland's valleys and lowlands where soil humidity is higher and more stable throughout the growing season – than in "tierra fria" – pockets of more arid land and slightly colder climate.[135] As with other *criollos,* white pozolero varieties are considered hardier and more resistant to pest infestation than red or blue varieties, during both the growing season and post-harvest storage.

Some local maize farmers perceive hybrid varieties as highly resistant to several local pests. In places that have experienced severe infestations, some farmers have responded by adopting hybrid varieties, though these farmers often simultaneously maintain plots with landrace varieties as well, sometimes in a different location. For example, one commercial farmer plants two hectares in Ozumba, an area that has experienced an influx of *pulgones* (aphids) and *arañas rojas (spider mites)* in recent years, with white hybrid maize, while cultivating three hectares of a white *Chalqueño criollo* variety in the nearby town of Zoyatzingo, where these pests are less of a problem.

The perception that hybrid maize is "hard" enough for local environments does not mean that farmers consider hybrids better suited overall to local production needs. Many farmers choose locally-adapted *criollos* in locations where pest and frost resistance are high priorities and,

[135] Smallholders in the Amecameca Valley routinely used these terms to describe the differences between microclimates in region and to explain why some crops do better in certain areas than others. However, it is important to note that these farmers' usage, and my description thereof, conflicts with the same terms' usage in most scientific literatures, which follows the definitions established by Alexander von Humbolt (see Kohlhepp 2005).

despite reported increases in the adoption of hybrid varieties in some highland communities in the past decade, *criollo* maize remains clearly dominant throughout the Amecameca Valley, as represented in the tianguis (11 out of 134 farmers surveyed cultivated hybrid maize in 2011, and only 4 of these farmers cultivated hybrids exclusively). One farmer, who purchased hybrid seeds from the Sedagro office (Secretaría de Desarrollo Agropecuario) in 2011 had wanted to experiment to see how the seeds would grow on his land. He was curious because he didn't know anyone else in his village who was growing them, and commented that few people in the region seemed to cultivate hybrids. Speaking of hybrid maize, this farmer stated "the government wants us to plant this, but the ears, the seeds, the husks are so very small." He was speaking in a general sense here about the Mexican government's explicit endorsement of and investment in so-called "improved" and "modern" hybrid maize since at least the 1950s (Crow 1998). It is also possible that this farmer is, in part, referencing a specific government program called "*kilo por kilo*" in which state officials offer to exchange one kilogram of hybrid seed, usually bred for regional conditions, for one kilogram of seed from a local criollo variety. Perales Rivera (1998: 128) reports observing that, at a meeting to showcase "kilo por kilo" in a town near Ozumba, "no one responded positively to the proposition," and that the government representative explained to him such a response "was common in the 'altos' (high areas)."

In explaining her preference for locally-adapted *criollos*, another farmer stated, "the other types [hybrid maize] do not grow well in this region," and went on to explain that *criollo* maize produces the large ears and kernels that she seeks. Ear and kernel size are a key marketable quality of maize in local markets and a major determinant of the price a farmer can fetch for her harvest (see below). It is thus a top priority for farmers when selecting varieties to cultivate, and consensus throughout the Amecameca Valley is that *criollos* produce dramatically larger ears and kernels than hybrids. This consensus is so well established, that the notorious smallness of hybrid maize forms the basis of routine humor among maize venders in the Ozumba market. Farmers often joke that they can distinguish between hybrid and *criollo* maize based solely on the former's puny kernels.[136]

Such perceptions can shape market interactions and have a significant influence on farmers' and consumers' maize preferences. In the Ozumba market, maize kernels are laid out in piles along the streets and alleyways, each farmer sorting his or her harvest into different piles by type. Many farmers sort kernels from a single maize type into two or three groups according to kernel size and color quality, sometimes with sample ears displayed to demonstrate the ear size that the seed can be expected to produce. Prospective buyers can thus directly compare kernel quality as they walk through the street market.

Whenever I saw a customer buying some of the hybrid maize for sale in the tianguis, I asked them if they wouldn't mind telling me the purpose for which they were buying this maize. Of the seven customers I happened to encounter over my time observing the market, each of them graciously shared her purpose with me (every customer happened to be a women), and all seven of them were buying hybrid maize strictly as poultry feed, specifically for chickens and turkeys. One maize vendor selling hybrid maize, in addition to her criollo maize, who had watched me

[136] They also scoff at the thickness of hybrid cobs, as a waste, and speak of kernel size as an indication of a varieties' suitability for human consumption. Small kernels are cheaper in the market and sold almost exclusively as feed for animals, often farm fowl.

ask this question of multiple customers in recent weeks, smiled and explained to me, gesturing to her criollo maize, “this maize is for people to eat,” and, pointing to her hybrid maize, “this is only for *animalitos*, not people.”

This was not a comprehensive inquiry on my part into customer perspectives, nor a formal component of my market survey, so these seven responses should not be assumed to represent a broader group of maize customers in the Ozumba tianguis without further data collection. It is possible that the dichotomy – of criollos for human consumption and hybrids for animal consumption – is a reflection of a certain degree of privilege among a subset of maize consumers in the region. Though further research is needed to investigate such dynamics, my preliminary observations suggest that the hybrid maize purchased in the tianguis for use as animal feed tended to be purchased by somewhat more economically-privileged customers and from somewhat more economically-privileged vendors. Among customers and vendors, there were varying perspectives regarding the purpose and value of hybrid maize (see discussion above and “Failures in Hybrid Seed Input Chains” section below). However, the pattern of where in the maize section vendors and customers were conducting their business suggests that one’s views on hybrid maize quality may correlate with one’s social and economic status.

There is a spatial division within the maize section of the tianguis between the central area, multiple blocks of Benito Juarez Avenue, and the peripheral area, on the side streets that connect to Benito Juarez. Benito Juarez is a wide avenue, with room for maize vendors to set up on the sidewalks of both sides of the street, while still leaving access to the storefronts and plenty of room for food carts and other vendors to set up a third lane in the center of the street. As one of the primary streets leading north-south the length of the tianguis, Benito Juarez has a high volume of foot traffic throughout the day. It is well-shaded from the brutal midday sun, thanks to the collaboration among vendors to rig an intricate system of ropes and tarps each market day (see Figure 4). By contrast, the side streets are narrower, and on the far (west) side of Benito Juarez from the rest of the tianguis. No other vendors, aside from maize vendors, rent spaces on these streets, and there are no store fronts located here. The customer foot traffic is very light. I am not privy to the social relations that guide the location of a given vendor in the maize section, and yield collaboration or a lack thereof between neighboring vendors. I do know that these particular side streets, unlike most areas of the market, never had tarps hung on market day, and that the sun was blindingly bright and uncomfortably hot there by mid-morning. Throughout my research in the area, maize vendors in the Ozumba tianguis always returned to the same stretch of vendor space every time they came to the market. This appeared to be an informal arrangement, but one so well respected that, if a given vendor did not attend the market one week, her stretch of sidewalk remained empty, even if it was in a prime location.

My market survey did not anticipate spatial differentiation among maize vendors, and was not designed to elicit information about this dimension of market activity. Nevertheless, I did observe some marked differences between the maize, producers, and consumers in the central area of the maize section, and those in the peripheral areas. By and large, the maize vendors in the central area, on Benito Juarez, tended to have higher quality maize in greater volumes than those selling in the peripheral areas, on side streets. Vendors on Benito Juarez had nicer display equipment, such as large handmade sieves with which to display clean maize kernels, than those on side streets, who uniformly piled their maize on top of used heavy duty bags, typically fertilizer bags. Average prices for maize were sometimes the same in both areas, and sometimes slightly lower on the side streets, but maize quality tended to be noticeably lower on average in these peripheral areas. There was variation among vendors across the entire maize section of the tianguis, but the vendors with the smallest and most damaged maize kernels were consistently located either along the side streets or on the corners leading from the main street to the side streets, rather than along Benito Juarez Avenue itself. In addition to less foot traffic overall, there seemed to be fewer customers buying from vendors on the side streets. When approached for participation in the survey, these vendors in peripheral areas were quicker to offer complaints about the state of the Mexican economy and relations with the United States than were vendors in the central area, and several volunteered extensive soliloquies on themes of inequality, lack of rural investment, political corruption, and the general hardship of being a campesino. Such sentiments may well be shared by other maize vendors, but were not expressed to me with the same readiness and passion by vendors in the central area. There were other characteristics of maize vendors in the peripheral areas of the Ozumba tianguis that suggested lower access to healthcare, and other possible indications of lower socioeconomic status, on average, than those maize vendors in the central area. However, further research is needed to provide a detailed understanding of any such spatial patterns or internal hierarchies within the maize market.

Though the twelve total maize vendors who had hybrid varieties for sale were located across the maize section of the tianguis, the six who were selling exclusively hybrids were all located on side streets, while the six who sold both hybrids and criollos had much larger volumes of criollos for sale, and were all located on Benito Juarez Avenue. I took note that I only ever witnessed hybrid maize being sold by the vendors in the central area, though my observations are not comprehensive and should not be generalized without further research. These vendors, and the consumers buying the hybrid maize, agreed that hybrid maize was best suited for animal feed. The vendors in the peripheral areas, whom I never witnessed selling their hybrid maize, and who routinely expressed deep grievances about the unfairness of trying to make a living as a smallholder maize farmer, consistently argued to me that hybrid maize was perfectly well suited, in flavor and texture, for making tortillas and all manner of antojitos for human consumption.

That any preference for hybrid maize over criollo maize seemed marginalized, both spatially and socially, in the Ozumba tianguis serves to highlight the dominance of criollo varieties of maize in this market. There is a strong consensus among most maize farmers selling here that criollo maize is higher quality and preferable for human consumption. My findings also indicate a need for further research into the role that hybrid maize may play in the livelihoods of less privileged smallholders farmers and the subsistence of less privileged consumers in the region.

Perceptions of Maize Profitability

Hybrid maize has a higher cost of inputs than *criollo* maize: their ideal growing conditions demand a higher level of fertilizer use and irrigation than is uncommon in the region. Even when hybrid varieties have been designed for a rain fed region, one must purchase hybrid seeds every planting season rather than recycling the seeds from one’s harvest. Hybrid maize also brings a higher processing cost: unlike *criollo* maize, which can be degrained by hand, one must purchase or rent a degraining machine to degrain the harder hybrid ears. At the same time, farmers in the Ozumba market receive a markedly lower price for hybrid maize than for *criollo* maize. The starting price for hybrid maize ranged from $6-9/cuartillo in the market. 10 out of 11 farmers with hybrid maize sold their harvest by cuartillo in Ozumba. One farmer participant[137], who was selling criollo beans in the maize section of the tianguis, explained that she had sold her harvest of hybrid maize in bulk to a local granary for $3,500/ton. She stated that she did so for convenience – selling her maize harvest all at once freed her to focus on selling her diverse beans, a more marketable crop than hybrid maize in the Ozumba market – but she shook her head in lament at receiving such a low price for her maize. The granary price was less than a tenth of the price she would have received had she sold the same maize by the cuartillo.

In contrast to hybrid maize, only the most unsightly *criollo* maize, marked by pest damage and mottled in color, is sold for as low as $8/cuartillo. Small, damaged maize is typically sold as animal feed. Medium-sized grains sold for household consumption fetch slightly higher prices. Grains with pure, bright color can be sold for even higher prices to food vendors or choosier consumers. The largest kernels, unadulterated in color and unmarred by any pest damage, are carefully selected and sold at the highest prices as seed suitable for planting. At the same time, the distinction between seed and grain is mutable; it is quite common for farmers who can't afford the highest priced seed to purchase lower-quality maize for planting that someone else might consider to be grain.

[137] I conducted the survey with this woman because she was super gregarious and located in the maize section so she saw me every week and started poking fun at me, asking why I never interviewed her, she was a farmer too. So I did.

White *Chalqueño* maize – including both “blanco” and “cremosa” varieties, which are sold at similar prices for similar uses – makes up the majority of maize sold in the *tianguis* and starting prices range from $8-15/cuartillo. White maize has been dominant in the region since at least the 1990s (see Perales 1998).

The category of Blue *Chalqueño* maize includes maize called “azul” (blue) or “negro” (black) because the maize is all the same color: blue/black outside that turns white by the tip, is chalky white inside, and produces blue tortillas. Blue *Chalqueño* makes up a somewhat smaller yet substantial portion of maize for sale in Ozumba. Because it is considered more delicate to cultivate (more sensitive to pests and poor weather), and because the nutty flavor and smooth texture are highly valued for making tortillas, tlacoyos, and atole, it tends to fetch slightly higher prices than white maize of comparable quality; starting prices range from $8-17/cuartillo. Blue *criollo* maize is a favorite of food vendors and is highly prized for serving at parties and special occasions. In certain communities where blue maize is grown in large quantities, it is also preferred over white maize for households’ daily tortilla consumption.

Red *Chalqueño* maize is considered more delicate still and starting prices range from $12-15/cuartillo. There were only a small handful of farmers offering red maize for sale (five on the day of the market survey) and none of these could explain to me the intended use of this color maize. I learned through discussions with other farmers, that is possible to use red maize for anything from animal feed to human consumption to planting, though the male farmers who happened to be selling it in Ozumba on this day reported no perceived benefit that would seem to justify the higher price. It was only after consulting a group of older women, selling white maize nearby, that I learned red maize, especially the luminous brick-colored variation known as *xitocle*, is considered to have medicinal benefits, especially for young children suffering from high fevers. They told me that if you prick the child's arm with raw maize kernels, it will ease the fever. Atole from red maize is also supposed to calm an upset stomach.

Cacahuacintle maize, sometimes called "pozolero" here,[138] makes up a substantial portion of the maize sold in the *tianguis*, slightly less than that of blue maize, and fetches the highest average prices out of all the maize varieties. Possibly for this reason, it is also the most likely variety to be produced and sold as an extra source of money by farmers who otherwise sell primarily herbs and tree fruit and who cultivate only a very small plot of maize. Such farmers are typically not selling their wares in the maize section of the *tianguis;* as you walk through other sections, where local smallholders display a collection of piles of various homegrown fruits and vegetables, any maize for sale here is almost certain to be *Cacahuacintle. Cacahuacintle* maize that has not had the tip or germ, removed, and is thus viable for planting or other uses, ranges in price from $8-27/cuartillo. *Cacahuacintle* with the tip removed ("despuntado" or "decabezado") is sold ready to cook in pozole and can reach prices as high as $30/cuartillo.

[138] In recent decades, this variety has undergone significant changes in appearance through farmer breeding and seed selection so as to change it into "pozolero." It's name comes from the Nahuatl word for peanut (cacahuatl), because the kernels used to resemble the legume. Since gaining popularity among consumers and small-scale farmers, the variety has developed much wider kernels, a shape deemed better-suited for use in pozole, a traditional local stew.

I also found three anomalies in the market survey, which were not present regularly on other days: one farmer was selling a rare, bright yellow *criollo* ($12/cuartillo)[139], another was selling a red *pozolero* maize of unidentified variety (not *Cacahuacintle* in appearance, likely *Ancho*) ($14/cuartillo), and one farmer was selling what he identified as “semillas mejoradas” (yellow, $10/cuartillo).

When asked why they chose to plant criollo varieties, most farmers referenced their perception that criollo maize varieties were more profitable than hybrid varieties, given the dramatically higher prices they receive in the tianguis. Farmers also consistently emphasized that they believed criollo varieties to be more marketable than hybrid varieties; that is, more appealing to consumers and more highly in demand, so as to reliably sell at a profitable rate. This perception was based on their particular experiences selling maize in the Ozumba tianguis, but also reflects their consideration of other options, including selling maize in other markets. For example, many farmers described having consistent access to the Ozumba market. Here, anyone can offer their wares for sale, as long as they have transportation, time to spend on market day, and the means to pay the modest municipal fee for a vendor space. In contrast, several farmers mentioned that the coyotes, or intermediaries, who travel from small town to small town buying hybrid maize for industrial processors, can be unreliable. These farmers gave several reasons, including that the coyotes come inconsistently, might abruptly decide not to visit their town, and don’t always pay a fair price. It was not clear whether these farmers were relating their own personal experience with coyotes, or speaking secondhand of the experiences of someone else. However,

[139] See Chapter 7 on Farmer Livelihoods for additional details on this case.

this perspective was common among farmers selling criollo maize in the tianguis, and it clearly played a part in their decisions to continue doing so.

Farmers describe enough of a consistent demand for their criollo maize in the tianguis that most continue to attend, rent a vendor space, and sell their maize year-round. Food cart vendors, in particular, rely on a steady supply of high-quality maize with which to make the tortillas, tlacoyos, and other antojitos (snacks) that they sell. Both maize farmers and food vendors at the Ozumba tianguis with whom I spoke observed that small food vendors, especially those who run pop-up or mobile food carts, often lack adequate storage for a long-term supply of the maize they use, and instead stock up regularly, even weekly, from the Ozumba tianguis.

From my observations, two additional factors seem likely to reinforce the conviction among criollo maize farmers in the region that the Ozumba tianguis is a reliable market for their maize. First, the economic relations involved are relatively simple and transparent, at least as compared to those for commodities in speculative financial markets. In the tianguis, producers are selling directly to consumers, and making their own decisions about what price to ask and whether to add value to their maize with additional processing steps. These decisions are made in the presence of other producers, who are selling their maize next to one another in the public market, and using the same shared information as the basis for their pricing decisions. Second, producers and consumers are overlapping and intimate populations. Maize farmers know their customers and see them every week. They also know one another. If a maize farmer runs out of her own supply before the next harvest, she may buy from another producer selling in the tianguis to provide for her own household consumption. Farmers also regularly purchase maize for seed from one another, and rely on longstanding relationships of *confianza*, or trust and reciprocity, in their seed networks. Trust is a crucial factor in seed exchange networks, for securing high quality seed and for arranging favorable transaction terms (see Badstue et al 2007), and the farmers with whom I spoke expressed high confidence in determining who was trustworthy in the tianguis.

Of the farmer survey participants, those who grew and sold exclusively criollo maize frequently commented that the prices of their criollo maize were “stable,” “dependable,” and “constant,” as opposed to hybrid maize prices, which they described as “unreliable,” and “vacillating.” Since they relied on selling their maize as a primary source of household income, these farmers framed price stability as an advantage of criollo maize. From our conversations, I have identified three dimensions to maize price stability, as described and perceived by farmers selling criollo maize in the Ozumba tianguis: 1) short-term maize price variance in the tianguis versus in the global commodities market; 2) change in the price of one category of maize (by germplasm type, variety, color, size, and quality) sold in the tianguis relative to another category sold in the tianguis; and 3) change in all maize prices in the tianguis from month to month and year to year.

When weighing the first dimension, farmers describe observing that the prices for their criollo maize in the tianguis have only fluctuated by a few pesos per cuartillo in recent years, whereas prices for hybrid maize grain in the global market could skyrocket or depreciate without warning, and farmers relayed vivid memories of hybrid tortilla prices doubling and tripling in a single year (see discussion of “tortilla crisis” in Gabriel chapter).

When assessing the second dimension of price stability for themselves, farmers explain to me that the different categories of maize sold in the tianguis “change together,” meaning when one increases slightly, the others tend to as well. From my own observations in the market, the prices for different categories of maize did appear to be tethered to one another. For example, if the price for high-quality blue *Chalqueño* maize rose from $15/cllo one month to $16/cllo the next month, the price for high-quality white *Chalqueño* maize would also rise, from $14/cllo the first month to $15/cllo the next. While prices did exhibit modest fluctuation during the time period in which I was observing them, the relative difference between categories of maize remained constant.

When discussing the third dimension of price stability, farmers seemed less confident in their assessment of trends in the tianguis. Multiple times, when asked about what maize types they plant and why, farmers would begin answering with a description of the reliably higher prices they can ask for criollo maize, and then would falter, seeming unsure as they tried to describe their predictions for the coming season. Several farmers asked me if I knew why prices were a peso per cuartillo lower than this time last year, or whether prices would rise in the year to come, or why it seems that fewer customers are coming to buy maize in the tianguis than in years past. To such entreaties, I could only apologize that I am not an economist and have been unable to find any economic studies of markets like this one with which one might make predictions of price trends. While much more research is needed to understand how this kind of peasant market differs from commodity markets that are subject to financial speculation, these farmers clearly express an anxiety about decreasing demand for the products upon which their livelihood depends. The tianguis offers a more direct relationship between producer and consumer than global commodity markets, which these farmers perceive as providing a necessary degree of security in a landscape of economic risk, as granting them a level of autonomy and control over the terms of trade of their harvest. However, as their anxiety indicates, this degree of livelihood security is tenuous.

Additional Maize Products

Criollo varieties fetch higher market prices than hybrid varieties, for those farmers selling in Ozumba. Those who cultivate *criollos* often harvest additional maize products beyond the kernels themselves, a valuable benefit that hybrid varieties do not offer. These include the stalks and cobs, which can be used or sold as animal feed, and the husks, which are sold as wraps for cooking particular food dishes. Animals – including cows, horses, mules, and donkeys – that will readily consume the stalks of *criollo* varieties, tend to refuse to eat the harder, less palatable stalks of hybrid varieties. This is reflected in the sale prices of different types of maize fodder in the Ozumba market. A bale of pure *criollo* stalks typically sells for $50-60. Hybrid stalks are not sold on their own, but rather mixed with *criollo* stalks, a combination which most animals reportedly will eat. However, the higher percentage of tough, indigestible cellulose in hybrid stalks means that they provide less nutrition, and some farmers report a higher incidence of impaction colic and other digestive troubles among animals fed with hybrid fodder. A mixed hybrid-*criollo* bale is typically sold for $35, those with a higher portion of husks included (as opposed to stalks) sell for $40/bale.

Ojas, or maize husks, for culinary use are a thriving sector of the Ozumba market, and a valuable opportunity for additional income for local maize farmers. However, only husks from *criollo* maize are suitable for the culinary market. The husks from hybrid maize are small and brittle by comparison and considered unsuitable for use in food preparation. Husks from *criollo* maize make up a substantial section of the *tianguis* – there is an entire alley dedicated exclusively to *ojas* – and these vary in price depending on their size. The smallest husks, used for wrapping and steaming small tamales (*tamales de frijole*, or bean tamales) sell for $10/packet. Larger husks for most kinds of tamales (including those filled with meat) sell for $12-16/packet, and the largest husks (more than a foot long, used for wrapping *mixiotes*) sell for $30-35/packet. *Criollo* maize husks represent a significant additional profit from a single harvest that harvests of hybrid maize do not yield.

Failures in Hybrid Seed Input Chains

According to my participants, the single entry source of hybrid seed in the Amecameca Valley is SEDAGRO, the Secretaría de Desarrollo Agropecuario, or Secretary of Agricultural Development. Four out of twelve farmers who cultivated hybrid maize in 2011 purchased their seeds directly from the SEDAGRO agricultural extension office located in the town of Ayapango for $700/bag (these farmers reported planting approximately one bag of seed per hectare). Six of the twelve farmers purchased hybrid seeds from SEDAGRO representatives at a promotional fair in the town of Juchitepec, and another recycled hybrid seed purchased from a fellow farmer in the Ozumba market (whose hybrid seeds had themselves been purchased from SEDAGRO). The experiences of these farmers highlight serious flaws in the transfer of technology from government support agencies to farmer networks. Farmers who purchased hybrid seed directly from SEDAGRO representatives seem to have received very little technical information about the seeds. Only one farmer, who had purchased his seeds from a store in Morelos, expressed familiarity with the idea that hybrid maize was designed to be grown at a higher density than *criollo* maize in order to increase the yield per hectare; the other eleven planted their hybrid maize plants the same distance apart as they did their *criollo* maize. While it was common knowledge that hybrids were "thirstier" than *criollo*s, more demanding of water and fertilizer, none of the farmers reported receiving guidelines regarding fertilizer or herbicide application or other recommended cultivation techniques for hybrid maize in these rain-fed high-altitude valleys. In addition, none of the farmers expressed familiarity with the concept that hybrid seeds do not breed true and that they cannot be recycled without dramatic losses in productivity and quality, but rather are designed to be purchased anew every season. In the Amecameca Valley, small amounts of hybrid seed have been incorporated into a *criollo*-based network of farmers in which maize-as-seed and maize-as-grain are interchangeable in important ways. In this network, the consequences of a lack of information about commercial hybrids are greatest for the farmers with the fewest resources: the poorest farmers cannot afford to buy the highest quality maize seed offered in the market, and tend to compromise by planting lower quality, less expensive seed. Since its introduction into the Ozumba market, hybrid maize has presented an attractive potential alternative to resource-poor farmers: higher quality hybrid maize, as assessed by color and size, sells for the same price as very low quality *criollo* maize. The single farmer in this study who planted recycled hybrid maize had become interested in hybrids after hearing praise for their high yielding qualities from government programs. Unable to afford the high prices for hybrid seed charged by the SEDAGRO office, this farmer purchased hybrid maize from a fellow farmer's harvest at the low prices of the Ozumba market, unaware of the biological differences between these seeds and open-pollinated maize. His hybrid harvest yielded ears that averaged 8cm in length, less than a third the average length of *criollo* ears for sale in the market, and kernels 0.5cm in length, compared to *criollo* kernels averaging 4-5 times that size. In cases such as this, the lack of transparency of the hybrid maize seed system produces a potentially devastating harvest for the very farmers who are least able to afford it.

Conclusions

Small-scale commercial farmers in the study area experiment with different types of maize varieties, but generally perceive *criollo* varieties as superior to hybrid varieties. Hybrid maize has some advantages, particularly for farmers in pest-ridden areas, but these seem to be outweighed by the disadvantages related to consumption, marketability, and profitability. Farmer comments suggest that *criollo* maize is highly valued because it is better adapted to the environmental, cultural, and economic conditions under which these farmers live. A qualitative analysis of farmers' perceptions and their market practices reveals a more detailed picture. These commercially-oriented farmers value a diverse array of traits, from agronomic performance to seed quality, ease of degraining, and culinary use.

Marketability is the primary goal of maize production for these particular farmers, whose livelihoods rely on selling a large portion of their harvest, though this goal is not unrelated to the secondary goal of household consumption. Farming households typically subsist off a portion of their harvest, in addition to relying on the income from selling it, and farmers are selling directly to both fellow farmers looking for seed and to customers seeking grain for household and retail food production[140]. This study also highlights the important role of additional maize products in regional markets, particularly maize husks and the stalks and cobs used as animal fodder.

The results presented here highlight the ongoing inadequacy of a simplistic concept of yield by which to evaluate the impact of a given maize variety on farmers' well-being. As others have argued, it is necessary to consider the range of traits valued by farmers, and the trade-offs associated with the maize germplasm available (see Bellon *et al* 2006). Farmers have different ways of measuring yield – by volume, by ears per stalk, by ear size, and by kernel size – beyond the development and industry standard of grain tonnage per hectare. How farmers prefer to measure the productivity of their maize depends on how they intend to use what they harvest. For those who intercrop beans or squash with their maize, or who plan to sell the maize stalks and husks and huitlacoche, as well as the kernels, it makes little sense to exclude these other products when assessing the yield from each hectare. When so many farmers in the region grow farmer-bred varieties of maize, and high quality criollo seed fetches such a high price in regional markets, it's bad business to apply the reductive metric of grain to one's entire harvest. And, when farmers sell their maize to consumers directly, they use the volumetric *cuartillo* to measure the kernels; there's never an opportunity to weigh a whole hectare's worth at once.

[140] Quality is therefore a top priority for both producer and consumer perspectives, and is the most immediately reinforced metric of harvest value, given that producers are interacting directly with consumers, receiving feedback on perceived quality, and negotiating higher prices per volumetric unit of sale according to these perceptions.

The standard measurement of yield fails to fully serve the diverse dimensions of productivity used in the livelihood decision-making of these small scale criollo maize farmers. Furthermore, these findings underscore how different cultivation practices themselves determine the yield of different germplasm. In traditional cultivation systems and highland agronomic environments, *criollo* maize may outperform hybrid maize, even those hybrid varieties designed for high performance in "marginal" environmental conditions. This study demonstrates that *criollo* maize is perceived as more profitable and more productive than hybrid maize in the context of local and regional markets designed around the needs of small scale maize producers and consumers.

These findings also emphasize the importance of diverse economic practices to smallholder livelihoods. Alternative markets and not-necessarily-capitalist economic relations (see Gibson-Graham 1996; 2008) will require more serious attention from interdisciplinary scholars and development practitioners if we are to better understand and support the wellbeing of all the lives, including human ones, at stake in diverse agroecosystems. It is conventional within development circles to talk about the challenge of "enhancing smallholder farmers' access to markets," (Meijier, Hellin, Lundy 2007: 41). The markets in question in such discussions are invariably those of a global agricultural economy, in which small-scale producers are at a severe disadvantage relative to their larger competitors. Just as creating markets is seen in such circles as a "top-down" venture initiated by national and international elite actors, so too is "enhancing" access for systematically excluded social groups, typically through government subsidies and support from not-for-profit non-governmental organizations.

In contrast, the Ozumba *tianguis*, which supports thousands of smallholder households from all across the Amecameca Valley, exists despite decades of concerted efforts by the leaders of national and international agricultural development to eliminate the smallholder sector. Behind this municipal market is a social and economic community sustained by the women and men who come together twice a week to buy and sell products for which no other market exists. And this site of exchange feeds into myriad other social networks in the countryside, small towns, and urban neighborhoods across the region where people cultivate, craft, and use these products as a central part of their everyday lives. That there is a supply and demand for *criollo* maize at all, let alone markets in which to exchange it, stands as a critique of the trajectory of Mexico's national neoliberal agricultural restructuring.

After studying maize farmer livelihood decision-making, I do not claim that everyday practices and intimate socio-ecological relationships at play in the Ozumba tianguis constitute a radical movement to overthrow industrial food regimes. These farmers do not articulate direct opposition to hegemonic agro-industrial complexes; in fact, if asked, most would state firm if reserved support for the promises of agricultural modernization, while expressing skepticism toward the purported benefits of existing modernization initiatives. I do claim that the provocative patterns of persistent maize diversity in these highlands, on the edge of Mexico City, adjacent to global hubs of agricultural development, are not coincidental, and they are not vestigial. Peasant farmers in this region are deliberately and creatively building their lives around the maintenance of diverse maize populations as part of a complex and somewhat contradictory livelihood strategy in the midst of great volatility and conditions of food insecurity.

The work of these small-scale farmers to maintain their local maize, and the degree of economic autonomy that comes with it, presents a challenge to the state's assumption that integration into a global agricultural economy is inherently desirable, a "benefit" of globalization that development ought to extend to poor, small-scale farmers. In the face of renewed state efforts to dismantle the peasant economy, the *campesinos* of the Amecameca Valley continue to work in ways that call into question the premise of a homogenous agricultural modernization through their innovative breeding, cultivation, and marketing of *criollo* maize.

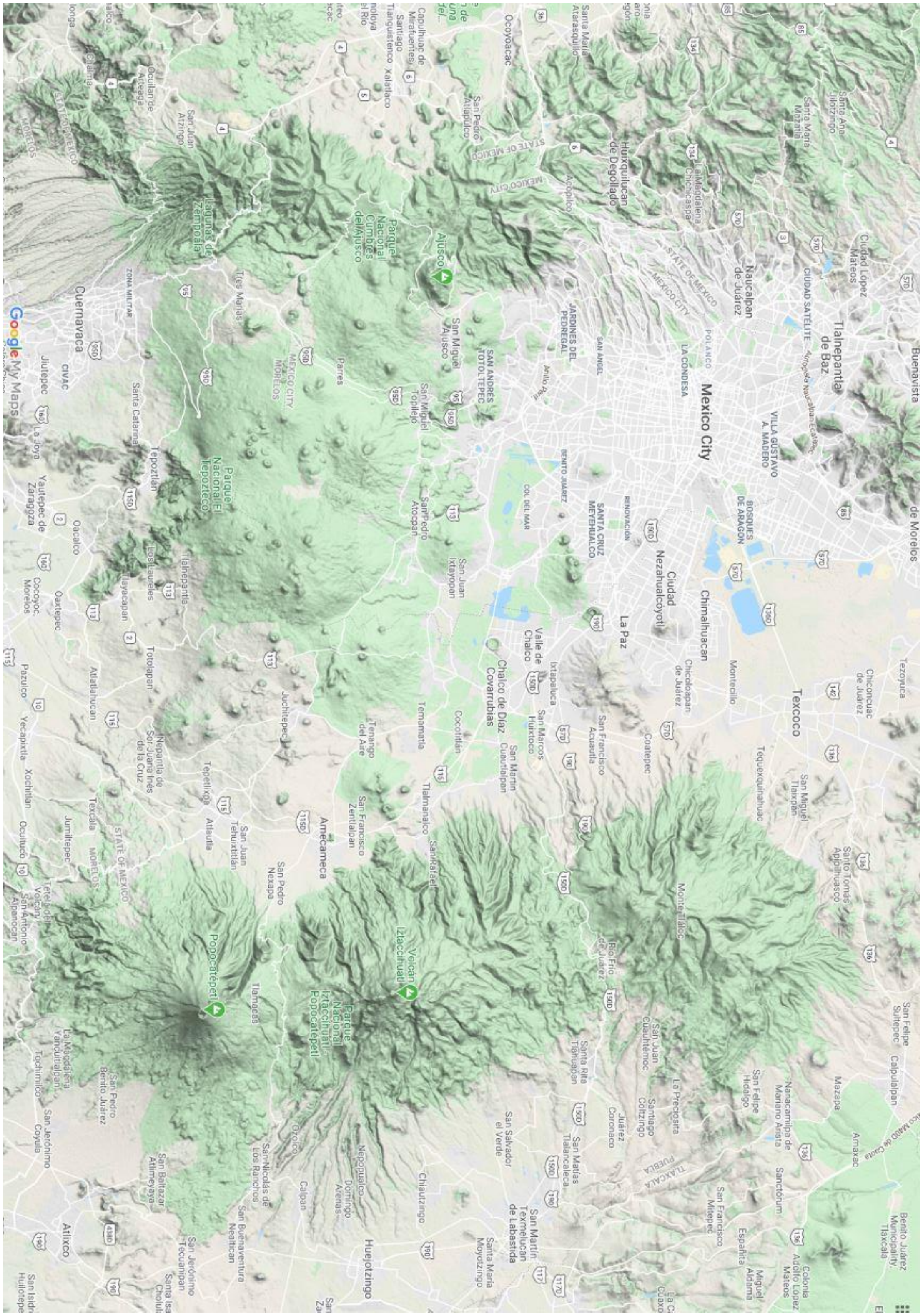

Figure 6: Map of Amecameca and Texcoco Valleys

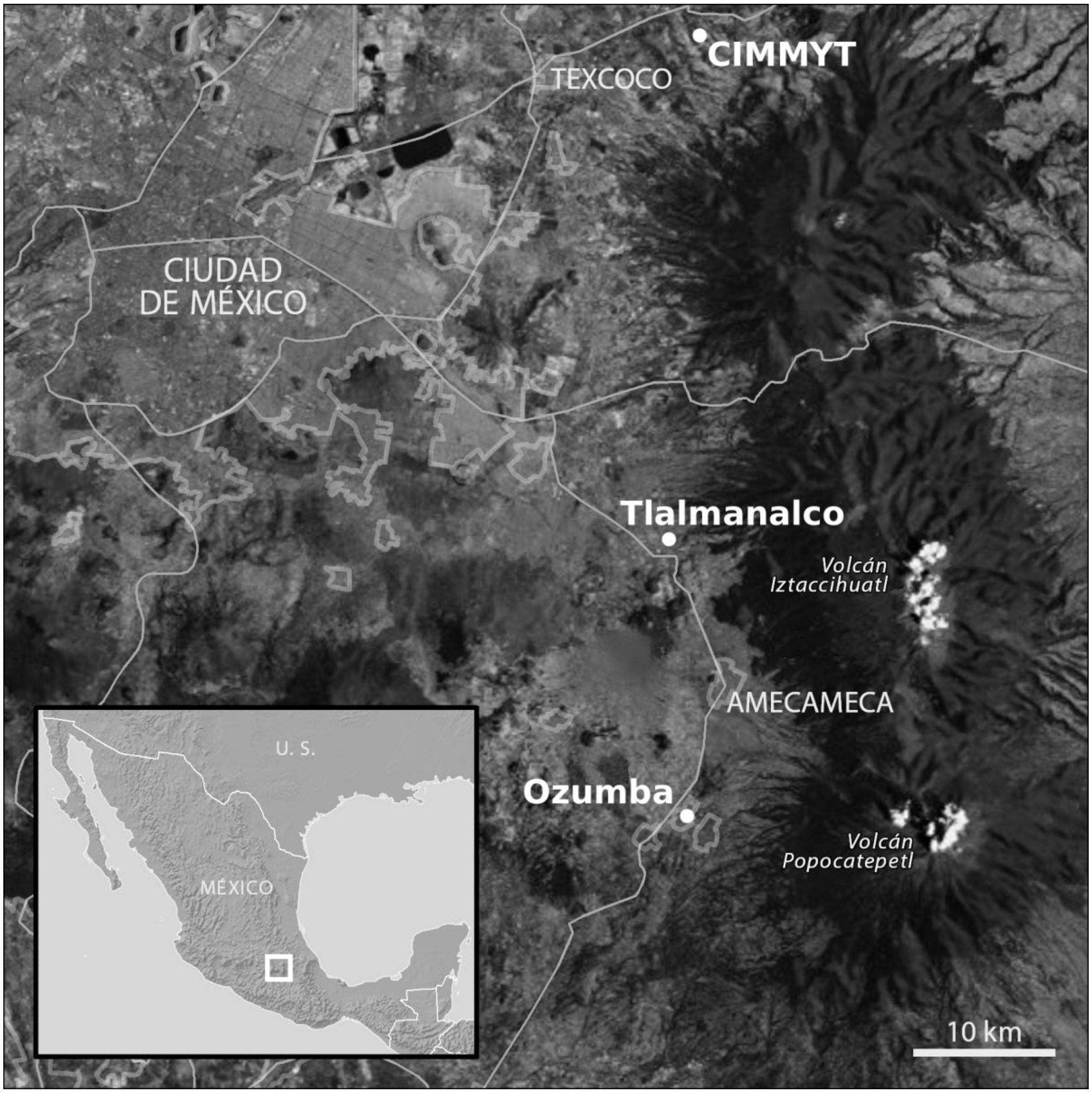

Figure 7: Map of Research Sites

Figure 8: Street Map of Central Ozumba

Figure 9: Satellite Imagery of Central Ozumba on Market Day (colorful overhead tarps visible on streets where tianguis venders have set up their stalls.)

Table 1: Snapshot of maize product prices in Ozumba tianguis during April 2012; total maize vendors = 137

	Maize Type	Price (pesos)					
		SEED/GRAIN	**COB**	**TORTILLAS**	**HUSKS****	**STALKS****	**HUITLACOCHE****
Criollo Maize, n = 131	White *Chalqueño* n = 77	$8-15/cllo* Average: $10.91	$7-10 each	$12-15/kg	$5-35/packet Average: $13.14	$50-60/bale	$40-60+ per kilo
	Blue *Chalqueño* n = 45	$8-17/cllo Average: $11.69	$7-10 each	$12/doz			
	Red *Chalqueño* n = 5	$12-15/cllo Average: $13.00	$7-10 each	--			
	Yellow *Chalqueño* n = 2	$10-12/cllo Average: $11.00	--	--			
	Cacahuacintle n = 34	$8-27/cllo Average: $18.00	$13 each	$12-15/kg			
	Uncertified Hybrid Maize° n = 12	$6-9/cllo Average: $8.25 or $3,500/ton***	$8 each	$12/kg	--	$35-40/ bale****	--

*a *cuartillo* (cllo) is the standard (volumetric) measurement used in the Ozumba *tianguis*
**husks, stalks, and huitlacoche can come from any *criollo* variety and are not sold as variety specific
***this price represents a reported sale to an intermediary outside the Ozumba *tianguis*
****a mix of hybrid and *criollo* stalks, rather than pure hybrid
°Hybrid seed that is farmer-saved, rather than certified first-generation seed sold by a licensed retailer

Table 2: Maize-Producing Localities Represented in Ozumba tianguis April 2012; total maize vendors = 137

NAME OF TOWN	FARMERS	*CRIOLLOS*	HYBRIDS	SEED ORIGIN
San Juan Tehiuxtitlan	30	30	1	Farmer-saved (*criollos*); SEDAGRO* (hybrids)
Juchitepec	26	23	3	Farmer-saved (*criollos*); SEDAGRO* and technology expo** (hybrids)
Tepetlixpa	18	18	1	Farmer-saved (*criollos*); inputs store in Morelos (hybrids)
Cuijingo	16	16	2	Farmer-saved (*criollos*); SEDAGRO* and technology expo** (hybrids)
Ozumba	11	8	5	Farmer-saved (*criollos*); SEDAGRO*, Ozumba store°, and tech. expo** (hybrids)
Atlautla	8	8	0	Farmer-saved (*criollos*)
Ecatzingo	6	6	0	Farmer-saved (*criollos*)
Tetecalco	5	5	0	Farmer-saved (*criollos*)
Ayapango	5	5	0	Farmer-saved (*criollos*)
Amecameca	4	4	0	Farmer-saved (*criollos*)
Tenango	2	2	0	Farmer-saved (*criollos*)
Atlatlahucan	1	1	0	Farmer-saved (*criollos*)
San Diego Huehuecalco	1	1	0	Farmer-saved (*criollos*)
San Pedro Nexapa	1	1	0	Farmer-saved (*criollos*)
Santiago Mamalhuazuca	1	1	0	Farmer-saved (*criollos*)
Tlalmapa	1	1	0	Farmer-saved (*criollos*)
Zoyatzingo	1	1	0	Farmer-saved (*criollos*)

*Regional SEDAGRO office located in Ayapango
**Technology exposition fair, located near cluster of agricultural input stores in Juchitepec
° recycled, uncertified hybrid seed

CHAPTER 6: FARMER LIVELIHOODS

Early April is maize-planting season in the Amecameca Valley of Mexico's Central Highland region. Farmers from all across this tumbling, volcanic landscape head out to their fields at dawn, bringing with them family members, neighbors, friends, and large sacks of seed – the very highest quality kernels, carefully selected and saved from last year's harvest. Many households till the soil using a tractor, which is often shared among a group of farmers from the same town; some use a horse- or mule-drawn plow. On one 6-hectare farm – much smaller than industrial-scale maize farms, but several hectares larger than most farms in this region – a family is planting blue Chalqueño maize by hand. This family owns their own tractor, which pulls a four-bottom moldboard plow attachment, churning the earth in its wake. Those who aren't engaged in plowing walk behind the plow, sowing seed with a series of deft moves synchronized to each step: while one hand holds a shovel and uses a plunge-twist-lift maneuver to make holes in the freshly-turned soil, the other snatches precisely four maize kernels from a waist-bound bag and drops them into the fleeting hole before the lifting shovel fills it once again with earth. In a few weeks or so, some family members will return to plant beans and squash in the same field; the maize is given a head start, since it has the longest maturation period and will serve as a trellis for the bean vines. By ten o'clock, the sun has begun to warm the cold mountain air, and a hearty lunch is on its way from home along a dusty track to the workers in the field. Stewed beans, quelites with salsa verde, a reused yogurt container full of homemade pickled chilies, jugs of cold pulque, and stacks of fresh, homemade tortillas made with blue Chalqueño maize from the same harvest as the seed being planted that day. Depending on the frequency with which large rocks trouble the plow, and on the endurance of the tractor (or draft animals), it can easily take until dusk to finish sowing a typical one-hectare plot. Farmers have grown maize in this valley for millennia. Diverse varieties of white, blue, red, yellow and mixed-color maize have been developed and specialized to local usage and agronomic conditions over countless generations of careful seed selection, experimentation, and exchange. Many households grow maize both in the campo – the cultivated fields surrounding each small town – and in backyard gardens, where it is often integrated with myriad kinds of vegetables, flowers, tree fruits and nuts, and medicinal and culinary herbs. The blue Chalqueño planted in early April won't be harvested until the late fall and winter months, when the ears have fully matured and dried on the stalk. A portion of this harvest will contribute to household consumption, while the rest will be sold as seed (for planting) and grain (for eating) in the local tianguis, or weekly municipal street market. These cultivation practices draw on knowledge systems and genetic resources that have been maintained in the region for generations upon generations, and yet such persistence takes on new significance in the current context of agricultural globalization.

The Amecameca Valley is neither remote nor isolated: it is less than forty kilometers and connected by major highways to both Mexico City and the Valley of Texcoco, a metropolitan hub of national and international agricultural research and extension. Members of farming households here, who tend to have above-average income and education levels relative to surrounding valleys , are following national trends of reinvestment in peasant cultivation practices and varieties of maize in response to declining opportunities in more urban and industrial sectors. Despite more than seventy years of concerted government efforts to effect the adoption of commercially bred hybrid maize seed, the overwhelming majority of farmers in this region continue to cultivate locally adapted, genetically diverse varieties of maize (criollo is the vernacular term) season after season.

In this chapter, I examine more closely the household resource base and livelihood decision-making of smallholder maize farmers from across the Amecameca Valley. I begin with a brief explanation of data collection methods used, describing how structured livelihood surveys and participatory observation build on the findings from the Ozumba market survey. I then discuss the results of this livelihood study, particularly the role that less-capital intensive maize cultivation and criollo varieties can play in supporting the dynamic resource base on which household subsistence and incomes rely. The chapter is organized around questions asked in the structured livelihood survey, though the participants' responses and my interpretations thereof regularly exceed the survey framework, and require that I reconsider the assumptions behind my research design. This chapter concludes with a discussion of the implications of these findings for a Household Resources

Almost all participants live in intergenerational households. The number of household members ranged from one to thirteen, with a median of 4.5. Of the 21 participating households, two consisted of unmarried men who lived alone, and two consisted of a husband and wife who lived as a couple. One household consisted of an unmarried woman who lived with her mother and had taken over the family farm following the death of her father. All other households included at least three people; the men and women selling maize in Ozumba tended to share their home with some combination of their parents, their children (both school age and adult), and occasionally even siblings, grandchildren, and grandparents. The largest participating household comprised thirteen individuals: my two participants, a 56 year-old woman and her 60 year-old husband ; his father; their five sons, ages four to thirty-three; a thirty-three year-old daughter-in-law; and five grandchildren, ages three to seventeen. This household was one of only two out of twenty-one participating households in which the primary maize vendors lived and farmed outside of their birth town.

My reference to primary maize vendors here is a deliberate reorientation away from the more conventional focus in livelihood and development studies on “head of household,” “primary wage earner,” or “breadwinner.” Many in feminist, peasant, and agrarian studies have provided convincing critiques of the “head of household” framework (CITE). Beyond the long history of denying women access to resources, such as public benefits, and eclipsing their work behind a male partner (where one exists), the focus on a “head” of household works to obscure the internal power relations within the household (McDowell 1992; Chant 2020)[141]. Though my research does not investigate intra-household power dynamics directly, it does seek to contribute to our understanding of such dynamics through a partial unpacking of the household economy, and an analysis of which members are engaged in which maize-related tasks.

This approach begins with inquiry, rather than assumptions, about who does maize work, and what role this work plays in the household economy. At the same time, I do make several important normative assertions through this research. Two of the most pertinent to this chapter

[141] Concepts of “primary wage earner” and ”breadwinner” are particularly problematic and distorting when applied to a dual-economy peasant household, where subsistence production is of existential importance.

are: 1) that the labor of maize production goes beyond the farm field, and 2) that we therefore must expand our consideration of who counts as a maize producer. These are not original assertions. I draw on a wealth of scholarship on the political ecology of social reproduction (see Katz 2004 and OTHERS), which demonstrates that the modes of economic production traditionally recognized as valuable in the formal capitalist economy are reliant on (and exploitive of) whole worlds of undervalued work and lives. The lens of social reproduction makes visible a more complete picture of everyday work. In the case of smallholder maize production in Central Mexico, we can see a form of commercial maize production not anticipated by conventional economic models, in which genetically-diverse farmer-bred maize varieties and women's decision-making authority are at the center of an intergenerational household resource base. In this mode of maize cultivation, commercial and subsistence production exist on a spectrum, marked by meaningful degrees of autonomy from global commodity markets. For some farming households, particularly the ones in focus in my research, commercial and subsistence maize production are interdependent. To the degree that such dual-economy households may be uncommon, their everyday lives make legible the kind of intimate social and ecological relationships through which we organize resource access the world over.

The remainder of this section explores some key household resources, and concludes with a reflection on the gendered patterns of intra-household resource governance that emerge from the livelihood survey and participatory observation.

Education and Knowledge Production

Farmers selling their maize in the Ozumba tianguis have wide-ranging levels of formal education. Of the twenty-six farmers surveyed, sixteen did not attend school beyond primary education, six attended some secondary school (the equivalent of junior high or middle school), and four attended a preparatory high school or earned a higher degree. Among those aged 50 and older, lack of access to school was a reoccurring theme in our conversations. Many participants framed their education level as a regrettable absence, responding to my question "what is your education level?" with phrases such as "lamentably, no more than primary school," or "nothing more than kinder[garten]." One woman in her forties who, along with her husband, had left school at the secondary level, elaborated: "Here in the campo, it's very backwards, we don't even learn English." This pattern stands as an indictment of rural divestment, but even more so as a contrast between how the state and rural communities value education. Though most participants were not afforded an opportunity to pursue as much formal education as they wanted, they expressed a deep commitment to the value of school. Most farmers with only primary or secondary education had encouraged their children to attend school for much longer than they had themselves. A woman in her late seventies who left school at the primary level spoke proudly of a son with a college degree in chemical engineering working at a factory a few valleys over. A woman in her fifties had likewise left formal education after primary school, and was determined to get all five of her children through secondary school and encourage them to attend college. Another woman in her fifties who said she had never attended school, told me that she "made sure" all six of her children completed secondary school "except the one who really didn't want to" who had moved to Florida to work in the hospitality industry instead.

At the same time, farmers expressed recognition that formal education was not any guarantee of a job or stable livelihood. As one woman explained, while discussing her eldest son's desire to attend college, "who knows, it's so hard here [in rural Central Mexico], it's a good thing to study in school, but there aren't many possibilities here. He really wants to study." Though national and global economic restructuring was not the focus here, there are likely broader forces at play in the patterns of education and livelihood decision-making suggested by this research.

Among these patterns is a regularly-occurring tendency of those with higher education to return to small scale maize farming. One woman in her late forties had been enrolled in preparatory school until dropping out to return to the 3-hectare family farm when both her parents became ill. She has been growing maize ever since, and doing so on her own, after her father died ten years ago, while also caring for her mother, now 81 years old. She grows only Chalqueño varieties, both white and blue, because "they work." She especially appreciates how easy this variety is to degrain herself by hand, and how readily she can sell the ojas for a good price in the tianguis.

A young man in his 20s is working on his family's 6-hectare farm while studying for his bachelor's degree in customs and international business. In his family, his generation seems to be trending away from farming for a living – each of his sisters have bachelor's degrees, in public administration and accounting, respectively – but, for the moment, are each contributing to maintaining the family farm, growing the criollo maize that his family has been planting "since forever; my parents plant maize, like their parents, and their grandparents." They plant blue and white Chalqueño for sale, and some Cacahuacintle for household use, because “seeds from the outside don’t grow well.”

A father in his mid-40s living with his three siblings and two-year-old has a bachelor’s degree in informatics, but has been growing criollo maize “forever, all my life,” even while his siblings left for stints of contract labor in Canada. His sisters now work “in the home” and his brother works with him “in the campo.” Their three-and-a-half-hectare farm specializes in Cacahuacintle because it is in high demand in the market, and because the seeds “give and give.” When I inquired whether he did any other work for money, he responded with several minute’s worth of impassioned analysis about how the criollo maize market “yes, indeed, is profitable,” how criollo varieties “resist pests, resist rot, resist extreme weather,” and how this region is “puro criollo” and “the government wants everyone to grow hybrids” but hybrids “aren’t worth it” and “they don’t produce seeds” and “they are poor forage.”

A man in his late 60s has a Master’s degree, and told me he used to be a teacher in a nearby normal school (teacher’s training college), where he taught for “34 years, 7 months, and 15 days.” Without clarifying whether he had retired or left for other reasons, he explained that he has also “always” been working on the 2-hectare farm that he owns with his wife. Six years ago, they switched from growing criollo varieties to growing hybrids, because the hybrids are “more resistant to pests” and “less labor intensive.” (He rents a tractor designed for compatibility with hybrid seeds, allowing for mechanical planting.) Whereas most farmers selling in Ozumba do so for most, if not all, of the year, this man only sells his hybrid maize during April and part of May "because our harvest is so small."

Another pattern that emerges from these livelihood surveys is that of household members returning to criollo maize farming after periods of various wage work. One father in his 50s – now living with his wife, two sons, and daughter-in-law – had spent four years, during the 1990s, living in Canada and working under contract as an agricultural worker harvesting lettuce, broccoli, and carrots. Another man in his mid-50s, now living with his father, had worked in a New Jersey car wash for two years; his brother and sister each stayed there for four years before returning home themselves to central Mexico. One woman in her late 50s explained that her adult son, now working on their family's half-hectare maize farm, had gone to Florida for twelve years to work in auto maintenance. She joked "what was he doing all that time I don't know; he has nothing to show for it!"

In each of these three households, the family member returning from work abroad encountered a steep learning curve at home. Multiple maize farmers described a strikingly similar process of teaching their son or husband how to help in the market and on the farm. Some of this teaching came from men; a young farmer in his late 20s, who developed a renewed interest in the family farm after many frustrating years of trying to earn a living through odd jobs in Mexico City, turned to his grandfather to teach him which maize varieties grew best on their small plot of land and how to plant and harvest them. But the significant majority of farmers telling me stories of mentoring their adult family members in the ways of criollo maize cultivation were women.

While men were away – in another town, another city, another country – trying to earn a living at an off-farm job, women were often at home, maintaining a comprehensive understanding of how to live and work with criollo maize. This put them in the position of primary educator for anyone seeking to contribute to the family's maize-centered livelihood for the first time.

I was able to experience some of this education firsthand during my fieldwork in the region. Four women from three different households each took it upon themselves to mentor me in their household's seasonal livelihood practices. In this context, I was able to observe female primary maize vendors guiding much of the family's farming trajectory from season to season. Women's work includes those concrete tasks most involved in assessing the overall household production strategy: as they degrain the maize ears and sort the kernels by quality, the intergenerational cohort of grandmothers and mothers-in-law and daughters and sisters make note of any pest or weather damage, and whether some maize varieties tolerated the environmental conditions of the growing season better than others; as they tend their vendor site in the Ozumba maize market, they observe consumer trends and calculate which varieties are selling most readily; as they prepare daily meals for their families, antojitos to sell from their street cart, or elaborate dishes for a special occasion, women track the flavor, texture, and suitability of each maize variety.

Readily apparent in each of these work spaces, is that these women are consciously connecting their work with maize to the broader context of their household and community. Catching up within a family while working at home, and between families while working at the market, serves to disseminate the latest information about how current weather patterns have taken a toll on the harvest, or whose kid has graduated, taken a job in the city, perhaps secured American or Canadian contract work in El Norte. Women's work therefore involves coordinating much of the social, even ecological, relations that bind their communities, including fostering education (and notably advancing my own education by orchestrating a major component of my dissertation research). I noticed that my apprenticeship paralleled that of a recently-acquired daughter-in-law of one of the households – she and I were both tutored in proper tortilla formation together, joined the same de-graining circle, and sat in the market at the family's vendor site, learning how to measure a cuartillo and studying the nuances of how our mentor pitched the various piles of maize seed to potential customers. It occurred to me that our learning process might be quite similar to that of a father or sister or son returning from work abroad, or from studies out of town, to learn the ways of the family farm.

This dynamic – of adults apprenticing with their own family members – is a more concentrated illustration of complex knowledge production and exchange that is always at the heart of smallholder farming, especially an agricultural system wherein farmers are breeding their own crop varieties and directly managing their own market. In these criollo maize systems, collective livelihood practices shape an intergenerational knowledge base of selecting, processing, storing, cooking, and marketing maize kernels, in addition to planting, cultivating, and harvesting the different criollo varieties. We might call these knowledge systems "informal," so as to distinguish them from the so-called "formal" institutions of education, research, technology development, and extension. However, in making such a distinction, we must be careful not to assume a concomitant dichotomy of rudimentary/sophisticated, stagnant/dynamic, or rote/innovative. The complexity of these informal criollo maize knowledge systems, in which many in the Amecameca Valley are immersed from early childhood, have kept alive the biodiverse agricultural systems in this region, not to mention the cultural, political, and economic relations that depend on criollo maize. The living process of knowledge production and exchange enables maize farmers to make livelihood decisions in response to dynamic weather patterns, changes in their consumer base, and volatility in other commodity and job markets.

These knowledge systems are clearly a vital resource base for criollo maize farmers. Informal education may be a more accessible resource to many, given the historical and persistent barriers to obtaining a degree, accessing agricultural extension services, or benefitting from formal agricultural research. While the Central Highland region is not considered to suffer from lack of access to formal education relative to other regions of Mexico (see Perales 1993), higher education is nevertheless not accessible to everyone who would want it, nor does it provide reliable access to a stable livelihood for those who do obtain it. In this context, the informal education provided to one another by criollo maize farmers seems a valuable livelihood resource for a range of households in the region.

My findings suggest the importance of further research into gendered dynamics of knowledge reproduction within small-scale maize systems. Research elsewhere has demonstrated the importance of being seen as knowledgeable in female farmers' ability to wield decision-making power (see Sachs et al 2021). My research indicates that women are central educators and knowledge producers in the criollo maize systems of Central Mexico. These findings further suggest that criollo maize systems may more consistently offer women greater power and agency as farmers than maize production systems centered on a more exclusive access to seed exchange, crop breeding, and varietal selection.

What remains clear from my research is that intimate understandings of the ecologies, economies, and social meanings of criollo maize are central to the livelihoods of these farmers. The practices of informal maize education are a resource base, not only for those who are consistently engaged with criollo cultivation during their lifetime, but even for those who have taken time away from maize farming in order to pursue formal education or off-farm jobs. At the same time, informal knowledge is a living system, responsive to dynamic conditions and kept alive through the everyday collective practices of producing, reproducing, and passing along maize knowledge. This is labor intensive work and, in no small part, women's work.

Land and Water

The average farm size among my research participants was 3 hectares, with a range from 0.5 to 7 hectares. For many of these farmers, the total land they cultivate is an aggregate of smaller individual, rain-fed plots, sometimes accessed through mixed land tenure regimes; a given farmer may rent one parcel, own another, and have usufruct rights to a parcel of formally-communal ejido land. According to the land-management typology outlined by Keleman et al (2013), just over three-quarters of my survey participants (sixteen out of twenty-one households) would be categorized as "small-scale," (less than 5 hectares) while the remaining five households would be categorized as the very low end of "medium-scale" farmers (between five and thirty hectares).

Of the 21 households participating in the livelihood survey, three reported renting all the land they accessed, six said they owned all their land, six reported accessing all ejido land, and six said they accessed land through a combination of renting and owning it. Over the course of conducting the surveys, I learned that this question, as asked, did not reliably solicit the information I had initially anticipated. In close consultation with my local research assistant, before beginning data collection, I phrased the standardized survey question (Question 11, see Addendum) in terms of land tenure, asking participants "How much land do you farm? Is it ejido, private, or rented?" This question was designed to differentiate the most common forms of access with as much clarity as was practical. However, over the course of the survey, several participants defaulted to an alternative phrasing, using the term "propias" (my own) rather than "privado" (private) to categorize their land. When I first noticed my research assistant recording this answer as "privately owned land," I followed up, asking the participant if they meant privately-titled land, or rather a collectively-titled but individually-allocated ejido parcel. That particular participant seemed confused by my follow-up question and unsure of how to answer. A subsequent participant who likewise responded "es mi propia parcela" ["it's my own land"] was, upon further questioning, unsure as to whether theirs was ejido land or not. He was an ejidatario (a member of his local ejido) but, as his wife sitting nearby reminded him, they had registered their ejido parcel through the program PROCEDE. This left them unsure as to whether the land actually counted as private or not. Another ejidatario who said he "owned" three hectares in his ejido and "rented" three others, stated that he had "documented" his land through PROCEDE but, upon further questioning, wasn't sure whether his ejido's general assembly had taken the final vote to proceed with privatization and officially disband the ejido's communal land. Two other participants mentioned crucial information that my survey structure had failed to target directly: the plots of land that they rented actually belonged to existing ejidos, an arrangement which is illegal according to ejido agrarian law, though increasingly common since the implementation of PROCEDE (see discussion below).

The Program of Certification of Ejidal Rights (El Programa de Certificación de Derechos Ejidales y Titulación de Solares, known by the acronym PROCEDE), is a national land-titling program. PROCEDE was first initiated as part of a sweeping neoliberal restructuring of the state-agricultural relationship, which begun under Mexican President Carlos Salinas de Gortari (1988-1994). In concert with other agrarian counter-reform measures, PROCEDE was designed to facilitate the privatization of the ejidos.

For those ejidos that choose to participate, PROCEDE mandates an unwieldy process, the intended end result of which is to legalize the sale and leasing of ejido land. Feminist geographer Heidi Hausermann explores this convoluted process as it unfolded in one ejido community in the Mexican state of Veracruz, describing it as the "transform[ation of] 'usufruct fields' into official 'parcels,' via a bewildering array of bureaucratic trámites (procedures), involving cartography, notaries, and other forms of certification," to be followed by ejido general assembly voting according to complex requirements. Because this process is so long and complicated, some ejido land became mired in a prolonged legal limbo in which ejidatarios received certified boundary maps of their individual "parcelas" from INEGI, but their land remains communally titled through the ejido. Some of these ejidatarios set about making informal arrangements to rent or even sell this land, in violation of ejido agrarian laws, which still governed the land, since the ejido had never taken the final vote to complete privatization.

Compounding the broader procedural confusion is PROCEDE's formalization of the term "parcels" to legally signify former ejido land converted to private property. Ejidatarios have long used the term "parcelas" (parcels) to refer specifically to their assigned, individually-managed, usufruct ejido farming plots, and to distinguish them from "solares" (urban home gardens) or "tierras de uso común" (commons, often forested or pasture land where the resources are shared). It remains unclear whether this contradiction was a deliberate move by policymakers. Though Hausermann (2014: 797) wonders whether "policymakers perhaps intentionally incorporated the word in PROCEDE to build on ejidatarios' use of the word," I would argue that the new definition of "parcels" does not further develop the previous meaning so much as directly conflict with it. If policymakers were indeed fully aware of the legal significance of "parcels" within ejido agrarian law, then choosing this word over all other available terms for a piece of land seems more likely an attempt to obscure the premise behind the earlier (and ongoing) usage. In a country defined by agrarian revolution, there is great incentive to avoid overt language of privatization when trying to garner support from rural communities, and instead to borrow the legitimacy of a preexisting term. This cooptation of a common colloquialism need not be deliberate to effectively undermine informed community debate on land tenure.

Regardless of policymakers' intentionality, PROCEDE has, in practical terms, codified a schism while muddying the distinction. In the Amecameca Valley, like much of rural Mexico, many ejidos have entered the program, but very few have fully completed the tortuous process to convert their communal land into private property (see Hausermann 2014). This imposes a lack of transparency on the lived reality of those who farm in such a landscape. In the everyday lives of smallholders, a single term – in fact, the most common term of reference for the land that one farms, upon which one's livelihood depends – now simultaneously has two opposite and mutually-exclusive meanings, leaving some unsure of the tenure status even of land to which their family has had farming rights for generations.

It is beyond the scope of this research to verify the tenure status of the land farmed by participants, or even to parse the understanding each individual has of their own tenure situation. It is quite possible that the confusion among my research participants reflects the unevenness of expertise within a household; perhaps the household members most familiar with intricate ejido procedures and land titles are not their families' primary maize vendors, or simply happened to not be present at the time of my surveys. I am certainly confident that my own lack of expertise on the matter, combined with a youthful lack of experience in land ownership on the part of my research assistant, rendered my surveys less effective in soliciting such information than they otherwise might have been. These caveats aside, the obfuscating impact of the PROCEDE program's use of language is real and salient. By referring to communally-titled ejido plots as "usufruct fields" – an awkward term with no previous documented usage in colloquial speech or ejido governance, to the best of my knowledge – and appropriating the ubiquitous term "parcel," PROCEDE discursively erases the ejidal framework of land access on behalf of a program that seeks to eradicate the communal land tenure system. Even in a region like Amecameca, where ejidos have persisted and maintained local political support (see below), this loss of a distinctive name for ejido land is meaningful. Farmers who aren't sure whether their "parcelas" are part of a larger communal land holding are less prepared to organize to defend it.

With this context in mind, I am unable to derive reliable information regarding the land tenure arrangement of individuals from my livelihood survey data. There is a clear need for future research which more effectively examines the heterogeneity of land tenure regimes in the region, as well as smallholder knowledge of competing legal systems of property. Though my data does not reliably differentiate communally-titled from privately-titled land, it does confirm that these particular maize farmers access the land they farm through a mix of renting and ownership, whether communal or private.

My research likewise documents a lack of transparency regarding land tenure. It suggests an ambiguity within ejido structures and competing land tenure regimes. This concurs with other studies, which have more thoroughly documented the complex land tenure negotiations within smallholder communities (see Hausermann 2014). In addition, my research suggests a broader gap between farmer knowledge and the quantitative metrics used in modern systems of governance. While some farmers knew their plot size down to a tenth of a hectare, some were deeply unsure, and offered an apologetic guess. Again, these answers came from only the household members present in the market at the time of their livelihood survey, and may not accurately represent complete household knowledge. In the case of the two women who couched their hectare guesses with a "mas o menos" (more or less), it is quite possible that their husbands would know more details of their plot size; this would be unsurprising, given that Mexican agrarian law has historically excluded women from ejido participation and land ownership. At the same time, we should not assume women are not involved in and knowledgeable about a given area simply because the related governance structure was designed to exclude them. Development programs can produce wholly unexpected and unintended consequences, including opportunities for new political arrangements that challenge existing forms of inequalities and oppressions. Further research would be needed to better understand the gendered implications of PROCEDE's impact on ejido governance and land access in these particular communities.

Ambiguity notwithstanding, the maize farmers who participated in this survey have slightly larger than average landholdings for the region. Keleman et al (2013) found that, according to SEDAGRO, the average land area per farmer in the State of Mexico is 2.5 hectares, while my participants have an average landholding size per farming household of 3 hectares. Keleman et al also analyzed the PROCAMPO database, which represents a significant (55%) if not necessarily representative sample of farmers in the State of Mexico, and found that "57 % of individual plots of land are less than 1 ha, and an additional 40 % less than 5 ha, i.e., only 3 % of individual plots in the State are greater than 5 ha," (Keleman et al 2013: 690). While my survey did not solicit full details on individual plot size, the data nevertheless suggests a trend among participants. Some participants volunteered that their total land was divided among several individual plots, a practice which is extremely common in the region. Several others indicated the same because some of their land was rented or privately owned, and other parcels were ejido land. One farmer with 5 total hectares explained that two were located in one town and three in another nearby town. Of the five farming households who reported total farm land greater than 5 hectares, only one could potentially be contained in a single plot. In this one exception, a 78-year-old woman, who lived with her husband and two adult children, specified that all six hectares farmed by her family were privately owned under a family member's name.

The other four households with a total greater than 5 hectares were clearly accessing a combination of smaller individual plots of land. A 24-year-old man living with his two parents and two sisters reported farming six total hectares: four "propias" (two of which were ejido parcels and two privately owned), and two rented. A 52-year-old man living with his wife, two sons, and a daughter-in-law also farmed 6 total hectares: 3 "propias" (ejido) and 3 rented. One couple in their mid-fifties who lived with the husband's father said they farmed 6 hectares total, all from a single ejido. My livelihood survey structure does not clarify the full details of their tenure in this case, nor confirm whether this land is divided among smaller plots. However, given the ejido status of the land, it is highly likely that these six hectares comprise several smaller plots, for ejido parcels in this region tend to be significantly smaller than 6 hectares (see Keleman et al 2013). One of my participants, for example, volunteered that her ejido parcels were each 2,000 square meters (0.2 hectares) in size. I visited four ejidos while accompanying maize farmers during my fieldwork, and the designated farmland of each was divided into long, skinny rectangles, each roughly 2,000 square meters in size.

Though the livelihood survey structure was not designed to solicit such information, several participants indicated strong support for their ejidos, and for the resource access and political power they are perceived to enable. One sixty-year-old woman was explaining that her family owned "one-and-half or two hectares, more or less," when I asked to clarify whether these were privately owned or ejido land. In response, the woman exclaimed “oh if only! I wish we had ejido!” She went on to say that her family has had an impossible time enrolling in any government support programs for accessing credit or fertilizer subsidies, which she understands would be much easier to access as part of an organized collective of ejidatarios.

Of the twenty-one participating households, seventeen planted maize on all of their available farm land. The remaining four planted maize on at least half of the land that they farm. The household with the most land, a couple living with seven family members including their Nahuatl-speaking grandmother “born during the 1910 revolution,” farmed a total of seven hectares: six planted in maize, and one hectare dedicated to herbs that they sold in Toluca. Another couple with six hectares total planted three hectares in maize each year, rotating plots annually, and planting the remaining three hectares with oats. Many “maize fields” are also intercropped with a variety of other crops including legumes, squash, and herbs.

This research demonstrates that these commercially-oriented maize farmers have greater-than-average farm size relative to other farmers in the region, though they are all classified as small-scale farmers or on the cusp of small- and medium-scale. Furthermore, this access to and control over land is somewhat precarious, as indicated by fragmented farming parcels and tenure regimes, and by a lack of transparency in the legal systems governing competing property regimes. At the same time, these diversified forms of land tenure, including the option to lease parcels, may offer beneficial flexibility and access to would-be farmers whose livelihoods are in flux more broadly. As detailed below and above, several farmers have returned to maize production after seeking employment and/or education elsewhere, and may not access to family land. In addition, some farmers take advantage of the agronomic variation afforded by farm plots located in different microclimatic regions of the Amecameca Valley. Overall, the farmland resources that these maize farming households have managed to access and maintain are clearly the result of navigating a complex legal, social, and ecological landscape, and wielding knowledge that far exceeds the proprietary designation of a given land title holder.

Every maize farmer participating in this region cultivates on rain-fed land. As discussed in greater detail in other chapters, the overwhelming majority of Mexican farm land is not irrigated. Unlike in nearby regions, which increasingly suffer droughts and extensive crop losses due to lack of rainfall, the Amecameca Valley has thus far, in general, continued to experience enough rain during the growing season, thanks to the serendipity of its geographic position relative to prevailing winds and the steep, humidity-provoking volcanic peaks.[142] Like farmers the world over, maize farmers in Amecameca worry about the weather: if there will be too little rain, or too much, how summer temperatures will affect soil humidity, watching when the weather is most conducive to plowing and planting and harvesting. However, in all our conversations, not a single farmer mentioned water as a limiting factor in their maize cultivation or livelihood decision-making. However, we know that overall trends are for increasing climatic volatility and risk (see Eakin 2006), and that these farmers cannot rely on government support should they begin to encounter flood damage or water scarcity.

[142] Known as "orographic precipitation," excessive rainfall (relative to surrounding areas) occurs on the windward slopes of mountains, when daytime heating and ascending ground cause forced lifting of moist air.

Maize Seed and Agrobiodiversity

In theory, any given kernel of maize could serve as either grain (for consumption) or seed (for planting), provided it is fully intact and undamaged. What makes a maize kernel into seed or grain is the relationship between the maize and the farming household for whom this maize is a resource.[143] This relationship can have many dimensions, which connect to every other household resource discussed in this chapter: the individual knowledge of the farmer in question, and the collective knowledge system from which they can draw information, as well as the trust needed to invest in the potential of a given maize germplasm; the access to farmland and sufficient water to grow crops; and the necessary mechanical, chemical, and capital inputs. As described in Chapter 5, there is a categorical difference between the resource provided to farmers by hybrid and criollo maize varieties. Whereas hybrid maize kernels are designed by commercial seed companies to lose their agronomic and economic value after the first planting, thereby forcing farmers to purchase new hybrid seed each year, the genetic diversity in criollo maize germplasm allows for farmers to save selected seed from their harvest year after year. Hybrid maize seed can serve as an important resource for some farmers in this region who are able to expend the necessary capital and value the labor-saving machinery and bulk buyer contracts possible in a hybrid maize commodity chain. However, for most farmers in this region, maize seed serves a much wider role in household livelihoods. It is a resource, not only for planting crops, but also for plant breeding, enabling farmers to select the characteristics they need for future seed and grain. This means that, in addition to providing immediate material necessities,

[143] Maize is unique, as a seed, for the ways in which it is dependent on human affect and labor to process and plant it. However, of interest to future political ecological research may be fungibility between seed and food in socioecosystems more broadly. Worth noting is that many plant-animal relationships have coevolved such that the plant's fruiting body must first be food, and pass through the animal's digestive system before becoming a seed, and future generation of plants, is even possible. The contrasting labor-intensive requirements of cereal grains has had profound implications on human social organization and power (see Scott 2017).

such as food for humans and animals, criollo maize seed also provides farmers with opportunity for innovation in farming and other farm-centered work. In their relationship to criollo maize seed, farmers become plant breeders, and thereby custodians and curators of cultural and ecological formations. The genetic diversity of criollo maize seed facilitates diversification in cropping systems[144], cuisine, even divisions of labor within farming households and communities.

This is true for communities around the world that cultivate open-pollinated crops from farmer-saved seed. Elsewhere in Mexico, extensive research documents the complexity and nuanced dynamics of smallholder seed systems (see Badstue et al 2002; 2007). However, the Amecameca Valley is set apart from other case studies by the robust commercial market, managed in large part by and for smallholder maize farmers, for criollo maize, as both seed and grain. As commercially-oriented farmers who wield an unusual level of influence over the economic conditions under which they sell their maize, my participants selecting maize seed according to, not only what kind of food they want to eat and what kind of crop they want to work with, but what kind of market they work for.

Criollo maize seeds are the reservoir of maize genetic diversity. In a region where the composition of so many farm fields and the stability of so many livelihoods center on

[144] Including integration with hybrid maize varieties and other technologies; criollo maize systems are not closed to industrial productions systems, and farmers regularly experiment with novel approaches.

genetically-diverse maize varieties, these maize seeds also serve as a reservoir for agrobiodiversity more broadly.

In-situ agrobiodiversity is at once a resource for biological reproduction at the scale of an individual organism, a species' population, and a landscape's ecology. It is a resource for economic production in the context of viable markets, under varying degrees of inequality and exploitation. Finally, it is also a resource for social reproduction, enabling innovative relationships of care, knowledge exchange, imagination, and subjectivity. Through working with criollo maize, smallholders gain nourishment and income, but also potentially transformative ideas about what kinds of agricultural futures are possible. In this way, criollo maize serves a kind of "resourcefulness" (see MacKinnon and Derickson 2012) capable of challenging, in some ways, the existing terms of extraction and accumulation. This seed has enabled generations of what Collard, Dempsey, and Sundberg (2015) call "multispecies abundance" in the Amecameca Valley, a greater degree of diversity and autonomy in which indigenous and campesino lives, both human and otherwise, have managed to persist and, occasionally, thrive.

Mechanization

Every maize farmer surveyed used some form of amplified plowing power, either tractor or draft animal, with which to till the soil. Almost all farmers (nineteen out of twenty-one) used a tractor, seven of them owned their own tractor, and the remaining twelve renting one as needed. My livelihood survey structure did not directly solicit price information, but one farming couple volunteered that they paid 1,200 pesos (roughly 60 USD at the time) per 10,000 square meters to rent a tractor from their neighbor. Five farming households used draft animals, including three who also accessed a tractor. These households all happened to favor horses and mules, though I have seen oxen and donkeys used regularly in the region. Horses and mules (the biologically-sterile hybrid offspring of a horse and a donkey) are more expensive to feed than either oxen or donkeys, but can have greater versatility, assisting with a wider range of hauling and transportation tasks. Of the two farmers who used exclusively animal power, one rented a pair of plow horses, and the other owned two mules for plowing. Two farming households owned both tractor and horses, while one rented a tractor as needed and owned a mule and a horse. Two farmers who currently rent tractors reported not liking how they compacted the soil when plowing: one woman in her mid-fifties reported that her family switched from keeping horses to renting a tractor ten years earlier, and she misses the horses, who she said did a better job of preparing the soil; a single man in his late thirties had never kept animals, and rents a planter that can till the soil and deposit maize seeds in a single pass.

This farmer was also one of only four livelihood survey participants who planted exclusively hybrid maize seed. Maize varieties are discussed in more detail in the Market Chapter, but warrant a mention here because farmers make their decisions regarding mechanization in relation to the maize varieties they cultivate. Hybrid seeds are designed as part of a technological package that includes machinery (as well as chemical inputs, see following subsection). In fact, part of the original motivation for investing heavily in maize hybridization as a plant breeding strategy was the standardization of plant characteristics it enabled, allowing plant breeders to create crop varieties that, unlike open-pollinated crops, conformed to the needs and limitations of machines (see Kloppenburg 2004). Some of these characteristics include: uniformity of plant size, maize ear and kernel size and shape, and maturation timing; and durability of maize ears and kernels. Such characteristics enable a machine to, for example, drop precise numbers of seeds into the ground without jamming, or cut the maize stalks and remove and degrain the maize ears without damaging the kernels or losing large portions of them. Machines are unable to complete these tasks with criollo maize varieties. Genetic diversity means criollos have greater variance in their phenotypical expression and growth. Different plants of the same variety, in the same field, may mature at slightly different rates and require harvesting at different times. Each plant may have a different number of ears at different locations on the stalk. These ears will vary in size, as will the kernels, and the kernels are soft enough that they will be damaged by machine processing, thereby harming their sale value and storage viability.

Those who cultivate criollo varieties are therefore limited in their options for mechanized planting and harvesting. Those who cultivate hybrid varieties are less limited by their varietal choice, though may remain limited by the prohibitive financial cost or lack of availability of machinery. Of the five farming households that plant hybrids, only one reported employing mechanized planting, while the remaining four used a tractor to till the soil and planted by hand.

The single participating household that reported planting semillas mejoradas used mechanized planting, and was the only household that reported harvesting by machine as well. I surveyed this farmer, a woman in her late seventies who lived with her husband and two adult children, as she sat at her sidewalk vendor site in the Ozumba street market, in a row of other maize farmers, several of whom I also surveyed. The next farmer down the row, a woman in her late fifties who, along with her eight household members, grew all criollo maize, was from the same town as the women who grew semillas mejoradas, and agreed to an survey as well. When we arrived at the question about mechanization, she interjected to correct my terminology: “no a cosechar,” wagging her finger at me admonishingly, “a pizcar.” I had been using the Spanish verb “cosechar,” meaning to harvest. My participant asserted that this term applied to her neighbor, who harvested semillas mejoradas by machine, whereas her own practice of harvesting criollos by hand should be referred to by the verb “pizcar.” This is a Hispanicized version of the Nahuatl word for harvest, pizcatl. While it is beyond the scope of this research to fully investigate the political implications of such a distinction, they are clearly of import, and very worth noting here.

All seventeen households that cultivated criollo maize varieties, including the single household that cultivated both hybrids and criollos, planted maize by hand. Though my livelihood survey structure was not designed to solicit these details, I learned through participatory observation of the wide-ranging hand-planting technique and instrumentation. One family invited me to join them on a planting day. They were planting blue Chalqueño maize, and had a technique for doing so I had never seen before. They had rigged an improvised device to the back of their family tractor. This device consisted of planks of wood tied to form a bench, with three funnel and pipe contraptions tied to the bench so that they stood vertically and roughly aligned with each of the three plow blades. The purpose of this device was to allow three people to sit on the bench with their bags of maize seed so that, instead of walking behind the plow and planting maize, one could simply drop seeds into the funnel and watch them fall out the bottom of the pipe into the turned earth behind the plow blade.

Later that week, I joined a second household from the same town on one of their planting days. They were likewise planting blue Chalqueño maize, but using a markedly different planting technique. This second household is the one whose planting technique is described in the opening to this chapter. They walk behind the plow, with bags of maize seed tied around their waists, use a shovel to make each hole, spaced about a stride apart, and toss four seeds into each hole. One of the farmers in this household made mention of his neighbors with the improvised tractor planting device, and expressed contempt for the idea of planting using a machine. "With the machine, you lose all precision," he exclaimed, "this is laziness, bad farming." He went on to argue that planting by hand allows you to control the exact location of each seed, the planting depth, and the soil coverage, thereby enabling a more successful crop. He framed the "laziness" of relying on machines for planting with sloppy farming practices more broadly, criticizing his neighbor for planting on the "wrong" day and the "worst" time of day. By this, he meant that his neighbor had planted on a day of the week when the area had not received sufficient rain, and too late in the day, after the sun had fully risen and the morning dew had burnt off, all of which placed the topsoil at far greater risk of drying out and blowing away. By contrast, he and his family planted the day after a heavy rain, and started early in the morning when the earth was wet.

With only a few days' experience on either farm, I can attest to a significantly different personal experience of the two divergence planting techniques. After walking behind the plow, my boots were muddy and my right wrist was sore from heaving the metal shovel around for hours. However, after planting from that bench behind the tractor, I was sore all over. It was a bumpy, whiplashing ride and, though we'd all worn long sleeves, hats, sunglasses, and bandanas tied over our faces, we were all coated in layers upon layers of the finest powdered soil. The dust was under my clothes, inside my ears, inside my lungs. Black goop seeped out the corners of my eyes for days afterwards.

Though my survey and observations were not designed to thoroughly solicit farmer perspectives on mechanization, they did document significant ambivalence regarding the use of machines. One farmer mentioned, when asked why he chose to plant exclusively hybrid maize, that machines made hybrid maize farming much less labor intensive than criollos.

At the same time, many participants framed machines as a negative, even those farmers who relied on them. The woman who grew semillas mejoradas lamented that they, along with hybrids, were “so hard to de-husk and de-grain.” Rolling her eyes, she mimed having to wrench off the small, tough husks, and explained she had to rent a machine to cut the kernels off the cobs. Another woman, whose family grew hybrid maize and criollo bean varieties, was in the middle of praising hybrids for their productivity, when she paused, shook her head in chagrin, and confessed, “but now we have to use a machine to degrain the ears!” Those who cultivated criollo maize varieties repeatedly expressed a similar sentiment: that it was an advantage of criollos that they could be degrained by hand. Clearly, the expense of renting a degraining machine was a burden. Likewise, the pressure to degrain all the harvested ears at once was seen as a disadvantage by farmers accustomed to storing their maize on the ear, where it was perceived to be at lower risk of desiccation. Hybrids’ dependency on machinery was, with few exceptions, consistently framed by most of these smallholder farmers as an added difficulty, rather than a labor-saving feature.

Chemical Inputs

Every farmer surveyed, except one, reported applying chemical fertilizers to their fields in the previous year. The one exception shook her head adamantly when asked about chemical applications: “no, no, puro natural.” She went on to detail her procedure for making compost from her garden and household waste. Seven farmers reported using both “natural” fertilizer (most often manure from their household’s pigs, chickens, cows, horses, and/or sheep) and a chemical supplement. Thirteen farmers reported using only chemical fertilizers. One explained that “natural” fertilizers were more expensive, so he used exclusively chemicals; this farmer did not have animals of his own from which to collect manure.

The most common fertilizer used by these farmers was urea, a white crystalline granule containing 46 percent nitrogen used as fertilizer, which can be applied as a solid, rather than a liquid, making it easier for farmers without elaborate spraying equipment. It is designed to be applied as part of a tilling operation, ideally applied by machine; much of it can be lost to the atmosphere if it remains on top of the soil in warm weather. Eighteen out of twenty-one farming households reported using urea. Of these eighteen, twelve reported supplementing the nitrogen urea with an additional phosphate fertilizer. What is known colloquially as “Super Triple” is likely the product Triple Super Phosphate, under the Hi-Yield brand, which is a granulated phosphate fertilizer (N-P-K: 0-45-0). “Triple 16” was another Hi-Yield brand fertilizer mentioned by farmers, which is more expensive, as it features slow-release granules and additional nutrients (N-P-K: 16-16-16).

Several farmers seemed to associate the term “chemical” (química) with herbicides and pesticides, rather than synthetic fertilizer applications. This association seemed, upon follow-up questioning, to derive partially from a distinction between liquid sprays (the most common form of pestcide and herbicide treatments) as opposed to granules applied topically to the soil (the most common form of chemical fertilizers available locally). These farmers corrected my initial survey question, explaining that “fertilizers” (fertalizantes) referred to Urea, Super Triple, and Triple 16, while “abono” or “fertalizante natural” referred to manure and compost.

Though they were not explicitly asked about herbicides and pesticides, three farmers mentioned using such chemical applications. There are countless brands and formulas available for sale at every local feed and hardware store, but the ones they mentioned were the herbicides Paracuat, Gesaprim, and Hierbamina, and the insecticides Tamaron, Furadan, and Malathion.

My livelihood survey was not designed to solicit comprehensive details from farmers about their chemical use, and this data may not be representative of commercial maize farmers selling in Ozumba, let alone the broader smallholder maize farming communities in the region. At the same time, patterns of regular chemical use seem largely consistent across criollo and hybrid farmers in this sample. With one exception, a farmer who expressed adamant opposition to anything but “natural” fertilizer, all these farmers considered routine applications of chemical fertilizer to be a useful component of their farming strategy. Consensus among these farmers seemed clear: if one already keeps livestock for other purposes, then composted manure is cheapest. If not, synthetic fertilizers are far cheaper than buying organic compost. Every farmer I spoke to applied both types of fertilizer only once per year, shortly after harvest, roughly three months before planting. None with whom I spoke seemed familiar with the risk of soil pH and temperature causing surface-added urea to volatize as ammonia, or more generally with the risk of losing exposed fertilizer to the air. Some farmers did, however, plan for a post-harvest plow to till their fields, which, if coinciding with fertilizer applications, would incorporate the urea into the soil and minimize losses.

In contrast to some other input supply chains and support services, there seemed to be ample transparency as to label-recommended agronomic use of available pesticides. Farmers confidently explained the timing and frequency of pesticide treatments, recommended liters per hectare, and which ones needed to be applied right before a heavy rain so as to be absorbed into the soil properly. Every farmer with whom I spoke during fieldwork reported getting information about chemical applications from the product label instructions, the feed store where they purchase chemicals, and from word of mouth between farmers. As discussed in more detail in the Education section above and the Government Programs section below, these farmers do not work with researchers and extension agents on maize, even though some may consult such professionals regarding other crops, typically vegetables and tree fruits.

It remains an important, open question, one beyond the scope of this research, whether farmers are fully informed of the documented risks such pesticides pose to their health and that of other species in the environment, such as birds, and whether farmers and their communities are suffering negative health impacts from such widespread use of these pesticides, many of which are currently banned in Canada and the European Union.

With the one exception mentioned above, these farmers did not express ideological commitments to "organic" cultivation practices or against chemical applications. They all considered chemical use compatible with their agrobiodiverse, criollo maize-centered intercropping cultivation system. At the same time, farmers did mention perceived differences in which maize varieties were more dependent on the chemicals. Four farmers mentioned, unprompted, when asked about chemical usage broadly, that hybrid varieties require more chemical applications. Two farmers who planted exclusively criollos explained that, if they did ever cultivate hybrids, they would expect to need more synthetic fertilizer in order for it to grow well. This contrast between self-sufficient criollos, on the one hand, and chemical-dependent hybrids, on the other, seemed to be a widely-accepted matter of common sense among smallholders in the region. In other interactions during my field work period, farmers would take an opportunity to show me the instruction labels on bags of chemical granules. These bags are often reused regularly for all manner of household tasks long after serving their original purpose. Farmers interpreted the chemical application instructions as intended for hybrid varieties; several commented that they had always assumed they could fertilize at lower than the recommended amount per hectare if they were cultivating criollo maize. One farmer, who had been trying to grow exclusively hybrid maize varieties for the past two years, noted that the hybrids responded dramatically to the urea chemical fertilizer, and grew rapidly after application. However, he had observed that initial robust growth did not lead to a successful harvest in either of these two years. Regarding the hybrid maize, he told me “when it gets big, it dies. This maize grows badly.”

These farmers are clearly aware that hybrid maize varieties and agrichemicals are technologies designed to be used together. Many of these farmers interpret it as a relative weakness of hybrid varieties, as compared to criollo varieties, that they depend on chemicals in order to grow well. This is perceived to represent both an agronomic vulnerability and a financial one – if hybrids depend to such a great extent on chemical fertilizer, then farmers who find themselves short on the cash to purchase sufficient fertilizer, or rent a tractor, at the necessary time, risk losing not only a higher yield, but potentially their entire harvest.

At the same time, it is worth noting the extent to which almost all participants were open to experimentation with new technology. This holds true for machinery, crop varieties, ideas, and agrichemicals – these farmers consistently expressed interest in the potential of new technologies and regularly experimented with them, while also managing risk to their harvest and livelihood. Such clear patterns run contrary to widespread assumptions in many development and agricultural science circles that smallholder farmers, particularly those invested in criollo varieties of maize, are close-minded, less innovative, and resistant to evidence-based experimentation.

On-farm Labor

For every household surveyed, small-scale farming of maize, and often other crops as well, constituted their primary form of labor, both in terms of the amount of time devoted to it by household members throughout the year, and in terms of the income contributed from this work to the household livelihood. The language survey participants chose in responding to the question deepens the connection between their labor and the social meanings of everyday life. When asked "what work do you do for money?" (see Appendix), all twenty-one households defined their primary income-generating work explicitly in terms of the "campo." For seven participants, "campo" was their entire one-word answer to the question. For several others, the point was worth elaborating. "Puro campo," [pure campo], was an oft-repeated response. Several participants linked the place of their work to their collective identity as workers: "Del campo, no? Somos campesinos," [Of the campo, no? We are campesinos.]; "Trabajo del campo, somos campesinos," [Campo work, we are campesinos]. Their emphatic intensity in responding to this question stood out among the matter-of-fact tone of most other responses, suggesting possible concern among my participants that I even felt the need to ask for such a self-evident answer. This sentiment is exemplified in the lyrical affirmation from one man in his mid-fifties: "Soy trabajador del campo, del campo, puro del campo, no más puro campo, puro campo, somos campesinos," [I'm a worker of the campo, of the campo, completely of the campo, just pure campo, pure campo, we are campesinos].

Far from being a neutral descriptor for the countryside, the Mexican campo names a place borne of agrarian revolution, laden with class politics, and embedded in gendered and racialized configurations of colonialism, war, and capitalist exploitation. In Mexico, and across Latin

America, postcolonial political regimes and social movements have leveraged “lo campesino” in order to locate particular populations in relation to modernity and citizenship (see Mallon 1995; Tsing 2003; Bebbington 2004; Perreault 2008). Like indigeneity, with which it often emerges in tension, lo campesino is a relational category, rather than an objective one. Political ecologists Yeh and Bryan explain, writing about indigeneity, that these are political identities, “at once historically based and emergent in relation to new political situations,” (Yeh and Bryan 2015: 534). We can apply this understanding to lo campesino as well. The meaning of identifying oneself or others as campesino can change with the particular social and ecological dynamics of a given place.

In Amecameca, farmers’ use of the term “campo” to describe and define their work stands in contrast to the emphasis by development interventions, professional extension agents, and most government programs on the term “agricultura”. From CIMMYT’s MasAgro program (Modernización Sustentable de la Agricultura Tradicional) to the federal agency that supports it, the Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, or SAGARPA) , “agricultura” is used to describe the cultivation of maize, as well as all other crops. In this context, agriculture is framed as a means toward the achievement of national development goals, and of increasing production yields of particular commodity crops, including maize. There is one government program that defines its mandate in terms of the campo: el Programa de Apoyos Directos al Campo (The Program for Direct Support to the Campo, or PROCAMPO). Unlike MasAgro and SAGARPA, which prioritize yield increases and the technology adoptions deemed necessary to accomplish them (see MasAgro 2011), PROCAMPO provides payments on a per-hectare basis directly to smallholder farmers.

However, this discursive terrain has been shifting in significant ways in recent decades, following shifts in agricultural development policy. PROCAMPO was originally created during post-NAFTA economic restructuring in Mexico. It was designed to replace cash crop subsidies, while easing the transition for farmers to free trade and open markets. From 1994 to 2009, PROCAMPO remained a single budgetary unit, dispensing payments to farmers. Then, beginning in 2010, at the same time as MasAgro is being initiated as a public-private partnership administrated under SAGARPA, PROCAMPO undergoes restructuring to divide it into two distinct programs. By 2012, a second component to the original program is established, known as "PROCAMPO Productivo", or PROAGRO. This new component provides "incentives" to farmers that "must be linked to improving agricultural productivity." Unlike PROCAMPO's direct payments to farmers, PROAGRO's "liquidity" offerings are contingent upon investment in "productive activities." Whereas PROCAMPO is a nation-wide program available to whoever actively farms the land identified as under cultivation before the 1994 implementation of NAFTA, regardless of the crops they choose to cultivate, PROAGRO "focuses on areas with medium and high productive potential, and on priority crops with market potential," (PROAGRO 2018).

The dividing of "campo" from "agro" extends from what crops are grown and where, to who is farming and why. PROCAMPO's promotional material states that farmers participating in the program are producing primarily for “self-consumption”, though this is likely an oversimplification, at the very least, given the high variation in smallholder production across the country. Scientific literatures, development researchers, and even extension agents actively working in regions of Mexico dominated by campesino communities, have widely assumed that campesinos farm primarily for subsistence, despite a lack of substantiating evidence, and the history of millennia of surplus maize production in the Central Highland region (Anderson and Barlow 1943; Shroeder 1991). Recent research has documented the persistence of significant surpluses of maize harvest by campesinos in many regions of Mexico, and called for greater attention to the connection between market-oriented smallholder livelihoods and maize biodiversity conservation (Bellon et al 2021).

At the state level, particularly in the State of Mexico, the concept of the “campo” is wielded in fickle ways on behalf of highly regressive rural development interventions. State-level rural development ministries share jurisdiction with SAGARPA for post-NAFTA agricultural restructuring, primarily through an umbrella program known as Alianza, which is the country’s second-largest agricultural support program, following PROCAMPO. The full title of the Alianza program was, at its founding in 1994, Alianza para el Campo (Alliance for the Campo). Though, at the federal level, this title was changed to the vague, sloganeering Alianza Contigo (Alliance With You) under President Vicente Fox (2000-2006), and, in 2008, the umbrella program was officially disbanded and its subprograms renamed and reassigned elsewhere within SAGARPA, Alianza has persisted within some state-level bureaucracies. In the State of Mexico, the entity responsible for assessing farmer applications and awarding funds to accepted applicants remains the Fideicomiso Fondo Alianza para el Campo del Estado de México

(Alliance for the Campo of the State of Mexico Trust Fund, or FACEM). FACEM was historically housed under the State of Mexico's Secretaría de Desarrollo Agropecuario (Secretariat of Agricultural Development, or SEDAGRO); in September of 2020, the name of this ministry was changed to the Secretariat of the Campo, or SECAMPO (Hidalgo 2020).

Keleman (2010: 20) notes that, given the privatization of state-run agricultural services as part of post-NAFTA restructuring, "the programs that compose Alianza are some of small-scale agriculturalists' only remaining options for accessing government support for technical assistance." However, despite proclaiming, at various turns, that the Alianza program is "for the campo," the program has never been particularly accessible, in practice, to low-income farmers. The federal criteria for allocating funds favors higher-producing, lower poverty states, while the state criteria for disbursing funds favors middle-to-high-income producers (Palmer-Rubin 2020). Even for those lower-income smallholders who are able to traverse the lack of transparency and political patronage biases, who successfully navigate the bureaucracy (a paid technical consultant is often required to complete the complex application process), who are able to afford the financial burden (as Alianza funds are exclusively paid as reimbursements for investments and technology purchases), and who aren't excluded by the Spanish-language-only application process or the requirement for proof of land title, Alianza places further constraints on the very kind of farming they can pursue. Alianza favors awarding funds for "especially expensive, capital-intensive investments, such as large tractors, that are both inappropriate and inaccessible for low- and middle-income producers," (Palmer-Rubin 2010: 39). Moreover, successful applications must convincingly demonstrate the "market-competitiveness" of their proposal. Many researchers have pointed out that this places lower-resourced farmers at a disadvantage, making Alianza resources more difficult to access (MacDonald 1999; MacDonald 2001; King 2006; Keleman 2010). In addition, I argue that this requirement structurally excludes those farmers producing for diverse economies. When neoliberal policies speak of markets, they mean exclusively those commodity markets of global capitalism. However, many Mexican maize farmers, including all of my research participants from the Amecameca Valley, grow maize varieties that resist commodification, cultivate using less capital-intensive methods, and participate in alternative markets. The Alianza program doesn't include many lower-income smallholders but, when it does, it dictates their economic conditions moving forward.

Since the 1990s, Mexican policy has defined the "campo" as a vestigial, unproductive agrarian system, and set it in discursive opposition to "agricultura," defined as modern, productive agricultural production of value to the nation and the global (capitalist) economy. Neoliberal restructuring since has been explicitly designed to replace the former with the latter (see Appendini 2001). As campesinos continue to refuse to be eradicated, these policies will occasionally hail them by name, and seek to secure their support for neoliberal policies by professing that these policies are "for the campo." The policies, however, are highly regressive and increasingly dedicated to the privatization of Mexican agriculture, and the capitalization of public agricultural support services. Even in this current moment, as the Mexican government is reinvesting in Mexican farmers for the first time since the neoliberal turn, it is partitioning and withdrawing funds from PROCAMPO, the single remaining government program designed to direct resources to actual campesinos.

This context is crucial to understanding the implications when farmers identify their work, and themselves, in terms of the campo. They are articulating, in Stuart Hall's (1996) dual meaning of the term, themselves as political subjects; lo campesino is being named, but it is also actively cohering under shifting political and economic conditions. Previous political ecologies of campesinos have not fully attended to this process of articulation, and the contingencies of those who position themselves as campesino. Even those that take seriously the nuance and complexity of the politics of identity can overlook the agency of those who self-identify as campesino in shaping the very meanings of lo campesino. For example, in her ethnographic study of campesino struggles for maize in the state of Puebla, just east of the Iztaccihuatl and Popocatepetl volcanoes from Amecameca, anthropologist Elizabeth Fitting (2011) draws a particular, detailed portrait of smallholder maize farmers who avail themselves of the term campesino as they struggle for access to and control over land and water. However, in her theoretical framing of what the term campesino can mean, Fitting relies on historical studies of social movements across Latin America (Gledhill 1985; Edelman 1999) and of Mexican postrevolutionary politics in the 1920s and 1930s (Vaughan 1997; Boyer 2003). Future political ecologies of campesinos should attend to the specific articulations of the campo as a place and a collective identity that ties groups of people to one another, but also to particular agroecologies in which they live and work. We must use the tools of this approach to trace the patterns of campesino subjectivity as emergent in relation to new political situations, and negotiated in the context of political and economic volatility. A political ecology informed by postcolonial studies will allow us to better understand the twenty-first century biopolitics and necropolitics of a state that hails campesinos on behalf of the very revanchist policies designed to make the campo disappear for good. It will help us better engage the claims and grievances asserted by divergent and allied groups who identify as campesino in relation to state power. Importantly, it will also enable us to recognize lo campesino as, to borrow Yeh and Bryan's (2015: 535) phrasing, "a thoroughly modern way of understanding, managing, and governing differences," including within a given campo, and how these differences are generative of new political possibilities.

I do not do so fully in this research, but I do argue that the meanings of the campo cannot be taken as self-evident to visitors and outsiders. Without providing a satisfactory answer, I raise the important question: what do these maize farmers of the Amecameca Valley mean when they invoke the campo, and their belonging to it, as an explanation of the work they do?

Unlike in some other regions of Mexico (see Fitting 2011), there was no generational divide evident among my participants; farmers of all ages, from the twenty-somethings to the septuagenarians, identified themselves as campesinos and theirs as trabajo campesino (campo work). Five participants differentiated their campo work from the commercial dimension of their maize-based livelihoods, responding to this survey question with some version of the phrase "campo y comercio" (campo and business). Of course, all of the twenty-one households surveyed engaged in commercially-oriented farming, and every participant was recruited for this survey at the market where they sold their harvest. The vast majority of them simply included sales and marketing under the rubric of trabajo campesino.

There did not seem to be a clear pattern, in this relatively small sample, behind who specifically distinguished the commercial aspect of their maize work. Three of the five participants who appended “comercio” to their “campo” response cultivated exclusively hybrid varieties of maize, and two cultivated exclusively criollo varieties. The remaining two households that cultivated hybrid maize categorized their work simply as “campo,” while the sole cultivator of semillas mejoradas (improved seed), described her work as “puro campo.” Three of the five participants who identified their work as “campo y comercio” were men and two were women.

Only two households out of twenty-one differentiated campo work from house work. One farmer in his early fifties stated that he did “trabajo campesino y comercio,” and then added that his wife worked in the home, though that didn’t stop him from checking with his wife, seated next to him, to confirm the numbers and harvest details of their land and maize production throughout our conversation. One farmer in her mid-fifties described her own work as both “campo” and “ama de casa” (housewife).

In this region, spatial divisions of gendered farm labor are commonplace. Men are most often in charge of work in the field – such as planting, weeding, plowing, and harvesting – while women are primarily responsible for maize-related work that takes place in the home – such as garden cultivation, post-harvest maize processing and seed selection, and household food preparation – and in the streets – including some retail food sales and most selling of maize in the Ozumba tianguis. These divisions are flexible in many ways; women without adult men in the household will do their fieldwork, and men assist with many household tasks. I was allowed, even encouraged, by women who do not work in the maize fields themselves to assist the men in their household with planting, plowing, and harvesting tasks. In general, however, these communities consider it normal for maize work in the fields to be completed by men, and maize work in the home to be completed by women.

The campo can, at its most basic, refer simply to the farm fields that surround every densely-populated small town in the region. However, in our conversations, and through their everyday work, these farmers are articulating a spatial conception of the campo that extends beyond the farm field, into homes and street markets. Women and men of all ages, with varying configurations of gendered divisions of household labor, claimed their work as "campo" work. Those campesinas who may never work the fields themselves are nevertheless sustaining and shaping what happens there. They articulate a campo that includes both maize production for household consumption and commercial maize production, though in such a way as to decenter capitalist commodity markets. In this articulation, the campo includes a wide array of agricultural technologies. Campesinos use tractors and the latest agrichemicals. Farmers who choose to cultivate hybrid maize varieties identify as campesino.

The campo is a landscape fraught with contradiction. A peasant economy, with subsistence farming and a semi-autonomous maize market is, in many instances, subsidized by the off-farm wage labor of household members (see following section). Many campesinos use exclusively family labor, or a labor exchange with neighbors, while several others hire additional workers to help with the harvest or plowing. Once the central subjects of sweeping agrarian reforms, campesinos today are building livelihoods on the margins of rural development, largely overlooked, if not targeted for displacement, by state interventions. As detailed in the section below, these farmers are largely not participating in the government programs dedicated to the capitalization- and technology-promoting programs established to convert the campo into agricultura.

Off-farm Labor

As described above, every participating household defined themselves, and their labor, in terms of the campo. However, many households discussed off-farm sources of income as well. The significance of maize cultivation to total household income clearly varied significantly between households. While this research was not designed to solicit or verify specific amounts of income from various sources, the combination of extensive participant observations and livelihood surveys provides an approximate sense of proportion. Participating in the Ozumba tianguis requires an extremely high investment of time, labor, and money. There are many spaces in this region of less intensive maize sales that are available to farming households less dependent on them. In order to sell in Ozumba, farmers must produce significant enough quantities of maize at high enough quality to sell for an extended market season; many sell piles upon piles of maize in the tianguis all year round. They must store, process, and transport all this maize while maintaining its quality, and then pay for their vendor site and spend market days – every Tuesday, if not Friday – tending to it. This would only seem to be a viable investment if the money from these maize sales amounted to, at a minimum, a plurality of household income in an average week.

When asked about work that household members do for money (see Appendix), eight households reported receiving remittances from family members working abroad, while five households described family members contributing to the family farm while simultaneously maintaining an off-farm job nearer to home. These two groups were mutually exclusive, for a total of thirteen households surveyed reporting income from off-farm labor.

This portion should not be construed as a comprehensive picture of off-farm income-generating labor among these households, particularly given the expansive spatial and occupational colloquial conceptions of what and where the "campo" is. Sixteen participating households responded to my question about paid labor with some version of the response "todo es el campo" ["it's all campo"]. Of these, I observed several household members engaged in income-generating work that might not necessarily be described as "on-farm" in another context. These included many kinds of odd jobs that one could sporadically pick up in town. Several families sold prepared food at local events and street markets, or offered services for sale out of their home, everything from wet-milling maize into masa, to mechanical repairs, to child care. Many, if not most families offered homemade or homegrown items for sale – garden produce, prepared food, crafts, etc – often directly out of their home courtyard or on the front sidewalk. And four households that I observed had small, annexed shops attached to their homes; one sold bulk candy, another ran a lunch café, and two had little general stores with batteries, sodas, and school supplies. None of these activities emerged in the livelihood surveys. It is unclear, and interesting to consider, whether this is due to the heterogeneous meanings of campesino life, or simply that my livelihood survey is too crude a tool. Likely both are true. Nevertheless, the survey does yield a glimpse into what off-farm labor can look like for these smallholder maize families.

One participating household reported that their sons both help on the farm, and the eldest also works full time in masonry. In another household, the adult daughter worked in waitressing while also helping in the home and on the farm. In another, the father, when not working in the family's maize fields, drove one of the ubiquitous private taxis that serve as public transportation to a rural population.

Remittances and local off farm jobs subsidize family farms in the Amecameca Valley, just as they do in farming communities around the world (see Sachs et al 2021). For the smallholders who sell their maize in the Ozumba tianguis, however, maize work seems clearly to be the gravitational center, and likely a primary source of income, for household livelihoods.

Government Programs and Seed Companies

There is clear confusion and lack of transparency regarding the functioning and accessibility of agricultural support and extension services for these farmers. Ten of the twenty-one participating households reported participating in Procampo. However, some of these participants had initially stated that they participated in no government programs; it was only later in our conversation that they mentioned receiving regular payments based on their hectares farmed, which could only be through the Procampo program. In these cases, the farmers seemed to be unfamiliar with Procampo by name, or to think of it as something other than a government-run program. This suggests that the other eleven intervewees who responded simply "no, never," to the question "Have you worked with seed companies or government programs before?" (see Question #25, Appendix) may have actually participated in Procampo, but not fully understood the program, or perhaps found my question confusing. One couple in their late 40s had received payments from Procampo in the past, but these ended after they lost the paperwork.

Procampo seemed to be the only government program with widespread name recognition among these farmers, though they were occasionally unsure as to what the program was for and how it functioned. One man in his late 60s reported that he purchased his hybrid seeds through "Procampo," though this has never been a feature of the program. I learned later, through casual conversation over extended visits, that several of my participant households also received cash payments through the poverty reduction program Oportunidades, though they stated they worked with no government programs in our conversation. This program seemed mystifying to many, even including those actively enrolled as beneficiaries. One women in her 50s with four adult children had heard that it might be able to help her family and asked if I could explain the program to her.

It is quite possible that my question, as asked, was misleading, and mistakenly implied that I was only interested in government support programs explicitly targeting agricultural production, for which my participants expressed near universal disdain. Three of the five participants who planted hybrid maize varieties said they did not participate in government programs, nor did they work with private seed company extension agents. These three farmers had each purchased their hybrid seeds from a local feed store in Ozumba, and seem to be at a clear risk of having purchased recycled hybrid seeds rather than first-generation hybrids (see Market Chapter for further discussion of the lack of transparency in hybrid maize supply chains and risks to farmers). One woman, who had purchased her seeds from this store, told me that the store owner "has been breeding hybrids acriollada for years and sells the seeds," and said that she planned to replant her harvested hybrid seeds as well. The two other farmers who grew hybrid maize varieties had each purchased their seeds from the Sedagro office in Ayapango (though one erroneously referred to it is as the "Procampo" office, see mention above). They, and several others, mentioned a subsidy program that I was unable to verify. I could not find published documents explaining such a program, and I was ultimately unable to secure an interview with a Sedagro representative. At the time of my fieldwork, Sedagro in the region was so underfunded, that its office in Ayapango remained virtually unstaffed. I visited the Sedagro office in Ayapango several times. Each visit, the large office was nearly abandoned, empty of furniture except two small desks in the middle of the floor, with one phone, and a receptionist reading a book, who was never able to provide me with a time when I could expect an extension agent to be in the office.

Some farmers seemed to understand this subsidy program as a discount for fertilizer, contingent upon the purchase of hybrid maize seeds, while others understood it as a discount for the purchase price of hybrids. Regardless of how they understood the details of this program, and whether they themselves participated in it, every one of my participants was full of complaints about Sedagro. The hybrid maize farmer who seemed most informed about the detailed of available government programs told me that he had purchased hybrid seed from Sedagro, but could access no support services: "there are technicians there [in the Sedagro office], but they don't do anything to combat the diseases [threatening our crops]. The seeds the government has are so very expensive. Plenty expensive, and plenty ugly."

Those farmers who planted criollo varieties were even more disparaging. One man in his mid-fifties couldn't remember the name of the program, but thought it was a partnership with Sedagro, and said an extension agent from an agricultural supply company had travelled to his town to promote the program. Curious, he had traveled to Juchitepec to the promotional event to learn more about the program. There, he said he was told that he would receive 300 pesos if he bought hybrid seeds, "but if you didn't plant hybrids you got nothing." He said the extension agent had told him all about how great hybrids were, and that there were many farmers from around the region at the event, but that he left because the coercion to plant hybrids instead of criollos made him angry.

Most farmers expressed a clear perception that government programs were pressuring them to replace their criollo varieties with hybrid maize. Several began immediately explaining why they didn't like hybrid maize varieties as soon as I asked them about their participation in government programs. One man in his forties made fun of government programs for always "arriving late for ejidatarios," and complained that "if we plant hybrids, they give us support, but hybrids, they only produce nibbles for chickens." Similarly, a man in his sixties responded to my question about participation in government programs by complaining about "SAGARPA," by which he likely meant SEDAGRO, and lamented that "hybrid [maize] is much less commercial [than criollos]." My youngest participant, a 24-year-old campesino helping on the family farm while earning his business degree, offered a nuanced critical analysis of the failures of government support programs:

> A deliveryman from Sedagro came last year to Ozumba with seeds for sale of wheat, but not of maize. The only government seed that functions is the wheat, the hybrid maize doesn't work. Those [hybrid maize varieties] are not ready for this area, they are not

> improved or adapted to this climate, and the [hybrid maize] seeds are not known [by the farmers]. We campesinos know that criollo seeds are better, and those [government] programs never come back after a season.

A farmer in his mid-seventies said he'd never felt support by government programs, "there are great programs, but they're only for big farmers, not for us small farms." He went on to criticize government investment in hybrid maize: "they call it improved seed. We [campesinos] are all trying to improve our seed every year, but we don't have the security for our harvest, we can lose everything." For these farmers, government endorsement of hybrid seeds has come at the expense of support services that could assist them with their criollo cultivation. Moreover, they risk financial ruin if they purchase expensive hybrid seed but find it falls short of the promising sales pitch.

A woman in her sixties made the connection between government support and hybrid maize varieties even more starkly: "we don't plant improved maize because it doesn't respond to the land here. We don't plant any government seed, we haven't experimented with those."

There is a clear perception among all of my participants – the few who have chosen to plant hybrid maize varieties, as well as the majority who have declined to do so – that government initiatives, academic researchers, and private company representatives were all pressuring farmers to adopt hybrid maize seed. Some, like the woman quoted above, even think of the hybrid maize varieties they encounter, which are owned and marketed by private seed companies, as "government seed." Many of these farmers see their relationship to hybridized maize germplasm as disenabling, as limiting their livelihood options and reducing their access to agrobiodiversity as a resource (see section above). Coupled with the high cost of access and structural lack of transparency in hybrid maize supply chains, consensus among my participants is that engagement with government programs and the seed technologies they promote will mean a significant increase in risk to their household livelihood.

This risk is deeply gendered. As described above and in Chapter 5, women play a decisive and authoritative role in commercially-oriented criollo maize production in the Amecameca Valley. It matters that the knowledge bound up in criollo maize is accessible to and maintained by a farmer, generations of her family, her surrounding community, when she needs to make decisions about what her household needs out of maize production this year, and which varieties will best serve those needs.

CONCLUDING THOUGHTS

Research Findings

The everyday interspecies work that constitutes maize agrobiodiversity in Mexico's Central Highlands is persisting in relation to a likewise persistent interventionist development project of agricultural modernization. While this development project, and its antagonism, comes as no surprise to smallholder criollo maize farmers, their continued existence seems a source of perpetual surprise to many development scholars and practitioners. In my dissertation, I investigate the interface of these two kinds of maize work, each centered in their respective, adjacent highland valleys. I sought out those agricultural development researchers and extension agents whose jurisdiction included the Amecameca Valley, and who were employed by the institutions leading the MasAgro project, purportedly a vanguard of government re-investment in rural development. MasAgro claimed to target resources at precisely those farmers with whom I was working – Mexican maize farmers with fewer resources and smaller land holdings who contribute to the country's food supply. These claims led many researchers (see Eakin et al 2014) to expect that MasAgro marked the advent of greater collaboration between agricultural development workers and smallholder maize farmers, and perhaps the cultivation of agricultural research and extension that better serves the needs of farmers whose diversified livelihoods and agroecosystems have never had a place in conventional development paradigms. However, I found that MasAgro was, if anything, driving the Texcoco Valley and the Amecameca Valley farther apart. As Gabriel's interview shows, even those most experienced researchers and extension agents, who are intimately familiar with the lived reality of smallholder farmers in the region and who affirm the value of criollo maize systems, are not working with the market-oriented criollo maize farmers the next valley over from CIMMYT headquarters. Gabriel's field deployments are bifurcated, split between the farmers seen as "commercial" – capital-intensive larger-scale commodity grain production in states like Sonora and Hidalgo – and those seen as "subsistence" farmers, or perhaps "niche market" producers in the heavily indigenous states of Oaxaca and Chiapas, or the highlands of Guatemala. Lilian, the Valles Altos hub manager, has no time or space in her work routine to reach out beyond the farmer networks established by private agribusinesses, nor to reconceptualize what kind of farmer belongs in Mexico's agricultural future. She has mandatory growth projections to achieve in every Friday project report. While some development workers like Gabriel, who have lived and worked closely with farmers in the region their entire careers, are fully informed of, and deeply interested in, the complexity of criollo maize persistence in Mexico, I found that this awareness largely evaporates within the work environment of a development institution like CIMMYT. For those working at even a slight remove from everyday life in the campo, smallholder maize farmers in the same region as CIMMYT headquarters are largely unseen, presumed to be exclusively subsistence-oriented, close-minded, hostile to innovation; in other words, entirely other than they are. And the biggest sticking point, in myriad discussions within CIMMYT, seemed to be this idea of smallholder criollo maize farmers as commercial producers. In passing conversations, even in the Q&A after research presentations, I would frequently encounter incredulity as I described these farmers as market-oriented. The correction was swift and stern: "but those are subsistence farmers, not commercial."

In this research, I find that maize diversity is persisting in the Amecameca Valley because farmers are maintaining economic diversity. Here, I define diverse economies as an alternative to capitalist hegemony (see Gibson-Graham 1996; 2008). Diverse economic practices also include the kind of livelihood diversification described in Chapter 6. In combination with other forms of livelihood diversification, the Ozumba tianguis enables a crucial level of risk management and resource control for maize farmers. The tianguis serves as a market for seed and grain exchange that is, in some partial ways, autonomous from the vicissitudes of global commodity markets. It is also crucially a market managed by peasant communities for peasant communities. Working in close contact with one another, maize producers and consumers are using the tianguis to maintain peasant livelihoods and, thereby, also maintain agrobiodiversity. This everyday reproduction of economic diversity is governed by the knowledge and labor of women, who connect market practices to the usefulness of particular kinds of maize, and whose decision-making shapes the seasonal modes of production.

This research also finds that, despite all rhetoric to the contrary, the current agricultural development projects at work in the region are undermining, rather than supporting, smallholder maize producer livelihoods. Though it is a nonprofit research institution with a public mandate and a renewed obligation to Mexican maize farmers and domestic food supplies, CIMMYT is ultimately only able to reproduce itself through facilitating flows and concentrated accumulation of global capital. In fact, it secured control over MasAgro, and the funding and power it brings, precisely by differentiating itself from other research institutions in the region. Nearby universities and national research institutes have immense expertise and capability to contribute to such a project, and enthusiastically engaged with preliminary project development workshops, but ultimately were excluded from administrative roles. This was because, as explained to me by several MasAgro employees, these Mexican universities had troubled those in power. They had stood up for worker and peasant rights, spoken out against government repression of students, and altogether cemented a reputation for being too critical of economic and political elites. CIMMYT, by implication, had not proven meddlesome to those in power, and had been rewarded with tens of millions of dollars for agricultural development. But, what does development look like, if it is not to trouble those who have accumulated so much power at the expense of so many? Can CIMMYT imagine agricultural transformations that challenge existing inequities, including those placing it in charge of Mexico's maize modernization? As the institution seeks to reproduce itself, it does so, at times unintentionally, through the continued marginalization of the majority of maize farmers in the country.

MasAgro, by design, helps to perpetuate the ongoing discursive and epistemological erasure of maize-centered economic diversity in Mexico. It redefines "traditional" agriculture to mean, not the small-scale rainfed criollo maize production that has been taking place across Mexico for millennia and which remains the mode of production for the overwhelming majority of Mexican maize farmers to this day, but rather what has typically been referred to as "conventional" agriculture in scientific literatures: industrial, capital-intensive production of commodity hybrid grains. MasAgro, reimagining this capitalist agriculture as the Mexican "tradition," proposes to render it more "sustainable," through less tillage, better water conservation, and more judicious use of agrichemicals. In doing so, it effectively renders the maize farmers of the Amecameca Valley, among others, as less visible, even disappeared from maps of diverse maize production. It also takes away our language for describing the everyday lives and livelihood decision-making of these farmers as they maintain diverse forms of economies and agroecologies.

These epistemologies are gendered, as is their erasure and the violence thereof. As we can see throughout Section II, women in the Amecameca Valley work to build and maintain a knowledge system in which maize agrobiodiversity has value. The agronomic, culinary, and nutritional potential of criollo maize varieties here is grounded in innovative economic practice: women from campesino households shape the selective breeding and cultivation of maize according to the logics of an alternative market in which they play a managerial role.

When these ways of understanding criollo maize, and the those who work so closely with it, are systematically excluded, at every turn, from scientific research and extension work, it restructures, not only development outcomes, but also how researchers and extension agents understand themselves and their work. More than ever, historically marginalized groups are being invited to work at institutions like CIMMYT and on projects like MasAgro. However, the knowledge systems of these marginalized groups remain largely ignored, denied, and dismissed. Incoming scientists and extension agents are assessed according to the metrics of modernization, leaving little space or time to reflect on the contradictions they see and experience. And so, even as individual women and members of campesino communities are increasingly present within agricultural development institutions, women's and campesino collective agricultural knowledge continues to be erased.

And yet, by engaging with development researchers and extension agents as research subjects, as knowledge producers, and as workers, and by taking seriously their everyday lives, we can see the unexpected openings and opportunities for changing these trajectories. While development workers are structured by their institutions, and the exigencies of global capitalism that govern them, they are also bringing complex subjectivities, passions, and ideas to their work. In doing so, they are shaping development outcomes, research agendas, and the resources and political recognition available to smallholder farmers. Though MasAgro does not formally provide space to recognize noncapitalist markets, or value the persistence of the campo, it does provide livelihood stability for a far greater number of researchers and extension agents than CIMMYT could support before. And some of these development workers hear what farmers like those in Amecameca are articulating. They turn critical attention to the assumptions behind agricultural modernization, and ask about the kinds of maize farmers, maize varieties, and maize livelihoods that we have been erasing from our imagination of Mexico (see Bellon et al 2021). This space for new imaginaries is also part of the harvest of criollo-centered campesinos in the Amecameca Valley. Through their diligent knowing and working with maize diversity, they give the rest of us a chance, at least for one more day, to witness alternative agricultural possibilities.

Contributions to an Interdisciplinary Feminist Geography

The predicament of feminist science is that we must constantly repeat ourselves for decades at a stretch. Generations of research has documented the "invisibility," the discursive and political erasure of women farmers who continue, to uphold the food systems upon which patriarchal households, nations, and capitalist industries depend. The very texts that long ago explained how this works are the same ones we have to cite today in disciplines that haven't yet absorbed the lesson. And, so, I echo those who've been telling us for quite some time (see Sachs 1983; Sach 1996; Momsen 2007; Sachs et al 2021) that we still fail to acknowledge, let alone understand, the role of women in agricultural production and agrobiodiversity conservation. My dissertation research makes some modest original theoretical and methodological contributions to the rich disciplines of Geography and Women's, Gender, and Sexuality Studies, and to inter- and trans-disciplinary research on agrobiodiversity and development.

I extend political ecologies of food and crop diversity into the institutional spaces of agricultural development, considering how smallholder farmers negotiate access to maize agrobiodiversity in relation to development interventions designed to facilitate the adoption of other kinds of germplasm and cultivation methods. I include as research subjects the researchers and extension agents working within these institutions. I also approach them theoretically as workers who, like smallholder farmers in this respect, are engaged in complex livelihood decision-making under working conditions not of their own choosing.

I advance feminist political ecology and science studies on the racialized and gendered dynamics of biotechnology through attention to hybrid maize, a much older and more prolific technology than transgenes or synthetic biology, and one which I posit has been severely understudied, particularly in contexts, such as Mexico's Central Highland region, where it sets the terms for contesting access to and control over in-situ agrobiodiversity. My research puts this literature in conversation with feminist geographies of the spatial practice of subjectivity formation which, in the context of agrobiodiversity and maize-centered livelihoods, is understood as a fundamentally more-than-human process.

I advance development geographies through the study of livelihood decision-making within development institutions, and also through attention to how the unevenness of development can produce new and unexpected spaces for alternative ways of living and knowing in the world. Agrobiodiversity is valued and thriving in the Amecameca Valley because of its very marginalization from agricultural modernization interventions.

Future Research Directions

This dissertation introduces an innovative methodological approach to the study of livelihoods, agrobiodiversity, and uneven development. Future research can advance on what is begun here in many different directions, including a simple sustained attention to how the MasAgro project continues to unfold, and to the market dynamics of maize agrobiodiversity in the Ozumba tianguis. In this endeavor, those at work within development institutions like CIMMYT are vital collaborators. Those of us who work outside such agencies, especially we who consider ourselves radical critical thinkers with an eye toward justice, will do our best work in dialogue with the extension agents, agricultural engineers, agronomists, and other researchers on the inside of how development is conceived and implemented. We will all fail to understand well enough the contradictions of development unless we are diligent in appreciating the internal heterogeneity and contradictions of the institutions that make it happen. Moreover, these institutions might just have the means and opportunity to change some things for the better within a human timescale, if only we can make them. Of all the institutions we have to make demands of, these public research institutions are among our most accessible, perhaps even accountable.

In addition to greater collaboration across disciplines and industries, I would also like to see greater engagement with scientists and extension agents as research subjects, particularly through the kinds of participatory research methods that feminist geographers have long advocated. Research that brings smallholder farmers, researchers, and extension agents into conversation with one another should ensure that historically marginalized voices are centered and amplified and that the terms of the research are open to critique by participants from beginning to end.

There is a great need for even more research into the mechanisms of diverse economies and, given that mainstream economists continue to largely deny their very existence, feminist geographers are well-positioned to continue leading in this emerging field of study. Geography should, as feminist geographers have called on it to do, "turn its powerful tools, some of which have been used in order to control marginal populations by repressive governments, for mapping the empirical data of disappearance," (Wright 2017: 266). Here, Wright is speaking specifically to state terror in Mexico and the humans that are killed, disappeared, and rendered disposable with impunity. I argue that maize agrobiodiversity is a central feature in these "landscapes of disappearance," that the erasure of criollo maize from data sets of national maize production, the denial of smallholder maize farmers as economically relevant, and the exclusion of farmer-bred maize varieties from visions of national food security are at the heart of what Wright (2017) calls "a cruel modernity" and the "epistemological ignorance" upon which it feeds.

In my next research venture, I will be adding a new methodological approach: the participatory modeling of complex systems dynamics. Like ethnography, systems dynamics thinking embraces the fullness of contradictions at work in the world. I hope that such tools may enable more sophisticated visualizations and ways of documenting and valuing the plant and human lives of which a repressive state would prefer us to remain ignorant.

CODA

In Ayotzinapa, like in the rest of the country's rural teaching colleges, teaching is never just theory but also practice. If graduates are to serve rural communities, they should know how to carry out agricultural activities. For many students from other universities, solidarity is not just about taking the streets together; it extends to productive work in the agricultural parcels of the Normal School.

(Hernández Navarro, Luis. 2014. 24 Horas en Ayotzinapa. *TeleSUR*. https://www.youtube.com/watch?v=SXeJCdvm1u4 Last accessed March 21, 2021)

Following the state-sanctioned and -enabled disappearance of forty-three young men, all student-teachers from a rural teaching college, known as a Normal School, on September 26, 2014, Mexico convulsed in public protests. People from all over the country joined family members of the disappeared, traveling to Mexico City and filling the central Zócalo with their bodies, their anger, and their demands for justice. Chants of "¡Fue el Estado!" (It was the State!) thrummed in the air. These families, their friends, and supporters organized marches that crossed the country and brought this incident of state terror to the attention of international news media.

To travel from their town of Ayotzinapa, in the State of Guerrero, to protest in Mexico City, these bereaved families took public highway 115 straight through the center of the Amecameca Valley. In September, the maize would have been towering tall in the fields, heavy with ripening ears. In order to participate in these demonstrations, in order to undertake the work of organizing, the families had to leave their farm fields at a crucial time in the harvest season. Some maize varieties would need harvesting soon, and careful processing for storage. Fields and gardens would need weeding. Farm animals would need care.

And so, along the same highways, students from urban universities in Mexico City journeyed to rural Guerrero to lend their support to the families of the disappeared, not by joining them in the city streets, but by keeping their crops alive in their absence. TeleSUR journalist Luis Hernández Navarro visited these exchange students on the campus of the rural teaching college and featured a conversation with them in his documentary "24 Hours in Ayotzinapa." Panoramas of carefully-tended vegetable plots and flower gardens are interspersed with clips of young men diligently crawling between rows of maize to pull weeds. In rapid-fire alternating bursts of speech and pronounced chilango[145] accents, a pair of young men explain their duties to the campus farm:

> We're brothers, no? From the same land.
>
> Brothers of the same pain.
>
> Well, it's only that, we're from UAM Xochimilco.[146]
>
> Exactly, and our compañeros asked us, commissioned us, to come here and to weed, basically, these rows of maize.
>
> For this, they had to teach us everything about weeds!
>
> Our compañeros can't be here right now.
>
> They're preoccupied.
>
> They're fighting, our compañeros. They don't rest. They don't sleep. And so they can't work their land right now.
>
> When the caravan returns, we work with them in the fields, we will hug them, we will hold their face, we will tell them they are not alone, your pain is my pain. We could have been 44. We could have been disappeared. Our Ayotzinapa compañeros are absolutely stockpiling forms of solidarity with us.

The last young man to speak waves his hand, gesturing to the fields of Ayotzinapa maize behind him. From the gangly height and varied appearance of the maize plants, these are undoubtedly

[145] A distinctive way of speaking particular to Mexico City, especially among youth from the working class.
[146] One of five academic units of the Metropolitan Autonomous University (UAM), a public university and among the top-ranking universities in Mexico.

criollo varieties. Some of that maize was planted by the hands of the forty-three who were disappeared. All of it embodies the knowledge and aspirations of generations of *normalistas*.

While conducting my field research in the Amecameca Valley from 2010-2012, I regularly passed billboards along the rural highways for maize-centered festivals. There were seed exchange fairs in the spring, harvest celebrations for elote (fresh sweet corn) in late summer, and many, many celebrations in honor of Mexico's National Day of Maize on September 29. During my field research, these posters tended to feature ears of corn in an appealing array of colors and sizes, with the kind of banal revolutionary agrarian slogans ubiquitous in a campesino landscape. Since 2014, this Day of Maize falls a mere three days after the anniversary of the Ayotzinapa attack, and posters around the country have grown even more pointed. Now, many National Day of Maize posters feature a single giant ear of maize, with the faces of each of the Ayotzinapa Forty-Three featured on the maize kernels. Demonstrators chant in rhythmic succession: "¡Sin Maíz no Hay País!" (Without Maize there is no Country); "¡Fue el Estado!" (It was the State!); "¡Vivos los queremos!" (We Want Them Alive!); "¡No al Transgénicos!" (No to Transgenics!)

And everywhere, on posters, and event billboards, and street murals, and social media posts, is the same phrase, at once an analysis and a promise: "Quisieron enterrarnos sin saber que eramos semillas." They tried to bury us without knowing that we were seeds.

APPENDIX - Structured Livelihood Survey Questions for Maize Farmers

1. Name
2. Age
3. Where do you live?
4. Where were you born/have you lived other places?
5. # of people in house? Gender? Ages?
6. What work do you do to earn money?
7. How do other family members earn money?
8. Has anyone migrated? For work/where/how long/$$$?
9. Education level achieved? Plans to return to school?
10. How long growing maize? Have you ever stopped?
11. How much land? Ejido/private/rented? Home garden?
12. How much land did you plant in maize last year? year before? How much do you expect to plant next year?
13. What types of maize did you plant last year? Year before? What types do you expect to plant next year?
14. Why did you plant these types of maize?
15. How long have you been planting these varieties?

16. Have you changed the maize you plant? Why?

17. Do you own/rent/use a tractor to plow/plant/harvest?

18. Do you own/rent/use animals to plow/plant/harvest?

19. Do you hire workers to help with plowing/planting/harvest? How many? Do family members/friends help? Did this arrangement used to be different?

20. Do you use chemical/natural fertilizers? How much? Why?

21. Do you irrigate your maize?

22. Do you plant other things with the maize in the field?

23. When did you plow/plant/harvest last year? Year before? Next year? Why?

24. Where/when are you selling maize products from last year? Have you sold other places? Why?

25. Have you worked with seed companies or government programs before? What do you think of programs to “improve” or “modernize” maize farming?

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Zimmerer, Karl. 2010. Woodlands and Agrobiodiversity in Irrigation Landscapes Amidst Global Change: Bolivia, 1990–2002. *The Professional Geographer*. 62(3): 335-56.

Zimmerer, Karl. 2011. The landscape technology of spate irrigation amid development changes: Assembling the links to resources, livelihoods, and agrobiodiversity-food in the Bolivian Andes. *Global Environmental Change*. 21: 917-34.

Vita

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EDUCATION

Ph.D. Geography; Women's, Gender, & Sexuality Studies (Dual Degree), The Pennsylvania State University, 2021.

M.A. Geography, Miami University, Oxford, Ohio, 2009
Thesis title: *Carib Territory: Negotiated Boundaries of Indigenous Land and Livelihood in Dominica*

B.A. Sarah Lawrence College, Bronxville, New York, 2007
Thesis title: *The Bayou's Edge: Ecology, Economy, and Displacement in Post-Katrina New Orleans*

SELECTED GRANTS AND FELLOWSHIPS

2021 PI, National Science Foundation SBE Postdoctoral Research Fellowship, Proposal #2105247 "Investigating Agrobiodiversuty in Michigan" Co-PI Laura K Schmitt Olabisi, Department of Community Sustainability, College of Agriculture and Natural Resources, Michigan State University.

2015 Co-PI, Latin American Studies Association: FORD/LASA Special Projects Grant # FL-10-01 , "Insurgencies: Racialized Geographies of Police Terror, Insecurities and Resistance in the Americas."

United Nations Environment Programme Global Environment Outlook (GEO) Fellowship.

2012 National Science Foundation Doctoral Dissertation Research Improvement Grant.

Society of Women Geographers Evelyn L. Pruitt Dissertation Fellowship.

2011 National Security Education Program David L. Boren Graduate Fellowship.

Penn State Department of Geography Endowment Dissertation Research Scholarship.

2009 Penn State University: E. Willard and Ruby S. Miller Distinguished Graduate Fellowship.

Penn State University: The Carl H. and Helen H. Chelius Graduate Fellowship in Earth Sciences.

SELECTED HONORS AND AWARDS

2016 Pennsylvania State University Harold F. Martin Graduate Assistant Outstanding Teaching Award.

2015 Women's Studies Department Sara Woods Outstanding Graduate Teaching Award.

Geography Department E. Willard Miller Paper Award, Doctor of Philosophy, first place.

AAG Cultural and Political Ecology Specialty Group (CAPE) Student Paper Award.

AAG Political Geography Specialty Group Student Paper Award.

Dimensions of Political Ecology (DOPE) Graduate Paper Award.

2014 Women's Studies Department Sara Woods Outstanding Graduate Student Award.

Pennsylvania State University Spirit of Internationalization Award.

Supporting Women in Geography (SWIG) Jennifer Fluri and Amy Trauger Essay Competition, first place.

2012 Penn State College of Liberal Arts Superior Teaching and Research (STAR) Award.

United Nations Commission on the Status of Women Citizen Science Paper Competition, first place.

2011 E. Willard Miller Award in Geography, PhD proposal, first place.