

REASSEMBLING THE *MILPA*

MULTI-SPECIES ENTANGLEMENTS OF FORAGED FOODS IN HIGHLAND MEXICO

By

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AUTHOR'S DECLARATION

I, the undersigned Kyle Piispanen, candidate for the PhD degree in Environmental Science and Policy, declare that the present thesis titled Reassembling the *Milpa*: Multi-species Entanglements of Foraged Foods in Highland Mexico is exclusively my own work, based on my research and only such external information as properly credited in notes and bibliography. I declare that no unidentified or illegitimate use was made of the work of others, and no part of the thesis infringes on any person's or institution's copyright. I also declare that no part of the thesis has been submitted in this form to any other institution of higher education for an academic degree.

Vienna, 31 March 2025

Kyle Piispanen

Abstract

This dissertation explores how foraged foods—*quelites* (edible greens), *chapulines* (grasshoppers), and *cuitlacoche* (corn fungus)—reconfigure meanings, ethics, and livelihoods within *milpa* agroecosystems in the of highland Mexico. Drawing on two years of ethnographic fieldwork (2018-2019) in rural communities in the Mexican states of Puebla, Tlaxcala, and Oaxaca, I examine how certain edible semi-domesticated plants, insects, and fungi challenge dominant agronomic categories of crop, weed, pest, and pathogen.

Framed though a lens of political ecology, and explored through both conventional and multi-species approaches to ethnography, I develop the concept of *milpa reassembly* to describe how *campesinos* navigate overlapping pressures of ecological disturbance, cultural erasure, and market commodification. Rather than treating the *milpa* as a static model of traditional agriculture, I argue that its vitality emerges through adaptive, often contested, reconfigurations of multi-species relations.

Each empirical chapter centers a different foraged species to illuminate broader dynamics: the ethics of weediness in *quelite* collection; the contradictions of pest management and commodification in *chapulín* harvesting; and the fungal agency and aesthetics of *cuitlacoche* cultivation. Across these cases, I show how *campesinos* enact moral ecologies grounded in a multi-species ethic against purity, of cohabitation (*comunalidad*) with other species.

This dissertation contributes to debates in agroecology, anthropology, and political ecology an *milpa* studies by foregrounding the entangled agency of plants, insects, and fungi in shaping agroecosystems. It also offers a methodological reflection on conducting multi-species research in collaboration with Indigenous and *campesino* communities across shifting and lively landscapes.

This dissertation builds on the following discussions:

The *Milpa* as Multi-species Assemblages: This research reconceptualizes the *milpa* not merely as a resilient polycultural farming system but as a dynamic multi-species assemblage wherein human and non-human actors, including plants, fungi, insects, and microorganisms, collaboratively shape landscapes for more-than-human multi-species thriving.

Cultural and Ecological Significance of Liminal Foods: This foregrounds the adaptive and cultural significance of *quelites*, *chapulines*, and *cuitlacoche*, species marginalized in industrial agriculture that are central to agroecological resilience and food sovereignty in the Anthropocene.

Ethical Dimensions of Diversity: This dissertation challenges purity-driven paradigms and advocates for multi-species ethics that recognize the ecological contributions of weedy, pesty, and smutty species in *milpa* agroecosystems.

Critique of Agricultural Simplification: Drawing on a multi-species political ecology, this dissertation critiques industrial agriculture's emphasis on purity, monocultures, and

homogenization, exposing their ecological and epistemic consequences.

Deterritorialization–Reterritorialization: This dissertation investigates the ways in which *milpa* agroecosystems are shaped by deterritorialization, defined as the displacement or unraveling of socio-ecological relationships, and reterritorialization, which refers to the reconfiguration of new forms of adaptation, particularly in response to climate change, urbanization, and industrial agriculture. Agroecology serves as a reterritorializing force that challenges the simplification of industrial agriculture by fostering biodiversity, enhancing resilience, and valuing local knowledge. This approach allows *campesino* and Indigenous farmers to resist and transform the pressures that aim to homogenize their landscapes.

Keywords: Keywords: *milpa* agroecosystem, multi-species assemblage, environmental anthropology, agroecology, multi-species ethnography, multi-species political ecology, visual methods, deterritorialization–reterritorialization, *recampesinización* (re-peasantization), weediness, *quelites*, *chapulines* (*Sphenarium purpurascens*), *huitlacoche* or *cuitlacoche* (*Mycosarcoma maydis* or *Ustilago maydis*), Mexico.

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LIST OF ABBREVIATIONS

This dissertation employs several abbreviations. The following list is intended as a reference to aid the reader. Abbreviations are listed alphabetically, followed by their full names, and, where relevant, a brief contextual explanation.

ANT: Actor-Network Theory

CaC: Farmer-to-Farmer (*Campesino-a-Campesino*); a horizontal methodology for knowledge exchange and agroecological learning among smallholder farmers

CDMX: Mexico City (*Ciudad de México*)

CESAVETLAX: State Committee of Plant Health of Tlaxcala (*Comité Estatal de Sanidad Vegetal de Tlaxcala*)

CIMMYT: International Maize and Wheat Improvement Center (*Centro Internacional de Mejoramiento de Maíz y Trigo*)

ECOSUR: The College of the Southern Border (*El Colegio de la Frontera Sur*)

ENAH: National School of Anthropology and History (*Escuela Nacional de Antropología e Historia*)

EPF: Entomopathogenic Fungi

EPM: Ecological Pest Management

EWM: Ecological Weed Management

FAO: Food and Agriculture Organization of the United Nations

GIAHS: Globally Important Agricultural Heritage System

GM: Genetically Modified

GVG: Vicente Guerrero Group (*Grupo de Desarrollo Rural Integral Vicente Guerrero*); a *campesino*-led organization promoting agroecological education and food sovereignty based in Tlaxcala, Mexico

INALIM: Food Marketing Industry (*Industria Alimentaria Comercializadora*)

IPM: Integrated Pest Management

IRB: Institutional Review Board

MIAF: milpa intercropped with fruit trees (*Milpa intercalada con árboles frutales*); an agroforestry system integrating the staple annual crops of the milpa with fruit-bearing perennials

NAFTA/USMCA: North American Free Trade Agreement (now replaced by the United States–Mexico–Canada Agreement)

SADER/SAGARPA: Secretariat of Agriculture and Rural Development (*Secretaría de Agricultura y Desarrollo Rural*), the current federal agency responsible for agricultural policy in Mexico. It was formerly known as SAGARPA (*Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación*), the Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food, before its reorganization and renaming in 2018.

TK or TEK: Traditional Knowledge, often used interchangeably with its ecological counterpart, Traditional Ecological Knowledge (**TEK**). Both terms refer to the cumulative body of traditional, Indigenous, and local knowledge and practices that offer a situated understanding of ecological relations and the environment. This dissertation primarily uses the term “local knowledge” to reflect greater inclusivity that acknowledges the diverse origins of ecological knowledge

UDLAP: University of the Americas, Puebla (*Universidad de las Américas, Puebla*)

UNAM: National Autonomous University of Mexico (*Universidad Nacional Autónoma de México*)

UNESCO: United Nations Educational, Scientific, and Cultural Organization

CHAPTER ONE: INTRODUCTION

This dissertation explores the liminal foods of *milpa* agroecosystems—*quelites* (edible greens), *chapulines* (grasshoppers), and *cuitlacoche* (corn smut)—as critical sites for understanding multi-species entanglements and resistance within *campesino* and Indigenous agroecosystems in highland Mexico. By interrogating these organisms, often misunderstood as weeds, pests, or pathogens, this research reveals their agency, ecological roles, and political significance in the context of industrial agricultural pressures and socio-environmental transformations (Morales and Toledo, 2017:45; González-Jácome, 2020:28). At the heart of this investigation lies the recognition that *milpas* are complex multi-species assemblages in which human and non-human actors co-create landscapes characterized by biodiversity, ecological resilience, and cultural heritage.

Quelites, *chapulines*, and *cuitlacoche*s, which often time occupy liminal places within *milpa* and occupy the ambiguous intersections between categories such a as cultivated and wild, desirable and undesirable, commodity and rarity, and between delicacy and pest, weed, or smut/blight. This liminality is not merely symbolic but materially significant, revealing how *campesino* and Indigenous communities have sustained intricate agroecological relationships through practices that resist dominant narratives of agricultural purity, control, and simplification. This dissertation argues that these liminal organisms flourish because they exist in interstitial spaces that are overlooked or actively suppressed by industrial agriculture. Through their persistence, *quelites*, *chapulines*, and *cuitlacoche* disrupt conventional agricultural binaries—pest/crop, weed/food, blight/delicacy—highlighting the intertwining of biodiversity and cultural practices in fostering resilient agroecological systems.

Milpa is a cornerstone of Mesoamerican food systems and has long been described as a polyculture³ or a polycultural farming system in which maize is planted alongside beans and squash in the same field (Fonteyne et al. 2023; Hames 1983; Hart 1974; Liebman 1996). This polyculture can include a dozen or more crops, such as avocados, melons, tomatoes, chiles, sweet potatoes, jicama, and amaranth, among others. It also includes volunteer plant species, semi-cultivated species, bacteria, fungi, and visiting animals and insects. *Milpas* can also be reservoirs of crop diversity, including multiple varieties of maize, squash, and beans. This multi-species assemblage is both nutritionally and ecologically complementary. This dynamic agroecosystem has been recognized as “one of the most successful human inventions ever created” (Wilkes, quoted in Mann 2005, 197).

Its significance extends beyond its structure and productivity. This dissertation reconceptualizes *milpa* as a multi-species assemblage in which human and non-human actors or *actants*⁴, including weedy greens, edible fungi, and insects, interact symbiotically to create dynamic agroecological

³ **Polyculture:** The practice of growing multiple crop species in the same space simultaneously, contrasting with the monocultural approach of industrial agriculture.

⁴ **Actant:** A term from actor-network theory (Latour 2005), referring to any entity (human or non-human) that participates in shaping relationships and outcomes within a network.

landscapes. The *milpa* assemblage challenges monocultural purity ^{5 6}

A defining feature of *milpa* is its cyclical regenerative soil and nutrient strategy, in which two years of cultivation are followed by extended fallow periods, often spanning up to eight years. These fallows are not simply abandoned fields, but are integral components of the *milpa*, facilitating soil regeneration, biodiversity restoration, and the maintenance of long-term agroecosystem resilience. As Ford and Nigh (2009, 2015) described in their work on forest gardens, these fallows evolve into complex, managed landscapes in which agroecological processes continue to unfold.

The diversity of the *milpa* fosters beneficial ecological processes, protecting and regenerating soil fertility, enhancing nutrient availability, and mitigating pest proliferation (Ford and Nigh 2015; Vides-Borrell et al. 2019; Serralta-Batún et al. 2024). Pollinators traverse blossoms, forming invisible yet essential connections. More than a method of cultivation, the *milpa* operates as a dynamic, living system of interdependence, in which plants, people, and landscapes co-create conditions for mutual survival.

⁵ **Monoculture:** The agricultural practice of cultivating a single crop species in a given field, a dominant characteristic of industrialized agriculture. And monocultural purity:

⁶ Within this region, the *Milpa System Interspersed with Fruit Trees* (MIAF) is widely practiced. This system integrates fruit trees with heirloom maize, beans, squash, husk tomatoes (*Physalis spp.*), *cempaxúchitl* (marigold), and a diverse array of *quelites* (edible greens) and other semi-domesticated species. The MIAF system is promoted as compatible with both traditional polycultural *milpas*—based on heirloom maize, beans, and squash—and simplified *milpa* systems that incorporate agrochemical packages alongside hybrid seeds (*Secretaría de Agricultura y Desarrollo Rural* 2022; *Agroecología y patrimonio biocultural* 2022). The associated fruit trees include apple, plum, apricot (*chabacano*), pear, peach, *tejocote*, *capulin*, and walnut, planted on broken or mountainous terrain. Additionally, fruit trees adapted to different climatic conditions—such as peach and apple for temperate zones, and guava, avocado, lime, and *chicozapote* for tropical and subtropical zones—further enrich the system. This carefully assembled agroecosystem exemplifies the enduring resilience, adaptive ingenuity, and ecological harmony that have defined Mesoamerican agricultural heritage for millennia (*Secretaría de Agricultura y Desarrollo Rural* 2022; *Agroecología y patrimonio biocultural* 2022).

For millennia, the *milpa* has been a cornerstone of Mesoamerican food systems and rural livelihoods (Zizumbo-Villarreal, Flores-Silva, and Colunga-García Marín 2012; Zizumbo-Villarreal and Colunga-García Marín 2010; Sugiyama and Somerville 2017; Alcántara 2023). Maiz (maize), *frijol* (beans), and *calabaza* (squash) crops are nutritionally and ecologically complementary. Maize, which is deficient in lysine and tryptophan, two essential amino acids necessary for protein synthesis, is nutritionally balanced by beans, which provide both. These biochemical exchanges reflect deeper ecological and social entanglements that have long sustained agrarian livelihoods and biodiversity in Mesoamerica.

The *milpa* diet is more than a model of healthy eating; it is deeply embedded in Mesoamerican food cultures and regional culinary traditions. Its foundational components, maize, beans, chili, and squash, are complemented by other heirloom foods that are essential to traditional Mexican cuisine. The combination of maize and beans provides a complementary protein profile that matches the nutritional value of animal-based proteins.

Volunteer greens, known as *quelites*, enrich local diets with essential micronutrients, and *milpas* also serve as sites for hunting and trapping small mammals. These animals not only provide protein but also help control populations that might otherwise damage the crops. Edible insects, such as *chapulines* (grasshoppers), which can sometimes appear in overwhelming numbers, are thus seen as both pests and resources, offering protein-rich and flavorful addition to many dishes.

Cuitlacoche, a fungus that colonizes immature maize ears, is considered a delicacy in many parts of Mexico and contains essential amino acids. Additionally, fruit trees interspersed within the *milpa* contribute fruits and seeds, further diversifying this system. Collectively, these elements form a

nutritionally balanced and culturally significant diet.

Together, these entangled relationships between plants, animals, fungi, humans, and landscapes coalesce into what I refer to as the *milpa* landscape, a dynamic multi-species assemblage in which human and non-human actors continuously shape and are shaped by one another. This constantly evolving and morphing form is often encapsulated in a single word, *milpa*.



FIGURE 1. WITHIN THE DENSE *MILPA* VEGETATION, A WEB OF *INTRA*-ACTIONS UNFOLDS, VISIBLE IN THE TANGLED LEAVES OF MAIZE, SQUASH, *QUELITES* (PHOTO BY AUTHOR, AUGUST 2018).

HIDDEN FROM VIEW, INSECT COMPANIONS, UNDERGROUND ROOT SYSTEMS, MICROBIAL EXCHANGES, FUNGAL SPORES AND RHIZOMES. THIS PROLIFERATING LIFE IN THE LANDSCAPE WHERE PLANTS, SOIL ORGANISMS, POLLINATORS, AND HUMANS SHARE THE WORK OF ASSEMBLING A MULTI-SPECIES WORLD, PROVIDES A SHARP CONTRAST TO A SIMPLIFIED MECHANIZED AGRICULTURE

THINKING WITH *MILPA*

Thinking with *milpa* begins with the experience of walking into and getting entangled inside a fully grown *milpa*, where the distinction between “crop” and “weed” insects and “pest” in agronomic terms dissolves among vines leaves, roots, rhizomes, mandibles, spores and human hands of *milpa* agroecosystems.

I began to understand this early in my fieldwork in Ozolco, Puebla, when I found myself kneeling inside the rows of towering *maíz* (*Zea mays*). I was fully enclosed in the *milpa*, maize leaves arc overhead fracturing the early morning September sun light. I try to advance, catching my feet and tripping on an abundance of thin vines of beans spreading themselves across and climbing up the stalks of maize and through the thick prickly patches of *calabaza* (*Cucurbita* spp.) covering the ground. If there is a gap among this thicket, I find myself trampling the tender leaves of the *quelites* such as (*Amaranthus* spp. and *Chenopodium* spp.) folded into the *milpa*. Insects move through this foliage—*chapulines* (grasshoppers, Orthoptera) scraping past stems, beetles tunneling into the litter, bees tracing quick circuits between flower blossoms. Below the surface, unseen threads of fungal hyphae lace together roots, and soil bacteria metabolize the constant rain of falling tissue. The air feels thick, almost crowded, with vegetal breath and insect sound. From this vantage point, the field is not an orderly grid of “crops” but a layered web of *intra*-actions in which no single species stands alone; each busy and entangled into the others’ lives.

Insects hum, and fungi decompose. The *milpa* here appears not as a bounded unit of production, but as a collaboration between humans and non-humans, memory, and improvisation. Rethinking the *milpa* means attending to liminal spaces where coordination is negotiated across all the

kingdoms of life, and the labor of tending and learning is shared across generations and species.



FIGURE 2. WALKING THE EDGES OF THE MILPA IN OZOLCO, PUEBLA. MAIZE (*ZEA MAYS*) TOWERS ON ONE SIDE, WHEREAS *QUELITES* (EDIBLE GREENS) AND WEEDY PLANTS ENCROACH IN ALL DIRECTIONS (PHOTO BY AUTHOR, SEPTEMBER 2023).

Farther upslope the *milpa* opens into a wide corridor between two walls of maíz. An adult and a child walk the grassy track, hooded against the highland chill, brushing past tassels and the seed heads of encroaching monte. On one side, maize in disciplined rows; on the other, *quelites*—volunteer greens such as *quelite cenizo* (*Chenopodium berlandieri*), *quelite* (*Amaranthus* spp.), and other leafy companions—push into the path, leaning from ditches and margins, refusing to stay put. Insects hum at knee height, and somewhere in the damp undergrowth fungi are at work

decomposing last year's maize stalks and calabaza stems. As they walk, Roberto names plants in passing—*maíz criollo*, *quelite*, *hierba mala*—points out patches where soil holds more moisture, recalls a season of hail or a neighbor's experiment with a different seed. The path becomes a moving classroom in which local epistemologies, memory, improvisation, and *intra*-species coordination are found. Here the *milpa* is much more than an agriculture, and cannot be easily translated into units of production, rather better understood as a living laboratory of multi-species *intra*-actions, and of ongoing human and nonhuman co-creation.

In March, on a terraced hillside in Vicente Guerrero, Tlaxcala, maize seedlings beginning to sprout punctuate the bare, furrowed soil of a newly planted field. Along the edge, the scene shifts: *verdolaga* (*Portulaca oleracea*) creeps in dense mats, young bean plants (*Phaseolus vulgaris*) twine up small stakes and volunteer stems, and *quelites*—amaranths and *Chenopodium*—stitch together the bank that holds the terrace in place. Beyond them, mature shrubs and small trees, including *encinos* (*Quercus* spp.) and other woody species, cast irregular shade, their branches busy with birds and insects, their roots binding soil that might otherwise wash downslope with the first heavy storm. A discarded hoofprint, a burrow entrance, and a flush of tiny mushrooms at the base of a tree mark the presence of other foragers and decomposers moving through these margins. From this perspective, the field's "edge" is less a boundary than a hinge that holds together cultivated rows, semi-wild greens, and wooded thickets. Thinking with *milpa* in these border zones reveals how resilience is assembled at the periphery: in the small, continuous labors of plants, animals, fungi, and farmers that keep soil from sliding, seeds from disappearing, and agroecosystems from collapsing into monocultural silence.



FIGURE 3. A CULTIVATED FIELD BORDERED BY DIVERSE VEGETATION, INCLUDING WILD AND SEMI-WILD PLANTS SUCH AS BEAN SPROUTS, *VERDOLAGA* (*PORTULACA OLERACEA*), AND *QUELITES* (*AMARANTHUS* *SPP.* AND *CHENOPODIUM* *SPP.*) (PHOTO BY THE AUTHOR, MAY 2018),

the presence of mature shrubs and trees along the edge further supports pollinating insects, birds, and small foraging animals, while also providing habitat for fungi. These ecological assemblages exemplify the integral role of field margins in maintaining biodiversity, soil stability, and overall resilience within *milpa* agroecosystems.

A rich assemblage of wild and semi-wild flowering plants, insects, foraging wild and domestic animals, mushrooms, *magueyes pulqueros* (*Agave* spp.), *nopales* (*Opuntia* spp.), and fruit trees take root along the terraced rock walls. These often-overlooked margins are not merely residual zones; flourishing within these liminal spaces, diverse species, and cultural practices reinforce the intricate ecological and agricultural interdependencies central to *milpa* agroecosystems and provide vital habitats supporting biodiversity.

Colonial legacies and capitalist pressures have profoundly shaped agricultural practices in the central Mexican highlands, privileging market-driven monocultures over traditional, biodiverse systems such as the *milpa* (Benrey, Bustos-Segura, and Grof-Tisza 2024; Kapayou et al. 2023; Novotny et al. 2021; Sánchez Morales and Romero Arenas 2018; Pérez-García and del Castillo 2016; Moreno-Calles et al. 2012; Boege and Carranza 2009; Altieri 2016). These ongoing forces have led to the deterritorialization of the *milpa* landscape, manifesting in shifts in land tenure, displacement, resource extraction and deforestation, biological invasions, soil degradation, and climate change, and more broadly, the disarticulation of relational ontologies⁷ of human and more-than-human relationships with the land.⁸

Thus, *milpa* is not merely a cropping system; it is a multi-species, culturally situated landscape that

⁷ Eduardo Viveiros de Castro contends in his research that Amazonian societies conceive of the world through relational ontologies, where humans and non-humans engage in complex, fluid relations that do not map neatly onto Western categories. See: (Viveiros de Castro and Skafish 2015; Viveiros de Castro 1998; 1992; 2015).

⁸ Two recent edited volumes from the *Handbook of the Anthropocene in Latin America* series seek to examine the Anthropocene from a Latin American perspective, positioning the region within broader socio-environmental crises. These volumes provide an empirical basis for tracing the genealogy of the Anthropocene, emphasizing historically and regionally specific trajectories (Kaltmeier et al. 2024a; Kaltmeier et al. 2024b).

resists the extractivist logic of industrial agriculture. Rooted in local and local knowledge, the *milpa* embodies agroecological resilience, sustaining biodiversity while fostering food sovereignty and cultural continuity in the face of ongoing socio-environmental transformations (Altieri and Toledo 2011; Nigh and Diemont 2013; Levy-Tacher et al. 2019; Toledo and Barrera-Bassols 2017).

Through a multi-species lens, this dissertation reconceptualizes *milpas* as dynamic agroecosystems in which weedy, pesty, and smutty species are not marginal intrusions, but integral actors. Rather than framing these species as threats to productivity, this perspective foregrounds their contributions to the resilience and adaptability of *milpa* agroecosystems, which are disregarded in industrial agriculture (Altieri and Toledo, 2011). By centering on multi-species assemblages, this research challenges dominant agronomic paradigms that prioritize monocultures and seek to eradicate so-called undesirable species. Instead, it argues for the ecological necessity of biodiversity and the ethical imperatives of multi-species cohabitation as foundational elements of agroecological futures. Moreover, this research examines how *campesinos* and Indigenous farmers navigate the tensions between external pressures to purify and standardize their fields and the imperative to sustain biological and ecological diversity.

Karen Barad's (2007) concept of *intra*-action offers a way of conceptualizing species relationships that views each entity as integral to, part of, dependent upon, and co-evolved with others. The subtle shift from *inter*- to *intra*-actores in Barad's framework underscores that each actor is composed of a multitude of external influences and exists in a state of continuous transformation. Barad (2007) emphasizes that entities do not preexist in their interactions but rather emerge through relational entanglements.

By integrating these perspectives, this dissertation provides a more situated analysis of how human and non-human species coexist, adapt, and transform within shared ecologies of practice (Stengers, 2003). Specifically, it examines how *campesino* and Indigenous farmers resist dominant agro-industrial forces by sustaining diverse multi-species agroecosystems. Through a focus on *quelites*, *chapulines*, and *cuitlacoche*, this research illustrates how these liminal foods are not only sources of nutrition but also actants in the face of contemporary environmental disruptions and economic pressures that extend to the broader politics within which they are embedded.

To better engage academically with *milpa*, it is necessary to move beyond a focus on staple crops and to acknowledge the broader sociopolitical and multi-species relationships that shape it. This dissertation adopts a multi-species political ecology framework that integrates political ecology (E. Anderson 1994; Batterbury 2018; Darcy Tetreault 2017; Ahmed and Gasparatos 2022; Biersack and Greenberg 2006; Bryant 2015; Peet, Robbins, and Watts 2011; Robbins 2007a; 2007b; Perreault, Bridge, and McCarthy 2015) with multi-species ethnography (Kirksey and Helmreich 2010; Hartigan Jr. 2021) to examine how human and non-human actors co-create the *milpa* agroecosystem. Multi-species political ecology examines how non-human life forms co-constitute social and ecological processes, often in ways that resist, mediate, or reinforce hegemonic structures. This perspective is particularly relevant in agroecological systems such as *milpas*, where crops, wild plants, insects, and fungi engage in complex *intra*-actions that sustain not only biodiversity but also cultural and political resistance against industrial agricultural regimes.

By foregrounding the agency of non-human species, multi-species political ecology also troubles the conventional understanding of resistance and resilience (Haraway 2016). Rather than viewing

adaptation solely as a human-driven process, this framework reveals how non-human actors actively negotiate survival under shifting environmental conditions, colonial legacies, and capitalist extractivism.

RESEARCH QUESTION

Through the lens of multi-species political ecology, this research seeks to answer the following questions:

1. *How do non-human actors co-create and reshape agroecological landscapes under the pressure of industrialization, urbanization, and colonization?*

SECONDARY RESEARCH QUESTIONS

- a) *How do campesino and Indigenous farmers integrate non-human species, such as quelites, chapulines, and cuitlacoche, within milpa systems to challenge industrial agricultural paradigms?*
- b) *What roles do weedy, pesty, and smutty species play in maintaining the ecological resilience and cultural significance of milpa agroecosystems?*
- c) *How do the processes of deterritorialization and reterritorialization affect the sustainability and adaptability of milpa systems in the face of socio-environmental pressures?*
- d) *How can assemblage thinking and multi-species ethnography illuminate the adaptability of milpa systems in the Anthropocene?*

This approach enables a critical analysis of how external forces, such as market demands, environmental policies, and state interventions, shape these intra-actions (Barad, 2007) and influence the sustainability of the *milpa*. By foregrounding the roles of species traditionally labeled as pests, weeds, or smut (Tsing 2005a; Paxson 2008; Wanderer 2020), this framework offers a more nuanced understanding of how *campesinos* navigate competing imperatives to either simplify

or diversify their fields. For instance, the cultivation of *quelites* (edible greens) in *milpa* systems exemplifies a form of more-than-human resilience, as these plants emerge through ecological relationships rather than direct human intervention, challenging dominant discourses that frame them as weeds that must be eradicated. Similarly, the entanglements of *chapulines* (grasshoppers) and *cuitlacoche* (corn smut) with maize farming complicate the rigid distinctions between pests, pathogens, and food, instead highlighting the political and cultural stakes of species classification. In this sense, multi-species political ecology not only broadens the scope of political ecology but also destabilizes entrenched binaries between nature and culture, human and non-human, and subject and object, ultimately offering a more nuanced understanding of socio-ecological transformations.

The following photographs capture what I refer to as the *milpa landscape* in three highland communities—Vicente Guerrero in Tlaxcala, Nevería in Oaxaca, and Ozolco in Puebla—during the weeks between May and July, when plants are just sprouting, insects are hatching, and fungi begin to surface in the damp soil. In these months the land is neither bare nor fully grown; it is in the midst of becoming milpa, as seeds, rains, and labor converge across long-inhabited slopes and valleys, and as campesino categories of *milpa*, *monte*, and *buen terreno* intersect with scientific descriptions of soils, species, and habitats.

In Vicente Guerrero, Tlaxcala, the hillside is carved into a sequence of terraces forming narrow milpa plots, scattered amid patches of bare earth, shrubs, and small trees that cling to the terrace faces. Retaining walls of packed soil and stone hold back erosion, but they also host their own growth—grasses, mosses, and trees and scrubs. the milpa appears as a layered arrangement of cultivation and regrowth, in which the work of contouring the hill is shared among roots, and stones.

In Nevería, Oaxaca, the milpa landscape takes the form of a long, forested valley cupping a small village.

Pines and broadleaf trees cloak the surrounding hills, their dark silhouettes broken by lighter patches of planted ground. Newly sown plots trace the curve of the slope, while small rectangles of green signal where maize and beans have already germinated. Low clouds hang over the ridge, and the moist air carries the smell of wet earth and decaying leaf litter, the substrate for fungi and soil invertebrates that campesinos fold into the broader category of *bosque*. Here the milpa does not stand apart from the forest but is nested within it, a temporary thinning of the canopy where light, moisture, and soil organisms are reassembled into seasonal cultivation.

On the plateau above Ozolco, Puebla, the view opens onto a broad expanse of maize fields interspersed with shrubs and scattered trees, framed by distant ridgelines. By July the *maíz* plants reach knee height, forming a textured carpet that ripples in the wind. Between parcels, hedges and uncultivated strips harbor insects, birds, and the first flushes of mushrooms in shaded hollows; these are the spaces that farmers casually describe as *monte* yet that ecologists might parse as hedgerows, secondary growth, or riparian corridors. From this vantage point, the milpa landscape reads as a mosaic rather than a single field—an uneven patchwork of cultivated rows, regenerating fallows, wooded corridors, and damp depressions. Together, these scenes invite us to think with milpa not only as a crop association of *maíz*, *frijol*, and *calabaza*, but as a more-than-human geography where terraces, valleys, and plateaus are continually assembled through the seasonal labors of plants, animals, fungi, and the people who tend them.



FIGURE 4. “*MILPA* LANDSCAPE” IN VICENTE GUERRERO, TLAXCALA; (PHOTOS BY THE AUTHOR MAY 2018).



FIGURE 5. '*MILPA* LANDSCAPE' IN NEVERÍA, OAXACA (PHOTOS BY THE AUTHOR MAY 2018).



FIGURE 6. ‘MILPA LANDSCAPE’ IN OZOLCO, PUEBLA (PHOTOS BY THE AUTHOR JULY 2020).

This landscape, meticulously cultivated over generations, reflects the deep ecological knowledge and sustainable farming practices of Tlaxcalan *campesinos*. The terracing evident in the landscape is a testament to centuries of intentional environmental engineering designed to mitigate soil erosion, optimize water retention, and expand arable land in rugged terrains. The diverse hues of green and brown indicate the complex agroecological characteristics of the milpa agroecosystems in the region. The interspersed woodland patches suggest a deliberate balance between annually cultivated fields and agroforestry (*Secretaría de Agricultura y Desarrollo Rural* 2022;

Agroecología y patrimonio biocultural 2022).⁹

THE MILPA ENIGMA

Despite the extensive literature on milpa agroecosystems in anthropology and agroecology, their lively, more-than-human entanglements remain under-theorized. A multi-species ethnographic lens brings these entanglements into sharper focus, attending to the agents often relegated to the periphery—those weedy greens, insects, and fungi that resist neat categorization as either crops or pests, resources, or nuisances. These species do not merely occupy the milpa; they make it, co-constituting its material and social realities.

Rooted in environmental anthropology, multi-species ethnography invites us to step beyond the anthropocentric gaze that dominates agricultural studies, centering instead on the myriad non-human actors that shape agroecosystems. Following Anna Tsing’s notion of “patchy landscapes” and Bruno Latour’s actor-network theory (ANT), this research situates the milpa as a dense, dynamic assemblage where plants, insects, fungi, and microbes negotiate life alongside human cultivators. Here, agency is distributed: *quelites* stabilize soil and enrich diets; *chapulines* contribute to nutrient cycles and provide protein; and *cuitlacoche*, a fungal pathogen, transforms into a prized delicacy, a re-worlding of the field through fungal incursion. These species are not only present in the milpa; they remake it, offering alternative visions of what agriculture might mean in the Anthropocene.

Agroecological and agroecosystem research, particularly in Mexico, has long integrated social

science methodologies, thereby blurring the boundaries between ecological and anthropological approaches. This interdisciplinary convergence is evident in historical agroecology, which emphasizes long-term human–environment interactions (Rivera-Núñez, Fargher, and Nigh 2020; Fisher et al. 2003), and participatory agroecology, which foregrounds localized knowledge and farming practices (Cockburn 2015; Meek 2014). Political agroecology research highlights the entanglement of power, policy, and grassroots movements in shaping food sovereignty initiatives (Rosset and Martínez-Torres 2012, 2013; Martínez-Alier et al. 2014).

Ethnobiology has also profoundly influenced agroecological scholarship by examining knowledge systems, traditional agricultural practices, and ecological heritage (Anderson, 2011). These approaches underscore the role of local and traditional knowledge in sustaining biocultural diversity and inform multi-species ethnography, which explores the dynamic relationships among humans, plants, animals, and microbes (Moreno-Calles et al. 2016; Aldasoro 2012; Wolverton, Nolan, and Ahmed 2014; Bastida et al. 2024; Pimbert 2017; Toledo 2002).

Through participatory research and visual ethnography, this dissertation foregrounds the milpa's multi-sensory and multi-species dimensions, exploring how campesino and Indigenous knowledge systems cultivate intra-species collaborations that sustain biodiversity and agroecological resilience in milpas. As a result, agroecological studies frequently overlap with multi-species approaches, particularly in research that emphasizes resilience, adaptation, and interspecies collaboration (Chao 2021; Armiero and Pellow 2023; Garnier et al. 1997). This overlap has led to methodological innovations, including visual methods (Morgan and Trubek 2020) and multi-species political ecology, which examines historical and contemporary agrarian transformations

(Münster 2015; Williams 2016; Rahman, Moussouri, and Alexopoulos 2021).

Multi-species political ecology articulates an emerging research framework that integrates multi-species ethnography, political ecology, and assemblage thinking. This approach reveals the milpa as more than a site of food cultivation; it is a space of negotiation, a contested terrain where interspecies entanglements confront and rework broader sociopolitical, economic, and ecological forces.

The milpa is not simply an agricultural system; it is a living, entangled world where maize, beans, squash, *quelites*, *chapulines*, and *cuitlacoche* emerge as co-actors in an intricate multi-species choreography. Neither fixed nor fully knowable, the milpa resists reduction to mere production logic; instead, it pulses with co-becoming histories shaped by both human and non-human agencies.

A milpa multi-species assemblage is a dynamic, co-productive agroecosystem characterized by interdependent relationships among diverse plant species (such as maize, beans, squash, and *quelites*), animals (e.g., *chapulines*), fungi (e.g., *cuitlacoche*), and microorganisms, alongside the human communities that cultivate and sustain them. These assemblages transcend traditional definitions of milpa as a “Mesoamerican triad” cropping system by emphasizing the broader ecological, cultural, and political entanglements that sustain biodiversity, food security, and agroecological resilience. Unlike industrial agricultural systems, which prioritize monoculture and simplification, milpa multi-species assemblages embrace biodiversity and the productive roles of “weedy,” “pesty,” and “smutty” species, situating them as integral rather than marginal to the system’s functioning.

HISTORICAL CONTEXT FOR THE CURRENT STATE OF HETEROGENEITY IN MEXICAN AGRICULTURE

Agriculture in Mexico has unfolded as a layered history of colonial impositions, land struggles, and shifting economic paradigms. *Hacienda* estates, plantation-style agribusiness, smallholder farming, and Indigenous agricultural systems are not merely distinct modes of cultivation but are entangled within the broader trajectories of conquest, resistance, and adaptation. Their histories do not follow a linear progression but rather accumulate in fragments—legacies of dispossession, state interventions, and global market forces that continue to shape rural landscapes (Wolf 1955; Warman 1982).

HACIENDAS, ENCOMIENDAS, AND PLANTATIONS

The *hacienda* was a system of large-scale landholdings that shaped the economic and social landscapes of Spain and its former colonies, bearing structural similarities to the Roman latifundium (Gonzales 2002, 48). Emerging from land grants allocated to conquistadores and Spanish elites, *haciendas* functioned as multipurpose estates that integrated agriculture, livestock, mining, and manufacturing. The term itself derives from *hacer* (“to make,” from Latin *facere*) and *haciendo* (making), signifying the estate’s role as a productive economic unit (Markiewicz, 1993).

While the term *hacienda* is imprecise, it typically refers to extensive landed estates, whereas smaller holdings are known as *estancias* or *ranchos*. Although not legally tied to the *encomienda*, the two systems overlapped in terms of land tenure and labor exploitation. Many *encomenderos*, who held rights to Indigenous labor and tribute through *encomiendas*, acquired *haciendas* and consolidated their control over land and labor (Wolf 1955, 97). The *hacienda* system became the

backbone of colonial economies, cultivating sugarcane, coffee, and cotton for export, and later expanding into cattle ranching and grain production as local economies transitioned from mining to agriculture in the 17th and 18th centuries (Barkin, 1989, 1998).

The emergence of *haciendas* in Mexico can be traced back to the early 16th century, particularly with land grants bestowed upon Hernán Cortés by the Spanish Crown in 1529, including vast territories in present-day Morelos (Gonzales, 2002, p.65). Initially reserved for the elites, land grants were petitioned by ordinary Spaniards, leading to the proliferation of *haciendas* across the Americas. As the Spanish Crown phased out the *encomienda* system following the New Laws of 1542, which were meant to curb Indigenous exploitation, many Spaniards consolidated private landholdings. They began recruiting laborers on a permanent or casual basis. As a system of private property and socioeconomic power, the hacienda persisted well beyond the colonial period, extending into the 20th century (Perramond, 2008).

The *encomienda* system was a colonial labor arrangement that permitted Spanish *encomenderos* to demand tribute and work from Indigenous peoples. *Encomenderos* oversaw Indigenous labor in agriculture, mining, and infrastructure, as well as religious and language instruction. Indigenous leaders organized tribute payments, including metals, crops, livestock, and other goods (Gonzales, 2002, 53). While encomiendas in many parts of the empire resulted in the forced relocation and fracturing of Indigenous communities, in New Spain, the system operated through existing Indigenous hierarchies, maintaining communal settlements while embedding colonial rule into local governance structures (Wolf 1955, 104).

By the late 19th and early 20th centuries, under the Porfirio Díaz regime (1876–1911), *hacendado*

agriculture was transformed into plantation-style production, increasingly oriented toward export markets. Sugar, coffee, and *henequén* plantations grew, intensifying monoculture and increasing rural labor divisions (Warman, 2001, 132). This change was both economic and ecological, as large areas were converted for industry, reducing biodiversity and replacing traditional farming (González 2001).

After the Mexican Revolution of 1910, which resulted in the loss of over a million Indigenous lives due to the fight for land, the Mexican federal government established the *ejido* system. This form of communal land tenure was created to tackle persistent inequalities in land distribution across the country. The revolution sought to dismantle this long-standing inequity, aiming to break the grip of the *hacienda* system, which had dominated rural life for centuries through exploitative labor practices and monopolistic control over land and resources (Kelly, 1993, 214). Enshrined in Article 27 of the 1917 Constitution, the *ejido* was intended to redistribute land to the dispossessed and restore territory to displaced communities (Kelly 1993, 218).

As the Spanish Crown sought to curtail the *encomienda* system, the transition toward haciendas marked a shift from tribute-based labor extraction to debt peonage and wage labor. The *hacienda* did not disappear as much as they mutated. While agrarian reform sought to curb the power of *hacendados* and provide land autonomy to *campesinos*, the entrenched structures of land-based inequality proved resilient (Dinerstein 2014; Mora 2023; González et al. 2023; van der Ploeg and Schneider 2022). Many landowners resisted redistribution or adapted by maintaining de facto control over land through legal loopholes, patronage networks, and economic pressure (Kapoor 2025; Grandia 2024; Gonda 2019; Brass 2003; Scott 2008).

The fundamental logic of racialized labor exploitation persisted, linking the *hacienda* system to the broader historical processes of the Plantationocene, a term underscoring the ecological, economic, and racialized violence of plantation economies in shaping global capitalism (Blickstein 2024; Chao et al. 2024; Ofstehage 2024; Peano, Macedo, and Le Petitcorps 2023; Paredes 2023; Chao et al. 2023; Borrás Jr. and Franco 2023; Barua, Ibáñez Martín, and Achtnich 2023; Wolford 2021; Ofstehage 2021). By the mid-20th century, large-scale agribusinesses emerged, retaining the echoes of their predecessors and reconfiguring past forms of exploitation under the guise of modernization and efficiency (Potvin et al. 2005; Giraldo 2019; Vides-Borrell et al. 2019). These systems illustrate how historical forms of agrarian inequality have persistently shaped Mexico's rural landscape despite revolutionary attempts at transformation.

SMALLHOLDER FARMING: PERSISTENCE, ADAPTATION, AND RESISTANCE

If *haciendas* and plantations represent histories of land consolidation, smallholder farming tells a different story—one of endurance and adaptation. Throughout the colonial and post-independence periods, smallholder farmers, often *mestizo* or Indigenous, have worked modest plots, cultivating resilience at the margins of dominant agricultural economies (Esteva and Marielle 2003). These farmers employ diverse cropping strategies—intercropping, rotational farming, and agroforestry—not merely as techniques but also as deeply embedded ways of navigating the unpredictability of soil, weather, and market forces (Alayón-Gamboa and Ku-Vera, 2011; Toledo, 1990). These strategies reflect nuanced agroecological knowledge honed over generations, sustaining both livelihoods and biodiversity in increasingly fragile landscapes (Bermeo, Couturier, and Galeana Pizaña 2014).

The twentieth-century *ejido* system sought to institutionalize smallholder farming by offering legal recognition to communal landholdings. However, structural limitations, such as restricted credit access, minimal technical support, and volatile market conditions, have constrained its potential (de Janvry, 1981). The advent of neoliberal reforms in the late twentieth century further destabilized smallholder agriculture. The dismantling of *ejidal* protections and Mexico's entry into NAFTA accelerated land consolidation, flooding rural markets with subsidized US imports that outcompeted local producers (Gálvez, 2018). Consequently, many smallholder farmers were forced into wage labor, migration, or precarious livelihoods on increasingly fragmented landholdings (Groenewald and Van Den Berg 2012).

Nevertheless, smallholder farming has persisted. It persists in the backyards of rural families, in the informal exchanges of seeds and knowledge, and in the quiet defiance of those who continue to cultivate, despite the forces urging them otherwise. The continued practice of *milpa* cultivation in Indigenous territories, despite land pressures and declining state support, underscores the resilience of agricultural traditions (Bermeo, Couturier, and Galeana Pizaña 2014). Smallholder participation in organic certification programs demonstrates another avenue of adaptation, offering both economic alternatives and reinforcing agroecological principles (González and Nigh, 2005).

Smallholders actively shape their environments, not only adapting to climate variability but also resisting industrial agricultural hegemony through localized conservation efforts. In southern Yucatán, land use decisions are deeply tied to cultural and historical factors, demonstrating how smallholders negotiate changing economic and ecological conditions (Gurri, Vallejo-Nieto, and Molina-Rosales 2021; Jácome and García 2007). In Chiapas, maize landrace conservation reflects

a plurality of values that transcend market considerations, linking genetic diversity to identity, autonomy, and food sovereignty (Monroy-Sais et al. 2024). The capacity to maintain agroecological diversity in the face of economic and climatic pressures highlights the political dimensions of smallholder farming: an insistence on survival, sovereignty, and alternative ways of relating to land.

Smallholders' responses to environmental crises illustrate their adaptive capacities. Farmers in southeastern Mexico employ a range of strategies, such as crop diversification, water management techniques, and adjustments in planting cycles, to cope with drought and climatic variability (Mardero et al. 2015). These adaptations, far from passive responses, reflect active engagement with ecological uncertainty rooted in long-standing agroecological knowledge. However, broader agricultural policy reforms continue to shape the conditions under which smallholders operate, often privileging large-scale agribusinesses and exacerbating existing inequalities.

INDIGENOUS FARMERS AND *MILPA*

Far from being a relic of the past, *milpa* persists as a dynamic and adaptive system structured around the interdependent cultivation of maize, beans, and squash. This multi-species assemblage functions as more than a method of food production; it is a carefully maintained ecological relationship that sustains soil fertility, mitigates pests, and fosters nutritional diversity (Altieri, Funes-Monzote, and Petersen 2012). These agroecological strategies predate colonial disruptions and persist despite centuries of dispossession, land privatization, and shifting policy interventions.

Spanish colonization violently reconfigured Indigenous agricultural landscapes, forcing communities onto marginal lands and imposing extractive economies oriented toward monoculture

and market dependency. Instead, Indigenous farmers actively reworked their agricultural traditions within new constraints. *Milpa* is not merely a productive system but an enduring expression of cultural resilience, intimately tied to Indigenous identities, territorial claims, and cosmologies. Its cyclical rhythm counters the linear temporality of capitalist agriculture, asserting an ontological orientation that refuses to erase local knowledge.

Today, Indigenous farmers confront new and intensifying threats: the encroachment of genetically modified maize, aggressive expansion of industrial agribusiness, and accelerating disruptions of climate change. However, they are not merely resisting; they are actively reshaping agricultural landscapes through agroecological movements that demand seed sovereignty, territorial autonomy, and the defense of agrobiodiversity (González de Molina et al. 2020). Their struggle is not one of nostalgia or survival alone, but a deliberate assertion of alternative futures, challenging the homogenizing logics of industrial agriculture and reclaiming their right to cultivate on their own terms.

CAMPESINOS: CONTINUITIES AND STRUGGLES

The term *campesino* gained prominence in post-revolutionary Mexico, encapsulating the central role of rural peasants in land redistribution and agrarian reforms. However, *campesinado*¹⁰ as a social category has long existed as a distinct formation, separate from both Indigenous communities and land-owning elites, yet often engaging in reciprocal relationships with both (Stavenhagen

¹⁰ *Campesinado* refers to the social category encompassing rural peasants in most of Latin America who engage primarily in small-scale, subsistence-oriented agriculture, maintaining distinct identities and practices separate from Indigenous farmers and large *hacendado* landowners.

1976). Their agricultural practices, rooted in subsistence production and deep ecological knowledge, reflect an enduring commitment to agrobiodiversity and minimal reliance on external inputs (Brosius, Lovelace, and Marten 1986; Katz 1993; Toledo 1992; Hunn 1999). Contrary to modernization narratives that cast campesinos as vestiges of the past (Warman 1982), their adaptive strategies and resilience illustrate a dynamic process of negotiation with shifting agrarian and economic structures (Esteva 1978).

The persistence of campesinos must be understood within the broader historical trajectory of Mexican agriculture, shaped by colonial land tenure systems, hacienda economies, agrarian populism, and the neoliberal dismantling of peasant-oriented policies (Leal, 1986). The historical context of the peasantry is rooted in episodes of systemic dispossession, such as the Enclosure Acts in the 1700s, which privatized common lands and displaced millions of peasants across Europe and its colonies. The English word “peasant,” first appearing in the late medieval period, carried derogatory connotations strategically used by elites to dehumanize and control subsistence-based communities.

The identity of “peasant” has historically been burdened with negative implications, reflecting fractured relationships with land and culture. However, reclaiming the identity of peasants has become an empowering act, enabling communities to confront their collective histories, assert dignity, and resist forces attempting to uproot traditional ways of life. Modern discomfort around the term highlights deeply ingrained societal views shaped by historical dehumanization. Revaluing the term can help reframe relationships with land and strengthen contemporary agrarian movements.

During the 20th and 21st centuries, *campesinos* faced agrarian reform, neoliberal changes, and industrial agriculture's expansion. The rollback of *ejido* protections, coupled with trade liberalization policies such as NAFTA, has placed immense pressure on smallholders (Barkin, 2002). Corporations and governments continue to displace campesino and indigenous communities, undermining traditional subsistence methods. Nevertheless, campesinos persist as central actors in Mexico's agricultural landscape, reconstructing their livelihoods through co-operative models, agroecological practices, and diversified economies (Barkin, 2002; Toledo, 1992).

Their struggles are actively generative and not merely defensive. Global peasant movements, notably *La Via Campesina*, have articulated the demands for food sovereignty, territorial rights, and agroecological alternatives to industrial agriculture. *La Via Campesina* is the world's biggest movement championing peasant rights. It has played a key role in pushing for initiatives like the United Nations Declaration on the Rights of Peasants, which formally recognizes their basic rights to land and resources. These efforts highlight the challenges faced by *campesino* communities and the urgent need for legal protection.

Peasant movements challenge the homogenization of agriculture imposed by transnational agribusiness while simultaneously reclaiming campesino identity as a political force against dispossession. In doing so, they invoke historical legacies of resistance, echoing earlier struggles against the hacienda system, land dispossession, and state-led agricultural modernization (Leal 1986). *Campesinos*, thus, not only sustain subsistence cultivation but also actively shape alternative rural economies and ecologies. As Esteva (1978) provocatively asked, *¿Y si los campesinos*

existen? (And if *campesinos* exist?). Rather than vanishing under the weight of modernity, campesinos continuously reaffirm their existence and value through adaptive strategies, historical consciousness, and collective advocacy.

ANTHROPOCENE AND PLANTATIONOCENE

Recent anthropological and geographical scholarship has increasingly turned to plantations as critical sites for examining human–environment interactions in the context of late capitalism and enduring colonial legacies. Plantations, as extensive monocultural agricultural systems, are typically owned by a single entity or corporation and are geared toward the commercial production of cash crops. Their historical entanglement with colonial expansion, racial hierarchies, and capitalist extraction underscores their continued significance in shaping contemporary socio-ecological formations (Kaltmeier et al. 2024; Pérez-Montesinos 2025; Kapoor 2025; Zibechi 2024). As a mode of production and governance, the plantation not only organizes landscapes but also disciplines labor, reinforcing racialized and gendered hierarchies that persist beyond its original colonial formations (McKittrick, 2013; Li and Semedi, 2021).

Scholars have argued that plantations fundamentally reorder landscapes by supplanting Indigenous ecosystems with commercialized, standardized environments. Ofstehage (2021) highlighted how plantations impose a radical simplification of landscapes, replacing diverse ecologies with uniform, high-yield crops designed for global markets. This transformation is not only ecological but also social, as plantations have long functioned as sites of labor exploitation, racialized hierarchies, and colonial governance (Wolford 2024). In this sense, the plantation operates as what Tsing (2019) calls (non)scalability, enforcing a model of production that eliminates ecological and cultural

heterogeneity to optimize capitalist extraction. Li (2021) further conceptualizes the plantation as a mechanized assemblage that systematically integrates land, labor, and capital, operating under colonial assumptions of local inefficiency and subordination.

The Plantationocene, a conceptual extension of the Anthropocene, has emerged as a critical framework for understanding how plantation economies have historically structured and continue to shape planetary ecological and social systems. Haraway (2015), in her essay “Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making Kin,” proposed the term Plantationocene to highlight how plantations reshape life via monoculture, displacement, and labor control. Engaging in dialogue with Haraway (2015), Chao et al. (2023) emphasize that the Plantationocene underscores not merely human impact on the environment but the specific logic of plantation capitalism—one that simplifies ecologies, reconfigures multi-species relationships, and enforces extractive labor regimes (Chao 2022). The Plantationocene lens thus reveals how capitalist logics of simplification and control extend beyond agriculture, structuring broader relations between power, ecology, and labor (Stoler, 2016).

Numerous scholars have elaborated on the conceptual terrain of the Plantationocene and examined its manifestations across diverse geographies. Li and Semedi (2021) describe the plantation as a machine that systematically assembles land, labor, and capital to produce monocrops for global markets, embodying colonial assumptions about local inefficiencies. They frame plantations as key sites of contemporary capitalist expansion, where plants and human lives are entangled in extractive circuits (Li and Semedi 2021). Carney (2020) traces plantation economies to their subaltern counterparts, such as dooryard gardens maintained by enslaved peoples, demonstrating

how plantation systems generate spaces of both domination and resistance. Wolford (2021) and Chao (2021) argued that plantation landscapes continue to structure racialized geographies long after formal plantation economies have declined. Davis et al. (2019) advocate for a more explicit engagement with ecological justice in Plantationocene scholarship, calling attention to how plantation landscapes exacerbate environmental degradation and sociopolitical inequities. Indeed, the plantation model is foundational to contemporary forms of environmental injustice, as its legacy persists in land dispossession, racialized labor exploitation, and ecosystem degradation (Borras Jr. and Franco 2023; Peano, Macedo, and Le Petitcorps 2023; Le Petitcorps, Macedo, and Peano 2023).

Ofstehage (2021) emphasizes that plantations simplify landscapes by replacing Indigenous ecosystems with commercialized ones. Wolford (2021) argues that plantations perpetuate racial and colonial hierarchies by sustaining elite groups, driving expansion, enforcing forced labor, and shaping cultural norms. Krumpf (2021) sees plantations as symbols of colonialism and capitalism, turning landscapes into resources through unstable labor.

This research supports ongoing discussions by highlighting that plantations, which are monocultures, tend to create fragile and unstable socio-ecological systems. When these landscapes are simplified, it encourages the spread of species considered weeds, pests, or pathogens—labels defined by capitalist approaches focused on control and elimination (Paredes 2023; Blickstein 2024). The Plantationocene framework reveals how these landscapes extend beyond agricultural production, structuring broader relations of race, labor, and ecology in ways that persist long after plantations themselves are abandoned (Whitaker, Armstrong, and Odonne 2023; Whitaker 2020).

In this sense, the Plantationocene provides a crucial analytical lens for understanding the enduring afterlives of plantation economies, particularly because contemporary agribusiness and extractive industries reproduce plantation-like dynamics under new guises (Murphy and Schroering 2020).

In contrast to the Anthropocene epoch, which broadly examines human impact on the environment, Haraway (2015) introduces the term “Plantationocene” in her commentary in *Environmental Humanities*, titled “Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making Kin.” The Plantationocene underscores the transformative and simplifying impact of plantation agriculture on ecologies, emphasizing global undertakings involving the relocation and extraction of both living and non-living elements as fundamental to the plantation system. In conversation with Tsing and other anthropologists, Haraway suggests that the Plantationocene links the current ecological crisis to modernity’s principles of modular simplification and hierarchical control of ecosystems and labor, tracing these back to the plantation (Haraway 2016; Haraway et al. 2016).

As this research suggests, simplified landscapes, such as monocultures, result in unruly and weak socio-ecological formations. Therefore, this research emphasizes that plantations, as monocultures, simplify landscapes, leading to the proliferation of species considered weedy, pestilential, or smutty, thereby affecting both local and global ecologies in complex and often detrimental ways.

By centering the plantation as a key analytical site, this research examines how monocultural systems shape multi-species entanglements, disrupt local ecologies, and sustain forms of racialized labor exploitation. As scholars continue to refine the Plantationocene as an analytical category, it remains a critical framework for interrogating the intertwined histories of colonialism, capitalism, and environmental transformation (Stoler, 2016; Woods, 2017; Tsing, 2022). Future research

should examine how plantation logics persist in new bioeconomies, where practices like genetic engineering, synthetic agriculture, and ecological restoration may repeat past patterns of simplification and exclusion.

WHY REASSEMBLE THE MILPA?

In the wake of the Green Revolution and decades of agricultural industrialization, Mexico's *milpa* systems—traditionally known for their agrobiodiversity and cultural significance—have undergone profound transformations. Capital-intensive monocultures have increasingly displaced multi-species, polycultural systems. As agro-industrial regimes promote the eradication of “weeds,” “pests,” and “fungal diseases,” they simultaneously erase the ecological roles and cultural value of species long integrated into campesino lifeways.

At the same time, a resurgence of interest in “ancestral” and “wild” foods among urban chefs, food activists, and alternative markets is revalorizing these same species—such as *quelites*, *chapulines*, and *cuitlacoche*—as delicacies, heritage foods, or superfoods. This contradictory moment—of erasure and exaltation—demands closer ethnographic attention.

Yet scholarly and public representations of milpa often reproduce static, symbolic framings (e.g., maize-beans-squash trinity), obscuring the messy, multi-species realities of milpa practice. These framings frequently fail to account for the role of semi-wild and marginal species, the everyday decisions of campesinos, or the complex negotiations between tradition, livelihood, and ecological change.

This dissertation addresses these gaps by reassembling the milpa as a dynamic, contested, and

multi-species agroecosystem. Through a political ecology and multi-species ethnography of the “liminal” foods that thrive at the edges—*quelites* (edible greens), *chapulines* (grasshoppers), and *cuitlacoche* (corn smut)—it asks: How do these species and their entanglements illuminate ongoing processes of resistance, reterritorialization, and ethical worldmaking in Mexican agriculture?

THE PARADOXES OF *QUELITES*, *CHAPULINES*, AND *CUITLACOCHÉ*

To think with *quelites*, *chapulines*, and *cuitlacoche* is to enter the shifting terrain of domestication, agriculture, and culinary adaptation. Often dismissed as weeds, pests, or blights in industrial farming, these species have emerged as central figures in the entanglements of agroecology, late capitalism, and colonial legacies. Like the *milpa* itself, they are neither fully wild nor entirely domesticated, inhabiting a liminal space in which human and non-human agencies intertwine. Their histories, embedded in the material and political landscapes of Mexican agriculture, offer a counter-narrative to the dominant understanding of farming, one that foregrounds resilience, adaptation, and multi-species collaborations.

Each of these species, *quelites*, *chapulines*, and *cuitlacoche*, arises within *milpa* systems as volunteers, growing alongside cultivated crops without deliberate human intervention. In this sense, they defy strict agricultural categories: they are neither weeds to be eradicated nor crops to be neatly cultivated, but rather oscillate between these roles. They exemplify what Tsing (2015) calls “gaps”—zones of indeterminacy where universalizing agricultural projects falter and unexpected multi-species relationships flourish. These gaps in domestication complicate the distinction between cultivated and wild species, suggesting a co-evolutionary process that unfolds in response to shifting sociocultural, economic, and political conditions.

Their presence in contemporary Mexican cuisine reflects the fluidity of *the milpa* as a centerpiece of the cuisine. While *chapulines* and *quelites* have recently gained popularity among urban elites as a gourmet and exotic foods, *cuitlacoches* have a more complex and misunderstood historical trajectory. Once prized in colonial Mexico, it later became stigmatized as a fungal blight before re-emerging as a delicacy with global appeal. However, even today, its status remains contested, being recognized in some culinary traditions and dismissed as an agricultural affliction in others. These shifting perceptions illuminate the political and ecological entanglements that have shaped food, taste, and value over time.

PESTY, WEEDY, AND SMUTTY

Pesty, weedy, and smutty describe species with culturally constructed negative connotations, which I use in order to rethink and draw attention to the cultural connotations of these terms.

***Pesty*:** Refers to species such as *chapulines* (grasshoppers), which are considered pests in simplified agricultural systems but are culturally and economically significant in traditional agroecosystems. For example, *chapulines* are viewed as pests in monocultures lacking natural predators, but in diversified *milpa* systems, they can be manually controlled and even used as a food source. This concept emphasizes the cultural construction of *pestiness* rather than an objective ecological definition, challenging conventional pesticide use, and advocating agroecological approaches that foster biodiversity.

Weedy plants are often considered undesirable in conventional agriculture but can play beneficial roles in traditional and agroecological farming systems. Some species are tolerated or even cultivated for their ecological benefits, such as acting as green manure or trap crops. Weedy plants

can also serve as ground cover to prevent erosion and support diverse agroecosystems, illustrating a nuanced understanding of weeds in *milpa* agroecosystems (Guillen-Pasillas et al., 2024; Guillen-Pasillas et al., 2025).

Smutty: refers to bacteria and fungi perceived as undesirable or problematic because of their association with disease or spoilage. Fungi offer innovative ways to think about assemblages and *intra*-species actions.¹¹ There is also renewed interest in broadening commodity production and novel uses of these lesser-understood kingdoms.

These terms advocate for a paradigm shift in the conventional negative perceptions of these species by emphasizing their integral roles within *milpa* agroecosystems. Focusing on these often-marginalized species, the importance of agroecological practices that embrace biodiversity and ensure resilient food systems and ecosystems is underscored. This approach highlights the cultural construction of these terms and provides a deeper understanding of their diverse functions in *milpa* agroecosystems, suggesting broader implications for environmental and agricultural policies.

QUELITES

The term *quelite* is derived from the Náhuatl word *quilitl*, meaning tender edible herbs. The

¹¹ Karen Barad introduces the term “*intra-action*” in *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (2007, 33) to emphasize that distinct agencies do not precede but rather emerge through entangled relations. In this framework, agency and even the boundaries of “individuals” are co-constituted through relational processes rather than inherent in isolated beings (Arlander 2014). Applied to fungal assemblages in agroecological contexts, such an understanding of “*intra*-species actions” among fungi (e.g., interconnected mycelial networks that facilitate resource exchange) illustrates that each fungus’s identity and capacity—indeed, even its bodily boundaries—are co-constituted through entanglements with conspecifics. This emphasis on relational co-constitution departs from classical notions of organisms as discrete, independently acting agents.

category itself resists fixed definitions, encompassing a diverse array of plant species, some annual, some perennial, some cultivated, and others thriving on the margins of fields and roadsides. *Quelites* are weedy in the sense that they grow opportunistically and appear wherever conditions allow. They are resistant to drought, soil depletion, and the homogenizing tendencies of industrialized agriculture. As such, they challenge dominant models of control and productivity, offering an alternative mode of cultivation that thrives in spaces left unattended by agribusiness.

Weeds, as Tsing (2015) reminds us, flourish in ruins. They are unwanted and overlooked, yet persist. *Quelites* also persist not through intensive breeding but through their ability to adapt to disturbances. In *milpa* systems, they are not merely tolerated but are actively harvested, forming an essential part of *campesino* diets. This dynamic illustrates what environmental anthropologists have increasingly recognized: that weediness is not a fixed trait, but an emergent property of agroecological relationships (Huang et al. 2017; Ellstrand et al. 2010; Stewart et al. 2009; Tsing 2005a; Zimmerman 1976; R. Hart 1976; De Wet 1966).

CHAPULINES

Chapulines, the most widely consumed insects in Mexico, occupy a similarly ambiguous space. Commonly known as *chapulín de la milpa*, it has long been an integral component of Mesoamerican diets (Ramos-Elorduy and Pino Moreno 1989). Their presence in milpa fields exemplifies multi-species entanglement, as their populations fluctuate in response to climatic conditions, crop cycles, and human harvesting practices.

For industrial farmers, *chapulines* are framed as pests, a threat to maize production that necessitates chemical interventions. However, for *campesinos*, *chapulines* are not merely agricultural

nuisances; they are also food. The act of collecting them is a form of pest management that does not rely on synthetic pesticides, but instead transforms an ecological *intra*-action into sustenance. This shift in perception from pest to opportunity illustrates the contingent nature of agricultural classifications.

Chapulines have undergone further transformations over the past few decades. Once a subsistence food, they have been rebranded as gourmet delicacies and appear in high-end restaurants catering to cosmopolitan consumers. This shift reflects the dynamics of global food markets, where foods that were once markers of rural subsistence have become valuable as authentic and exotic commodities (Paxson, 2013). However, this commodification also alters the ecological balance of *chapulín* populations, as increased demand leads to the expansion and intensification of *chapulín* collection. What was once an integrated aspect of *milpa* agroecology now risks being extracted from its original context, severing the relationship between *chapulines* and *campesinos*.

CUITLACOCHÉ

Few organisms embody the contradictions of agricultural classification as starkly as *Mycosarcoma maydis*, synonym *Ustilago maydis*, known in English as corn smut and in Mexico as *cuitlacoche*. This fungal pathogen infects maize and causes the kernels to swell into dark, spore-filled tumors. In industrial monocultures, *Mycosarcoma maydis* is treated as an affliction to be eradicated through fungicides and resistant maize varieties. However, in Mexican culinary traditions, *cuitlacoche* is prized for its deep-earthly flavor and is often incorporated into quesadillas and tamales.

Cuitlacoche embodies what we might call *pestiness*, an unwanted presence in one context that becomes valuable in another. It is a fungal invasion of maize that disrupts agricultural expectations,

reminding us that domestication is never complete and that cultivated crops remain vulnerable to their entangled histories with non-human species. Studies suggest that *cuitlacoche* co-evolved with maize's wild ancestor, *teosinte*, over twenty-five million years ago (Munkacsi, Stoxen, and May 2008). Thus, the fungus is not an intruder but a long-standing companion, and its presence is woven into the history of maize cultivation.

Here, we return to “gaps”—spaces where dominant agricultural narratives break down. On the one hand, *cuitlacoche* is a disease and a threat to maize yields; on the other hand, it is a delicacy and a marker of culinary sophistication. These contradictory classifications reveal the limits of industrial agriculture's attempts to impose order on ecological systems. The *milpa*, as an assemblage, resists such simplifications. It accommodates weediness, pestiness, and fungal unruliness, transforming agribusiness treats as a failure into a source of nourishment.

THE UNRULY POTENTIAL OF *MILPA* ASSEMBLAGES

In the wake of the Green Revolution and decades of agricultural modernization, Mexico's milpa systems—traditionally known for their agrobiodiversity and cultural significance—have undergone profound transformations. Capital-intensive monocultures have increasingly displaced multi-species, polycultural systems. As agro-industrial regimes promote the eradication of “weeds,” “pests,” and “fungal diseases,” they simultaneously erase the ecological roles and cultural value of species long integrated into *campesino* lifeways.

At the same time, a resurgence of interest in “ancestral” and “wild” foods among urban chefs, food activists, and alternative markets is revalorizing these same species—such as *quelites*, *chapulines*, and *cuitlacoche*—as delicacies, heritage foods, or superfoods. This contradictory moment—of

erasure and exaltation—demands closer ethnographic attention.

Yet scholarly and public representations of milpa often reproduce static, symbolic framings (e.g., maize-beans-squash trinity), obscuring the messy, multi-species realities of milpa practice. These framings frequently fail to account for the role of semi-wild and marginal species, the everyday decisions of campesinos, or the complex negotiations between tradition, livelihood, and ecological change.

This dissertation addresses these gaps by reassembling the milpa as a dynamic, contested, and multi-species agroecosystem. Through a political ecology and multi-species ethnography of the “liminal” foods that thrive at the edges—*quelites* (edible greens), *chapulines* (grasshoppers), and *cuitlacoche* (corn smut)—it asks: How do these species and their entanglements illuminate ongoing processes of resistance, reterritorialization, and ethical worldmaking in Mexican agriculture?

Thinking with *quelites*, *chapulines*, and *cuitlacoche* unsettles the conventional categories of the agricultural order. These lively presences blur the boundaries of crops and weeds, food and pests, and diseases and delicacies, categories that once seemed stable but now appear porous, shifting, and deeply entangled. They do not merely disrupt the logic of agricultural management but also expose its limitations. As environmental anthropologists have argued, pests, weeds, and fungi are not marginal disruptions but essential participants in the ongoing improvisational work of food production (Lorimer, 2017; Robbins, 2012; Swanson, 2017).

Attending to the gaps, assemblages, and multi-species encounters that animate *milpa* agroecosystems, this dissertation foregrounds the adaptability of *campesino* and Indigenous

farming practices—not as vestiges of the past but as living negotiations in a landscape of uncertainty. Industrial agriculture seeks to render particular species invisible, irrelevant, or expendable; however, these supposed contaminants persist, proliferate, and transform. Rather than viewing them as obstacles, this research reconsiders them as agents of agroecological possibilities. In this light, cultivation is not an act of mastery but an ongoing conversation with the unexpected, choreography of human and non-human lives that refuses to be fully contained.

This dissertation re-examines the *milpa* as a multi-species assemblage that resists agricultural simplification. By foregrounding *quelites*, chapulines, and *cuitlacoche* as actors, it shows how *campesino* moral ecologies sustain biodiversity and challenge purity-based models of productivity. The conceptual tools are elaborated in Chapter Two: Theoretical Framework.

SIGNIFICANCE

This dissertation situates itself at the confluence of environmental anthropology and agroecology, re-examining the *milpa* as a multi-species assemblage that resists agricultural simplification. It contributes to interdisciplinary conversations in environmental anthropology, agroecology, political ecology, and critical food studies by:

1. Demonstrating how campesino knowledge systems and traditional ecological practices persist—and evolve—amid capitalist disruption;
2. Expanding the conceptual toolkit for multi-species ethnography in agricultural contexts;
3. Offering a nuanced account of how value is constructed across cultural, ecological, and economic registers;
4. Proposing “reassembling the milpa” as an analytical frame that highlights shifting ontologies, ethical negotiations, and adaptive practices.

Recent anthropological shifts, particularly in multi-species ethnography, have challenged human-centered narratives by foregrounding the agency of non-human actants. However, agricultural systems such as *milpas* remain underexplored through this lens. This study aims to address this gap by positioning non-human participants, such as *quelites* (wild edible greens), *chapulines* (grasshoppers), and *cuitlacoche* (corn smut), as integral co-creators within the *milpa*. These organisms are not passive elements of agroecosystems; instead, they actively shape resilience, productivity, and cultural significance.

Milpas stand in stark opposition to the purity, control, and homogeneity of industrial agriculture. Species often dismissed in industrial contexts as “weedy,” “pesty,” or “smutty” play crucial ecological and cultural roles in *milpas*, underscoring the system’s embrace of biodiversity. By rejecting the purity-driven logic of industrial agriculture, *milpas* cultivate ecological resilience and offer an alternative paradigm that recognizes the interdependence of human and non-human actors in food production. This research interrogates the ways in which such inclusive agroecological practices disrupt dominant agricultural ideologies, revealing their political, ethical, and epistemological stakes.

This research contributes to broader conversations in environmental anthropology and agroecology by emphasizing the role of multi-species relationships in sustaining agrobiodiversity. This underscores the ethical imperative of supporting multi-species entanglements within agroecosystems and critiques the reductionist frameworks that underpin the unsustainable pursuit of purity in industrial agriculture.

Integrating multi-species ethnography, political ecology, and assemblage thinking enables a

nuanced understanding of how *milpa* systems adapt to external pressures while sustaining biodiversity and resilience. Moreover, this research highlights the importance of *campesino* and Indigenous knowledge in maintaining these assemblages, positioning *milpas* as a living model for sustainable agriculture in the Anthropocene.

Synthesizing these theoretical perspectives, this dissertation advances a “multi-species political ecology” that captures the complexity of *milpas*. This framework provides a means of analyzing the convergence of local knowledge, ecological *intra*-actions, and broader sociopolitical forces within agroecosystems. It also situates the *milpa* as a contested space, one where the global narratives of industrial agriculture are actively resisted and reimagined.

This dissertation reimagines the *milpa* as a multi-species assemblage, challenging dominant agricultural paradigms and calling for a re-evaluation of human-non-human relationships in food systems. It positions the *milpa* as an active site for agroecological transformation, offering solutions to pressing global challenges, from biodiversity loss to food insecurity. This research ultimately makes a significant contribution to anthropology, agroecology, and beyond, illuminating pathways toward a sustainable, interconnected, and just agricultural future.

The concept of “reassembling the milpa” draws on the vocabulary of assemblage theory (Deleuze and Guattari; Tsing 2015) and recent discussions of agricultural reterritorialization (Matthews, Burandt, Tsing 2021) to describe how milpa agroecosystems are being transformed through emergent relationships among humans and nonhumans in a rapidly shifting agroecological, economic, and cultural landscape.

To “reassemble” the milpa is not to recover a lost whole, but to track the ongoing reconfiguration of species, practices, meanings, and values that make up this historically rich but dynamically evolving agroecosystem.

By engaging with these entangled challenges, this research addresses a critical gap in agroecological and anthropological scholarship on interdisciplinary intermingling. While the notion that agroecological systems, such as *milpas*, embody both ecological resistance and cultural persistence is well established in both fields (Altieri and Toledo 2011; Gliessman 2015; Nigh and Diemont 2013), this research contributes a nuanced analysis of how these dynamics unfold in specific socio-environmental contexts. This offers vital lessons for sustainability and food justice. By centering liminal and often marginalized species, such as *quelites*, *chapulines*, and *cuitlacoche*, this research deepens our understanding of *milpa* agroecosystems as dynamic, adaptive assemblages that resist simplification and demand recognition as complex, multi-species collaborations (Haraway 2016; Kimmerer 2013).

NEXT CHAPTERS

This introductory chapter establishes the theoretical foundations, key concepts, and methodological approaches that shape this dissertation. Grounded in an environmental anthropological and agroecological framework, this research aims to bridge the divide between sociocultural and natural scientific perspectives by conceptualizing *milpa* agroecosystems as dynamic multi-species assemblages. The following chapters examine the interwoven relationships between *chapulines*, *quelites*, and *cuitlacoche* within *milpa* agriculture, foregrounding their ecological, cultural, and economic roles in contemporary Mesoamerican societies.

Chapter Four: Weediness and the Politics of Purity₁ engages with weedy-*quelites* to interrogate the liminal spaces within *milpa* agroecology, where botanical classifications, labor practices, and food politics intersect. Chapter Five: Patchy Landscapes₁ traces the entanglements of *chapulines* (*Sphenarium purpurascens*) within shifting agricultural paradigms, particularly their integration into plantation-style production. Finally, Chapter Six: Becoming Fungi, employs *cuitlacoche* as a focal point for exploring fungal agencies and their broader implications within the multi-species networks of the *milpa*. Collectively, these chapters illuminate the complex ecologies and sociopolitical dimensions of *milpa* agroecosystems, offering an interdisciplinary perspective on agroecological resilience and multi-species coexistence.

CHAPTER TWO: THEORETICAL FRAMEWORK

Patterns of unintentional coordination develop in assemblages. To notice such patterns means watching the interplay of temporal rhythms and scales in the divergent lifeways that gather. Surprisingly, this turns out to be a method that might revitalize political economy as well as environmental studies. Assemblages drag political economy inside them, and not just for humans. Plantation crops have lives different from those of their free-living siblings; cart horses and hunter steeds share species but not lifeways. Assemblages cannot hide from capital and the state; they are sites for watching how political economy works. If capitalism has no teleology, we need to see what comes together—not just by prefabrication, but also by juxtaposition.

—Anna Tsing 2015, 23

HUMAN–NON-HUMAN ENTANGLEMENTS AND MULTI-SPECIES POLITICAL ECOLOGY

This chapter brings into dialogue three frameworks—agroecology, multi-species ethnography, and assemblage theory—showing how each illuminates different dimensions of milpa.

Multi-species ethnography offers a methodological bridge between the natural and social sciences, attuning research to the relational dynamics that shape agricultural ecologies. Following Bruno Latour's (1996, 2005) articulation of actants, this approach unsettles rigid distinctions between humans and non-humans, making co-constitutive agencies at work in farming landscapes visible. Rather than privileging human intent and action, multi-species ethnography demands attentiveness to non-human forms of agency, such as soil microbes that shape fertility, maize varieties that respond to climatic variability, or pollinators whose movements enact the conditions of agricultural reproduction. This challenges anthropocentric framings and opens up new conceptual spaces for understanding agrarian life.

Primarily situated within cultural and environmental anthropology, multi-species ethnography expands the anthropological subject beyond humans, attuning research to the intra-actions among plants, fungi, soil microbes, and humans. As Barad (2007) suggests, shifting from “interaction” to “*intra-action*” makes visible the ways in which all actants—whether human or non-human—are continually shaped by broader material and historical entanglements (Barad 1998; 2003; 2007; Stengers 2011). Through this lens, the *milpa* is not a static agricultural system, but an emergent and shifting space of interdependence, where relations among species, economies, and ecologies are always in a state of flux.

Multi-species ethnographers integrate theories and methods from both natural and social sciences, unsettling disciplinary boundaries to better account for the complexity of human–non-human entanglements (Latour 1996, 2005). As Tsing (2015) demonstrated, such entanglements defy the logic of bounded and stable categories, thus requiring new ways of thinking about agency, power, and ecological transformation. In the *milpa*, *campesinos* cultivate not only maize but also soil microbes, pollinators, and climatic patterns, none of which are static or predictable. These entanglements require conceptual tools that acknowledge both contingency and historical embeddedness, resisting the impulse to impose universalizing frameworks.

However, the epistemological challenge of researching non-humans persists. What does it mean to take the agency of maize or the labor of fungi seriously? How do we theorize interspecies relations without subsuming them into human-centered narratives? These questions remain central to the ongoing ontological debates in environmental anthropology concerning the shifting boundaries between nature and culture, humans and non-humans, and subjects and objects. By engaging with

these debates, this research foregrounds multi-species entanglements as both an analytic and empirical reality, situating the *milpa* within broader conversations about relational ontologies and ecological interdependence.

Multi-species political ecology extends this analysis by embedding human–non-human relations within histories of power, economic restructuring, and environmental governance. Agroecosystems do not exist in isolation; they are shaped by external pressures—state policies, market demands, and infrastructural shifts—that reconfigure human and non-human *intra*-action. Understanding the *milpa* then requires recognition of how these external forces intersect with local ecologies, influencing patterns of resilience and transformation. Simultaneously, this framework allows for the analysis of how non-human species exert their own forms of agency, resisting, adapting to, or being reshaped by human interventions. Thus, *intra*-actions between *campesinos*, maize, weeds, pests, and soil microorganisms emerge as sites of negotiation where ecological processes and political economies collide.

Critical food studies provide an additional layer for this analysis, highlighting the cultural, social, and economic dimensions of food production. This perspective illuminates the ways in which traditional agricultural knowledge is preserved, adapted, or contested in response to shifting conditions, underscoring the role of *campesino* and Indigenous practices in sustaining food sovereignty in the region. In tracing these continuities and transformations, this research situates food not merely as a commodity, but also as a relational substance that links humans to land, history, and multi-species ecologies.

Together, these theoretical perspectives form an integrated analytical framework that informs the

interpretation of ethnographic data and advances the central research questions. By engaging multi-species political ecology, this dissertation contributes to broader discussions of agrarian resilience, environmental change, and the more-than-human dimensions of agriculture. It foregrounds the *milpa* as an emergent assemblage—one shaped not only by human knowledge and labor but also by the unruly agencies of non-human actors, whose entanglements remain central to its survival.

MILPA WORLDS: ENTANGLEMENT, ASSEMBLAGE, AND LIMINAL SPECIES

As previewed in the introduction, this dissertation draws on a set of interrelated concepts—entanglement, assemblage, and liminality—to develop a framework for understanding how the *milpa* is being materially and symbolically reconfigured. These terms require further unpacking here, in relation to the broader theoretical architectures already discussed.

I use the term entanglement to describe the mutually constitutive relationships—ecological, political, and epistemic—that bind species, people, and practices together in the *milpa*. Entanglement here signals more than interaction; it refers to co-becoming, embeddedness, and histories of interdependence. Rather than viewing species and actors as discrete units that interact from a distance, a focus on entanglement draws attention to the ways in which all participants—human and more-than-human—emerge through their relations with one another.

Assemblage offers a complementary lens through which to analyze the *milpa*—not as a bounded system, but as a constellation of heterogeneous elements that come together provisionally to form a living landscape. Drawing on Deleuze and Guattari (1987) and Anna Tsing (2015), I use assemblage to think with flux, friction, and contingency. A *milpa* assemblage includes humans,

plants, insects, fungi, infrastructures, markets, policies, and memories. These do not cohere into a seamless system but form an evolving socioecological formation shaped by partial connections and shifting alliances.

Liminal species are those that exist at the boundaries of accepted ecological and cultural categories. Quelites, chapulines, and cuitlacoche are at once weeds, pests, or blight—and food, medicine, or delicacy. Their liminality destabilizes conventional agricultural classifications and reveals the blurred lines between purity and contamination, wild and cultivated, nuisance and nourishment. These species are especially useful for tracing the tensions between capitalist simplification and campesino relationality.

FROM AGROECOSYSTEM TO ASSEMBLAGE: RETHINKING MILPA WORLDS

The milpa has long been described as a highly diversified agroecosystem—a dynamic, co-evolved system in which ecological functions like soil fertility, pest control, and nutrient cycling are maintained through intercropping (maize, beans, squash) and traditional knowledge practices (Toledo et al. 1985; Altieri 1995). This perspective has been central to agroecology and conservation biology, emphasizing sustainability, resilience, and productivity without synthetic inputs.

Yet describing the milpa solely as an agroecosystem can obscure the cultural, ontological, and more-than-human relations that also constitute it. Assemblage theory offers an alternative lens: one that foregrounds the emergent, unstable, and open-ended interactions among species, technologies, histories, and institutions (Deleuze and Guattari 1987; Tsing 2015). Thinking of the milpa as an

assemblage allows us to explore not only its functional dynamics but also its entanglements with broader capitalist transformations, shifting classifications (e.g., weed/pest/superfood), and the affective and ethical relationships that shape everyday milpa practice.

This move from agroecosystem to assemblage is not meant to discard ecological analysis, but rather to expand it—to accommodate epistemological pluralism, multi-species agency, and the reterritorialization of agriculture in the Anthropocene. It invites us to ask:

- What holds the milpa together today?
- Who or what is reassembling it?
- How do knowledge, labor, species, and ethics converge to maintain or transform its form?

This dissertation therefore draws on both lenses—agroecosystem and assemblage—treating them not as mutually exclusive but as complementary heuristics that illuminate different dimensions of milpa practice. While the former emphasizes ecological structure and function, the latter attends to relational process, ontology, and transformation. It is in the tension between these perspectives that new conceptual and political possibilities emerge.

***MILPA* AS A MULTI-SPECIES ASSEMBLAGE**

The *milpa* is a dynamic multi-species assemblage in which weedy plants, insects, microorganisms, and staple crops, such as maize, beans, and squash, interact symbiotically. My use of the term assemblage refers to the evolving intra-actions and co-evolution of various species within a shared environment shaped by ecological, social, and historical contingencies. This perspective aligns with community assembly theory, which highlights the role of historical contingency, environmental fluctuations, and stochasticity in shaping ecological communities, rather than

assuming a deterministic trajectory of succession (Drake 1990; Chase 2003; Fukami 2015). Community assembly processes influence the composition and stability of multi-species systems such as *milpa*, where species interactions are contingent upon priority effects, species pools, and environmental constraints (Fukami and Morin 2003; Godoy et al. 2024).

Recent studies underscore the importance of mutualistic relationships and cooperation in structuring ecological communities (Araujo, Gui, and Lurgi 2024; Godoy et al. 2024). Within the *milpa* system, plant-pollinator networks, soil microbial communities, and intercropping relationships exemplify how mutualism contributes to biodiversity and system resilience (Campbell et al. 2011; Ni et al. 2025). Moreover, emergent ecological properties in assemblages arise through nonlinear interactions, environmental feedback, and network complexity (Hraber and Milne 1997; Vollert, Drovandi, and Adams 2024).

Unlike an ecological community, which typically describes a relatively stable group of coexisting species interacting within a defined habitat, an assemblage emphasizes the fluid and processual nature of species entanglements. These assemblages are not bound by fixed spatial or taxonomic boundaries but emerge through constant biotic and abiotic fluxes, including species migrations, climate variations, anthropogenic influences, and shifting interspecies relationships (Law 1999; Polazzo et al. 2025). Organisms within these assemblages co-constitute their environments through reciprocal transformations that foster novel forms of relationality, adaptation, and emergent ecological functions.

Multi-species assemblages emphasize the relational and situated nature of agricultural practices, whereas agroecosystems provide a systemic and functionalist perspective. While both frameworks

recognize the interdependence of human and non-human actors in agricultural systems, their analytical focus differs. Recognizing this distinction enables researchers and practitioners to adopt methodologies and frameworks to analyze and address agricultural issues. Multi-species assemblages foreground the dynamic, co-constitutive relationships among plants, animals, microbes, and humans, whereas agroecosystem approaches tend to emphasize structural components and ecological functions. Understanding *milpa* as a multi-species assemblage allows us to view them as living, adaptive systems that embody both ecological resilience and cultural heritage. By examining the *milpa* through this lens, we gained insights into the complex networks and intra-actions that shape *milpa* agroecosystems. This dissertation focuses on these assemblages to uncover the intricate relationships and negotiations that constitute the multi-species world of the *milpa*.

CLARIFYING KEY CONCEPTS: GAPS, ASSEMBLAGES, AND ENTANGLEMENTS

Throughout this dissertation, three conceptual threads have grounded my analysis of the *milpa* and its entangled species: reterritorialization, resistance, and multi-species ethic. I use reterritorialization, following Deleuze and Guattari (1987), to describe the ways in which species, spaces, and meanings are reassembled after disruption—not as a return to tradition, but as an adaptive reconfiguration. In the context of the *milpa*, reterritorialization occurs when *chapulines*, *quelites*, or fungi are repositioned within shifting ecological and economic regimes: sometimes revalued, sometimes excluded, but always negotiated through practice.

I use resistance not solely in terms of political confrontation, but in a broader agroecological and

epistemological sense—encompassing the ways campesinos refuse the totalizing logics of state pest control, seed commodification, and monocultural rationality. This includes subtle practices: letting weeds grow, collecting insects, altering planting rhythms, or speaking to fungi. Resistance here is relational—not always visible, but enacted through forms of care, patience, and improvisation.

Finally, multi-species ethic refers to the situated, embodied modes of attention and accountability that shape how humans engage with other beings in the milpa. This ethic emerges not from abstract rights, but from daily interactions—letting a fungus grow, thanking a field, avoiding overharvest, or tolerating “weeds” as collaborators. It is an ethic grounded in uncertainty, reciprocity, and restraint, and it challenges anthropocentric notions of control or mastery.

Together, these concepts help illuminate the central claim of this dissertation: that the milpa is not only a farming system, but a dynamic ethical terrain, where life is reassembled in the ruins of capitalist simplification—and where the margins hold lessons for more just and livable worlds.

In *Emergent Ecologies*, Kirksey (2015) employed the concept of entanglement to illuminate the interdependent relationships that shape the cohabitation of humans and other species. Moving beyond rigid taxonomic or hierarchical distinctions, Kirksey (2015) foregrounds the ways in which life forms —human and non-human —constitute one another through the dynamic processes of communication, cooperation, and cohabitation. Rather than existing as discrete entities, species become enmeshed in multi-species worlds, in which their lives and trajectories are contingent upon complex ecological and social interactions.

Kirksey (2015) mobilizes entanglements to examine cases that challenge anthropocentric narratives of agency and resilience. From the symbiotic relationships between fungi and plants that facilitate nutrient exchange to the intricate modes of cooperation among different bird species, he traced the material and semiotic flows that structure these interactions. These examples reveal not only the depth of interspecies dependencies but also the vulnerabilities inherent to these assemblages. When entanglements unravel, whether due to environmental degradation, extractive economies, or climate change, the consequences can be unpredictable, exposing the fragility of certain assemblages.

This framing of *emergent ecologies* offers a crucial perspective for understanding the present moment, where climate disruptions and biodiversity loss make the stakes of *intra-species* entanglements increasingly apparent. Kirksey's (2015) approach challenges human exceptionalism by demonstrating how humans, too, are enmeshed in these precarious ecological webs, subject to the same forces of co-constitution and collapse as other species. His work thus provides a conceptual framework for this dissertation, allowing for a more interconnected analysis of human–environment relations that foregrounds the unpredictability and liveliness of multi-species worlds.

GAPS

Our categories and discriminations always produce zones of 'boredom' and unreadability; powerful projects of categorization, including development and conservation (as well as your scholarly reading practices, whatever they may be), produce persistently uninteresting, invisible, and sometimes illegitimate zones—which I call 'gaps.' Universal knowledge projects cannot be understood without attention to gaps.

—Anna Tsing, *Friction* (2005, 172)

In mapping the *milpa* as an agroecological and social system, this dissertation follows many of the pathways established by the “Matsutake Worlds Research Group” and other multi-species ethnographers, while also forging new analytical routes through the landscapes of the central Mexican highlands. Anna Tsing’s (2005, 171–202) concept of gaps becomes particularly relevant here. Gaps mark the spaces where dominant knowledge structures fail, where universalizing projects falter in their attempts to impose singular, interpretive frames. These are the spaces of erasure and illegibility, the margins where complexity resists simplification (Tsing, 2005, p.175).

Milpas also exist in such gaps. It persists as a site of both agricultural continuity and disruption, caught between the modernization imperatives of agribusiness and the long-standing ecological knowledge of *campesinos* and Indigenous farmers. As Tsing (2005) notes, gaps are not voids but sites of possibilities. In these spaces, unexpected collaborations and ecological co-dependencies emerge, reshaping the conditions of agricultural production in ways that cannot be easily classified within prevailing developmentalist discourses.

ASSEMBLAGES

Assemblages are open-ended and dynamic, thus allowing us to ask questions about communal effects without making a priori assumptions.

—Anna Tsing, *The Mushroom at the End of the World* (2015, 22–23)

The concept of assemblages offers another key theoretical tool for understanding *milpa* agroecosystems. First articulated by Gilles Deleuze and Félix Guattari (1987) and later operationalized by Manuel DeLanda (2016), assemblage theory disrupts linear causal models of social and ecological *intra*-actions, emphasizing the fluidity and relationality of socio-material formations. In an assemblage, agency is distributed not only among human actors but also across

species, infrastructures, and historical contingencies.

As Bennett (2010, 23–24) suggests, assemblages are “throbbing confederations” in which human and non-human actants co-produce emergent realities. This insight is critical for multi-species ethnography, as it enables an analysis that moves beyond anthropocentric assumptions, foregrounding the roles of plants, fungi, insects, and soil microorganisms as active participants in agroecological networks. The *milpa*, then, is not simply a cultivated field, but a complex multi-species assemblage in which maize varieties, weeds, pests, a plethora of microorganisms, weather patterns, and global commodity markets all play constitutive roles.

Following Deleuze and Guattari (1983, 1987), assemblages are not defined by fixed structures but by relations of exteriority; that is, elements within an assemblage do not determine one another’s behavior but interact in ways that remain open-ended and contingent (DeLanda 2016, 2). This conceptualization resonates with ANT, particularly as developed by Latour (1996, 2005) and Callon (1984), who argue for an understanding of social and ecological formations as dynamic, networked entanglements rather than stable systems (Callon, 1984; Law, 1992; Murdoch, 1997).

TABLE 1. CONCEPTUAL COMPARISON OF *QUELITES*, *CHAPULINES*, AND *CUITLACOCHE*

Species	Agroindustrial Lens	Agroecological Lens	Assemblage Lens
<i>Quelites:</i>	<i>Weeds; non-marketable; targeted for eradication with herbicides</i>	<i>Edible greens; part of traditional diets; tolerated or selectively harvested</i>	<i>Liminal species co-produced through cultural practices, soil, and social memory</i>
<i>Chapulines:</i>	<i>Pests; threat to crop yield; managed via insecticides</i>	<i>Protein-rich insects; traditionally harvested and consumed; pest control through</i>	<i>Agents in pest outbreaks, labor economies, and culinary reinvention; entangled in feral niches</i>

	<i>collection</i>	<i>and markets</i>
<i>Cuitlacoche:</i>	<i>Fungal disease; crop contamination; product loss</i>	<i>Edible delicacy; often encouraged in smallholder plots</i>
		<i>Hybrid figure of contamination and luxury; emerging actor in niche food networks</i>

This table offers a conceptual comparison of how three key species in the milpa—quelites, *chapulines*, and *cuitlacoche*—are framed differently depending on whether they are viewed through an agroindustrial, agroecological, or assemblage lens. This comparative framework highlights how values, categories, and ecological functions shift across ontologies and political imaginaries.

ENTANGLEMENTS

Sometimes, common entanglements emerge not from human plans but despite them. It is not even the undoing of plans, but rather the unaccounted for in their doing that offers possibilities for elusive moments of living in common.

— Anna Tsing, *The Mushroom at the End of the World* (2015, 267)

In this dissertation, I use the term entanglement to refer to the relational processes through which human and more-than-human beings—including plants, insects, fungi, microbes, and their environments—mutually constitute one another across ecological, cultural, and political domains. Drawing on Karen Barad’s (2007) notion of intra-action, entanglement here signals more than interaction between discrete entities; it reflects the idea that beings do not preexist their relations but emerge through them. This relational ontology challenges nature–culture dualisms and centers the co-becoming of species, practices, and landscapes.

Entanglement also functions as a methodological and analytical device, allowing me to track how

social, economic, and biological processes fold into one another in the daily life of the milpa. For example, the proliferation of *chapulines* is not just a biological event, but one conditioned by pesticide regimes, labor practices, ecological shifts, and market values. To describe this as an entanglement is to highlight the dense layering of causality, agency, and temporality.

However, I avoid using entanglement as a vague metaphor for complexity. Instead, I treat it as a specific heuristic for examining how ecological relationships are politically charged, ethically negotiated, and ontologically unstable. By foregrounding entanglement, I aim to render visible the assemblages through which multi-species worlds are made, contested, and reassembled in the milpa.

This dissertation examines the entanglements that shape *milpa* agroecosystems, foregrounding the complex ways in which human and non-human actors co-produce agricultural landscapes. Tsing (2015) described entanglements as the unintended consequences of human and non-human coexistence, moments where unexpected collaborations and ecological relationships emerge despite—or because of—the disruptions of global capitalism.

As an agroecosystem, the milpa embodies such entanglements. The domestication of maize, for example, has led to unforeseen vulnerabilities, such as its reliance on human intervention, susceptibility to pests, and intricate relationships with fungal and bacterial communities. Despite state-led modernization efforts that have sought to impose industrial monocultures, *campesinos* continue to cultivate diverse *milpa* assemblages that resist standardization. These assemblages persist not through centralized planning but through ongoing negotiations among species, farmers, policies, and landscapes.

Ian Hodder's (2011) archaeology of entanglement similarly suggests that human-thing relationships are characterized by dependency and constraint—humans shape material worlds, but those worlds, in turn, shape human possibilities.¹² In exploring human-thing entanglements, Archaeologist Ian Hodder (2011) makes five points:

Humans depend on things. In much of the new work in the social and human sciences, in which humans and things co-constitute each other, there is, oddly, little account of things themselves.

Things depend on other things. All things depend on other things along chains of interdependence.

Things depend on humans. Things are not inert. They are always falling apart, transforming, growing, changing, dying, running out.

The defining aspect of human entanglement with made things is that humans get caught in a double bind, depending on things that depend on humans.

Traits evolve and persist. When evolutionary archaeologists identify lineages of cultural affinity, they claim to be studying cultural transmission.

By employing gaps, assemblages, and entanglements as analytic frameworks, this dissertation moves beyond static conceptualizations of agriculture to explore the dynamic, relational, and multi-species dimensions of *milpa* agroecosystems. Tracing these interdependencies contributes to ongoing discussions in environmental anthropology, political ecology, and multi-species ethnography, foregrounding the entangled futures of *campesino* farming, non-human agency, and agroecological resilience. In this way, *milpa* agroecosystems cannot be understood as isolated

¹² In material culture studies, anthropology, and science and technology studies (STS), the agency of “things” and “non-humans” continues to make an important contribution to the scholarship. Marilyn Strathern, Anna Tsing, and Ian Hodder each approach these concepts in unique yet overlapping ways. Strathern and Tsing focus on the relational effects of things and their constituted assemblages, while Hodder and archaeologists use assemblages of material culture to explain how things have influenced human history. Notably, all three authors agree that non-human entities, both living and non-living, possess agency that has shaped history up to our present Anthropocentric world.

human creations; they are deeply enmeshed in broader ecological and historical forces that extend far beyond human control.

INTRA-SPECIES COMMUNITIES

Multi-species assemblages, agroecosystems, and ecological communities all describe interspecies relationships but emerge from distinct theoretical perspectives, emphasizing different dimensions of ecological interactions. These distinctions should not be understood as mutually exclusive but as complementary analytical lenses.

- Multi-species assemblages foreground relationality, emergence, and co-constitution (Haraway, 2016; Tsing, 2015).
- Agroecosystems emphasize systemic functionality and the interplay between ecological processes and agricultural management (Francis et al. 2003; Pimbert 2017).
- Ecological communities focus on structured interactions among species within defined habitats, often privileging equilibrium-based models (Drake, 1990; Fukami, 2015).

Rather than imposing a rigid conceptual separation, these distinctions highlight the theoretical orientations that inform this dissertation. Agroecosystem studies in Mexico increasingly incorporate ethnographic, historical, and political analyses, complicating the boundaries between ecological models and multi-species assemblages (González-Jácome 2023; Falkowski et al. 2023). Although multi-species approaches emphasize interspecies agency, mutualism, and emergence, agroecosystem research has progressively adopted qualitative and participatory methods to explore socio-ecological dynamics (Einbinder et al. 2019; De La Cruz and Dessein 2021).

TERRITORIALIZATION AND ASSEMBLAGE THINKING

Human activities are organized within specific spatial territories, with the state serving as the

primary agent of territorialization. In contemporary global politics, the state is commonly understood as the principal actor in defining administrative boundaries for purposes such as defense, elections, education, healthcare, policing, managing international borders, collecting statistics by geographic units, and enforcing property laws. In contrast, Deleuze and Guattari (1987) suggest that these processes of state action could be viewed as a form of deterritorialization. These processes reduce the connection between human activities and their territorial foundations, effectively weakening the relationships between people and their environments and leading to alienation or deterritorialization (Deleuze and Guattari 1987).

Assemblage thinking is a philosophical framework for examining the diverse ways in which agency operates across a socio-material network rather than being solely located in an individual. This approach emphasizes how actions and capacities are distributed among people, non-human actors, materials, and narratives. It offers a lens to study the complexity of social systems by focusing on their fluid, exchangeable, and interdependent relationships, showing how human actions rely on material and discursive infrastructures spread across legal, geographical, cultural, and economic systems (Anderson & McFarlane, 2011; DeLanda, 2016).

Assemblage thinking has been developed through various philosophical traditions, including Manuel DeLanda's work on assemblage theory (2016), Bruno Latour (2005) and Michel Callon's (1986) actor-network theory (ANT), and Gilles Deleuze and Félix Guattari's ([1980] 1987) theories on multiplicity and assemblages. These perspectives recognize that agency and emergent qualities arise from interactions between humans and non-humans. In an assemblage, the relationships among the parts are not fixed or stable; components can shift, be replaced, or connect with new

bodies, highlighting the relational and contingent nature of systems (Bennett, 2010; Müller, 2015). Ascribing agency to non-human species is a hallmark of Indigenous thought, as discussed by Robin Kimmerer, who highlights how Indigenous epistemologies recognize plants and animals as intentional beings engaged in reciprocal relationships with humans (Kimmerer 2013).

The term *agencement*, which Deleuze and Guattari (1987) originally used, translates to “arrangement” or “fitting together,” suggesting that meaning and function arise from the connections between elements. In contrast, assemblage captures the dynamic nature of these interactions, where both connections and their configurations generate meaning. This framework helps to understand agroecological systems, such as the *milpa*, where human and non-human actors (such as *quelites*, insects, and crops) coalesce into a mutually sustaining network, revealing the socio-ecological complexity that challenges the purity-driven paradigms of industrial agriculture.

Deleuze and Guattari’s (1987) concept of assemblage, especially as articulated in *A Thousand Plateaus*, incorporates ideas from dynamic systems theory to explain how material, social, and philosophical systems self-organize. They described an assemblage as a heterogeneous gathering of elements that functions as an organizing logic. Assemblages are open-ended and dynamic, enabling us to explore how species within an assemblage interact in various ways, including cooperatively or antagonistically. They argue that assemblages are formed through coding, stratification, and territorialization processes. These processes bring together heterogeneous elements— social, material, or biological—into a functional system, as seen in the symbolic ordering of the polis, law, or specific historical moments. From this perspective, assemblages reflect the dynamic and fluid nature of social complexity in which relationships are continuously

redefined. The process of territorialization in assemblage theory refers to the way in which bodies and components within an assemblage come together to form a coherent whole.

Manuel DeLanda (2006) builds on Deleuze and Guattari's (1987) ideas by emphasizing the autonomy of components within an assemblage, suggesting that the parts maintain their identity even when they are part of a more extensive system. His contribution adds a third axis—genetic/linguistic resources—to the material/expressive and territorializing/deterritorializing dimensions of assemblages, highlighting how coding and recoding influence interactions within a system. This perspective is particularly relevant in agroecological settings, such as *milpa*, where the relationship between local knowledge, environmental management, and cultural expression coalesces into a resilient socio-ecological system.

The *milpas* discussed in this dissertation illustrate how the territorialization of human and non-human actors, such as *quelites*, *chapulines*, and crops, creates functional agroecosystems. These assemblages are not static, as they are constantly undergoing processes of deterritorialization (when components exit or relationships break down) and reterritorialization (when new components or relationships are formed). This cyclical process demonstrates how assemblages adapt and evolve, reflecting the resilience of agroecological systems to the pressures of industrial agricultural models.

As conceived of in ecology, an assemblage is a collective in which no single member can be fully understood in isolation (Sicoli, 2020). In multi-species assemblages, such as *milpa*, both humans and maize emerge as key actants. In *milpa* agroecosystems, the ecological relationships between *quelites*, *chapulines*, and crops are dynamic and interdependent, forming a complex web of interactions that sustain the ecosystem. These relationships challenge conventional agricultural

models, in which non-crop plants are typically viewed as competitors to be eradicated. In contrast, in *milpa* systems, these so-called “weeds” are integral to creating a resilient, multi-species assemblage. This term works to describe the interwoven, co-productive relationships between diverse species in an ecosystem.

This concept expands our analytical scope to include not only biological organisms but also cultural practices and non-living entities, acknowledging their historical shifts and complexities. As Tsing (2015, 22–23) states, “Assemblages invite us to ask questions about communal effects without making a priori assumptions.” Therefore, agriculture is not merely a human-centered enterprise but involves complex alliances between humans and various non-human species, continuously transforming landscapes.

The concepts of multi-species assemblages and feral dynamics directly inform agroecological practices, such as polycultures and selective weeding. By recognizing the value of biodiversity, these practices maintain soil health, control pests through natural means, and support a variety of plant and insect species that enhance the resilience of agroecosystems. This research extends this understanding by recognizing *milpas* as complex multi-species assemblages composed of humans, plants, animals, fungi, and microorganisms. The *milpa* represents a web of interdependencies, co-evolution, and *intra*-actions, seldom recognized in agronomic research that informs the expansion of plantation-style monocultures.

Assemblage thinking therefore allows us to move beyond a binary human/non-human or nature/culture framework to one in which relationships are fluid, contingent, and interconnected. This framework is essential to my dissertation, as it underscores the importance of ecological

diversity and multi-species relationships in shaping the agricultural landscape. By applying assemblage theory, I show how the *milpa* system resists the monocultural purity of industrial agriculture and maintains its ecological and cultural resilience through dynamic networked interactions.

DETERRITORIALIZATION AND RETERRITORIALIZATION

Deterritorialization refers to the process by which established social, cultural, or ecological relationships, referred to as territories, are disrupted, altered, or dismantled, leading to a shift in the organization of these relationships. Deleuze and Guattari (1980) developed this concept, which is key to understanding how assemblages change over time. When a territory is de-territorialized, its components are dislocated from their original contexts, resulting in the formation of new assemblages through a process known as reterritorialization.

Deterritorialization encompasses the reordering and simplification of ecological systems, as well as the displacement and transformation of social, cultural, and economic practices. Globalization is often viewed as a force of deterritorialization that displaces local cultures and identities. This can result in weakening ties between a specific culture, the landscape, and its geographic territory, a phenomenon I explore through the lens of *campesino* resilience in the face of industrial agriculture's deterritorializing forces.

Deleuze and Guattari's concept of deterritorialization is neither static nor unidirectional. As they argue in *A Thousand Plateaus*, "deterritorialization and reterritorialization are not separate events but occur simultaneously and are part of the same movement" (Deleuze and Guattari [1980] 1987, 10). Deterritorialization represents a departure from an established territory, a process they also

describe as a “line of flight,” while reterritorialization constitutes the creation of a new territoriality. For instance, in *milpa* agroecosystems, introducing industrial agricultural practices deterritorializes traditional biodiverse farming methods. However, *campesino* communities engage in reterritorialization by integrating new practices while preserving their ecological knowledge and relationship with the land.

Deterritorialization highlights the dramatic simplification of agricultural landscapes under the pressures of monoculture and agribusiness. In this dissertation, I use deterritorialization to analyze how industrial agriculture displaces *campesino* and Indigenous forms of *milpa*, which encompass multi-species communities and local knowledge systems often overlooked in agronomic research that has promoted systems of landscape and agricultural simplifications that harm the *milpa*’s multi-species assemblages.

Reterritorialization, on the other hand, emerges as a critical response as Indigenous and *campesino* communities reassert their control over the land and reestablish diverse multi-species communities in the form of *milpa*. This dynamic reshapes not only the agricultural landscape but also the cultural and social frameworks that sustain *campesino* communities, revealing the adaptability and resilience of these systems in the face of external pressures.

By focusing on the processes of deterritorialization and reterritorialization, this dissertation reveals how multi-species interactions, cultural practices, and ecological systems are continually reorganized and reassembled in response to both external forces and internal adaptations. This framework helps explain the ongoing struggle between industrial agriculture and traditional farming systems, where each attempt at de-territorialization leads to new forms of resistance and

reconfiguration within the *milpa*.

Recampesinización is a form of reterritorialization that is gaining momentum in peasant studies and agroecology. This process involves *campesinos* reasserting control over their lands. Agroecological knowledge is asserted in the context of resistance to monocultures and corporate food regimes. *Recampesinización* works to restore degraded landscapes, emphasizing biodiversity and producing healthy food for local markets (Rosset and Martínez-Torres 2016). This reterritorialization not only reshapes the agricultural landscape but also revitalizes the cultural and social frameworks that sustain *campesino* communities, revealing the adaptability and resilience of these systems in the face of external pressures. This dissertation concludes with the importance of *recampesinización* and the reconstitution of multi-species assemblages central to *milpa* agriculture.

Each of the three analytical chapters illustrates different facets of territorialization and assemblage thinking within *milpa* agroecosystems, demonstrating how multi-species entanglements shape agricultural and ecological resilience. “Weediness and the Politics of Purity” employs weedy-*quelites* to challenge the notion of agricultural purity, revealing how these so-called weeds deterritorialize industrial farming logics by demonstrating their ecological and nutritional value within the *milpa*. Their presence resists the homogenization imposed by monocultures, highlighting the dynamic reterritorialization of *campesino* knowledge systems that integrate weedy species into cultivation practices rather than eradicating them. “Bugs in the System” examines *chapulines* as both agricultural pests and valuable food sources, illustrating how their integration into plantation-style agriculture reflects an assemblage in which insect life is simultaneously controlled and

commodified by humans. This dual role reveals the tension between deterritorializing forces, such as agrochemical interventions that seek to eliminate *chapulines*, and *campesino* efforts to re-territorialize consumption within sustainable foodways. Finally, “Becoming Fungi: Expanding the Rhizome” explores *cuitlacoche* as a lens to examine fungal networks within the broader *milpa* ecosystem, emphasizing their role in disrupting rigid agricultural classifications. The rhizomatic nature of fungi challenges a linear, territorialized understanding of agricultural production, demonstrating how fungal assemblages deterritorialize conventional boundaries between pests and resources, crops and non-crops, and humans and non-humans. Taken together, these chapters reinforce the central argument that *milpa* agroecosystems resist the industrial simplifications imposed by territorializing forces, instead functioning as fluid multi-species assemblages that persist through cycles of deterritorialization and reterritorialization.

AGRICULTURAL SIMPLIFICATION AND PATCHY LANDSCAPES

Drawing on key theoretical contributions—particularly Anna Tsing’s work on multi-species assemblages, patchy landscapes, landscape simplification, and feral proliferations—this discussion highlights the unintended consequences of human interventions in agroecosystems, especially in the context of industrialization and monoculture agriculture (Tsing 2015, 2018, 2019, 2022, 2023; Tsing, Mathews, and Bubandt 2019). This framework foregrounds the interdependencies that constitute multi-species environments, challenging conventional ecological models that center human agency while obscuring the more-than-human forces that shape agricultural worlds.

Agricultural simplification translates complex, entangled ecosystems into legible and controllable forms, aligning with the state-driven rationalities described by Scott (1998) in *Seeing Like the State*.

Rooted in Enlightenment principles, this process seeks to discipline nature using scientific and technological interventions. However, as industrial agriculture attempts to sever the multi-species relationships that sustain biodiversity and resilience, it inadvertently fosters feral proliferations—unruly ecological dynamics in which non-human lifeforms escape human control, generating novel and unpredictable outcomes.

Viewing agriculture through the lens of simplification reveals the mechanisms through which states and agribusiness enterprises impose order onto dynamic agroecosystems. This logic of control renders certain agricultural practices more visible and governable, yet simultaneously erases the intricate methodologies developed by *campesino* communities. The agricultural knowledge embedded in *campesino* farming systems remains elusive to Western science and state apparatuses, making it difficult for external entities to regulate or quantify this knowledge (Scott, 1998).

Anna Tsing's *The Mushroom at the End of the World* (2015) explores how life persists in degraded landscapes, illustrating how simplified agricultural ecologies create openings for unexpected multi-species assemblages. Tsing et al.'s (2019) concept of *patchy landscapes* articulates how processes of simplification restructure ecosystems, inadvertently enabling certain species to thrive beyond human intention or control. Both Scott and Tsing complicate the notion of human dominance over nature by exposing the unintended consequences of industrialized agricultural systems. Building on the work of Bubandt and Tsing (2018), my research examined feral dynamics within diverse agricultural landscapes, offering a nuanced account of anthropogenic disturbances and multi-species world-building that unfolds in landscapes damaged by industrial processes (Mathews and Bubandt 2019).

FERAL DYNAMICS

Plantations are an example of modular simplifications; plantation-encouraged diseases are an example of feral proliferations.

—Tsing, Mathews, and Bubandt (2019, S187)

Feral dynamics, as described by Bubandt and Tsing (2018) in their article “Feral Dynamics of Post-Industrial Ruin: An Introduction,” refers to the complex and often unpredictable interactions that emerge when human-controlled landscapes are abandoned or altered. These interactions lead to the proliferation of non-human lifeforms that operate independently of human intentions, particularly in post-industrial sites where human activities have caused significant environmental disturbances. Unpredictable in their specifics but increasingly understood in their generalities, these dynamics resonate with Levins et al. ’s (1995a, b) observation that the world is stranger than we can imagine and that scientific surprises are inevitable. Levins et al. (1995a, b) noted that interventions such as pesticides, antibiotics, and flood control often yield paradoxical outcomes: pesticides can increase pests, antibiotics can create pathogens, and flood control can lead to flooding.

Feral dynamics illustrate how organisms, including plants, animals, fungi, and microbes, thrive in landscapes that were once heavily managed or exploited by humans but are now left to their own devices. These organisms take advantage of disturbances caused by industrial activities, adapting to, and flourishing in altered environments. For instance, abandoned mining sites and polluted areas often become habitats for species that can tolerate or even benefit from degraded conditions, leading to unexpected ecological developments. These dynamics are particularly evident in regions where human intervention has created simplified and uniform environments, such as monoculture plantations. When *milpa* systems are abandoned in favor of monoculture, feral dynamics emerge

as *quelites* or *chapulines*, which were once carefully managed as food sources and soil enhancers, and proliferate uncontrollably in the absence of human oversight. Simultaneously, new pesty proliferations emerged as certain insects thrived on the weedy diversity of disturbance of the rapidly expanding monocultures that have come to define our current Anthropocene/Plantationocene.

Bubandt and Tsing emphasize that feral dynamics do not signify a mere return to a “natural” state. Instead, they represent novel ecological relationships arising from the interplay between human-induced changes and autonomous responses of non-human life forms. These dynamics challenge the dominant narratives of human control over nature, demonstrating that landscapes continue to evolve through the actions of non-human agents long after human activities have ceased. In the Anthropocene, where human and non-human histories are deeply intertwined, feral dynamics underscore the unpredictable and ongoing nature of ecological change.

Feral proliferations, as discussed by Tsing, Mathews, and Bubandt (2019), refer to the rapid spread and uncontrolled growth of species and ecological phenomena that escape human control, particularly in environments simplified or disturbed by human activity. This proliferation is often a direct consequence of modular simplifications imposed by industrial agriculture and other large-scale interventions. For instance, a monoculture plantation designed for efficiency may inadvertently create ideal conditions for the spread of pests, diseases, and other organisms that flourish in the absence of ecological diversity. The spread of coffee rust fungus across monoculture coffee plantations exemplifies such feral proliferations (Perfecto, Jiménez-Soto, and Vandermeer 2019).

However, as Awerbuch, Kiszewski, and Levins (2002) emphasize, some of these surprises could have been avoided if the problems had been framed within a broader understanding of complexity and systemic interactions. Predicting the impact of a changing world on both ecosystems and human health requires an interdisciplinary approach that incorporates evolution, biogeography, ecology, and social sciences. Such analyses rely on methodologies such as mathematical modeling and historical analysis to trace how disturbances propagate through networks of physical, biological, and social interactions (Awerbuch 1994; Levins 1995a, b; Awerbuch et al. 1996; McMichael 1997).

The study of feral ecologies benefits from an integrated assessment. When human interventions or abandonments alter landscapes, their effects percolate through intricate feedback loops, sometimes attenuating or disappearing, and at other times amplifying and emerging in unexpected locations. As Levins and Lane (1977) described, even a simple environmental change, such as the addition of nitrogen to a lake, can produce counterintuitive outcomes, sometimes reducing rather than increasing nitrogen levels. These insights reinforce the need to understand feral dynamics within the broader complexities of ecological and social systems, recognizing that interventions, both intentional and accidental, often have consequences far beyond their immediate scope of impact.

Anna Tsing's work further deepens this understanding by examining how non-human life flourishes in disturbed and damaged landscapes. In *Blasted Landscapes (and the Gentle Arts of Mushroom Picking)* (2014), Tsing explored the resilience of certain species, such as matsutake mushrooms, at sites of industrial devastation. She argued that these fungi thrive in post-disturbance ecologies, forming multi-species assemblages that highlight how life persists in degraded

landscapes. This notion is expanded in *the Feral Atlas: The More-than-Human Anthropocene* (Tsing et al. 2020), which conceptualizes the Anthropocene not as a monolithic epoch but as an uneven process driven by unintentional feral effects—ecological transformations that escape human control. These studies emphasize that the unintended consequences of human activity create novel ecological assemblages, where feral species interact in unpredictable ways, often resisting management or restoration efforts.

In *Arts of Living on a Damaged Planet*, Tsing et al. (2017) argued for attunement to life forms and ecological processes that persist despite environmental destruction. They highlighted the importance of multi-species entanglements, where organisms ranging from fungi to bacteria play crucial roles in shaping damaged ecosystems. These themes resonate with cases of fungi growing in the Chernobyl reactor, where radiation-resistant fungal species, such as *Cryptococcus neoformans*, have been observed thriving within the radioactive environment. These fungi exhibit radio-trophic behavior, using melanin to convert radiation into energy (Dadachova et al. 2007). This remarkable adaptation illustrates how non-human life not only survives but also creatively responds to extreme disturbances, embodying the feral dynamics described by Tsing, Mathews, and Bubandt (2019).

Feral dynamics and proliferations reveal the entanglement of human and non-human histories in the Anthropocene, where attempts to control and simplify nature frequently yield unpredictable and uncontrollable outcomes. These feral elements become key actors in the patchy and uneven landscapes that characterize the Anthropocene, where modular simplifications (such as plantations) coexist with and often exacerbate feral proliferations. These concepts highlight the limits of human

control over nature and the complex, often chaotic, consequences of efforts to simplify and manage ecological systems on a large-scale. Understanding feral dynamics and proliferations is crucial for analyzing the “patchy Anthropocene,” in which human interventions and ecological responses create a mosaic of landscape forms—some controlled, others wildly beyond control.

AGRI-CULTURAL ASSEMBLAGES: AGRI-CULTURES AGAINST PURITY

This research critically engages with the concept of purity in agricultural practices, advocating for a shift toward more inclusive, dynamic, and ecologically integrated forms of food production. Rather than adhering to rigid agricultural paradigms that prioritize uniformity and control, this study foregrounds agri-cultures, a concept that highlights the entanglements between agricultural practices, cultural traditions, and ecological resilience.

The term agri-culture encapsulates a vision of food production and consumption that is grounded in ecological principles and attuned to the knowledge, collective capacities, and cultural practices of local producers (Pretty 2002). By emphasizing the localized and socially embedded dimensions of agriculture, this concept challenges the dominant Western agricultural models that strive for purity through industrial monocultures, standardized seeds, and chemical interventions. These models, while promising efficiency and control, often lead to ecological instability by eroding biodiversity and disrupting agroecological assemblages of the landscape.

In contrast, *agri-cultures* that advocate purity endorse agricultural systems that embrace ecological diversity, resilience, and adaptability, including the strategic incorporation of weeds. This distinction reflects two contrasting paradigms: *agri-cultures* of purity, which emphasize uniformity, control, and the eradication of species deemed undesirable. These systems require

constant intervention through chemical inputs, mechanized weeding, and genetic standardization to maintain the illusion of control. However, such interventions are ecologically disruptive, resource-intensive, and costly, making them increasingly unsustainable in the face of climate change and declining soil fertility.

Agri-cultures against purity celebrate ecological diversity and symbiotic relationships within agroecosystems, recognizing weeds as integral rather than invasive. These systems require fewer interventions because they work with rather than against ecological processes. By allowing dynamic interactions among plants, microbes, and pollinators, agri-cultures of diversity reduce the burden of constant management, making them less cumbersome and more resilient over time.

As climate change and food insecurity intensify, the urgency of scaling-up sustainable agroecological practices becomes increasingly critical. This shift necessitates renewed engagement with local knowledge and the reconceptualization of weeds from agricultural nuisances to ecological and cultural assets. Moving beyond purity entails embracing a paradigm of ecological inclusivity, one that values the interactions between plants, soils, and human communities rather than seeking to impose rigid, external controls.

In this context, *agri-cultures* against purity emerge as symbiotic and ecologically attuned assemblages. These systems eschew chemical interventions in favor of honoring the intrinsic diversity of agroecosystems, such as *milpa*. This approach aligns with the practices of *campesinos* in Mexico, who cultivate *milpa*, a polycultural system that inherently fosters soil health and biodiversity. Within the *milpa*, diversity manifests at multiple levels, from staple crops such as maize, beans, and squash to the presence of lesser-known but ecologically valuable plants. This

system harbors an array of flora, including insect-attracting flowering plants, nitrogen-fixing cover crops, and what Western agronomy might dismiss as weeds.

Among these so-called weeds are *quelites* and semi-domesticated leafy greens, which have both ecological and culinary significance in the *milpa*. Far from being unwanted intrusions, *quelites* contribute to agroecological resilience by enriching soil fertility, fostering pollinator populations, and expanding the dietary diversity of the local fauna. Their presence challenges the notion that farming must be a pursuit of purity, offering a counter-narrative to the increasingly tech-centric and monocultural tendencies of industrial agriculture.

Agri-cultures against purity do not merely constitute an alternative mode of farming; they represent an essential strategy for the stewardship of resilient, ecologically sound, and culturally meaningful agroecosystems. By problematizing purity as an illusory control mechanism, this framework underscores the necessity of diversity, not as a byproduct but as the foundation of agricultural sustainability.

MORAL ECONOMY AND MULTI-SPECIES ETHICS

Following James C. Scott (1976), the *milpa* may be read as a moral economy with a multi-species ethic: a system where ethical judgments about care, labor, and diversity guide ecological decisions. This ethical orientation is extended through multi-species ethnography, where the well-being of plants, insects, and fungi is integral to the well-being of people.

Campesino agriculture in highland Mexico is not only an ecological practice but an ethical one. Embedded in decisions about what to plant, weed, eat, or let grow wild are judgments about care,

reciprocity, responsibility, and limits. This constellation of values constitutes what I refer to as a multi-species ethic—a locally embedded system of environmental ethics that guides interactions with the land and its multi-species inhabitants (Boelens 2015; García 2021). These ethics are often not articulated as universal principles but enacted in everyday practices such as selective weeding, seed saving, and the respectful harvesting of “weedy” or “pesty” species.

At the same time, drawing from multi-species ethnography, I use the term multi-species ethics to describe the more-than-human moral entanglements that emerge when humans and nonhumans shape each other’s possibilities for life (Kirksey and Helmreich 2010; Haraway 2008). In the milpa, such ethics are evident not only in the conservation of agrobiodiversity but in the relational ontologies that frame *quelites* as *compañeras*, *chapulines* as edible guests, or fungi like *cuitlacoche* as both blessing and blight.

These ethical frameworks are not always harmonious. Tensions arise between market incentives (e.g. growing *quelites* in monoculture for restaurants) and older forms of multi-species responsibility. Likewise, the reclassification of a species from pest to protein may not align with *campesino* notions of good taste, ritual use, or seasonal timing. By placing moral economy and multi-species ethics in conversation, I trace how campesinos navigate shifting ecological conditions and moral imperatives, often improvising between TEK, agroecological exchange, and external pressures.

Rather than positing a singular ethic of the milpa, this dissertation maps a terrain of situated ethical negotiations. It asks not only what is the *milpa*?, but what should the milpa become in a world of agroecological crisis and capitalist ruin.

TOWARD A MULTI-SPECIES POLITICAL ECOLOGY

Political ecology, as a transdisciplinary field, interrogates the entanglements between sociopolitical structures and ecological systems, emphasizing power relations in environmental governance (Escobar 1999; Peet and Watts 1996; Robbins 2012). Emerging in the 1970s and the 1980s, political ecology synthesized political economy and ecological studies to critique mainstream environmental narratives that depoliticized resource struggles (Blaikie and Brookfield 1987; Bryant and Bailey 1997). This framework analyzes how environmental transformations are both shaped by and reshape existing power dynamics, particularly in the context of agrarian change and territorial dispossession (Peluso and Watts 2001). Over time, political ecology has expanded to incorporate decolonial and feminist critiques, broadening its scope beyond human actors to include more-than-human agencies (Haraway, 2016; Tsing, 2015).

In the agricultural context, political ecology reveals how monocultural expansion and agro-industrial simplification are embedded in broader colonial and capitalist projects that commodify and discipline nature. In contrast, agroecological practices informed by Indigenous epistemologies resist these power structures, fostering multi-species relationships and sustaining biodiversity through place-based ecological knowledge. Latin American political ecology has emphasized the significance of *territorio* (territory) as a contested space. Leff (2015, 34) conceptualizes *territorio* as a site of struggle where the decolonization of knowledge and reappropriation of nature coalesce in alternative forms of environmental governance. These struggles materialize in contrasting agroecological realities—on one hand, resilient agroecosystems maintained through peasant and Indigenous stewardship, and on the other, vast monocultural landscapes devoid of biodiversity and reliant on external inputs (Perfecto, Vandermeer, and Wright 2009). The expansion of capitalist

agricultural frontiers, often framed as progress, erodes traditional agroecological networks, displaces multi-species assemblages, and restructures human–environment relations along extractivist logics.

Arturo Escobar (1999) and Paul Robbins (2012) advocate for an anti-essentialist political ecology that foregrounds both human and non-human agencies in shaping ecological transformations. Anti-essentialist political ecology rejects deterministic explanations that attribute environmental change solely to structural forces or predefined cultural identities. Instead, it emphasizes the situated and relational nature of ecological transformations, recognizing how diverse actors—human and more-than-human—co-produce socio-environmental dynamics through historically contingent interactions (Biersack and Greenberg, 2006). Expanding this critique, Carlos Mondragón (2024), in his keynote lecture, *Antropología ambiental*, calls for an anthropology of cohabitation that acknowledges the reciprocal entanglements between human and more-than-human worlds. However, dominant political ecological discourses often marginalize the active roles of non-human agents, reducing them to passive resources within human-centered ontologies. In contrast, multi-species political ecology requires recognition of the agency of plants, animals, fungi, and microbial communities in co-producing landscapes, livelihoods, and cultural practices.

Recent scholarship integrating multi-species ethnography with political ecology has expanded this inquiry. Studies by Tsing (2015), Kirksey and Helmreich (2010), and de la Cadena (2015) illustrate how multi-species entanglements redefine socio-environmental relations, challenging anthropocentric assumptions within political ecological analysis. Multi-species ethnography disrupts biocultural determinism by reframing human corporeality as enmeshed within dynamic

multi-species assemblages (Ogden, Hall, and Tanita, 2014). This perspective is particularly salient in the analysis of *milpa* agriculture, an Indigenous agroecosystem that exemplifies multi-species interdependence. The *milpa* is not merely a site of maize cultivation; it is a socio-ecological system where human labor, maize, beans, squash, soil microorganisms, pollinators, and climatic forces coalesce to maintain agrobiodiversity and ecosystem resilience. By centering the *milpa* within a multi-species political ecology framework, this research highlights how Indigenous agroecological practices sustain biocultural diversity while resisting the homogenizing imperatives of industrial agriculture.

Campesino knowledge systems embody relational ontologies; knowing and being co-emerge through milpa practice, where experience and ontology are inseparable.

Multi-species political ecologies necessitate an ontological reorientation—one that moves beyond extractivist paradigms to embrace a politics of *intra*-dependency. By foregrounding Indigenous agroecologies and non-human agencies, we can reimagine agricultural landscapes not as sites of domination but as spaces of multi-species collaboration and resilience. This approach challenges the epistemic hierarchies that undergird industrial agriculture, advocating modes of cultivation that honor reciprocity, autonomy, and ecological justice.

This theoretical framework integrates multi-species assemblages, agricultural simplifications, and feral dynamics to reveal how human and non-human actors co-create complex agroecosystems. Subsequent chapters will apply this framework to examine how industrial agriculture disrupts these multi-species relationships and how peasant communities resist by fostering biodiversity and ecological resilience through agroecological practices. The discussion of agricultural

simplifications underscores the vulnerabilities that arise when ecosystems are reduced to monoculture. Concepts such as “feral dynamics” and “ethnobiology in reverse” further expand our understanding of how landscapes evolve in response to human interventions, revealing the unpredictable and often uncontrollable outcomes that emerge when non-human lifeforms interact with human-altered environments. By shifting the analytical focus to the perspectives of non-human organisms, this approach foregrounds the complex networks of interdependence that shape agroecosystems and their multi-species assemblages.

CONCLUSION

This dissertation’s theoretical framework provides a critical lens for examining the dynamic multi-species relationships that shape *milpa* agroecosystems. Integrating insights from environmental anthropology, political ecology, and agroecology illuminates how *milpa* systems function as resilient socio-ecological assemblages that challenge the paradigms of industrial agriculture. Through the analytical perspectives of agricultural simplification, patchy landscapes, and feral dynamics, this work foregrounds the agency of non-human actors in shaping agricultural ecologies.

The following chapters expand upon these theoretical approaches through ethnographic fieldwork, case studies, and vignettes that illustrate both the complexities and contradictions within agroecosystems. Chapter Four: Weediness and the Politics of Purity, interrogates the ecological and political disruptions caused by agricultural simplifications, focusing on how the classification of certain plants as weeds reflects broader sociopolitical ideologies of purity and control. Agroecological practices that embrace patchiness and biodiversity actively resist these classifications, offering an alternative to industrial agricultural logics. Chapter Five: Patchy

Landscapes, examines how insect populations both challenge and adapt to industrial agriculture, exposing the limitations of pest control strategies and the unintended consequences of monoculture expansion. The interplay between agricultural simplification and patchy landscapes is key to understanding how insect-plant interactions persist despite efforts to standardize environments. Chapter Six: *Becoming Fungi*, explores fungal networks as agents of multi-species survival and transformation, demonstrating how their entanglements complicate human attempts to impose order on agricultural landscapes. These multi-species relationships resist simplification, generating emergent ecological dynamics that challenge conventional agricultural models.

Taken together, these chapters reveal that agroecosystems are not solely shaped by human intention but are continually negotiated through the agency of non-human actors. Adopting a multi-species perspective, this dissertation underscores the necessity of rethinking agricultural landscapes as sites of entanglement, resistance, and ecological complexity. *Milpa* agroecosystems, rather than representing static remnants of traditional agriculture, emerge as dynamic and adaptive spaces where human and non-human actors co-construct resilient futures. In doing so, this research contributes to broader conversations in environmental anthropology, political ecology, and agroecology, advocating for an approach to agriculture that values multi-species collaborations and challenges the extractivist logics of industrial farming.

CHAPTER THREE: METHODS

METHODOLOGICAL APPROACHES

This chapter outlines the methodological approaches and specific methods employed in this dissertation, each selected to generate novel insights into the complex intra-actions between humans and non-human species within *milpa* agroecosystems. By integrating multi-sited and multi-species ethnography, this research seeks to uncover the socio-ecological assemblages that shape our understanding of more-than-human worlds within these agricultural ecologies.

The methodological frameworks employed not only address the central research questions but also reveal critical gaps in existing knowledge, offering new directions for research in environmental anthropology and agroecology. This approach underscores the challenges faced by ethnographers working within agricultural ecologies, where the entanglements of human and non-human actors unfold within unstable environments and capitalist systems. These methodologies illuminate the agency and worldmaking capacities of non-human species, expanding our comprehension of more-than-human relationalities within *milpa* agroecosystems.

Although this dissertation advances key insights, certain unresolved gaps remain that have also been identified by scholars across both the social and natural sciences. These unresolved areas point to the need for continued interdisciplinary inquiry into the dynamic interactions shaping agricultural landscapes.

PHENOMENOLOGICAL APPROACHES TO MULTI-SPECIES ETHNOGRAPHY

This research suggests that agroecological knowledge cannot be fully understood through

extractive data collection methods alone. Instead, it requires a participatory, phenomenologically grounded approach that recognizes how knowledge emerges through and with multi-species entanglements. By foregrounding lived, embodied experience, this dissertation not only deepens our understanding of *milpa* agroecosystems but also contributes to broader theoretical conversations about how anthropology can decenter the human while remaining deeply engaged in the material and relational worlds we inhabit.

A phenomenological approach foregrounds the lived experiences of individuals within specific cultural and environmental histories. Phenomenology, as articulated by philosophers such as Maurice Merleau-Ponty (1962) and later expanded within anthropological discourse by Tim Ingold (2000), emphasizes embodied perception and the ways in which experience is shaped through multi-sensory engagements with the world. Phenomenological anthropology, in this sense, does not merely seek to describe interactions, but rather aims to understand how people inhabit, perceive, and make sense of their worlds through lived experiences. This is particularly crucial for multi-species ethnography, as it allows for an attunement to the affective and sensory dimensions of human–environment interactions that might otherwise be overlooked in more rigidly structured ethnographic methodologies.

By engaging in in-depth interviews and immersive ethnographic encounters, I sought to illuminate the affective and embodied dimensions of agroecological lifeworlds, focusing on the ways that Indigenous farmers and *campesinos* understand and interact with their multi-species surroundings. In particular, I was interested in the temporal rhythms and embodied practices through which humans attune themselves to non-human lifeforms. For example, the practice of selectively

weeding a *milpa* is not merely an agricultural technique, but also an epistemological act that requires intimate knowledge of plant ontologies, seasonal cycles, and interspecies relationships. The decision to remove certain plants while allowing others to thrive is shaped by multi-species histories of coexistence as well as by shifting ecological conditions and economic imperatives.

A phenomenological approach also highlights intercorporeality, a concept Merleau-Ponty (1962) developed to describe the ways in which bodies are not self-contained but are instead constituted through relationships with other beings. In the context of multi-species ethnography, this concept is particularly useful for thinking about how human bodies attune to the rhythms and agencies of non-human life. As Ingold (2011) argues, perception is not a passive act but an active engagement with the material world, one that unfolds through movement, tactile interaction, and environmental attunement.

For instance, *campesinos* working in the *milpa* frequently describe a sense of “knowing” when a fungal network is beginning to alter the soil composition or when a particular species of *quelite* (edible wild green) is thriving. This knowledge does not emerge from abstract reasoning alone, but is cultivated through deep, embodied familiarity with the land and its multi-species inhabitants. In such instances, knowledge production is not an act of cognitive abstraction but a process of attunement, in which bodily experience, memory, and multi-sensory perception converge to shape agroecological decision-making.

Such intracorporeal relationships extend beyond human-non-human dyads to encompass entire multi-species assemblages. As Tsing (2015) noted, multi-species interactions are not reducible to direct, dyadic relationships, but unfold through patchy landscapes in which multiple organisms

coalesce in unpredictable ways. This was particularly evident in my ethnographic encounters with fungal networks in maize fields. Fungi, often perceived as an agricultural nuisance in industrial farming contexts, are understood by many *campesinos* not as contaminants but as integral components of soil health and crop vitality. Through phenomenological engagement, I was able to document how fungal presence is experienced—how it is felt in the soil, observed in the texture of maize husks, or even smelled in the changing humidity of the *milpa*. Similarly, *campesino* knowledge of insect ecologies is not based solely on mechanistic pest control logics but emerges from prolonged interactions with *chapulines*, bees, and other insect species that inhabit *milpa* landscapes. These relationships are mediated through sensory engagements—watching the movement of insects across maize leaves, listening to the hum of pollinators at different times of day, or feeling the texture of soil as an indicator of subterranean insect activity. By adopting a phenomenological lens, I was able to trace how these sensory engagements shape agricultural decision-making, revealing agroecological knowledge as an embodied, historically situated practice rather than a static set of technical skills.

Multi-species ethnography requires an epistemological shift—one that embraces what Eduardo Kohn (2013) describes as the “open whole,” a concept that challenges anthropocentric epistemologies by acknowledging the communicative and semiotic capacities of non-human life (see also Kirksey and Helmreich 2010; Tsing 2005). This approach does not dismiss the enduring impacts of colonialism, capitalism, patriarchy, or the epistemic legacies of the Enlightenment. Rather, it necessitates a recalibrated sensitivity to relational ontologies, multi-species entanglements, and emergent assemblages shaped through ecological interdependencies (Raffles 2010). These interdependencies demand methodological approaches that move beyond human

exceptionalism, engaging with the ways in which non-human organisms—whether plants, fungi, insects, or microbial communities—participate in and shape shared landscapes.

In developing an approach attuned to these entanglements, I employed Grounded Theory, an inductive methodology designed to generate theoretical frameworks from qualitative data. This methodology, originally developed by Barney Glaser and Anselm Strauss (1967), facilitates an iterative research process in which data collection and analysis inform one another in an ongoing reflexive cycle. Through semi-structured interviews and participant observation, this approach enabled continuous comparative analysis, allowing for emergent categories to be refined through iterative engagement with fieldwork data (Charmaz, 2006). Unlike deductive methodologies that impose predefined theoretical frameworks onto empirical material, Grounded Theory provides a structure for developing theory in direct response to the lived realities of research participants. In the context of multi-species ethnography, this approach was particularly useful in tracing the ways that human and non-human actors co-constructed agroecological assemblages, challenging the notion that agricultural landscapes are exclusively the product of human agency.

These insights highlight the broader methodological implications of attunement as an ethnographic practice. Attunement, as Tsing (2015) and Myers (2017) suggest, involves a heightened sensitivity to the more-than-human world—one that resists imposing rigid analytical categories and instead remains open to the emergent, often unpredictable qualities of multi-species interactions. In practice, this required me to develop research techniques that could capture not only verbalized knowledge but also embodied, affective, and sensory forms of knowing.

For example, walking interviews, in which I accompanied *campesinos* through their fields, proved

to be an essential methodological tool. Unlike formal sit-down interviews, these mobile conversations allowed participants to point to plants, soil textures, insect activity, and microclimatic variations in real time. These situated conversations provided rich insights into how agroecological knowledge is not just articulated discursively but is enacted through movement, gesture, and everyday engagement with the land.

Additionally, participatory observation of agricultural practices, such as seed selection or fungal harvesting, enabled me to move beyond the limitations of textual descriptions to the realm of embodied practice. Through these engagements, I gained a deeper appreciation for the ways that multi-species ethnography requires participatory epistemology—one in which the researcher does not merely observe but actively engages with the relational processes that constitute agroecosystems.

By integrating Grounded Theory and phenomenology, this research foregrounds the lived experiences of multi-species entanglements within *milpa* agroecosystems. These methodological approaches challenge anthropocentric modes of knowledge production, instead emphasizing the affective, embodied, and sensory dimensions of agroecological life. Through attentiveness, attunement, and emergent multi-species relations, this work contributes to the growing field of multi-species ethnography, offering a methodological model that is responsive to the complexities of more-than-human worlds.

This dissertation employs a multi-species ethnographic methodology that integrates both qualitative and quantitative data collection techniques. Fieldwork was conducted in various *milpa* agroecosystems in the central highlands of Mexico, drawing from participant observation, semi-

structured interviews with *campesinos*, and methods adapted from natural history. By embracing an interdisciplinary, mixed-methods approach, this research seeks to capture the relational and contingent nature of multi-species assemblages, where human and non-human actors co-produce the material and social conditions of agriculture.

Multi-species approaches emphasize the agency of non-human species within socio-ecological systems, offering a nuanced analysis of human interactions with plants, animals, fungi, and microbes. This perspective reveals the interconnected social lives shared among these entities. For example, by focusing on *chapulines* (grasshoppers), *cuitlacoche* (corn smut), and *quintoniles* (wild greens), this research examined how these species actively shape and transform landscapes through diverse agricultural practices. These insights will contribute to the development of alternative agricultural methods and deepen our understanding of multi-species assemblages.

To methodologically engage with multi-species approaches, this research incorporates nonconventional ethnographic tools, including the following:

- a) Use of experimental methods to study non-human entities.
- b) Emphasis on language and translation in ethnographic inquiry.
- c) A critical examination of the representation and non-representation of species.
- d) The juxtaposition of traditional ethnographic texts with contemporary insights from the same region.

EPISTEMOLOGICAL PLURALITY AND SITUATED KNOWLEDGES

Agricultural knowledge in the milpa is never singular. It emerges through diverse and sometimes competing epistemologies: traditional ecological knowledge (TEK) passed down through

campesino families and ritual practices; scientific agroecological models that frame biodiversity in terms of ecosystem services or soil fertility; and emergent multi-species ethics that foreground nonhuman lifeways as co-constitutive of agricultural systems.

Rather than privileging one framework over another, this dissertation begins from the premise of epistemological plurality: that multiple ways of knowing the milpa coexist, intersect, and at times collide. A farmer may describe quelites as *comida que sale sola* (food that emerges on its own), while an agroecologist might frame them as indicators of soil health, and a chef may refer to them as ancestral superfoods. These framings are not mutually exclusive but reveal different ontologies and logics of value.

I treat these diverse knowledges not as static “worldviews,” but as situated and relational practices. They are shaped by access to land, education, gender, class, ecological history, and institutional power. Crucially, they also reflect different ethical commitments: to caretaking, commodification, experimentation, or biodiversity preservation.

This pluralism has methodological implications. Throughout my fieldwork, I moved between ethnographic observation, agroecological interviews, and attention to nonverbal, multi-species cues—such as the timing of mushroom growth, insect behavior, or soil conditions after rain. These modes of knowing are not easily reconciled, but together they offer a more nuanced and grounded account of how the milpa is reassembled today.

RESEARCHER POSITIONALITY AND LONG-TERM ENGAGEMENT

My relationship to the milpa, and to the communities who sustain it, is not one of academic

detachment. I first arrived in central Mexico more than two decades ago as a student of agroecology and returned again and again—first as a student, then as a researcher, collaborator, and now as a friend to many of the community members I have come to know. This dissertation grows out of those enduring relationships: with farmers in Vicente Guerrero and Zacatepec, with members of the Grupo Vicente Guerrero cooperative, with students and colleagues at Universidad Iberoamericana and UDLAP, and with fellow practitioners working to protect and regenerate milpa worlds.

This long-term engagement has shaped not only what I could observe, but what I could ask—and how I was asked to be accountable. Many of my informants are also my mentors, co-teachers, and friends. Our conversations unfolded not just in interviews, but in kitchens, *comedores*, milpas, workshops, and classrooms. I was invited to eat, to weed, to collect, to cook. My knowledge of *quelites*, *chapulines*, and *cuitlacoche* is deeply entangled with these embodied, shared experiences.

At the same time, I remain aware of the asymmetries that structure ethnographic research. As a white, U.S.-born researcher enrolled at a European University, I am myself entangled in extractive potential and carry certain forms of mobility and privilege. I also recognize that the academic languages of assemblage, entanglement, and multi-species ethics do not always translate to the fields where these practices are lived. My aim has never been to “represent” campesino knowledge, but to be an attentive interlocutor, curious to co-create when appropriate, while at the same time frequently silent, having reached my epistemological limitations or boundaries.

Throughout this dissertation, I position myself not as an outside observer, but as an active participant in ongoing conversations—about the ethics of food, agriculture, and environmental

conservation. My methodological approach is shaped by this stance: not as a neutral translator of cultural knowledge, but as a situated co-inhabitant of multi-species worlds under threat.

[REVISE] Integrate fieldsite context (water/land): Insert 1–2 paragraphs here from Annex 3 on water dispossession and land tenure in Vicente Guerrero and Ozolco, linking field context to subsequent analyses in Chapters 4–6.

STUDY AREA

This research was conducted in the Mexican states of Oaxaca, Tlaxcala, Puebla, and Mexico City, based on long-term fieldwork carried out between March 2018 and September 2019. Employing a multi-species ethnographic approach, this research examines the historical, ecological, and political entanglements that shape *milpa* agroecosystems. It highlights how *campesino* and Indigenous communities navigate agribusiness expansion, land privatization, and environmental change.

The fieldwork focused primarily on the Puebla–Tlaxcala Valley and the regions surrounding the Popocatepetl and Iztaccíhuatl volcanoes, areas historically central to maize cultivation and agrarian transformations. The research engaged with rural, peri-urban, and urban agroecosystems, each offering insights into the territorialization and deterritorialization of agroecological knowledge.

The territorialization of the *milpa* refers to the ways in which land, agroecological knowledge, and multi-species relationships remain embedded within *campesino* and Indigenous landscapes. Conversely, deterritorialization is driven by industrial agriculture, genetically modified crops, and neoliberal land restructuring. This research also traces the processes of reterritorialization in which *campesinos* reclaim control over food systems through seed sovereignty, agroforestry, and agroecological networks.

The Puebla–Tlaxcala Valley, a highland basin spanning parts of the states of Puebla and Tlaxcala, encompasses much of the Puebla–Tlaxcala Metropolitan Area. The valley is geographically delineated by natural landmarks, including the Tlaxcala uplands to the north and the Popocatepetl and Iztaccíhuatl volcanoes to the west. The following figures provide the spatial context for the research:



FIGURE 7. THIS MAP SHOWS THE FOUR MEXICAN STATES WHERE THE RESEARCH TOOK PLACE: MEXICO CITY, TLAXCALA, PUEBLA, AND OAXACA.



FIGURE 8. MAP OUTLINING THE APPROXIMATE EXTENT OF THE PUEBLA–TLAXCALA VALLEY. THE VALLEY IS BORDERED BY THREE PROMINENT VOLCANOES: IZTACCÍHUATL AND POPOCATÉPETL TO THE WEST AND MATLALCÚEYATL (LA MALINCHÉ) NEAR THE CENTER. THIS MAP ALSO HIGHLIGHTS THE SURROUNDING TOPOGRAPHICAL FEATURES AND URBAN AREAS.

CONTEXTUALIZING FIELD SITES

Selecting both rural and urban field sites was integral to understanding the diverse agroecological practices that emerge across distinct socio-economic and ecological landscapes. Each site—ranging from the traditional milpas of Vicente Guerrero to the bustling markets of Mexico City—offered unique insights into the interplay between ancestral knowledge and contemporary agricultural practices. By engaging with multiple locations, this research highlights the adaptive strategies employed by campesino and Indigenous communities to navigate ecological

uncertainties and economic pressures (Toledo and Barrera-Bassols 2009; Altieri and Nicholls 2017).

The rural field sites reveal the dynamism of agroecological knowledge as it responds to shifting environmental and economic conditions. In regions such as Puebla, Tlaxcala, Oaxaca, and Mexico City, the milpa functions not only as a site of maize cultivation but as a complex multi-species assemblage where local ecological knowledges intersect with broader agrarian transformations (González Jácome 2019). These sites also illuminate how communities negotiate pressures from agribusiness expansion, land privatization, and state-led agricultural modernization programs (Edelman 2019).

RURAL FIELD SITES

These sites represent diverse agroecological landscapes and socio-environmental contexts central to the study.

XOCHIMILCO, CDMX

Xochimilco, located in the southern reaches of Mexico City, is a historically and ecologically complex landscape that reflects the enduring tensions between urban expansion, environmental conservation, and traditional agriculture. Best known for its extensive system of canals and chinampas—artificial agricultural islands built by pre-Hispanic societies—Xochimilco is one of the last remnants of the once-extensive lacustrine system that defined the Basin of Mexico. Despite its designation as a UNESCO World Heritage Site, the region faces significant socio-environmental challenges, including water contamination, land subsidence, and the pressures of urbanization.

My research focuses on the small-scale farmers who continue to cultivate within this landscape, navigating shifting environmental conditions, policy frameworks, and market dynamics. While Xochimilco is often framed through its role in tourism, particularly the colorful trajineras that ferry visitors through its canals, it is also a critical site of agroecological knowledge and resilience. The farmers I work with employ a mix of ancestral and contemporary practices to sustain production, despite growing ecological and economic uncertainty. Their experiences offer insight into broader questions of food sovereignty, environmental governance, and the future of urban agriculture in Latin America.

By examining Xochimilco as both a cultural and ecological space, I aim to explore how local actors engage with and adapt to environmental change. This site provides a compelling lens for analyzing the intersections of TEK, state-led conservation initiatives, and the informal strategies that sustain agricultural livelihoods in one of the world's largest megacities.

VICENTE GUERRERO, TLAXCALA

Located approximately forty kilometers from Tlaxcala de Xicohténcatl, the state capital, Vicente Guerrero is a rural community shaped by a long history of collective land management and agroecological innovation. The community's land tenure is primarily ejidal, though private landholdings also exist, reflecting broader shifts in Mexico's rural governance and property regimes. Agriculture in Vicente Guerrero remains diverse, with farmers practicing traditional rainfed milpa systems and crop rotation techniques, where maize monocultures are interspersed with crops such as fava and dry beans. These strategies reflect both historical agricultural knowledge and contemporary adaptations to environmental and economic pressures.

Grupo Vicente Guerrero (GVG) is an Integral Rural Development Project that has played a central role in promoting sustainable farming practices. Founded in the 1970s and formally established as a civil association in 1997, GVG has been instrumental in disseminating agroecological knowledge across twenty-three highland communities in Tlaxcala and one in Puebla. The organization draws heavily from the Campesino-a-Campesino (CaC) movement, a grassroots model of knowledge sharing that has significantly contributed to the scaling of agroecological practices in Mexico and Latin America more broadly.

SAN MATEO OZOLCO, PUEBLA

San Mateo Ozolco, a Nahua campesino community situated in the foothills of the Iztaccíhuatl volcano, is a dynamic site of agroecological resilience and Indigenous self-determination. At an altitude of approximately 2,800 meters above sea level, the community inhabits an ecotone where highland temperate forests transition into cultivated lands, shaping both agricultural practices and local environmental knowledge. Ozolco's inhabitants have long engaged in subsistence and small-scale commercial agriculture, maintaining a deep relationship with native maize and other traditional crops adapted to the region's climate and soil conditions.

In recent years, San Mateo Ozolco has gained recognition for its efforts to preserve native crop varieties and promote food sovereignty in the face of economic and ecological pressures. These initiatives have been spearheaded mainly by a youth organization of returned migrants, whose members, having worked in the United States, have returned with a renewed commitment to strengthening local agricultural traditions. Their work challenges dominant narratives of migration

as solely a means of rural exodus, demonstrating instead how transnational experiences can reinvigorate community-based agroecological movements. Through seed conservation programs, the revitalization of milpa systems, and advocacy for local food networks, these young leaders are actively reshaping Ozolco's agricultural landscape.

Beyond agriculture, migration has profoundly shaped social and economic life in the community. Rather than accelerating the abandonment of traditional farming, the return of young migrants has fostered a critical dialogue between ancestral agricultural knowledge and contemporary sustainability initiatives. This ongoing negotiation of tradition and innovation makes San Mateo Ozolco a crucial site for understanding the intersections of migration, agroecology, and Indigenous food sovereignty in Mexico.

SANTA MARÍA ZACATEPEC, PUEBLA

Santa María Zacatepec, located in the Puebla-Tlaxcala Valley within the municipality of Juan C. Bonilla, has become a focal point for grassroots resistance against water privatization and megaprojects in Mexico. As a predominantly Indigenous Nahua community, Zacatepec is deeply engaged in struggles to protect its territory from state-led and transnational resource extraction projects, particularly those affecting local water systems. These conflicts exemplify the broader tensions between corporate-driven development initiatives and Indigenous self-determination, positioning Zacatepec at the forefront of Latin American environmental justice movements.

One of the most significant struggles in Zacatepec has been its opposition to the "Puebla-1" hydroelectric dam, a megaproject that community members argue would divert water from local aquifers and disrupt agricultural livelihoods. Despite years of protests, legal challenges, and

national and international advocacy efforts, dam construction began in 2021, underscoring the persistent asymmetries of power between local communities and corporate-state alliances. The fight against Puebla-1 reflects a broader pattern of water dispossession in Mexico, where rural and Indigenous populations frequently bear the brunt of large-scale infrastructural developments designed to benefit industrial and urban centers.

Another central point of contention has been the community's resistance to the operations of Bonafont, a subsidiary of the French multinational Danone. Residents accuse the company of over extracting groundwater, depleting subsoil aquifers, and contributing to severe environmental disruptions. This conflict came to a dramatic head on May 30, 2021, when a massive sinkhole—initially about 60 meters in diameter—suddenly opened on the outskirts of Zacatepec. Over the following weeks, the sinkhole expanded to approximately 130 meters, swallowing a nearby home and damaging surrounding buildings. While official explanations have pointed to natural causes related to underground water dynamics, community members directly link the phenomenon to Bonafont's excessive water extraction, framing it as a visible consequence of corporate environmental mismanagement.

The sinkhole has since become a symbol of resistance, attracting media attention and grassroots mobilization against water privatization. Far from being a passive site of ecological destruction, Santa María Zacatepec has leveraged this event to further its political activism, organizing protests, blockades, and independent environmental monitoring efforts. In 2021, community members occupied and shut down Bonafont's water bottling plant, renaming it the Casa de los Pueblos (House of the Peoples)—a space for regional Indigenous and campesino organizations to strategize

around territorial defense and autonomous governance.

My research engages with Zacatepec as a site where local knowledge, environmental activism, and Indigenous political movements intersect in the fight for water sovereignty. By examining how community members frame and mobilize around water crises—through legal action, direct action, and alternative governance models—I seek to contribute to broader discussions on environmental justice, Indigenous resistance, and the political ecology of water in Latin America.

ATLIXCO, PUEBLA

Situated at the base of the Popocatepetl volcano in the state of Puebla, the municipality of Atlixco has become a key site for technified *cuitlacoche* production, driven by university-led agricultural programs that integrate small-scale farmers and campesinos into controlled cultivation systems. Unlike traditional milpa agroecosystems, where *cuitlacoche* emerges opportunistically under specific environmental conditions, these programs rely on laboratory-produced fungal spores, which are then injected into maize ears cultivated in greenhouses. This process allows for precise environmental regulation, increasing yield consistency and commercial viability.

The shift to technified *cuitlacoche* production reflects broader trends in agro-industrialization, biotechnological intervention, and the restructuring of traditional agroecological relationships. In contrast to the milpa system, where *cuitlacoche* is often harvested as an emergent byproduct of maize cultivation—interwoven with the rhythms of rainfall, soil microbiota, and plant interactions—greenhouse-based production entails a high degree of environmental control and standardization. This disassembly from the broader milpa agroecosystem represents a form of deterritorialization, where agricultural practices are increasingly mediated by institutional

knowledge, technological inputs, and market demands rather than localized ecological interactions and campesino knowledge systems.

Despite offering economic opportunities for participating farmers, this model raises critical questions about the commodification of traditional foods, the role of scientific institutions in shaping rural livelihoods, and the reconfiguration of human–environment relations. The controlled conditions of greenhouse cultivation contrast sharply with the dynamic, co-productive processes of traditional milpa farming, where cuitlacoche has long been embedded within a broader network of ecological relationships, social practices, and cultural significance. As such, this site serves as an entry point for analyzing the tensions between agroecological traditions and technoscientific interventions, as well as the shifting positionalities of campesinos within globalized agri-food systems.

By examining the political ecology of technified cuitlacoche production, my research explores how knowledge, labor, and fungal ecologies are reconfigured through biotechnological interventions. I engage with this site as a case study in the ways academic institutions, agricultural policy, and market forces intersect to reshape local practices, revealing the complexities of food sovereignty, biocultural knowledge, and the governance of emerging agrarian economies in contemporary Mexico.

IXTENCO, TLAXCALA

Ixtenco, a small Otomí community in the eastern part of Tlaxcala, is one of the last strongholds of heirloom maize cultivation in central Mexico. Nestled in the semi-arid highlands of the Tlaxcala-Puebla Valley, Ixtenco has long been recognized for its agrobiodiversity, with local farmers

maintaining and cultivating a wide variety of native maize landraces. These traditional maize varieties—ranging in color, texture, and nutritional composition—have gained increasing national and international recognition, supplying specialty tortillerías and restaurants across Mexico, North America, and Europe that prioritize heirloom and native maize in their culinary practices.

Unlike large-scale industrial maize production, which prioritizes high-yield hybrid or genetically modified varieties, Ixtenco's campesinos continue to rely on ancestral seed-saving practices, intergenerational knowledge transmission, and agroecological techniques that sustain both the cultural and ecological dimensions of maize farming. Many farmers employ rain-fed milpa systems, intercropping maize with beans, squash, and other traditional crops, reinforcing soil fertility, biodiversity, and food sovereignty. The region's maize varieties—including blue, red, yellow, and the prized cacahuazintle used for pozole—have not only been preserved but also adapted to changing climate conditions, demonstrating the resilience of Indigenous and campesino agroecological knowledge.

Ixtenco's maize economy operates at multiple scales, from local markets and regional networks to high-end restaurants and export markets, reflecting the complex entanglement of local agricultural traditions with global food trends. The growing demand for native maize in gourmet and the Slow Food movements has positioned Ixtenco as a critical supplier for chefs and food activists seeking to reclaim Mexican maize diversity in the face of industrial homogenization. However, this increasing market visibility also raises important questions about the commodification of native maize, the politics of seed ownership, and the role of smallholder farmers in globalized agri-food systems.

By examining Ixtenco as a site of heirloom maize preservation, culinary innovation, and agroecological resilience, my research explores the intersections of seed sovereignty, rural economies, and global food movements. Through ethnographic engagement with farmers, seed custodians, and food industry actors, I seek to understand how traditional maize varieties are mobilized, valued, and contested in shifting landscapes of power, taste, and environmental change.

LA NEVERÍA, OAXACA

La Nevería, a small Zapotec community in the Sierra Norte of Oaxaca, is a region of high agrobiodiversity where traditional milpa agriculture, forest conservation, and small-scale ecotourism intersect. Situated at a high elevation with abundant mountain springs, La Nevería provides ideal conditions for heirloom maize cultivation, wild mushroom foraging, and organic farming practices that sustain both local food traditions and emerging economic opportunities.

The community has maintained a diverse array of native maize varieties, integrating traditional seed-saving practices with agroecological methods that promote soil fertility, biodiversity, and climate resilience. Here, the milpa system and forest conservation are deeply interwoven, as community-led conservation efforts help maintain watershed health, regulate local microclimates, and sustain the ecological conditions necessary for rain-fed agriculture. In addition to maize, the region is known for wild mushroom collecting, a seasonal activity that connects local livelihoods with both subsistence and commercial markets.

Recently, La Nevería has also found a niche market in the cultivation of berros (watercress), a crop that thrives in the region's pristine mountain spring waters and organic farming conditions. This emerging cash crop highlights the ways in which Indigenous agroecological knowledge adapts to

new economic opportunities while remaining embedded in local environmental stewardship.

Beyond agriculture, La Nevería has developed a small but growing tourism project, offering visitors guided experiences in traditional milpa farming, mushroom foraging, and forest conservation practices. This initiative reflects broader community efforts to balance economic diversification with environmental sustainability, reinforcing the role of place-based knowledge systems in fostering both ecological and cultural resilience.

My research engages with La Nevería as a site where agrobiodiversity conservation, Indigenous ecological knowledge, and alternative economic strategies converge. By examining how forest management, small-scale tourism, and agroecological practices interact, I aim to contribute to broader discussions on rural sustainability, food sovereignty, and Indigenous-led conservation models in contemporary Oaxaca.

NATÍVITAS AND SAN MIGUEL DEL MILAGRO, TLAXCALA

Nativitas and San Miguel del Milagro, two neighboring communities in the southern part of Tlaxcala, are deeply rooted in milpa agriculture, amaranth cultivation, and specialty food production. Situated in the semi-arid highlands of the Tlaxcala-Puebla Valley, these communities maintain a diverse agroecosystem where heirloom maize, beans, squash, and amaranth thrive under rain-fed and small-scale irrigation systems. Their agricultural practices, based on traditional campesino knowledge and agroecological techniques, contribute to the regional food economy and local food sovereignty efforts.

Amaranth, a crop with deep Mesoamerican significance, plays a particularly important role in these

communities. Once suppressed during the colonial period due to its ceremonial associations, amaranth has seen a resurgence in recent years, with local farmers cultivating it for both subsistence and commercial markets. Its nutritional value, resilience to drought, and adaptability to changing climate conditions make it a key crop in discussions on agrobiodiversity and climate adaptation in central Mexico.

Beyond staple crop production, Natívitas and San Miguel del Milagro are also known for their specialty food economies, including the *carnicería* (butcher shop) Carnivette butcheries that have gained a regional reputation for their artisanal meat processing techniques. This family-run business focuses on high-quality, locally sourced meats, and locally sourced pesticide free insects such as chapulines. Unlike many chapulines that are collected from industrialized farms that often use pesticides, the chapulines from Carnivette are collected from the family ranch and therefore can assure they are free from chemical contaminants.

By examining Natívitas and San Miguel del Milagro as sites where agrobiodiversity conservation, traditional foodways, and specialty markets intersect, my research explores the ways smallholder farmers, butchers, and foragers navigate contemporary shifts in food economies, climate challenges, and cultural heritage preservation. These communities illustrate how historical food traditions persist, evolve, and gain new relevance within contemporary discussions of agroecology, sustainability, and Indigenous food sovereignty in Mexico.

CUETZALAN, PUEBLA

Cuetzalan, a Nahua-majority town in the Sierra Norte of Puebla, is a site of agroecological

resilience, Indigenous autonomy, and dynamic local markets. Located in a humid cloud forest ecosystem, Cuetzalan's agricultural landscapes are shaped by high rainfall, rich volcanic soils, and a long history of intercropping systems that sustain both subsistence farming and regional trade networks. The town is widely recognized for its coffee, native maize varieties, vanilla, and shadegrown agroforestry systems, which reflect a deep entanglement of TEK and contemporary economic adaptations.

Milpa cultivation remains central to local livelihoods, with heirloom maize varieties grown alongside beans, squash, chilies, and medicinal plants. However, coffee agroforestry has also become an important economic activity, with many farmers participating in co-operative models that emphasize organic and fair-trade production. These cooperatives—often organized through Indigenous-led initiatives—serve as both economic strategies and political platforms, reinforcing territorial autonomy and resistance to agribusiness expansion.

Beyond agriculture, Cuetzalan has emerged as a key site for Indigenous political mobilization and alternative economic models. The region has actively resisted megaprojects, mining concessions, and hydroelectric dams, positioning itself within broader movements for territorial defense and environmental justice in Mexico. Community-led institutions such as the Tosepan Titataniske cooperative have played a crucial role in strengthening local economies, food sovereignty, and sustainable resource management while maintaining a vision of autonomous, self-determined development.

The town's weekly tianguis (market) remains a cornerstone of regional exchange, where farmers, artisans, and foragers bring locally produced goods, including wild-harvested mushrooms, honey,

cacao, and traditional textiles. The market operates not only as an economic hub but also as a site of cultural reproduction, where Nahuatl language, culinary traditions, and reciprocal exchange networks persist despite increasing pressures from tourism and commercialization.

My research engages with Cuetzalan as a site where agroecology, Indigenous resistance, and alternative economies intersect. By examining the ways farmers, cooperatives, and activists navigate shifting agricultural landscapes and state policies, I aim to contribute to discussions on food sovereignty, environmental governance, and the endurance of Indigenous place-based knowledge in contemporary Mexico.

URBAN FIELD SITES

These cities serve as key sites for examining urban-rural connections, food networks, and agroecological practices within the broader research context.

MEXICO CITY

Following Latour's assertion that "it is best to start in the middle of things," Mexico City serves as the political, economic, and cultural fulcrum of the nation, a site where competing narratives of modernity, sustainability, and crisis unfold simultaneously. As one of the largest and most densely populated metropolitan areas in the world, Mexico City's urban fabric is shaped by historical sedimentations of colonialism, rapid industrialization, and ongoing processes of neoliberal restructuring. The city's relationship to the countryside, food systems, and environmental governance is highly dynamic, marked by both extraction and dependence, disconnection and entanglement.

Despite its vast urban sprawl, Mexico City remains intimately linked to the agroecological landscapes that sustain it, from the chinampas of Xochimilco to the rural peripheries of Milpa Alta and Tláhuac, where smallholder farmers, Indigenous communities, and food activists continue to negotiate the tensions between urban expansion and agricultural persistence. The city is also a key node in global food commodity chains, where heirloom maize from rural regions, specialty coffee from cooperatives, and high-end gastronomic movements intersect with corporate agribusiness, industrial food distribution, and state policies on food security.

At the same time, Mexico City serves as a crucial space for social movements, environmental activism, and knowledge production. The city hosts key universities, research institutions, and policy organizations, where debates on agroecology, Indigenous land rights, and food sovereignty are actively shaped. Additionally, it is a site of political contestation, where rural and Indigenous movements frequently mobilize against megaprojects, land dispossession, and environmental degradation, amplifying their struggles on a national and international scale.

By engaging with Mexico City as a field site, I approach it not simply as an urban center, but as a relational space—one that mediates, absorbs, and refracts the ecological and political dynamics of rural Mexico. Through interactions with government agencies, NGOs, academic institutions, and markets, my research examines the ways in which agricultural policies, Indigenous food networks, and environmental narratives are produced, circulated, and contested within the city. This perspective situates Mexico City as both a site of power and resistance, where the shifting geographies of food, labor, and ecological governance converge.

CHOLULA, PUEBLA

Cholula, Puebla, served as my home base for much of this research, providing both a practical and intellectual foundation for fieldwork. As a city with deep historical, cultural, and agricultural significance, Cholula exists at the intersection of Indigenous heritage, academic scholarship, and contemporary food movements, making it an ideal vantage point from which to engage broader conversations on agroecology, food sovereignty, and environmental governance in Mexico.

Cholula is home to the Universidad de las Américas, Puebla (UDLAP), which served as a key institutional anchor during my research. Access to UDLAP's library, faculty, and academic networks facilitated engagement with regional scholars, policymakers, and practitioners working on issues related to agriculture, sustainability, and Indigenous knowledge systems. Among these contacts, Anthropologist Tim Knab's work on Nahuatl oral traditions and ritual practices provided valuable historical and ethnographic context for understanding the ongoing entanglements between food, identity, and land in central Mexico.

Beyond the university, Cholula was also home to the Mexican branch of the Slow Food movement, with its director at the time, Alfonso Rocha, based in the city. Slow Food-Mexico, part of a global network advocating for biodiversity conservation, small-scale farming, and local food traditions, played an important role in shaping conversations around native maize, milpa agriculture, and the preservation of regional culinary knowledge. Being situated in proximity to farmers, chefs, and activists affiliated with Slow Food allowed for direct engagement with the political and economic forces shaping contemporary food systems, particularly in relation to the commodification and globalization of heirloom maize and Indigenous foodways.³¹⁰

Cholula itself, with its mix of Nahua, mestizo, and urban populations, embodies the tensions between tradition and modernity, rural and urban, local and global that characterize contemporary Mexico. It is a site where long-standing agricultural practices and sacred landscapes—such as those surrounding the Great Pyramid of Cholula, the largest archaeological site of its kind in the world—exist alongside expanding urbanization, international tourism, and transnational food markets. This dynamic landscape provided a critical lens for exploring how historical continuities and contemporary transformations shape the production, circulation, and consumption of food in Mexico today.

By using Cholula as a base, my research was embedded in a setting where academic inquiry, activist networks, and food politics intersected. This positioning allowed for an engagement with key actors and institutions shaping contemporary agroecological debates, while also providing access to the broader regional and transnational contexts in which food sovereignty struggles unfold.

OAXACA DE JUÁREZ, OAXACA

Oaxaca de Juárez, the capital of the state of Oaxaca, served as a key research site where Indigenous agroecological knowledge, food sovereignty movements, and transnational culinary economies intersect. As a city with deep historical and cultural significance, Oaxaca is often framed as the epicenter of Mexico's gastronomic and biocultural diversity, home to a rich array of heirloom maize varieties, traditional milpa agriculture, and regional foodways that are actively preserved, reinterpreted, and, increasingly, commodified within global markets.

Beyond being a site of research, Oaxaca was also a place of deep intellectual and personal growth.

I was fortunate to be mentored by Gustavo Esteva, whose work at Universidad de la Tierra (Unitierra) challenged me to think critically about autonomy, decoloniality, and alternative forms of knowledge production. Unitierra's co-operative learning environment, along with the Center for Convivial Research and Autonomy, provided a space to engage in horizontal dialogue with activists, campesinos, scholars, and students, reinforcing a methodology grounded in convivial research and collective learning.

Oaxaca's markets, particularly Mercado de la Merced, Mercado 20 de Noviembre, and Mercado Benito Juárez, function as crucial spaces where small-scale farmers, Indigenous women vendors, and urban consumers negotiate access to local, seasonal, and heirloom foods. These markets, while sustaining traditional food economies, also reflect broader socioeconomic tensions, including gentrification, tourism-driven demand, and the challenges of maintaining agricultural livelihoods in an increasingly globalized food system.

The city is also a major hub for Indigenous activism, environmental justice movements, and alternative food networks on issues related to seed sovereignty, agroecological resilience, and Indigenous land rights, often in direct response to the encroachment of industrial agriculture, mining projects, and genetic modification of native maize. These movements articulate a critique of neoliberal development while fostering community-led agricultural and educational initiatives that reclaim food autonomy.

Oaxaca's culinary economy also plays a significant role in shaping contemporary discourses on heirloom maize, terroir, and Indigenous food heritage. The city has become a magnet for chefs, food writers, and gastronomic entrepreneurs, many of whom draw inspiration from traditional

cooking techniques, heirloom ingredients, and Indigenous food knowledge. However, this increasing global fascination with Oaxaca's food culture raises important questions about the politics of representation, culinary appropriation, and the uneven distribution of economic benefits in the wake of Oaxaca's rise as an international food destination.

Through my time in Oaxaca, I was fortunate to build friendships with an extraordinary group of food and milpa activists, talented chefs, and food writers, who each contributed to my understanding of the social, ecological, and political dimensions of food systems. These relationships, alongside my engagement with Unitierra, reinforced the importance of conviviality, reciprocal learning, and grassroots knowledge production as methodological commitments in my research.

By engaging with Oaxaca de Juárez as a research site, I analyze the ways in which Indigenous agricultural knowledge, food sovereignty struggles, and global culinary circuits converge in a complex web of economic, political, and ecological relationships. This site serves as an entry point for understanding the shifting dynamics of rural-urban food systems, the contested meanings of “authenticity” in Indigenous cuisine, and the resilience of small-scale farmers in the face of agrarian and climate change

MULTI-SPECIES ETHNOGRAPHY: METHODS FOR MORE-THAN-HUMAN WORLDS

To study the milpa as a dynamic multi-species assemblage required a methodology attuned to both human and more-than-human lifeways. While my research relied on classic ethnographic methods—semi-structured interviews, fieldnotes, and participant observation—it also drew on the

evolving toolkit of multi-species ethnography: methods designed to trace how plants, insects, fungi, microbes, and landscapes co-constitute agricultural life.

For example, I documented the seasonal emergence of chapulines not only through human narratives, but through nighttime harvesting walks, field sketches, and sensory fieldnotes that tracked light, moisture, and noise. My attention to quelites emerged through shared weeding sessions, where women named plants while working, distinguishing those to eat, those to compost, and those whose meanings shifted with context. With cuitlacoche, I followed fungal growth not only as food or blight but as a spore-based temporality, noticing how humidity, maize variety, and proximity to other infected fields shaped its emergence.

These encounters were often unscripted and required slowing down, observing, tasting, touching, and listening beyond language. My Grinnell-style journals became a way to log not just dialogue, but sensory impressions, non-verbal interactions, spatial configurations, and interspecies movements. In workshops and community gardens, I observed how humans attuned to nonhuman rhythms—when to harvest quelites, how to manage fungal spread, how to “read” the behavior of grasshoppers.

This attunement to nonhuman agencies was complemented by conversations with agroecologists, farmers, and chefs who offered overlapping and sometimes conflicting interpretations of species behavior, value, and ethics. Multi-species methods thus helped me trace not only ecological relations, but also epistemological frictions—between TEK, scientific models, and experiential know-how.

Ultimately, this approach allowed me to ask: how do multi-species lives make the milpa possible, and how are they implicated in its reassembly? Methodologically, the answer lies not in choosing between human or nonhuman actors, but in staying with their entangled emergence.

MULTI-SPECIES ETHNOGRAPHY: BEYOND HUMAN-CENTERED NARRATIVES

The *milpa* agroecosystem, an intricate interplay of maize, beans, squash, *quelites*, *chapulines*, and *cuitlacoche*, is far more than a system of agricultural production. It is a dynamic assemblage of multi-species relationships, sociopolitical negotiations, and ecological resilience. This dissertation examines the complexity of the *milpa* by integrating multi-species ethnography, political ecology, and assemblage thinking into a novel analytical framework called multi-species political ecology. By weaving together these theoretical approaches, this research not only elucidates the unique dynamics of *milpa* systems but also contributes to broader debates on sustainability, biodiversity, and food sovereignty in the Anthropocene.

Rooted in environmental anthropology, multi-species ethnography challenges human-centered narratives that often dominate agricultural studies. Instead, it foregrounds the agency of non-human actants—plants, insects, fungi, and microorganisms—that co-construct agroecological landscapes. Drawing on Anna Tsing’s concept of “patchy landscapes,” this approach positions the *milpa* as a site where interdependent relationships between humans and non-humans actively shape the agroecosystem.

Within the *milpa*, species such as *quelites* (weedy greens), *chapulines* (grasshoppers), and *cuitlacoche*s (corn smut) are not relegated to the margins as nuisances or byproducts. Rather, they play integral roles: *quelites* stabilize soil and enhance nutrition, *chapulines* contribute to nutrient

cycling and serve as a protein source, and *cuitlacoche* transforms from a fungal pathogen into a prized delicacy. Through participatory methods and visual ethnography, this dissertation captures *milpa*'s multi-sensory and multi-species dimensions, underscoring its relational ontology.

VISUAL METHODS FOR MULTI-SPECIES RESEARCH

To understand human-non-human interactions, I employed multi-species visual methods using various forms of visual media to bridge the communicative gap between human and non-human entities. These methods enrich conventional anthropological research techniques by adding depth and context to the study of *intra*-species communities and assemblage formation

The visual methodologies I used included the following:

- i. Photography employing varied framings to present different perspectives on non-humans.
- ii. Video recordings, capturing behavioral nuances, and ecological contexts.
- iii. Artistic renditions, such as drawings and sketches, are a way to get closer to certain aesthetic and emotional dimensions of human-non-human intra-actions.
- iv. Participatory techniques, including the use of video cameras to capture insights into more-than-human experiences and movements.

By integrating these visual methods into my research, I sought to cultivate a more immersive and empathetic understanding of multi-species interactions within specific social and ecological contexts.

PARTICIPANT OBSERVATION

Participant observation was a central ethnographic method used in this research, enabling an in-depth understanding of daily practices, social interactions, and human-non-human relationships

within the studied communities (Spradley 1980). As a methodology, participant observation allows for a form of embedded ethnography in which the researcher does not simply document external behaviors but actively engages in the rhythms of everyday life, learning through doing, and through multi-sensory attunement to the studied environment. Within multi-species ethnography, this is particularly significant, as agroecological knowledge is not solely communicated through discourse but is enacted through gestures, embodied practices, and sensory engagements with the landscape.

Field notes were meticulously documented to capture the nuances of these interactions, reflecting both immediate observations and the evolving interpretations that emerged through long-term engagement. The process of writing fieldnotes itself became an iterative act of sense-making, where descriptions of bodily gestures, agricultural techniques, and multi-species encounters were revisited and analyzed in relation to broader theoretical frameworks. To complement these textual records, observations were supplemented by visual methods, including photography and video recordings, to provide a multi-sensory representation of interactions within the *milpa* agroecosystems (Pink 2011). These visual materials served not only as a means of documentation but also as analytical tools, allowing for a deeper exploration of the spatial and material dimensions of agroecological practices (Pink, 2011).

SEMI-STRUCTURED INTERVIEWS

In addition to participant observation, semi-structured interviews were conducted to explore the diverse perspectives of *campesinos*, chefs, food activists, journalists, and academics engaged in agroecological practices and discourse. This methodological approach facilitated richer dialectical encounters that allowed interlocutors to articulate their experiences, worldviews, and reflections

on the shifting landscapes of food production and environmental stewardship.

A snowball sampling technique was employed, beginning with initial contacts in both urban centers and rural communities. Snowball sampling proved to be a particularly effective strategy, as it allowed for the organic expansion of the research network, linking actors across different scales of engagement, from smallholder farmers preserving ancestral seed varieties to chefs in urban centers advocating for the resurgence of local indigenous ingredients. This approach facilitated access to a broad range of perspectives, enabling the research to trace connections between localized agroecological knowledge and broader political, economic, and gastronomic movements (Bernard 2017).

The interviews followed a pre-formulated guide (See: Appendix 2. Examples of Semi-Structured Interview Questions), but their semi-structured format allowed for flexibility, ensuring that emergent themes and participant narratives guided the conversation. This adaptability was crucial in capturing the lived complexity of agricultural knowledge and multi-species entanglements, as rigidly structured interviews often fail to accommodate the fluid, context-dependent nature of agroecological practices. Audio recordings were transcribed and coded for recurring themes, employing an iterative approach that identified patterns across interviews. In cases where participants opted out of recording, detailed field notes served as the primary data source, ensuring that their insights were still incorporated while respecting their preferences regarding data collection.

Forty-seven interviews were conducted with *campesinos* and Indigenous farmers in rural communities and landscapes.

TABLE 2. COMMUNITY INTERVIEWS: LOCATION AND GENDER

Community	Women	Men	Total
Vicente Guerrero, Tlaxcala	3	4	7
Muni. of Españita, Tlaxcala	3	2	5
San Mateo de Ozolco, Puebla	3	5	8
Ixtenco, Tlaxcala	3	4	7
La Nevería, Oaxaca	3	2	5
Zacatepec, Puebla	2	3	5
Nativitas, Tlaxcala	3	1	4
Other Communities	1	5	6
Total	21	26	47

Thirty interviews were conducted with professionals across urban sectors, categorized as follows:

TABLE 3. URBAN PROFESSIONAL INTERVIEWS: GENDER

Profession	Women	Men	Total
Chefs	4	4	8
Food Activists	3	4	7
Journalists	2	0	2
Academics	4	5	9
Government Officials	1	1	2
Agronomists	1	1	2
Total	15	15	30

The integration of semi-structured interviews with participant observation enabled triangulation of data sources, ensuring that agroecological practices were not only discussed in an abstract sense, but were also observed in action. By layering multiple ethnographic methods, this approach provided a holistic view of the socio-ecological dynamics shaping *milpa* agroecosystems.

FOLLOWING AND TRACING

Building on these methods, the research employed two additional ethnographic approaches: following and tracing, which provided complementary perspectives on the movement of people, objects, and ideas within and beyond the studied communities.

The following method involves extended ethnographic engagement in which the researcher

actively observes and participates in the daily activities of individuals or groups over time. Unlike static interviews or isolated observations, following enables an in-depth understanding of how social and cultural practices evolve within dynamic, lived environments (Marcus, 1995). This approach was particularly useful for tracing the seasonal cycles of *milpa* cultivation, as well as the shifting relationships between farmers and non-human actors, such as insects, fungi, and soil ecologies. By accompanying farmers throughout the different phases of planting, harvesting, and soil regeneration, I was able to document how agroecological knowledge is not only transmitted verbally but also enacted through embodied practices that respond to shifting environmental conditions.

For example, the act of selecting seeds for replanting is not merely a technical task but an embodied practice informed by multi-species relationships. Farmers often describe their seed selection processes as guided by observation, tactile engagement, and inherited knowledge, with certain physical characteristics—such as husk texture or color—signaling a seed’s viability. These selections were informed not only by human agronomic preferences but also by attentiveness to ecological factors, such as soil composition and anticipated rainfall patterns. By following these processes over time, I was able to develop a more nuanced understanding of how agricultural knowledge is enacted through lived practices, rather than being confined to static taxonomies.

By contrast, tracing focuses on the movements and interconnections of people, objects, or ideas across different temporal and spatial scales. This method is particularly useful for examining the historical evolution of agricultural practices, foodways, and social networks (Tsing, 2005). In this research, tracing was employed to follow the trajectories of *milpa*-related knowledge, mapping

how traditional agricultural techniques persist, adapt, and circulate across different social and ecological contexts.

By integrating participant observation, semi-structured interviews, following, and tracing, this research employs a multi-sited and multimodal ethnographic approach to understanding *milpa* agroecosystems as dynamic, multi-species assemblages. These methodological choices reflect a commitment to ethnographic depth and analytical breadth, ensuring that agroecological knowledge is not only documented but also situated within its lived, political, and ecological contexts.

The combined use of these methods allows for a nuanced examination of how multi-species entanglements shape agricultural landscapes, while also revealing the historical and political trajectories that underpin contemporary agroecological struggles. By attending to both the micro-level of embodied practice and the macro-level of agroecological movements, this research contributes to a growing body of work that seeks to reimagine agricultural systems beyond the logics of industrial simplification—foregrounding relational ontologies, multi-species resilience, and the enduring struggles for food sovereignty in an era of ecological precarity.

GRINNELL-STYLE FIELD JOURNAL

I employed the Grinnell Method, a systematic field journaling approach, to document observations throughout my research. Initially developed by Joseph Grinnell, this method standardizes the format of field notes, ensuring consistency and facilitating subsequent analysis (Grinnell, 1912). Widely used by field biologists and naturalists, the Grinnell Method complements other data collection techniques, such as participant observation and interviews, thereby contributing to a robust and comprehensive data set (Herman 1986).

COMPONENTS OF THE GRINNELL-STYLE FIELD JOURNAL

A GRINNELL-STYLE FIELD JOURNAL CONSISTS OF FOUR PRIMARY COMPONENTS:

- **Field Notebook:** A pocket-sized notebook for immediate observations.
- **Journal:** A detailed, diary-like account of the research process.
- **Species Accounts:** Comprehensive descriptions of observed species.
- **Catalog:** A systematic list of all collected specimens.

FIELD NOTEBOOK ENTRIES

IN MY FIELD NOTEBOOK, I RECORDED THE FOLLOWING:

- Date, arrival, and departure times.
- Geographical details, including landscape descriptions, place names, and GPS coordinates.
- Travel routes and companions.
- Meteorological conditions.
- General impressions and activities.
- Descriptive notes and sketches of encountered species, detailing attributes such as color, size, and behavior.

Following each day's fieldwork, I transcribed these notes into a digital journal using Evernote¹³ to enhance the narrative with additional contextual details. I also cross-referenced species observations, documenting both their common and scientific names to ensure taxonomic accuracy (Remsen, 1977). This systematic approach allowed for improved data organization and facilitated the integration of field observations into subsequent analyses.

¹³ Currently using Evernote Version 10.137.1 (20250513074317) Copyright © 2025 Evernote Corporation

ETHICAL CONSIDERATIONS

All research activities adhered to the ethical standards outlined by the American Anthropological Association Statement on Ethics.¹⁴ Participation in the research was entirely voluntary, and an Informed Consent Information Sheet was provided to all participants before their involvement. Care was taken to ensure that participants' identities were protected when requested, and efforts were made to represent them respectfully and collaboratively. The research design was guided by decolonial and participatory methodologies, emphasizing ethical engagement with community members (Smith, 1999).

To ensure compliance with best practices in research ethics, I successfully completed the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2: CORE) issued by the Panel on Research Ethics. The Certificate of Completion (See: Appendix 3. Panel on Research Ethics TCPS 2: Core Certificate of Completion) verified my training in navigating the ethical considerations of human research.

¹⁴ "AAA Statement on Ethics." n.d. *The American Anthropological Association* (blog). Accessed May 20, 2025. <https://americananthro.org/about/policies/statement-on-ethics/>.

CHAPTER FOUR: WEEDINESS AND THE POLITICS OF PURITY

At first light in Vicente Guerrero, Florencio walks into his one-and-a-half-hectare milpa while the soil is still cool with dew. The sun catches on the mixed plantings that stretch across the field: six varieties of maize—*cacahuacintle*, *blanco*, *amarillo*, *pepitilla*, *rojo*, and *azul*—interspersed with *ayocote* beans, *haba*, squash, and scattered rows of amaranth. Between them grow what he calls “volunteer plants”: *cenizo*, *verdolaga*, *malva*, *rosilla*, and others that appear on their own. As we move between the rows, he bends with the assurance of long familiarity, lifting a tender stem of *cenizo*. “Look, these *quelites* come up all by themselves,” he says. “They feed us... not just *campesinos* but all human beings.” He sets it back gently so as not to bruise it.

A few steps later he notices a thin grass drawing moisture from the young maize. “This one we have to remove because it steals strength from the maize,” he explains, pulling it up by the root and dropping it to the side. Then, seeing a cluster of *verdolaga*, he smiles. “How could I pull this out if we eat it?” When he spots the soft leaves of *malva* he adds, “When it’s tender, we use it too; it’s part of our human diet.” *Rosilla*, however, is not for eating: “This one is good for children; it’s diuretic. I don’t remove it because it’s for remedy.” Each gesture—leaving, cutting, gathering, folding—turns the field into a living map of decisions guided not by elimination but by situated readings of relationships.

At the upper edge of the plot, where the soil dries out sooner, Florencio pushes aside a thick stand of mature plants with his foot. “When I harvest my maize, this will still be green,” he says. “So I bring in the tractor to chop it and fold it back into the soil. The earth has to eat too.” Instead of “cleaning” the field, he bends the plants down into a loose mulch, letting them decompose into the

ground. For him, so-called weeds are not an obstacle but a living infrastructure: they attract pollinators, hold moisture, sustain soil fertility, return nitrogen, and offer food and medicine. “If I fumigate everything to leave it nice and clean like over there,” he says, pointing to a bare neighboring plot, “they burn all the diversity. You lose the food, you lose the native plants, you lose the pollinators.”

As the sun rises fully over the milpa, illuminating the dense weave of crops and monte, Florencio sums up the logic that guides his work:^[11] “Here it’s not about cleaning. It’s about living together. You have to know who grows with whom.”

Seen through Emiliano’s decisions, weediness becomes an entry point into the moral and ecological classifications that structure milpa life, inviting a closer analysis of how these categories are made, contested, and lived in practice. This ethnographic scene sets the stage for examining how weediness operates as a classificatory and relational practice, one that links everyday decisions in the field to broader histories of purity, agronomic discourse, and a multi-species ethics of coexistence. It shows how campesinos rework the field through discernment rather than purification, the following section traces how such practices intervene in the territorial politics of industrial agriculture and contribute to the ongoing reassembly of the milpa.

This chapter argues that weediness is not simply an agronomic category but moral practice of a multi-species ethic through which campesinos negotiate value, care, and ecological complexity in the milpa. Drawing on selective weeding in places such as Vicente Guerrero, I show how farmers distinguish ‘good’ and ‘bad’ monte in ways that unsettle industrial agriculture’s pursuit of purity, legibility, and chemical control. These practices reveal weediness as a relational process rather than

a fixed classification, one that participates in deterritorialization when herbicides and monocultures disrupt multi-species relations, and in reterritorialization when *quelites* are revalued as food, soil amendments, medicinal plants, or sources of pollinator support. By centering these everyday acts of discernment, the chapter demonstrates that weediness actively reassembles the milpa by reorganizing plant communities, sustaining biodiversity, and grounding an ethic of coexistence that resists agrarian simplification

In dominant agronomic paradigms, weeds are defined as “unwanted plants in the wrong place”—biological intruders whose very presence signals disorder. But this definition is not neutral. It encodes a worldview that equates biodiversity with chaos and frames control as the hallmark of agricultural success. Following Mary Douglas’ insight in Purity and Danger (1966), the label “weed” reveals more than botanical status: it marks the violation of an imposed order. For Douglas, what is considered impure or polluting is not inherently dangerous, but dangerous because it is out of place—a symbolic threat to the classification system itself.

In modern agriculture, weediness becomes a moral and managerial problem. The goal is to purify the field, to render it clean, predictable, and productive. This effort aligns closely with James C. Scott’s critique in Seeing Like a State (1998), where he argues that modernist regimes seek to impose legibility on complex systems. By privileging simplified, measurable, and uniform landscapes, industrial agriculture treats “spontaneous” plants not as companions or co-inhabitants, but as enemies of order. Weeds, in this framework, must be named, classified, and eliminated to maintain a field that is readable to agronomists, planners, and market logics.

In contrast, milpa farmers in highland Mexico often relate to these same plants through relational,

flexible, and situational classifications. Plants such as *cenizo*, *verdolaga*, *romerito*, and *quintonil*—often categorized as “weeds” in agronomic manuals—are known locally as *quelites*, and valued for their taste, nutrition, and seasonal abundance. Their removal or retention is not determined by taxonomy, but by context: soil condition, maize growth stage, household need, or rainfall patterns. These practices reflect a moral economy that tolerates and sometimes celebrates nonhuman unruliness, so long as it remains within negotiated bounds.

This chapter argues that weediness is not an ontological category but a contested political and epistemological terrain. To understand how species become coded as weeds—or reclassified as food—we must attend to how milpa farmers engage in a daily politics of plant recognition and removal: pulling, leaving, tolerating, or harvesting based on knowledge that is embodied, historical, and deeply relational. In doing so, I place Scott’s and Douglas’ insights into conversation with ethnographic material that shows how purity and legibility are constantly being negotiated in the field.

WEEDS AND WEEDINESS

What constitutes a weed? The definition of a weed is far from universal. Willis Stanley Blatchley proposes several interpretations: “A plant out-of-place or growing where it is not wanted,” “A plant that competes with humans for possession of the soil,” and “A useless plant growing wild, of sufficient size to be easily noticeable and of sufficient abundance to be injurious to the farmer” (Blatchley 1912).

Herbert G. Baker (1965) provides a widely used definition of weeds as plants that thrive in anthropogenic disturbances without deliberate cultivation. Yet, such definitions reveal a paradox:

weeds are both unwanted and useful, controlled, and unruly undesirable volunteers and staple resources. The term weed signifies not an inherent botanical identity but an artifact of human perception and intervention (Tsing 2005). This duality emerges in commensal relationships between humans and plants, wherein both co-constitute ecologies of survival. In agroecological practices, *campesinos* and Indigenous farmers navigate weediness through selective toleration and cultivation (Bye 1981).

Michael Pollan (1989, p.2) further underscores the human construct of weediness:

Weed, that is, is not a category of nature but a human construct, a defect of our perception. This kind of attitude, which draws on an old American strain of romantic thinking about wild nature, can get you into trouble. At least it did me. For I had Emerson's pretty conceit in mind when I planted my first flower bed, and the result was not a pretty thing.

It is difficult to pinpoint the definition of a weed; rather, the concept is constructed through a set of characteristics that depend on context and human interactions. We may more deeply consider the paradoxical nature of weeds as plants that defy human efforts to control nature while simultaneously proving useful in different geographical and cultural contexts (for examples, see also Baker 1974; Doody et al. 2014, 126; Hadan and de Wet 1965; Radosevich and Holt 1984).

Plants are often considered the epitome of the natural world.¹⁵ Agroecosystems, like other landscapes, are culturally assembled. In my research, I focused on plants commonly referred to as weeds in Western agronomic literature but considered essential vegetables—known as *quelites*—

¹⁵ As many have shown us before, nature is also a socially/culturally constructed concept.

in the diets of most of the communities I studied in Mexico. Biologically, and in the eyes of most agronomists and conservationists, weeds are both natural and disruptive, proliferating in disturbed and damaged landscapes. As Tsing (2005, 174) observes: “Weeds have been of little interest to conservationists; we think of them only as indicators of disturbance (Tsing 2005, 174).” Nevertheless, it is precisely such “weedy, mixed forest landscapes” that make up a large part of what we consider biodiversity (Tsing 2005, 174).

The concept of weeds is complex and difficult to define because it involves the relationship between cultivated and uncultivated plants, as well as human activities, such as domestication and environmental disturbance. Botanists have proposed different definitions of weeds based on plant morphology, behavior, and ecological interactions with human culture. Here, I focus primarily on the bidirectional intra-actions between human culture and plants.

Although weeds can potentially reduce yields through crop competition, certain species are beneficial and deliberately left as volunteers in association with planted crops. This practice increases agroecosystem diversity, not only by expanding plant species variety, but also by attracting new insects, animals, fungi, and microorganisms. Some researchers have suggested that allowing certain weedy species to persist in fields may enhance gene flow between crops and their wild relatives, aiding progressive domestication. Conventional agronomists often view this as “relaxed” or “selective” weeding, attributing it to a lack of labor or mismanagement. However, closer examination revealed that many weedy species tolerated by *campesinos* do not appear to cause harm.

The distinction between weeds and crops is ultimately a matter of perspective shaped by cultural,

economic, and ecological factors. In many traditional farming systems, weeds are not merely unwanted plants but are part of an intricate agroecological knowledge system that recognizes their potential benefits. Understanding these dynamic challenges dominant agronomic narratives and highlights the resilience of Indigenous and *campesino* agricultural practices.

According to Bye (1981, 109), *quelites* are “edible greens usually derived from young, tender, annual herbs, but they may also include flowers, inflorescences, and stem tips of perennials.” The term *quelite* is a “complex and encompassing category” that has more to do with how the plant is used than the species of the plant. Depending on the region, the term *quelite* can include various types of herbaceous species, shoots of trees, lianas, flowers, parts of perennial and annual crops, and even non-native leafy greens. Some weedy species, especially *quelites*, have recently gained economic value. The term *quelite* derives from the Náhuatl *quilitl*, meaning edible herbs and vegetables, itself rooted in *quiltic*, meaning “green.” Not all *quelites* are weeds.



FIGURE 9. ILLUSTRATION FROM THE FLORENTINE CODEX OF *QUELITES* (SAHAGÚN, BOOK 11, P.352).

QUILTONILLI: THE [LEAF] SURFACE IS WIDE. WHEN STILL SMALL, IT IS EDIBLE, WHEN LARGER ITS NAME IS *PETZICATL* OR *PITZICATL*. IT CAN BE COOKED IN AN *OLLA*, IT CAN BE TREATED WITH SALTPETER; WATER CAN BE PRESSED OUT, WATER CAN BE SQUEEZED OUT, THIS *QUILTONILLI* HAS BLACK SEEDS. NAHUATL-TO-ENGLISH TRANSLATION (ANDERSON & DIBBLE 1953–1982)



FIGURE 10. ILLUSTRATION FROM THE FLORENTINE CODEX OF AN INDIVIDUAL HARVESTING *QUELITES*, POSSIBLY *HUAUZONTLES* FROM: SAHAGÚN, BOOK 11 (ANDERSON & DIBBLE 1953–1982).

For centuries, Mesoamericans have used volunteer *quelites*. Growing in and around the milpa as fresh vegetables: an ingenious way of making use of weedy plants that naturally emerge in *milpas*.



FIGURE 11. A VARIETY OF *QUELITES* ARE DISPLAYED IN OAXACA (PHOTOS BY THE AUTHOR, APRIL 2018).



FIGURE 12. *GUIAS*, *QUELITES* OF BEAN PLANTS ON DISPLAY IN OAXACA (PHOTOS BY AUTHOR, APRIL 2018).

Quelites have received recognition as exceptionally nutritious food with minimal environmental impact and with the revalorization of local and Indigenous foods. Consumers are increasingly recognizing *quelites* for the reasons mentioned above, and *campesinos* are beginning to encourage their growth in new ways. I suggest that the *campesinos* that I accompanied in the fields for this research would a) discourage, b) tolerate, c) manage, d) encourage, and e) stimulate the growth of *quelites* in their fields.

Robert Bye (1981, 111) reminds us that human disturbance is an important factor in determining the presence and density of *quelites* in the Sierra Madre Occidental. He notes the importance of the

weedy-*quelites* for both the Indigenous and *campesino* small-scale *milpa* farmers, as well as the importance these weedy species have for humanity (Bye 1981, 114-118). He notes that “weeds can provide food after the initial growing period (Bye 1981, 114),” and “The exploitation of weeds may represent one pathway to domestication and subsequent agriculture (Bye 1981, 118).”

Like many other *quelites*, *quintoniles* grow spontaneously in *milpas*, where they are foraged as part of traditional agricultural and culinary practices (Bye 1981, 44; Mapes and Basurto 2016, 112). Several *Amaranthus* species, including *Amaranthus hybridus* and *Amaranthus retroflexus*, are particularly valued for their high nutritional content, culinary versatility, and cultural significance within Indigenous and *campesino* food systems.

The genus *Chenopodium* in the Amaranthaceae family encompasses numerous species of perennial and annual herbaceous flowering plants, commonly known as goosefoot. Earlier taxonomic systems separated *Chenopodium* and its close relatives into a distinct family, Chenopodiaceae (Cronquist 1981). Within this broader family, *Chenopodium* subfamily Chenopodioideae, reflecting its historical and systematic significance (Kadereit et al. 2003). These species are cosmopolitan in distribution and occur across a wide range of ecological regions worldwide (Mosyakin and Robertson 2003).

Rather than being a fixed category, weediness emerges through context-dependent characteristics and relational entanglements between human and non-human actors. A plant’s classification as a weed fluctuates with its perceived utility, ecological affordances of place, and broader regimes of agricultural control. The paradox of weediness—resisting human order while offering ecological

benefits— has been illuminated in studies on agroecological practices that embrace multi-species assemblages (Aistara 2013; Doody et al. 2014).

Plants are often considered the epitome of the natural world, yet agroecosystems, like all landscapes, are culturally assembled (Tsing, 2005). In the *milpa* agroecosystems of Mexico, plants commonly labeled as weeds in Western agronomic discourse are recognized as *quelites*, which are integral components of dietary and ecological practices. The dynamic interplay between cultivation and wildness challenges the purity ideals of industrial agriculture and opens up alternative agrarian epistemologies that foreground interspecies interdependence (Rodríguez and Martínez 2019; Hernández 2020).

Alexis Shotwell (2016, p.6) critiques the broader implications of purity politics:

Many of us are settlers living on unceded native land, stolen through genocidal colonial practices. We feed domestic animals more food than starving people lack and spend money on the medical needs of pets while eating factory-farmed meat and spraying our lawns with pesticides that produce cancer in domestic animals.

— Alexis Shotwell 2016, 6

The discourse of weediness disrupts notions of purity and control, revealing the limitations and failures of human attempts to impose order on nature (Tsing 2005). The embrace of weediness within *campesino* and Indigenous agroecosystems thus exemplifies a multi-species ethic of coexistence that contrasts with the industrial agricultural paradigm of monocultural efficiency. Aistara (2013, 117) contends that “neat and orderly fields free of weeds— ‘pure’ fields—are more ‘legible’ (Scott 1998) to scientists and governments.” However, this logic of legibility overlooks the ecological benefits of weedy mixed-species environments. The maintenance of multi-species

relationships within the *milpa* disrupts the hegemony of purity-based agricultural regimes.

Following Shotwell (2016), I argue that purity is not only unattainable but problematic. The *campesinos* and Indigenous farmers I worked with operate within ecological ethics that resist the binary of cultivated versus wild. Their practices of selective weeding, seed-saving, and intercropping challenge dominant paradigms that privilege control over relationality. By nurturing weedy species, such as *quelites*, these farmers engage in an agroecological ethic that values diversity over exclusion. As Bye (1981, 114–118) notes, “The exploitation of weeds may represent one pathway to domestication and subsequent agriculture.”

OBSERVING AND PARTICIPATING IN THE WEEDS

In the following sections, I examine two observations from my fieldwork:

Quelites are now occasionally cultivated as the main cash crop to meet the demand in the emerging market for this weedy species. This paradox highlights the way in which monocultures and markets continue to drive agricultural practices, even within systems traditionally informed by the diversity and ethics of the *milpa*. This contradiction underscores the complexities inherent in balancing economic viability with agroecological diversity. Specific weedy species are intentionally cultivated or promoted to attract *chapulines* for commercial purposes.¹⁶

As I observed in the communities where I conducted fieldwork, *campesinos* and Indigenous farmers are deeply engaged in ecological ethics that emphasize multi-species relationships within

¹⁶ For specific instances of planting for *chapulines*, refer to Chapter Five: Patchy Landscapes.

their agricultural systems. This ethics is evident in the continued use of weedy species, such as amaranth and purslane, within the *milpa*. These species, often dismissed as ‘pests’ in industrial agriculture, are instead valued for their contributions to soil health and their importance in local diets. In contrast to the monocultural logic of industrial farming, which seeks to purify fields by eradicating non-crop plants, the *campesinos* and Indigenous farmers I studied recognize the ecological and nutritional benefits of maintaining these so-called weeds within their agroecosystems.

However, this is not a straightforward narrative of resistance to industrial agriculture. Many *campesinos* face pressures to adopt monocultural practices driven by economic and political forces that promote “purity” in the form of standardized crops and pesticide use. Some *campesinos* are beginning to integrate the elements of these industrial approaches, leading to hybrid practices that reflect both traditional ecological ethics and the realities of modern agricultural pressures. This demonstrates that while ecological ethics rooted in multi-species interactions remain strong, they are increasingly under threat from the politics of purity.

THE CHINAMPAS OF XOCHIMILCO

The lacustrine zone of Xochimilco, located in the southern reaches of Mexico City, constitutes the last surviving fragment of the once-extensive lacustrine system that sustained the chinampas, a highly sophisticated agroecological technology with deep historical and biocultural significance. Recognized as a UNESCO World Heritage Site and designated by the FAO as a Globally Important Agricultural Heritage System (GIAHS), this landscape embodies a delicate entanglement of ecological, sociocultural, and economic dynamics (Altieri and Toledo 2011; Montoya-Gómez et

al. 2020). The chinampa system, an enduring example of human ingenuity in wetland agriculture, has persisted for centuries despite mounting pressures from urban expansion, shifting consumption patterns, and environmental degradation.

However, rapid urbanization and the attendant transformations in land use, labor structures, and water quality have profoundly altered the conditions for traditional chinampa farming. The increasing marginalization of small-scale producers, exacerbated by water pollution, declining economic returns from vegetable production, and the waning practice of communal labor (*tequio*), has led to the gradual abandonment of many chinampas (Jiménez et al. 2018). These pressures have not only disrupted local livelihoods but have also threatened the ecological integrity of the wetland system, which relies on the maintenance of agricultural activities to prevent further eutrophication and habitat loss.

Despite these challenges, emerging alternative food networks have fostered new alliances among producers, consumers, and food activists, reimagining the role of the chinampa within contemporary food systems. The growing demand for organic and agroecological produce, often framed as a response to the environmental and health crises associated with industrial agriculture, has created opportunities for chinampa farmers to engage in direct-to-consumer sales and community-supported agriculture models (González-Jácome 2021).

At the heart of this struggle for continuity and autonomy are the seeds, practices, recipes, and narratives that constitute the living archive of the *chinampa*. Through the cultivation of traditional crops such as *verdolaga* (purslane), epazote (*Dysphania ambrosioides*), maize, and *cempasúchil* (*Tagetes erecta*), alongside the adaptation of introduced varieties like kale, bok choy, and rainbow

chard, *chinamperos* demonstrate an ongoing negotiation between tradition and innovation (Toledo and Barrera-Bassols 2008). This agroecological dynamism is not simply a matter of economic adaptation but a form of resistance—an insistence on maintaining control over local resources and asserting alternative pathways to food sovereignty amid the encroaching pressures of urban development and globalized agriculture.

Over the past two decades, my observations indicate a discernible shift toward the monocultural cultivation of *quintoniles*, *verdolagas*, and other salad greens in the chinampas (floating gardens) of Xochimilco. This paradox highlights the tension between traditional agroecological knowledge and market-driven demand. I discussed this development with Rodrigo, a local *chinampero*, who revealed that his *quelites* not only supply high-end restaurants in Mexico City (such as *Quintonil* and Rosseta) but also contribute to farm-to-table meals organized by *Yolcán* and *Arca Tierra*. This raises important questions regarding the implications of market integration on traditional agricultural practices.

THE *MILPA* AS A SITE OF MULTI-SPECIES ETHICS

The *campesinos* in Vicente Guerrero emphasize the importance of *quelites*—wild or semi-wild edible plants—within their *milpa* agroecosystems. These plants, typically classified as weeds in industrial contexts, play crucial roles in both human diets and soil health. Despite external pressures to conform to industrial monoculture models that prioritize the elimination of such plants, many of the *campesinos* I worked with resisted these trends, albeit not without contradictions. While some are pushed toward monoculture practices, they simultaneously maintain multi-species assemblages that reflect their ecological ethics.

The *milpa* agroecosystem exemplifies this multi-species ethics of weediness. *Campesinos* and Indigenous farmers support high levels of biodiversity by integrating so-called weeds into their agroecological practices. The cultivation of *quelites*, for example, serves not only as a source of food but also as an integral element in maintaining soil health, encouraging beneficial insect populations, and fostering genetic diversity within crop species (Torres 2021). The escalating use of herbicides threatens these traditional practices, further entrenching industrial logics of purity that undermine agroecological sustainability.

Drawing on Douglas's (1966) concept of purity and pollution, which associates purity with moral and ecological order, the industrial agricultural model categorizes weeds as impurities that threaten the purity of monocultural fields. However, as observed in Xochimilco's *chinampas*, *campesinos'* practices reveal an alternate agricultural logic where so-called "weedy" species are embraced for their role in maintaining ecological balance, thereby challenging industrial paradigms of purity.

Extending Douglas' framework to agriculture, I examine how weeds are commonly perceived as impurities in the industrial model. However, in the *milpa* agroecosystems of Mexico, this dichotomy is more complex. Anna Tsing's concept of weediness further elucidates the ecological roles of these plants, while Shotwell's critique of purity highlights the ethical and environmental benefits of embracing ecological diversity. In *milpa* agroecosystems, this translates to the intentional inclusion of weedy species, such as amaranth and purslane, which, though traditionally seen as pests in industrial agriculture, are integral to local diets and form part of the multi-species assemblage known as *milpa*.

CUETZALAN, PUEBLA: WEED SEED SALE

One September, weekend, I traveled to the town of Cuetzalan. Located in the coffee-growing region of the Sierra Norte of Puebla, Cuetzalan is a popular weekend getaway for visitors from Puebla and Mexico City, drawn to its impressive Saturday market, scenic views, and the strength of Indigenous cooperatives. It is also one of the first *pueblos mágicos*.¹⁷

While exploring the market, I purchased green coffee from a vendor to take home and roast. During this exchange, I noticed that the vendor had some seeds I did not recognize. When I inquired, she told me that they were *quintoniles*. I was surprised, as *quintoniles* are a “weedy” *quelite* that reproduces quickly, often without deliberate cultivation (see Figure 21).

¹⁷ *Pueblos Mágicos* is an initiative led by Mexico's *Secretaría de Turismo*, with support from other federal agencies, to promote tourism in smaller towns in rural areas in Mexico that offer visitors special natural or cultural attractions and exhibit national identity (Uhnák 2014; Secretaría de Turismo 2020).



FIGURE 13. ASSORTED *QUELITES* FOR SALE IN CUETZALAN’S MARKET, UNDERSCORING THE CONTINUED VITALITY OF FORAGED FOODS IN CONTEMPORARY RURAL COMMERCE (PHOTO BY THE AUTHOR, SEPTEMBER 2018).

This conversation reminded me of a previous discussion with Florencio in Vicente Guerrero, where he shared his plan to attract *chapulines* by planting a field of *quintoniles*. I asked the vendor if I could buy seeds to take back to Florencio for his experiment. To my surprise, she generously gave me a spoonful as a gift (*de pilón*) for purchasing coffee.

The following week, I traveled back to Vicente Guerrero, Tlaxcala. The air was heavy as I followed Florencio down the narrow footpath to his *milpa*, where maize, beans, and squash intertwined in a tangle of green. His practiced eye scanned the ground, noting the encroachment of *the quelites* between the rows. Where an industrial agronomist may see weeds, Florencio sees sustenance.

Bending down, he gathered a handful, explaining that these plants not only nourished his family but also replenished the soil, invited pollinators, and formed part of a larger ecological community in which humans were but one participant.

I brought the seeds to Florencio and suggested that he could now plant his field of *quintoniles* to test their ability to attract *chapulines*. However, demonstrating my ignorance, Florencio explained that it was too late in the season to plant them, as the *chapulines* were already nearly fully grown. This planting would have to wait until spring.

Through their multi-species assemblages, *milpa* agroecosystems operate based on the principle of mutualistic relationships, in which humans and non-human species collaborate to create a biodiverse and resilient agroecosystem. *Campesinos* and Indigenous farmers, plants, and insects co-evolve, each influencing the conditions and outcomes of agricultural production. *Campesinos* deliberately leave *quelites* in their fields, not out of neglect, but as a strategic practice to foster biodiversity and enhance crop resilience. As Florencio reasoned with me, “If you remove all the *malezas* (weeds), or don’t have a cover-crop, you lose the soil, and why would I do that, when I can also take them home to eat?¹⁸” This sentiment underscores the ecological wisdom embedded in *campesino* practices, where the so-called weeds are valued contributors rather than obstacles to agricultural success.

This co-creation challenges the purity-driven paradigm of industrial agriculture, which seeks to

¹⁸ *Si arrancas todas las hierbas o no tienes cobertura, al rato la tierra se va perdiendo. ¿Y para qué haría yo eso, si también puedo llevarme estos quelites...hierbitas para la casa y comerlas?* — Florencio

impose orders by eradicating weeds and pests. In contrast, *milpa* agroecosystems recognize that the presence of diverse species, such as plants, insects, and microorganisms, contributes to a more sustainable and productive ecosystem. Here, humans are not the sole managers of the land, but rather participants in a multi-species network that supports agricultural and ecological health. As Latour (1993) argues, modernist purification attempts to rigidly separate nature from culture and science from tradition. However, in the *milpa*, this dichotomy collapses as *campesinos* actively incorporate non-human agents into their farming strategies. This contradiction becomes particularly evident when industrial agricultural projects attempt to cultivate *quelites* in monoculture settings—a process that strips them of their ecological context and, paradoxically, reinforces the very purity-driven logic that *quelites*, in the *milpa*, help resist.

The irony of cultivating weeds in a controlled monocultural environment highlights the contradiction at the heart of industrial agriculture's pursuit of purity. This attempt at purification involves removing plants from their relational context and reintroducing them into an artificial, controlled setting of capitalist accumulations that seek to extract value while disregarding ecological entanglements. In contrast, *milpa* embraces disorder as a source of productivity and resilience. “Without the *quelites*, the maize is weaker, more fragile,” another *campesino* explained, illustrating the ways in which agricultural health is fundamentally tied to multi-species relationships.

Shotwell's (2016) critique of exclusionary practices—whether in agriculture or broader environmental policies—often leads to fragility rather than resilience. By embracing the principles of multi-species assemblages, *milpa* agroecosystems offer sustainable alternatives that prioritize

biodiversity, resilience, and ecological balance.

VICENTE GUERRERO, *ACAHUALES* AGROECOLOGIES

In Vicente Guerrero, Tlaxcala, and other *campesino* communities, the cultivation of edible weedy plants, such as *quintonil*, amaranth, and purslane, contributes significantly to both the local diet and ecology. Employing principles of agroecology and local knowledge, *campesinos* enrich biodiversity not only spatially—by fostering a mosaic of cultivated and semi-wild landscapes—but also temporally, by working with the cyclical rhythms of agricultural succession. The dynamic interaction between cultivated plots and fallow fields, known as *acahuales*, plays a crucial role in shaping both the short-term availability of edible plants and the long-term ecological resilience of the landscape.¹⁹

The concept of *acahuales* holds a central position within Tlaxcala's *milpa* agroecosystems, which are exemplary models of sustainable land use that maintain high levels of biodiversity across time. Characterized by a triad of intercropping involving maize, beans, and squash, the *milpa* system capitalizes on the mutually beneficial relationships among these plants. However, its biodiversity is not static; rather, it unfolds over time, mediated by shifting cycles of cultivation, fallow, and regeneration. Intermittent fallow periods introduce a temporal dimension of ecological complexity, as fields that lie uncultivated do not simply remain inert but actively regenerate, transitioning into *acahuales*. These fallows function as intermediary ecosystems that bridge cultivated landscapes with mature forests, hosting successive waves of plant and animal species that change as the

¹⁹ *Acahuales* are fallowed fields where the plant *acahual* (*Helianthus annuus*), [common sunflower], is one of the dominant/pioneering species.

acahual matures. Over seasons and years, the ecological composition of these spaces evolves—early successional plants like *quintoniles* and purslane giving way to shrubs and eventually trees—until the land is once again cleared for cultivation, and the cycle begins anew. This temporal dynamism underpins the resilience of the *milpa* system, ensuring that biodiversity is not just preserved in space but continually renewed and reassembled over time.

Acahuals are crucial for fulfilling multiple ecological functions. For instance, they act as sanctuaries for various forms of life. Emergent secondary vegetation creates habitats for smaller mammals, avian species, and a plethora of arthropods. This accumulation of fauna contributes to essential ecosystem services, such as seed dispersal and pest regulation.

Soil fertility also significantly benefits from the *acahuals*. Processes such as nitrogen fixation by leguminous plants and the accumulation of organic matter are prolific during fallow periods. In addition, mycorrhizal symbioses are formed between the roots of native vegetation and soil fungi, thereby increasing soil nutrient availability. Consequently, when agricultural activities resume, once-fallow fields are endowed with nutrient-rich soil, minimizing the necessity for synthetic fertilizers and mitigating their associated environmental repercussions.

Acahuals function as reservoirs of agrobiodiversity. They offer refuge to local landraces of maize and other Indigenous plant species, serving as living gene banks. These gene banks are repositories for advantageous traits, such as pest resistance and drought tolerance. Beyond ecological benefits, the conservation of these genetic resources carries sociocultural implications, particularly for the Indigenous communities who have been the stewards of these sustainable agroecological practices for generations.

The practice of integrating fallow fields or *acahuales* into the *milpa* agroecosystems of Tlaxcala presents multifaceted benefits for biodiversity. These intermediary ecosystems serve as wildlife habitats, enhance soil fertility, and safeguard genetic diversity. This practice's inherent resilience and sustainability suggest that *acahuales* could offer valuable insights for the broader application of sustainable and biodiverse agricultural systems. Therefore, a comprehensive understanding of *acahuales* is indispensable for advancing agroecological theories and practices.

In the afternoon, working in the *milpa* with my host family in Vicente Guerrero, I noticed that Doña Rosa had left some weeds untouched amid the crops. Asking about these plants, she explained to me that many were *quelites*, which she would leave in the field until they reached the desired maturity, at which point she would take them home to use in salads and fillings for tamales, among other dishes. When I asked if there were other weedy plants they found useful, she smiled and pointed toward the edge of the *milpa* to blooming lupin flowers, teeming with the pesty-*frailes* (*Macrodactylus sp.*). She explained, "These insects have an affinity for the lupin flowers, keeping them diverted from the crops." In this way, the practice of selective weeding not only preserves the culinary delicacies of the weedy-*quelites* but also employs them as trap crops to attract agricultural pests away from nearby crops.



FIGURE 14. FLORENCIO DISPLAYS AGROECOLOGICAL PRODUCTS AT A MAIZE CONFERENCE/FAIR IN VICENTE GUERRERO (PHOTO BY AUTHOR, FEBRUARY 2019).



FIGURE 15. FLORENCIO HOLDS ONE YOUNG AND ONE DEAD *CHAPULÍN*; THIS IS FROM JUST BRUSHING HIS HAND THROUGH THE WEEDY EDGE OF ONE OF HIS *MILPAS* (PHOTOS BY THE AUTHOR, JUNE 2019).



FIGURE 16. FLORENCIO COLLECTING *CHAPULINES* AND ASSORTED OTHER WILD FOODS. COLLECTING *CHAPULINES* AND *QUELITES* IN VICENTE GUERRERO, TLAXCALA, DEMONSTRATES THE INTEGRATION OF WEEDY SPECIES INTO LOCAL AGRICULTURAL PRACTICES. (PHOTOS BY THE AUTHOR, AUGUST 2019).

In the community of Vicente Guerrero, Tlaxcala, weedy species form a part of the agroecosystem in multiple ways, attributable to a combination of local and agroecological knowledge. These practices highlight the ecological and cultural resilience of *milpa* agroecosystems, providing a

counter-narrative to the industrial agricultural model. Here, I outline the practices observed during fieldwork in the community.

Selective Weeding and Ground Cover in Vicente Guerrero, Tlaxcala: *Campeños* in Vicente Guerrero utilizes weedy plants as ground cover and practices selective weeding. *Lupinus* serves as a trap crop for pests.

Benefits of Weedy Plants in the *Milpa*: Tolerable levels of weedy plants can benefit *campesinos* by incorporating them into the soil as green manure, thereby maintaining soil fertility.

Trap Crops: A trap crop is a plant explicitly cultivated to draw agricultural pests, predominantly insects, away from primary crops. This acts as a protective barrier, ensuring that the main crop remains largely unscathed by these pests. This technique eliminates the need for chemical pesticides.

Agroecological Knowledge Exchanges on Weeds: Local agroecological knowledge informs the selective weeding of weedy-*quelites*. Agroecological knowledge exchanges have taught the optimization of nitrogen fixation with leguminous cover crops.

The *campesinos*' approach to weediness in *milpa* agroecosystems offers a crucial perspective on the limitations and consequences of human efforts to impose order on nature. This perspective not only challenges dominant agricultural paradigms but also raises broader questions about the shifting landscape of agriculture within environmental ethics and ontological politics. By engaging with the weedy dynamics of *milpa*, *campesinos* enact an alternative environmental ethic—one that resists the rigid separation of nature and culture, order and disorder, and useful and unwanted species. Their practices illustrate a form of ontological politics in which the very existence and value of certain plants are not predetermined by universalized scientific categories, but rather negotiated through localized, place-based relations between humans and non-humans.

In both traditional and organic agriculture, intercropping legumes, such as beans, plays a fundamental role in maintaining soil fertility. This function is especially critical when synthetic

nitrogen fertilizers are either unavailable, as in traditional agriculture, or deliberately avoided, as in organic agriculture. However, within *campesino milpa* agroecosystems, soil fertility management is not merely an agronomic concern; it embodies an ethical relationship with the land, informed by both intergenerational local knowledge and agroecological knowledge exchanges (*intercambio de saberes*). The selective weeding and use of weedy-*quelites* are primarily guided by local knowledge, while the optimization of nitrogen fixation through leguminous cover crops is largely acquired through agroecological exchanges. Other practices, such as incorporating local weedy species in the preparation of *tlaxcashi*, emerge from the intersection of these two knowledge systems, illustrating an epistemological pluralism that challenges the dominance of industrial agricultural models.

The *milpa* then functions not only as a productive agroecosystem, but also as a site of ontological negotiation, where different ways of knowing and being are enacted in relation to the land. The *campesinos* who steward these landscapes engage in an ongoing process of adaptation—one that is not dictated by profit-maximization but by the ethical imperative to sustain livelihoods within a dynamic ecological and social milieu. Their practices contrast sharply with industrial agriculture's imposition of order through monocultures, chemical inputs, and exclusionary definitions of agricultural value. In this sense, the selective weeding and incorporation of *quelites* into agroecosystems do not merely serve an ecological function; they represent a mode of engaging with nature that acknowledges the agency of non-human beings and the entanglements between social and ecological worlds.

By embracing the complexity of *milpa* ecosystems—rather than seeking to control or simplify

them—*campesinos* cultivate an alternative multi-species ethics that resists extractivist logic. This ethic aligns with an ontological politics that contests dominant classifications of weeds, fertility, and agricultural productivity, positioning *milpa* caretakers as active agents in shaping multi-species landscapes. Thus, their agroecological practices not only sustain soil fertility and biodiversity but also embody a political stance: one that defends localized knowledge, resists the erasure of non-market ecological relations, and enacts a vision of agriculture rooted in coexistence rather than domination.

Economic, ecological, and social pressures shape the agricultural decisions of *campesinos* and Indigenous farmers, revealing underlying tensions between purity and contamination in agroecological systems. As Mary Douglas (1966) argues in *Purity and Danger*, purity is a social construct that delineates the boundaries between acceptable and unacceptable practices. Within this framework, shifts toward single cash crops, such as amaranth and epazote in San Miguel de Milagro, illustrate how market imperatives impose an economic logic that favors monoculture over traditional *milpa* systems. The market-driven selection of crops reflects a form of purification in which economically viable species are elevated, while others are marginalized. This process mirrors the purification described by Bruno Latour (1988) in *The Pasteurization of France*, wherein agricultural modernity isolates certain elements, such as high-value crops, while obscuring the complex ecological relationships that sustain agroecosystems.

However, ecological imperatives necessitate counterpractices that resist this purification by maintaining biodiversity and soil fertility. The integration of legumes for nitrogen fixation, selective weeding, and the management of *acahuales* exemplify *campesino* strategies that

challenge the rigid purity of monocultures. Rather than viewing weedy species as contaminants, *campesinos* incorporate them into *milpa* agroecosystems and recognize their ecological benefits. The maintenance of agroecological diversity can be understood as the active rejection of agricultural purification resistance to the imposed dichotomy between cultivated and uncultivated species.

Social pressures further complicate these dynamics, as cultural heritage and local and traditional knowledge systems influence agricultural practices in ways that defy market-driven purity. Despite historical suppression, the resurgence of amaranth underscores its continued social and symbolic significance within traditional agricultural landscapes. The intentional cultivation of weedy species, including *quelites*, to attract *chapulines* for consumption and sale demonstrates how *campesinos* navigate economic and ecological realities without entirely relinquishing their cultural frameworks. Simultaneously, the need to cater to market demands leads to a certain purification, wherein certain crops are sorted out from their multi-species entanglements, and agricultural practices are modified to align with consumer expectations and market demands. The commercialization of *quelites* and *chapulines*, for example, often involves an extensive and time-consuming process of sorting and purifying them in a sanitary sense to respond to consumer preferences, shaping which species are promoted, how they are harvested, and the conditions under which they are sold. Such practices align with anthropological perspectives that emphasize the role of symbolic and material hybridity of artisanal producers negotiating markets and the desiring of clean and local foods (Paxson 2013; Méndez Cota 2015; Finnis 2012; Kawa, McCarty, and Clement 2013; Kawa, Rodrigues, and Clement 2011; Nazarea 2005; Nazarea and Gagnon 2021; Gagnon 2024). The persistence of these entangled agroecological relationships challenges the

purity-driven logic of industrial agriculture, reinforcing the idea that Indigenous and *campesino* farmers engage in a dynamic negotiation process rather than rigidly adhering to external pressures.

These examples highlight the contradictory forces that shape *campesino* and Indigenous farmers' decisions, illustrating how economic incentives promote agricultural purification, whereas ecological and cultural imperatives necessitate diversification. The tension between purity and diversity is a fundamental dynamic of these agroecosystems, as farmers must constantly navigate the push toward monoculture and the need for resilient, biodiverse cropping systems. This chapter has explored these pressures as they manifest in specific agricultural practices, setting the stage for the following discussion on the consequences of the dominance of purity: how monocultures emerge and, paradoxically, how uncontrolled feral proliferations follow in their wake.

Agricultural transformations in places such as San Miguel de Milagro reflect competing forces of purity and contamination, as theorized by Douglas, Latour, and Shotwell. While economic pressures drive the purification of crops to maximize marketability, ecological and social practices resist such simplification by embracing the inherent entanglements of agroecosystems. This tension highlights the broader struggle between industrial and traditional agricultural paradigms, where the purity of market-driven models is continually disrupted by the ecological and cultural complexities of *campesino* and local and traditional knowledge systems.

Through their multi-species assemblage, *milpa* agroecosystems operate on the principle of mutualistic relationships, where humans and non-human species work together to create a biodiverse and resilient agroecosystem. *Campesinos* and Indigenous farmers, plants, and insects co-evolve, each influencing the conditions and outcomes of agricultural production. *Campesinos*

deliberately leave *quelites* in their fields, not out of neglect, but as a strategy to foster biodiversity and enhance crop resilience. In doing so, they acknowledge the agency of non-human species in shaping agroecosystems.

This co-creation challenges the purity-driven paradigm of industrial agriculture, which seeks to create order by eradicating weeds and pests. In contrast, *milpa* agroecosystems recognize that the presence of diverse species, such as plants, insects, and microorganisms, contributes to a more sustainable and productive ecosystem. Here, humans are not the sole managers of the land, but rather participants in a multi-species network that supports agricultural and ecological health.

Campesino communities in Tlaxcala, Mexico, often rely on weedy-*quelites* as a nutrient-rich complement to local cuisine. These plants are commonly used in traditional dishes such as salsas, stews, and soups. Additionally, *quelites* play an important role in cycling nutrients and as cover crops to prevent soil erosion. In contrast, the use of herbicides and pesticides in industrial agriculture has led to the loss of biodiversity and soil degradation.

Campesinos can benefit from tolerable levels of weedy plants in the *milpa*. They are often incorporated into the soil as green manure to increase organic matter after harvest. Various legume species serve as green manure and part of crop rotations. The intercropping and cover-cropping of legumes, such as beans, in the *milpa* exemplify the local knowledge of *campesinos*, a knowledge base that has informed agroecology researchers.

David Williams's 1985 research with the *campesino* communities of Tlaxcala found that the *campesinos* in the study practiced a form of selective weeding, allowing weedy plants to mature

during the same cycle as crops, facilitating an integral harvest. His research also found that fields planted with barley could accommodate up to 4,700 wild *Solanum* plants per hectare without negatively affecting yields.

In Vicente Guerrero, Tlaxcala, there were similar examples of weedy plants, such as ground cover and selective weeding. As previously discussed, I would often observe my interlocutors collecting useful weedy-*quelites* while weeding out undesirable weedy ones. The weeded plants were then often left on the surface of the soil as mulch that could serve as a ground cover and later be incorporated back into the soil. Beans and other nitrogen-fixing plants are often used as cover crops to prevent erosion and damage from heavy rainfall.

EMBRACING AND WEEDINESS

Local campesinos in Vicente Guerrero practice a nuanced form of weed management that reflects deep traditional ecological knowledge. Rather than aiming for a perfectly ‘clean’ field, they engage in selective weeding, removing some plants while sparing others based on their utility and the degree of competition they pose. The milperos I worked with generally do not use the word “weed” (*mala hierba* or *maleza*) as broadly or in a deterministic way as the hacendado farmers do. As Chacón and Gliessman (1982) documented in their research in study in Tabasco “*monte*” (uncultivated areas of vegetation) is not insecurely considered *malezas*. Within the *monte*, they distinguish “*buen monte*” (good vegetation) and “*mal monte*” (bad vegetation), depending on the species’ uses and effects on the crop. Useful *quelites*, medicinal herbs, or soil-improving plants are classified as good, whereas those that are harmful, spiny, or “steal nutrients” with no apparent benefit are classified as bad. This classification guides how they weed: campesinos will leave the

buen monte in place or only lightly thin it while thoroughly uprooting the *mal monte*. For example, one study in Tabasco documented campesinos recognizing about twenty species of “good weeds” (food, medicine, ceremonial uses, soil improvers) versus twenty-one “bad weeds” in their milpas, a concept echoed in Tlaxcala and other regions as well.

The practice of “*no limpiar todo el campo*” (“not completely cleaning the field”) is deliberate. By tolerating a certain density of wild greens, campesinos ensure a secondary harvest of foods and herbs without replanting (Ebel et al. 2024). As noted from this research, some *milperos* even say they “attract” or encourage desirable wild plants in their fields up to tolerable limits (Ebel et al. 2024). This might involve timing the first weeding late enough to let *quelites* establish or leaving small patches of plants to actively encourage their growth. Such methods enable the *milpa* to produce not only maize, beans, and squash, but also a variety of *quelites* and medicinal plants, effectively increasing on-farm biodiversity and family nutrition in one stroke. Researchers have observed that many traditional campesinos consciously practice “non-clean” fields, rejecting the modern mandate of total weed eradication. Interestingly, agronomists used to misinterpret this as laziness or lack of labor, thinking the farmer simply did not finish weeding. In reality, it is often an intentional strategy: certain “weeds” are managed and even promoted because they serve a purpose for the household.

That said, context is key. Local campesinos will still classify a useful *quelite* as *maleza* if it is growing in the wrong place or at the wrong time. In spatial terms, a weed is often defined as “a plant out-of-place.” For instance, a *quintonil* growing densely around a young maize stalk is considered *mala hierba* and will be cut to avoid stunting the crop. The very same *quintonil* plant,

if growing a bit off to the side or at the field edge, might be happily left to grow , in that context it is a food resource, not a pest. Similarly, *verdolaga* covering the ground too thickly in bean rows might be thinned out and tossed aside as a weed, but *verdolaga* along a canal or on an idle patch of soil may be gathered as a beloved vegetable. Temporal context also matters: early in the season, many *quelites* are welcomed and tolerated; later in the season, once they have been harvested or once the maize is tall, campesinos may completely weed them out to reduce competition and allow easier harvest of grain. In other words, today's *quelite* can become tomorrow's weed if it has already been used or if it threatens the primary crop's yield.

Campesinos in Vicente Guerrero, whom I interviewed while working in the milpas, explained this with practical reasoning. “*Si hay demasiada maleza, la milpa no da*” [if there's too much weed growth, the milpa won't yield], so weedy-*quelites* must be removed, but they also would explain, “*De la milpa sale todo: el maíz y el quelite*” [“everything comes from the milpa, the maize and the greens”] also embracing them as an important part of a complete milpa-based diet. Even as they pulled out handfuls of *maleza*, they set aside the *quelites* that they could eat. This dynamic approach underscores that “weed” is not a fixed category; it is relative to human use. Indeed, ethnobotanist Robert Bye noted that traditional campesinos leave many wild plants in fields “as a second harvest” (Bye 1981). By distinguishing good from bad and knowing each plant's traits, campesinos maintain a balance: they safeguard their main crops while also reaping the benefits of the wild flora. The result is a milpa that is not a monoculture, but a *polyculture* , a field teeming with life, where maize stalks stand alongside edible weeds.

As Florencio told me, the first time I accompanied him to the field:

*The milpa does not just produce maize, but also beans, squash, and quelites, as well as medicinal plants. It is a sustainable system that we must protect.*²⁰

– Florencio



FIGURE 17. A SELECTION OF COMMON *QUELITES* HARVESTED FROM MILPA FIELDS IN THE PUEBLA, TLAXCALA

²⁰ *La milpa no sólo produce maíz, sino también frijol, calabaza y quelites, además de plantas medicinales. Es un sistema sustentable que debemos proteger.*

REGION (FROM LEFT TO RIGHT: VERDOLAGA (*PORTULACA OLERACEA*), *QUINTONIL* (*AMARANTHUS* spp.), AND *QUELITE CENIZO* (*CHENOPODIUM BERLANDIERI*) (PHOTO BY THE AUTHOR, JULY 2019).

These edible weeds are typically rinsed and sold in bundles at local markets or prepared fresh in home kitchens. Their vibrant green leaves and stems are a rich source of nutrients, illustrating the agrobiodiversity preserved in multi-species milpa systems.

In Vicente Guerrero and surrounding communities, *quelites* are an important seasonal food source, especially during late spring and summer, before the main crops mature. Many farming families describe these wild greens as a crucial supplement providing vitamins and variety to diets at a time when stored foods from the previous harvest run low. Common recipes include sautéed *verdolagas* with tomato, onion, and chile, often served alongside beans or as taco fillings, and mixed *quelites* soups, where greens such as *quintonil* and *cenizo* are boiled with salt, onion, and sometimes a chunk of pork fat for flavor. Knowledge of how to identify, gather, and cook each *quelite* is typically passed down through generations, especially by women in the household (Linares and Bye 2012). The continued use of *quelites* is closely tied to cultural heritage and local identity, as these plants are featured in the traditional recipes and rituals of the Puebla, Tlaxcala region. For instance, fresh pápalo leaves are a staple in Tlaxcala and Puebla (often eaten raw as a condiment for tacos or *cemitas*) and are commonly grown or tolerated around field edges and home gardens.

The persistence of *quelites* in farming reflects a conservation of agrobiodiversity and traditional knowledge. Researchers have observed that rural communities with strong traditional foodways continue to use *quelite* despite the availability of commercial vegetables, highlighting a form of food sovereignty (Castro-Lara et al., 2014). By valuing these wild species, *campesinos* help conserve diverse plant genetic resources and associated knowledge. Some *quelites* once considered

“poverty foods” have gained wider recognition recently for their nutritional benefits and culinary potential (Petrini 2012; Manzanero-Medina et al. 2020). This re-appreciation is evident in regional markets where *quelites* are sold; fresh bundles of purslane, *quintonil*, and others can be found for sale, connecting rural foragers with urban consumers interested in traditional and healthy foods (Manzanero-Medina et al. 2020). The renewed interest is not only gastronomic; public health and agriculture experts also recognize that promoting *quelites* can improve nutrition.

In Vicente Guerrero’s milpas, the interplay between crops and tolerated wild greens exemplifies a holistic agroecological strategy. Campesinos manage their fields in a way that yields both staple grains and a variety of edible “weeds,” reflecting a deep understanding of ecological processes and food culture. This case highlights how so-called “weeds” can be reframed as valuable resources. Through selective weeding, traditional campesinos balance crop productivity with the conservation of *quelites*, thereby enhancing dietary diversity and resilience. This practice underscores an important principle of *milpa* agroecosystems: biodiversity and cultural knowledge go hand-in-hand. As modern agriculture tends toward homogenization, the continued use of *quelites* in places such as Tlaxcala stands as a testament to the benefits of diversified farming. Embracing these humble greens, once relegated to the margins, is increasingly seen as part of forging sustainable food systems for the future (Ebel et al. 2024).

It is important to recognize that an agroecosystem extends beyond the immediate area of cultivation. It should also encompass the broader region under the stewardship of *campesino* and Indigenous farming communities. This broader perspective acknowledges that agricultural practices alter species assemblages within cultivated land while also affecting species interactions

in the surrounding ecosystem.

In many *milpa* agroecosystems tended by *campesino* and Indigenous farmers, weedy plants are not merely intrusive species requiring eradication but integral components of a multi-species assemblage. These plants fulfill functional and even symbiotic roles, such as enhancing soil fertility, providing ground cover, and serving as alternative sources of food and medicine. This nuanced understanding challenges conventional agricultural paradigms that often categorize weedy plants as undesirable entities to be removed for maximum crop yield.

In the Puebla–Tlaxcala Valley, *campesinos* intentionally leave *quelites* in their fields not as accidental intrusions but as vital actors within a multi-species assemblage. This assemblage, composed of human *campesinos*, *hacendados*, *quelites*, insects, and soil organisms, contributes to an agroecosystem that resists monocultural purity. This broader perspective also encompasses a diverse array of microorganisms, insects, and additional flora that coexist within agricultural spaces.

A multi-species assemblage is not merely an ecological descriptor; it also signals distinctive ontological orientations. This framework fosters a more inclusive understanding of *milpa* agroecosystems, reflecting a worldview that values *intra*-dependence among plants, animals, humans, and other organisms. The presence of weedy plants in *milpa* agroecosystems exemplifies a complex agroecological balance refined over generations.

Assemblages serve as an analytical framework for examining the complex, interdependent relationships between living and non-living entities within *milpa* agroecosystems. This perspective

deepens our understanding of agroecosystems as dynamic adaptive networks rather than as isolated static entities. It moves beyond conventional taxonomies to conceptualize the *milpa* as a landscape of weediness, where so-called agricultural “pests” or “weeds” are integral components of a balanced agroecosystem.

These theoretical frameworks help us understand that *campesino* practices in the *milpa* are not solely ecological strategies, but also ontological and ethical responses to industrial agriculture’s pursuit of purity. Douglas’s concept of purity illustrates how industrial agriculture constructs weeds as pollutants requiring eradication. However, as Tsing (2005) suggests, weeds are not external threats but essential members of a multi-species assemblage. Shotwell’s (2016) analysis further highlights the ethical dangers of exclusion, suggesting that embracing ecological diversity is not only environmentally beneficial but also crucial for resisting broader forms of control.

WEEDY-QUELITES IN THE RAIN-FED MILPAS OF VICENTE GUERRERO, TLAXCALA

In the rain-fed *milpa* of Vicente Guerrero, Tlaxcala, campesinos practice a traditional form of agroecology that tolerates and even encourages certain “weedy” greens known as *quelites*. The word *quelite* comes from the Náhuatl term *quiltil*, meaning an edible herb or tender green plant. These wild greens grow naturally among crops (particularly in the *milpa* system of maize, beans, and squash) and have been gathered as food in Mexico since pre-Hispanic times. Far from being viewed strictly as “weeds,” many *quelites* are valued for their nutritional content and culinary uses. Over 350 species of wild edible *quelites* are traditionally consumed across Mexico and are selected over generations by local communities. The most common are *pápalo* (*Porophyllum ruderale*

subsp. *macrocephalum*), *verdolaga* or purslane (*Portulaca oleracea*), *quintonil* (amaranth greens, *Amaranthus* spp.), *romeritos* (*Suaeda nigra*), *quelite cenizo* (lamb's quarters, *Chenopodium berlandieri*), *huauzontle* (*Chenopodium berlandieri* subsp. *nuttalliae*), *alaches* (*Anoda cristata*), and *epazote* (*Dysphania ambrosioides*). These *quelites* are integral to local food culture and are prepared in myriad ways: eaten raw in salads, boiled or steamed, sautéed, or used in soups, sauces, tacos, and other dishes (Basurto-Peña et al. 1998). Nutritionally, *quelites* provide diverse flavors and are rich in vitamins, minerals, antioxidants, and essential fatty acids, contributing significantly to the diet.

SELECTIVE WEEDING

Lacandón *milperos* do not remove weeds and trees indiscriminately; instead, they engage in selective weeding, allowing beneficial tree species to persist and guide the successional dynamics of their fields (Falkowski et al., 2020). This strategy enhances microclimatic conditions by providing shade, reducing evapotranspiration, and supporting a stable hydrological cycle. Trees also offer habitat and food sources for pollinators and seed-dispersing fauna, contributing to biodiversity conservation in agricultural landscapes.

As Falkowski et al. (2020) observed, the presence of certain tree species in *milpas* influences the structure of litter layers and soil organic matter, which in turn affects microbial activity and nutrient cycling. These trees effectively transform the *milpa* into a dynamic, regenerating system, wherein weedy vegetation and tree regrowth are not seen as signs of agricultural neglect but as integral components of ecological succession.

The Lacandón *milperos* exemplify an agroecological strategy that integrates tree species for long-

term soil health, biodiversity maintenance, and sustainable food production. Rather than viewing trees and weedy vegetation as competitors to maize, Lacandón *milperos* recognize their functional roles in stabilizing the agroecosystem. This approach offers key lessons for sustainable agriculture, particularly in contexts where industrial models of purity and control have led to soil depletion and biodiversity loss. By incorporating tree species into their *milpas*, Lacandón farmers engage in a form of agroecological engineering that aligns with the broader themes of this chapter: resisting purity-driven agricultural paradigms and embracing multi-species entanglements. Lacandón agroforestry underscores the ecological benefits of maintaining biodiversity within agroecosystems and offers a model for rethinking agriculture as an interdependent, multi-species assemblage (Diemont et al. 2005b). This research suggests that these practices cultivate resilience not through exclusion and control, but through adaptation and relationality. Their agricultural practices embody an ecological ethic that foregrounds biodiversity as a means of resistance against industrial agricultural homogenization (Tsing, 2005). As my research demonstrates, impure landscapes of *milpa* agroecosystems sustain robust multi-species assemblages, decentering anthropocentric conceptions of agriculture, and reconfiguring notions of purity in food production.

Campesinos in the Puebla–Tlaxcala Valley have long recognized the value of these spontaneous greens as a “second harvest” from their fields. Rather than clearing all non-crop plants, traditional campesinos distinguish between “*buen monte*” and “*mal monte*,” meaning good versus bad weeds. Useful or harmless plants are left to thrive at tolerable densities, whereas only those species that truly compete with crops or lack any use (“*mal monte*”) are removed. This practice of selective weeding, guided by deep traditional ecological knowledge, ensures that beneficial wild greens are available for food and do not significantly harm the main crop (Chacón and Gliessman, 1982;

Altieri and Trujillo, 1987). Altieri and Trujillo's seminal study in Tlaxcala documented that local maize producers even "attract" or encourage certain wild plants in their fields by timing weeding and soil tillage to favor these edible species. By maintaining a polyculture of crops and tolerating weeds, campesinos increase the nutritional diversity available to their families without sacrificing crop yield (Bye 1981; Altieri and Trujillo 1987). In other words, milpa is managed not as a monoculture, but as a more biodiverse system that yields both staple grains and supplementary greens (Altieri 2016; Ebel et al. 2024).

In *campesino* communities like Vicente Guerrero and Tlaxcala, milpas can host a variety of *quelites*; a Náhuatl term for edible wild greens. Local campesinos recognize many of these spontaneously growing plants as both weeds and as a nutritious vegetable that complements the local cuisine. Common *quelites* in local milpa systems include *alaches*, *quintoniles* (various *Amaranthus* species), *quelite cenizo* (goosefoot greens, *Chenopodium* spp.), *verdolagas* (purslane, *Portulaca oleracea*), and *nabo* (wild mustard greens, *Brassica rapa*). These plants grow intermingled with maize and other crops, and despite being considered "weedy," they are an important part of the farming household's diet, medicine, and agroecosystem. In fact, a typical traditional milpa in Tlaxcala can yield a substantial harvest of such *quelites*, up to ~13 tons per hectare of edible greens, which farm families regularly consume (approximately 3 kg, 2–3 times per week) (Altieri and Trujillo 1987). Nutrient-rich *quelites* are "important sources of vitamins, minerals and protein," significantly enhancing local diets (Ebel et al. 2024). They also serve as a safety net in hard times: being more drought-tolerant than maize or beans, wild greens like *Portulaca*, *Amaranthus*, and *Chenopodium* will still produce food in dry years when the primary crops suffer (Ebel et al. 2024). This deep reservoir of traditional knowledge and usage enables Tlaxcalan campesinos to integrate

“weeds” into their livelihoods rather than simply fight against them.



FIGURE 18. A CULTIVATED FIELD IS BORDERED BY DIVERSE VEGETATION, INCLUDING WILD AND SEMI-WILD PLANTS SUCH AS BEAN VINES, VERDOLAGA (*PORTULACA OLERACEA*), AND VARIOUS *QUELITES* (*AMARANTHUS* SPP. AND *CHENOPODIUM* SPP.) (PHOTO BY THE AUTHOR, MAY 2018).

The presence of mature shrubs and trees along the field edge supports pollinating insects, birds, and small foraging animals, while also providing habitat for beneficial fungi. These ecological

assemblages exemplify the integral role of field margins in maintaining biodiversity, soil stability, and overall resilience within milpa agroecosystems



FIGURE 19. *CAMPESINOS* MANUALLY WEEDING A RECENTLY PLANTED MILPA FIELD IN VICENTE GUERRERO, WHERE ROWS OF MAIZE SEEDLINGS FOLLOW THE TERRACED CONTOURS AND *MAGUEYES* (*AGAVE* spp.) MARK THE FIELD EDGES (PHOTO BY THE AUTHOR, JUNE 2020).

This practice highlights the continued importance of intensive, communal labor during the early

growth stages of maize cultivation, reflecting the agroecological traditions essential for sustaining the *milpa* agroecosystem.



FIGURE 20. WEEDING *MILPA* IN THE TERRACED *MILPA* LANDSCAPE SURROUNDING VICENTE GUERRERO, TLAXCALA. (PHOTO BY THE AUTHOR, MAY 2019)



FIGURE 21. *CAMPESINOS* MANUALLY REMOVE WEEDS FROM A NEWLY PLANTED MILPA FIELD IN VICENTE GUERRERO, HIGHLIGHTING HOW TRADITIONAL MANUAL WEEDING REMAINS IMPORTANT DURING THE EARLY STAGES OF MAIZE CULTIVATION. (PHOTO BY THE AUTHOR, JUNE 2020)



FIGURE 22. A YOUNG MAIZE PLANT IN VICENTE GUERRERO WITH *QUELITES* WAS CUT AND LEFT IN THE FURROW AFTER HAND-WEEDING WITH A HOE (PHOTO BY THE AUTHOR, JUNE 2018).

Campesinos selectively remove or cut back *quelites*, such as purslane (*Portulaca oleracea*) and *quelite cenizo* (*Chenopodium* Spp.), often incorporating cut weeds as green manure, while allowing some to continue growing for use as food. illustrates how certain plants can be both weeds and secondary crops. *Campesinos* recognize these *quelite* species for multiple purposes: as food, in herbal medicine, as livestock fodder, or as

green manure to improve soil fertility. The majority of weeds are still cleared to avoid competition with maize, but a few useful plants are managed rather than eliminated. This practice of selective weeding reflects deep traditional knowledge and agroecological reasoning: even useful *quelites* may be labeled “*malezas*” (weeds) when they threaten the crop, yet they are treated as valuable resources when conditions permit (Bentley et al. 2001).

SOME COMMON *QUELITES* IN THE *MILPAS* OF VICENTE GUERRERO

Below are some of the most notable *quelites* in Vicente Guerrero’s *milpa* system, with their culinary, medicinal, and agroecological significance.

ALACHES

Alache (also known as *malva*) (*Anoda cristata*) is a wild mallow of the hibiscus family that pops up in *milpas* and along its humid edges. It has star-shaped green leaves and hibiscus-like purple flowers and grows rapidly as a robust *arvense* (weed) (Rendón et al. 2001). Locally, people distinguish between two variants: a “male” *alache* (with slender, fuzzy leaves) that is fibrous and less palatable, and a “female” *alache* (with broader, smooth leaves) with a better flavor (Rendón et al. 2001). Campesinos preferentially gather the tender female *alaches* and often weed out the coarse male *alaches*, demonstrating detailed traditional knowledge of this plant.

Alaches are prized ingredients in seasonal soups and broths. Young leaves are cooked with garlic and onion, creating a green soup or stew that is rich in vitamins. A traditional *sopa de alache* is prepared by boiling the greens (after removing tough stems and flower parts) with ingredients such as onion, garlic, squash, green beans, and a sprig of mint, sometimes finished with chili and lemon. This results in a hearty, flavorful soup. *Alaches* are also eaten mixed with rice or other dishes, but

they are generally not consumed raw owing to their slight toxicity unless well cooked (a practice to eliminate oxalates).

In addition to their nutritional value, *alaches* are used in local herbal medicine. The leaves and flowers can be brewed as herbal tea, and recent studies suggest *that alache* has hypoglycemic properties and may act as an antidiabetic agent in traditional remedies. *Campesinos* recognize that consuming *alache*, along with other *quelites*, can contribute to overall health, potentially helping prevent chronic diseases by providing antioxidants and fiber.

Campesinos tolerate and even favor the growth of *alaches* in their fields up to a point. They allow female *alache* plants to sprout around the maize and harvest tender greens when available. When weeding (*escarda*), they selectively remove undesirable “male” *alache* individuals and any *alache* crowding too close to young maize. Not all edible *alache* plants are removed at once; some are left to continue growing, ensuring a supply over the season and allowing the plant to reseed. This selective weeding strategy keeps the *alache* population in check while preventing the preferred variety from being eliminated. In other words, *alache* is generally treated as a companion weed: it is weeded out only where it would seriously compete with maize, but in less harmful spots it is left in place to be later gathered as a food crop.

QUELITE CENIZO

Quelite cenizo (literally “ashen *quelite*,” named for the grayish, powdery coating on its leaves) refers to wild goosefoot greens, particularly *Chenopodium berlandieri* (and related species like *C. album*). *Quelite Cenizo* is common in highland Mexico, it sprouts spontaneously in disturbed soil such as cultivated fields, along roadsides, or almost any disturbed patch containing the seedstock.

Quelite Cenizo has dentate (toothed) leaves with a mealy white coating on the underside and can grow to a meter or more if unchecked. *Quelite Cenizo* is a weedy-relative of the domesticated Mesoamerican *Chenopodium* variety known as *huauzontles* and the domesticated Andean *Chenopodium* quinoa. In the milpas of Vicente Guerrero, *quelite cenizo* come up after the first rains, which occur in May, and with just a month or two of growth, the tender plants are ready to be eaten throughout the summer months of June-August.



FIGURE 23. *QUELITE CENIZO* (*CHENOPODIUM* spp.) FAMILY: CHENOPODIACEAE, COMMONLY REFERRED TO AS LAMBS-QUARTERS IN ENGLISH (PHOTO BY AUTHOR APRIL 2018)..



FIGURE 24. A LARGE *QUELITE CENIZO* STANDS PROMINENTLY IN THE FOREGROUND, WHILE A VARIETIES OF SPECIALTY SALAD GREENS FLOURISH IN THE BACKGROUND (PHOTO BY AUTHOR APRIL 2018).²¹

Several species within the *Chenopodium* genus are commonly referred to as *quelites cenizos* in

²¹ The photograph was taken during the “*Serie de comidas chefs semilla*” (chef’s meal series–seed) event with Chef Lucho Martínez on Saturday, April 7, 2018, hosted by Yolcán.

Mexico, a name derived from the grayish (*cenizo*) hue of their leaves (Laferrière 1994, 227). Among these, *Chenopodium berlandieri* is particularly valued in traditional Mexican cuisine because of its tender green flower clusters, which are harvested and prepared in a variety of regional dishes (Bye 1981, 43; Mapes and Basurto 2016, 111).

A closely related plant, the semi-domesticated *huauzontle* (which the leaves and stem of the plant includes the developed edible flower which containing protein-rich seeds), is usually prepared battered with frothed egg whites and fried and frequently eaten during the period of *Cuaresma* (Lent) when it is common for Catholics to abstain from eating meat.

The tender leaves and stems of *quelite cenizo* are used much like spinach or Swiss chard. Traditionally, they are boiled and then sautéed or added to soups, often flavored with onion or garlic. It can also be mixed with scrambled eggs or folded into omelets. Because raw *Chenopodium* leaves can be somewhat bitter or high in oxalates, they are usually preboiled before consumption, and *quelite cenizo* can be slightly stronger or earthier than *huauzontles*.

Huauzontle is prepared *capeado* (battered and fried, often with cheese). Another *Chenopodium*, the *quelite epazote* (*Chenopodium ambrosioides*), is used to treat parasites and stomach cramps.

Quelite cenizo is often one of the first weeds to sprout in a milpa after planting, and it can grow abundantly. Campesinos manage it by timing their weeding: they may allow a flush of *cenizo* seedlings to grow when the maize is young because those early greens can be thinned out and taken home to eat without significantly harming the still-small maize. Selective weeding is practiced ; a farmer might weed around each maize hill, pulling out most of the *quelite cenizo*, perhaps leaving

a few plants in between rows or on the fringes of the plot to continue growing. As the season progresses, they usually remove *cenizo* before it flowers (since it can drop many seeds) unless they plan to save seed for future use. Some campesinos point out that *quelite cenizo* is weeded out or harvested early in the growing season, so it does not compete with the maturing maize and beans, or other crops planted in the *milpa*. Late in the season, any remaining *cenizo* is typically considered just *maleza* and is cleared out to ease the harvesting of the main crops. However, during its young, tender stage, *quelite cenizos* are often tolerated and picked as needed.

VERDOLAGAS (PORTULACA OLERACEA)

Verdolaga (common purslane) is a prostrate succulent herb that often carpets the ground in *milpas*, vegetable gardens, and along pathways. It has smooth, fleshy oval leaves and small yellow flowers. Purslane is cosmopolitan (found worldwide) and has been present in the Americas since pre-Columbian times. In central Mexico, *verdolagas* emerge with summer rains, especially at low points with accumulated moisture. *Verdolaga* are one of the most beloved *quelites* in Mexican cuisine, appreciated for their crisp texture and tangy lemony taste. In places like Tlaxcala and Puebla, it grows naturally in milpas as a low understory, and campesinos gather basketfuls during the peak of the rainy season.

Verdolagas are extremely versatile as vegetables; they can be eaten raw, tossed in salads, or as crisp and crunchy fresh garnishes. More often, though, they are cooked. A popular recipe is *cerdo en salsa verde con verdolagas*, a stew of pork in a tomatillo green sauce with *verdolagas* added, imparting a tart flavor and thickening the sauce. Locally, people also simply sauté *verdolaga* with a bit of oil, onion, garlic, tomatoes, and chili, and serve it as a side dish or taco filling. Because

purslane releases a bit of mucilage when cooked, it can give a soup or stew a slight viscosity (similar to nopales or okra). The tender stem tips are the most valued part for eating; campesinos will often pinch off the top few inches of the plant, which encourages it to branch out and continue growing. *Verdolaga* is sold in markets by the bunch and is one of the more commonly commercialized *quelites* (it has even started to be formally cultivated in semi-urban areas, such as Xochimilco, due to high demand).

Verdolagas are also common and well-liked pig and chicken feeders, reflecting their versatility. *Verdolaga* is well known to be highly nutritious: it contains Omega-3 fatty acids, vitamins (like A and C), and antioxidants. These greens are sometimes used as a tonic or “cleanser” food; for example, some regional sayings claim that eating *verdolaga* can help “clean the blood.”

Campesinos generally welcome *verdolaga* as long as it does not threaten the main crop. They might call *verdolaga* a *maleza* if it becomes too abundant in the wrong place, but as long as the maize is not suffering, they are happy to let it spread.

NABO

The term *nabo* in this context refers to weedy mustards, often *Brassica rapa* (field mustard). Locally, it is sometimes distinguished as “*flor de nabo*” when discussing edible flowering shoots. This plant is not native; it was introduced from Europe and became naturalized as a roadside and field weed throughout Mexico. In the *milpa*, *nabo* typically appears at field edges or in fallow patches, particularly during the cooler season or early spring. It has serrated leaves and bright yellow, four-petaled flowers in clusters. Despite being an introduced *maleza*, campesinos have integrated *nabo* into their portfolios as a *quelite*.

Nabo greens have a pungent, peppery flavor when raw, but become mild and sweet after prolonged cooking. Campesinos usually harvest young flowering tops and tender leaves. One common preparation is to simmer them for a long time in soups or broths; for instance, a simple chicken soup with *flor de nabo*, carrots, and noodles is a rustic comfort food. The greens may also be sautéed with tomatoes and chili after parboiling or mixed with eggs. In some places, *nabo* is boiled and dressed with a little oil or cheese, similar to how one might eat broccoli rabe. It's worth noting “*nabo*” might also include related *Brassica* weeds (like *Brassica nigra* or *Sinapis* spp.), all of which are used similarly.

Wild mustard greens carry the general health benefits of cruciferous vegetables: they are high in vitamins (A, C, and K) and contain compounds believed to be anti-inflammatory. Traditionally, mustard poultices (*mostaza* plasters) are known to stimulate circulation; however, in the *quelite* context, the most cited “medicinal” aspect of *nabo* is simply its role in nutrition during food shortages (preventing starvation and providing vitamins to prevent scurvy).

Nabo can compete with crops, but it often grows in spots, such as in the edges and margins of the milpas or as understory. Campesinos generally weed out mustard sprouts if they are smack in the middle of a row of young maize, since they can overshadow seedlings. However, they frequently spare those that sprout into less troublesome spots. It is not uncommon to see mustard plants flowering along a milpa border that the farmer intentionally left standing so they can collect the blossoms later. *Brassica* weeds also tend to appear after the main weeding period or in cooler weather; thus, they may not interfere much with the primary crop cycle. In some cases, campesinos even save seeds from *nabo*; interestingly, *Brassica rapa* is cultivated in parts of central Mexico

mainly for its seed pods (*vainas*), which are gathered to feed chickens and other poultry. Allowing a few *nabo* plants to seed and then allowing them to fallow produces a handy fodder. Otherwise, campesinos will pull them up after harvesting the usable greens. They classify *nabo* as a useful *maleza*: if it is too prolific, it is weeded out, but a controlled presence is welcomed. As one might say, “*una planta es maleza o no según dónde esté*”, a plant is a weed or not depending on where it is.

These distinctions become clearer in the rain-fed milpas of Vicente Guerrero, where selective weeding reveals how farmers differentiate edible *quelites* from unwanted *malezas* through a multi-species ethic judgment rather than categorical purity.

TRANSFORMATION OF AMARANTH AND EPAZOTE CULTIVATION IN SAN MIGUEL DE MILAGRO

In September 2018, I traveled by bike from my apartment in Cholula, Puebla, to San Miguel de Milagro, Tlaxcala (about 30 km), to revisit the archaeological site of Cacaxtla. I also wanted to visit San Miguel de Milagro because, as an undergraduate, I interviewed a farmer in the community who became central to my thesis in agroecology at Prescott College. Before my trip, I reviewed my notes on the field site.

***QUINTONILES*, AMARANTH AND COLONIALISM**

Amaranth is native to Mesoamerica and has a long history of use in the region, commonly sprouting in disturbed areas such as *milpas* or other fields, along irrigation ditches, and in home gardens. The Amaranthaceae family represents a cosmopolitan assemblage of species characterized by extensive morphological variability and wide geographical distribution (Sauer 1967; Das 2016).

Within the Amaranthaceae family, some species, notably *Amaranthus hypochondriacus* and *Amaranthus cruentus*, are cultivated crops, grown deliberately for their seeds, which contain between 15 and 18 percent protein and are added to many commercial products in Mexico (Brenner et al. 2000; Castro-Lara et al. 2011). Mature amaranths, which have been selected for their seeds over many generations, provide the seeds used to make the popular snack bar known as *alegría* (a traditional sweet). A traditional preparation of the seeds is popped like popcorn and combined with honey, unrefined cane sugar (*piloncillo*), and occasionally dried fruits and nuts to produce flat bars known as *alegrías* (Espitia-Rangel 2016).



FIGURE 25. *AMARANTHUS* spp. GROWING IN VICENTE GUERRERO (PHOTO BY THE AUTHOR, AUGUST 2018).

Beyond amaranth's role as a grain crop, the young leaves of *Amaranthus* species are consumed as *quelites*, specifically as *quintoniles*. This wild and weedy tender leafy green appears as volunteer plants commonly found in *milpas*, which are gaining significance among foodies. Known as *Quintoniles* (also known as *bledo*) and regarded as a *quelite*, *Quintoniles* refer to several species of amaranth when collected and eaten as quelite, primarily tender leafy greens. *Campesinos* strongly associate *quintoniles* with their agricultural cycle and ability to thrive in disturbed soil, it is said that *quintonil* “*crece adonde trabaja el campesino*” (“grows wherever the campesino works”), reflecting how closely these plants follow humans as coconspirators of cultivated landscapes (Castro-Lara et al. 2011). *Campesinos* often tolerate *quintoniles* in at least some parts of their parcels, and sometimes intentionally scatter their seeds to attract *chapulines*, or simply to ensure a good supply of *quintoniles* that have become the quintessential *quelites* in Mexico City and its surrounding regions. Young leaves and stems are consumed much like spinach and other leafy greens. They have become especially popular and are increasingly sold in urban markets and restaurants (Castro-Lara et al. 2011).



FIGURE 26. *QUINTONIL* (*AMARANTHUS* spp.), FAMILY: AMARANTHACEAE. QUINTONILES REFER TO THE TENDER LEAVES AND STEMS OF WILD AND WEEDY SPECIES OF *AMARANTHUS*. BEFORE FLOWERING, YOUNG GREEN LEAVES ARE HARVESTED AND COOKED AS A VEGETABLE (PHOTO BY THE AUTHOR, MAY 2017).

Quintoniles are commonly added to quesadillas or onto other antojitos, contributing both flavor and essential vitamins and minerals (Mapes and Basurto, 2016). A typical preparation is to boil or sauté the greens with a bit of salt, then cook them with onion, tomato, garlic, and chilies as a side dish or as a filling for tacos and quesadillas. *Quintoniles* can also be added to soups and stews; for example, they can be steamed and topped with salsa or combined with other vegetables in broth. In some parts of Puebla, *quintoniles* are used as filling in tamales. The flavor is mild and vegetal when young (*quintoniles tiernos*), but older *quintoniles* can turn bitter; therefore, harvesting at a tender stage is preferred.

Quintoniles typically contain between 15 and 18 percent protein by dry weight and are particularly rich in iron, calcium, and vitamins A and C (Santiago-Saenz et al. 2019; Mapes Sánchez and Basurto-Peña 2016). Given these nutritional properties, *quintoniles* can supply essential nutrients to communities experiencing food insecurity or scarcity. Bye (1981) noted that the Rarámuri people of the Copper Canyon in northern Mexico rely on the volunteering weedy amaranths during the spring ‘hunger gap’²² providing proteins and key micronutrients, *quintoniles* help maintain health when other foods are not yet available.

Quintoniles thrive in and around *milpas* in Vicente Guerrero, and there are a variety of ways which I observed in which *quintoniles* are managed in the *milpas* surrounding Vicente Guerrero. Because these plants can grow tall (rivaling maize in height) and compete for light and nutrients, density control is important. Rather than eliminating all *quintoniles*, campesinos practice selective thinning; they weed heavy patches and remove *quintoniles* that emerge immediately next to a young maize stalk but leave many plants that are at a “tolerable” density. It is not unusual to see a cluster of *quintoniles* at the corner of a *milpa* or along a row that has been only partially weeded and saved for later harvest. In some cases, *campesinos* deliberately leave amaranth at the edges of fields as a secondary crop. This practice of tolerating *quintoniles* not only provides food but also serves other functions in multi-species *milpa* agroecosystems. Amaranth’s deep taproots help break up the soil and reduce erosion while scavenging nutrients from deeper layers. Its flowers produce pollen and nectar that support beneficial insects (including pollinators and pest predators). In

²² The term ‘hunger gap’ refers to the period, typically between harvests, when stored food from the previous season is depleted, and the current season’s crops have not yet matured, resulting in temporary food scarcity (Devereux, Vaitla, and Swan 2010).

essence, *quintonil* is managed as both a weed and a crop, controlled enough to protect maize yield, but present enough to contribute to the farm's productivity and biodiversity.

Amaranth serves as a compelling example of how colonial agricultural paradigms have been challenged and reshaped, particularly considering its historical significance and potential as a highly nutritious, resilient crop capable of thriving in diverse environments. A staple food for pre-Columbian Mesoamerican civilizations, amaranth was actively suppressed during the colonial period due to its association with Indigenous culture and religion. However, in the 1980s, it was rediscovered as a valuable food crop owing to its high-protein and nutrient content and its adaptability to varied growing conditions (Early 1977; Tucker 1986; Sobel 1993; Mapes Sánchez 2010). The renewed interest in amaranth stems from its nutritional value and its ability to withstand environmental stress. Furthermore, amaranth has been recognized as a crucial component of agroecological farming systems, particularly in small-scale and subsistence agricultural contexts. By integrating amaranth into farming systems, *campesinos* can diversify their crops while promoting food sovereignty and cultural heritage.

Amaranth species serve as important food sources throughout North and Central America as early as 4000 BCE (Sauer, 1967). The seeds of the wild form are typically black, whereas domesticated varieties produce white seeds. These seeds are traditionally ground into flour, popped like popcorn, cooked into porridge, or processed into confections, such as *alegrías* (Espitia-Rangel 2016). The leaves can be prepared similarly to spinach or sprouted for consumption as nutrient-rich greens. Although *Amaranthus cruentus* is no longer a staple in contemporary North and Central American diets, it continues to be cultivated and marketed as a health food owing to its nutritional value

(Espitia-Rangel 2016).

Prior to the Spanish conquest, amaranth (*huauhtli*) constituted a dietary staple for Mexico and other Mesoamerican peoples. Following colonization, however, Spanish authorities and the Catholic Church came to view amaranth as a symbol of Indigenous religious practices and sought to suppress its cultivation and consumption. The association of amaranth, particularly the tall, robust, and reddish varieties, with ritual practices, such as the crafting of sacred figurines from amaranth dough mixed with human blood or honey, led colonial authorities to prohibit its use (Tucker 1986; Early 1992; Mapes Sánchez 2010). The reddish hue of the flower, evocative of blood, further reinforced its symbolic link to the so-called “pagan” ceremonies. As a result, amaranth cultivation declined sharply during the colonial period and was replaced by European-introduced crops such as wheat and maize.

The resurgence of amaranth has been championed by *campesino* communities in the central highlands of Mexico, who seek to reclaim their local and traditional knowledge and practices while resisting the dominance of industrial agriculture. Many of these highland communities, where amaranth was abundant, never fully abandoned the crop entirely, but rather marginalized it to remote mountain communities and the liminal spaces of the *milpa* landscape. Wild and semi-wild relatives of amaranth, which are *quelites* collectively known as *quintoniles*, discussed in previous sections, continued to grow like weeds in disturbed areas. These wild relatives can be bred quickly by the sophisticated TEK that Mesoamerican Indigenous farmers and *campesinos* have become infamous for. By fostering agroecological approaches and cultivating crops such as amaranth, *campesinos*, and Indigenous farmers are reclaiming autonomy over food systems, acting as

guardians of their heirloom seeds, building resilience against climate change, and tactfully negotiating other significant environmental and economic challenges.

The cultivation of amaranth stands in direct contrast to the dominant industrial agricultural models that have contributed to environmental degradation and biodiversity loss. Its cultivation supports agroecological practices that prioritize biodiversity, soil health, and local knowledge, thus providing an alternative to monoculture and industrial agriculture.

Thus, the resurgence of amaranth and other traditional crops can be understood as part of a broader movement to decolonize agriculture and promote more equitable and sustainable food systems. Across rural and peri-urban communities, farmers, agronomists, and activists speak of amaranth's return not only in terms of its nutritional and ecological benefits but also as a form of resistance—a crop that survived colonial suppression and now serves as a symbol of resilience. Many describe its reintroduction as a process of “reclaiming our seed and our food,” emphasizing how local and TEK embedded in its cultivation connects past and present struggles for autonomy.

For *campesinos* and Indigenous farmers, the renewed cultivation of amaranth underscores their dynamism, as they continuously adapt agricultural strategies to foster ecological sustainability, enhance autonomy, and assert food sovereignty. Discussions around its resurgence often center on the capacity of traditional crops to endure, despite historical efforts to erase them, with farmers expressing pride in their role as stewards of agrobiodiversity. Some speak of their grandparents' quiet defiance—saving seeds and planting in hidden plots—while others highlight contemporary efforts to integrate amaranth into local economies, school meal programs, and agroecological projects.

By valuing and preserving local knowledge and practices and embracing the resilience of diverse agroecosystems, agricultural communities actively challenge the colonial gaze. Their narratives frame amaranth's resurgence as both a return and an act of future-making—one that not only restores lost agricultural traditions but also envisions a more just and sustainable food system rooted in autonomy, biodiversity, and deep historical memory.

TABLE 4. FIELD NOTES FROM AUGUST 2004

	Observation
Description:	<i>About a hundred meters down the road from the entrance to Cacaxtla, in the community of San Miguel de Milagro, Ramón grows maize intercropped with squash, beans, and tomatillo. In a neighboring field he cultivates amaranth. Amaranth is his most important cash crop followed by tomatillos, which provide secondary income if crop yield and prices are favorable. Maize, squash, and beans are primarily grown for subsistence.</i>
Traditional Sciences:	<i>Ramón practices intercropping of maize, squash, beans, and tomatillo within the milpa system. He saves heirloom seeds and opposes the use of hybrid varieties (semillas mejoradas) despite acknowledging their convenience. His fields are located on terraced hillsides that he says have existed since the time of his antepasados (ancestors). His amaranth is grown separately and serves as his principal cash crop. He takes great pride in being an amaranth farmer, emphasizing that, while amaranth was nearly abandoned in Mexico, San Miguel de Milagro is among the few communities that have never ceased its cultivation. Amaranth, known as huautli in Náhuatl, is one of the most important foods of the Mexicas along with maize, beans, and squash.²³ However, its cultivation significantly declined following the arrival of the Spanish and has only</i>

²³ The *Mexicas*, often referred to as the Aztecs, were a Mesoamerican people of Nahua descent who founded Mexico-Tenochtitlan. By the 15th century, during the Late Postclassic period, Mexico-Tenochtitlan had become the center of one of the largest states in Mesoamerica. It was settled on an islet to the west of the now-extinct group of lakes known as Lake Texcoco. These lakes extended across the central and southern margins of the basin, encompassing areas such as Huexotla, Coatlinchán, Culhuacán, Iztapalapa, Chalco, Xico, Xochimilco, Tacuba, Azcapotzalco, Tenayuca, and Xaltocan. This region corresponds to the present-day location of Mexico City.

	<i>recently reemerged as a popular health food.</i>
High or Low Input:	<i>Ramón's farming practices have increasingly incorporated high-input methods. He occasionally used a tractor for plowing, applied chemical fertilizers, and transported his harvest using a Ford pickup truck purchased with savings from working in the United States. He describes the pickup as essential for delivering his produce to local buyers.</i>
Resilience:	<i>Traditionally, long fallow periods were necessary to maintain soil fertility in these gently terraced fields. However, the introduction of synthetic nitrogen fertilizers has enabled campesinos in the area to cultivate the same plots year after year. This intensification has led to unintended consequences, such as increased pest prevalence and soil degradation. Based on my observations, improving the resilience of this farming system would require implementing crop rotations, extending fallow periods, and incorporating nitrogen-fixing crops to reduce dependence on chemical fertilizers. Additionally, many of the terraced walls (bordos) were crumbling, which is a common issue in the region. Planting agaves on these structures could help stabilize them and mitigate erosion.</i>

REVISITING THE SITE IN 2018

Upon returning to the site after visiting Cacaxtla, the hillside fields where I had met Ramón still appeared much as I remembered. However, despite my hopes of finding Ramón to update me on developments over the past fourteen years, he was nowhere to be seen. Fortunately, I had a vivid recollection of the site, thanks to a video-recorded interview in which he stood in his fields, explaining his crops, and recounting his experiences in the United States. Reflecting on my notes and video footage, I observed several changes in crop patterns. Most notably, amaranth was no longer present in these fields. However, based on subsequent visits and information provided by Nancy from the neighboring community of Nativitas, I learned that amaranth cultivation had likely expanded to include the broader region, which helps explain the presence of more maize-based *milpa* in my 2018 visit.

PHOTO ANALYSIS

Figures 23 to 26 illustrate amaranth fields in San Miguel de Milagro in 2004, demonstrating the resurgence of this traditional crop and its successful integration into the agroecological practices of *campesino milpa* growers. In contrast, the monocultural cultivation of *epazote* in San Miguel de Milagro underscores the shift toward commercial production of traditionally weedy species, reflecting evolving agricultural practices and economic strategies (see Figures 10-12). Figure 13 depicts the amaranth fields in San Miguel de Milagro in 2018, emphasizing their continued importance within the local agricultural landscape. The *Pirámide de las Flores* (Pyramid of the Flowers) at Xochitécatl underscores the historical and cultural significance of these agroecosystems.

The persistence of *milpa* cultivation, though this persistence appears to be driven, in part, by the broader acceptance of amaranth cultivation beyond a few communities, such as San Miguel de Milagro. Increasingly, I have encountered farmers growing amaranth, or at least experimenting with small-scale cultivation, at nearly all rural field sites included in this research.



FIGURE 27. AMARANTH INTERCROPPED WITH MAIZE IN A TRADITIONAL *MILPA* AGROECOSYSTEM AT SAN MIGUEL DE MILAGRO, TLAXCALA, HIGHLIGHTING THE ENDURING PRESENCE AND RESILIENCE OF AMARANTH-MAIZE AGROECOSYSTEMS AT THIS SITE (PHOTO BY AUTHOR, AUGUST 2004).



FIGURE 28. AMARANTH INTERCROPPED WITH MAIZE IN A TRADITIONAL MILPA SYSTEM AT SAN MIGUEL DE MILAGRO, TLAXCALA, HIGHLIGHTING THE ENDURING PRESENCE AND RESILIENCE OF AMARANTH-MAIZE AGROECOSYSTEMS AT THIS SITE (PHOTO BY AUTHOR, AUGUST 2004).



FIGURE 29. AMARANTH GROWING ALONGSIDE WEEDY FLOWERING PLANTS, ILLUSTRATING THE COEXISTENCE OF CULTIVATED AND WILD VEGETATION. IN THE BACKGROUND, THE *PIRÁMIDE DE LAS FLORES* AT XOCHITÉCATL RISES ABOVE THE LANDSCAPE (PHOTO BY AUTHOR, AUGUST 2004).



FIGURE 30. TAKEN IN JULY 2018 FROM NEARLY THE SAME LOCATION AS IN ABOVE (AUGUST 2004), THIS IMAGE SHOWS AMARANTH GROWING IN THE UPPER LEFT, ALONGSIDE *ACAHUALES* (FALLOWED FIELDS) IN THE LOWER RIGHT, ON THE TERRACED LANDSCAPE NEAR SAN MIGUEL DE MILAGRO (PHOTO BY AUTHOR, JULY 2018). THE PIRÁMIDE DE LAS FLORES AT XOCHITÉCATL STANDS AS A REFERENCE



FIGURE 31. TAKEN IN JULY 2018 FROM NEARLY THE SAME LOCATION AS IN ABOVE (AUGUST 2004), THIS IMAGE SHOWS A THRIVING *MILPA* WITH A STRONG MAIZE PRESENCE (PHOTO BY AUTHOR, JULY 2018).

In San Miguel de Milagro, Ramón's use of intercropping and heirloom seeds exemplifies the *milpa* system's resistance to industrial models of agricultural purity. His practices sustain biodiversity and maintain soil fertility, illustrating the ecological benefits of a weedy multi-species assemblage.

The cultivation of amaranth in San Miguel de Milagro represents a hybrid agricultural model that integrates traditional ecological ethics with other culturally appropriate, locally adapted, and resilient alternatives to export-oriented plantation-style agriculture. While the monocultural production of amaranth may seem to align with purity-driven models, the broader *milpa* system actively resists this paradigm by incorporating weedy species and maintaining a multi-species

assemblage that reflects Tsing's (2005) concept of relational ecology. Shotwell's (2016) critique of purity is particularly relevant here: *campesinos* and Indigenous farmers, while engaging with market forces, refuse to fully purify their fields, recognizing the value of plant diversity for both ecological and cultural resilience.

San Miguel de Milagro and Nativitas remain important centers of amaranth production in the region. Although amaranth continues to be cultivated, there has been a noticeable shift toward a more maize-centric milpa system, with a reduced emphasis on amaranth. Most producers now participate in cooperatives and position themselves as significant contributors to the regional amaranth economy. For example, Nancy's family cultivates organic amaranth and sells it as *alegrías* at the *Mercado Alternativo de Tlaxcala* (Tlaxcala Alternative Market). These diversified cropping systems illustrate the ongoing integration of traditional crops and farming practices into contemporary agricultural landscapes.

EPAZOTE: PURITY IN A WEEDY CASH CROP

Approximately 500 meters further down the road from San Miguel de Milagro, I encountered an unexpected sight: a vast, meticulously maintained crop growing in weed-free rows, tended by a young farmer. Intriguingly, I inquired about the plant, and he informed me that it was *an epazote*.

Epazote is an aromatic herb with a strong, pungent, and almost medicinal flavor that imparts a distinctive taste to many Mexican and Mesoamerican dishes. Beyond its culinary significance, epazote is widely known for its medicinal properties and is traditionally used to alleviate gastrointestinal issues, flatulence, and heartburn. Additionally, it is valued for its ability to repel certain insects and control soil nematodes.

As a staple of Mexican cuisine and traditional medicine, this aromatic herb thrives in disturbed soils and home gardens. Beyond its culinary role, epazote has been historically valued for its medicinal properties, demonstrating that many *quelites* can be many things at once: weeds, food, medicine, cover crops, and forage.

When I asked about the destination of the harvested epazote, the farmer explained that the entire yield was sent to the *Central de Abasto* (Supply Center or bulk goods market) in Mexico City. Probing further into the community's history of this crop, he revealed that while epazote had been cultivated for generations, it had not been traditionally grown for commercial purposes. However, in recent years, farmers have begun to recognize its market potential, transitioning it into cash crops. He emphasized that epazote had become one of the most financially rewarding crops.

This shift toward cultivating specialty 'weedy' crops aligned with my expectations. A plant once primarily grown in home gardens has now transitioned to large-scale commercial production. I found this particularly compelling because I was almost certain that, fourteen years earlier, this well-irrigated plain had been planted with *milpa* and amaranth. During my previous interviews with Ramón, he frequently lamented the financial difficulties of being a *campesino*, particularly the low prices intermediaries paid for their carefully cultivated crops. However, this *weedy* plant—now grown as a monoculture—has emerged as a viable income source for a new generation of farmers.

The monocultural cultivation of epazote raises interesting questions regarding the politics of agricultural purity. Farmers now cultivate a species historically considered a weed, while simultaneously striving to eliminate weeds from their fields. This paradox invites reflection on

whether the transition toward commercial monocultures ultimately reinforces purity-driven agricultural models. Does epazote cultivation as a cash crop necessitate the suppression of other weedy species? Or does its presence in large-scale agriculture challenge the conventional definitions of purity?



FIGURE 32. VIEW OF THE VALLEY BELOW, LOOKING NORTH FROM SAN MIGUEL DE MILAGRO (PHOTO BY THE AUTHOR, AUGUST 2004).

The landscape depicted in Figure 17 encompasses the same valley where *epazote* (*Dysphania ambrosioides*) was later observed growing, as shown in subsequent figures. Figures 18 and 19 illustrate the monocultural cultivation of *epazote* in 2018, highlighting a notable shift toward the commercial production of a species traditionally considered weedy within milpa agroecosystems.



FIGURE 33. WELL-IRRIGATED FIELDS OF EPAZOTE ON THE FLAT VALLEY FLOOR NEAR SAN MIGUEL DE MILAGRO (PHOTO BY AUTHOR, SEPTEMBER 2018).



FIGURE 34. WELL-IRRIGATED FIELDS OF EPAZOTE CULTIVATED FOR SALE AT THE CENTRAL DE ABASTO IN MEXICO CITY ILLUSTRATE THE TRANSITION OF THIS WEEDY SPECIES INTO COMMERCIAL PRODUCTION (PHOTO BY AUTHOR, SEPTEMBER 2018).

The case study of San Miguel de Milagro illustrates how the cultivation of amaranth as a cash crop

simultaneously preserves local and traditional knowledge and biodiversity, embodying Tsing's concept of a multi-species assemblage. Conversely, the monocultural production of epazote underscores the shift toward the commercialization of traditionally weedy species, reflecting evolving agricultural practices and economic strategies. The terraced fields of San Miguel de Milagro, with their diverse cropping systems, exemplify the integration of traditional and modern agricultural practices.

PURITY, AND POLLUTION—WEEDS AND AGRICULTURE

Mary Douglas (1966) explores the concepts of purity and pollution, associating purity with order and morality and pollution with disorder and immorality. She demonstrates that elements considered “dirt” or “weeds” are perceived as obstacles to order, leading to failed attempts to establish purely controlled environments. Douglas argues that purity is culturally embedded and continually redefined in response to social changes. In agriculture, purity has come to reflect values that view weeds as impurities that necessitate eradication.

Alexis Shotwell (2016) critiques the concept of purity, arguing that it reinforces oppression and control by creating rigid binaries of ‘pure’ and ‘impure,’ which often marginalize both certain human groups and non-human beings. For Shotwell, purity underpins broader forms of exclusion, reinforcing hierarchies that devalue non-human species and local knowledge. She advocates a holistic and inclusive approach, moving beyond purity to embrace ecological diversity. Recognizing the interdependence of living beings, she argues, is essential for addressing multiple forms of oppression. Embracing impurity and diversity can help us appreciate the significance of weediness in *milpa* agroecosystems.

Impurity and weeds thus illuminate the resilience and complexity of diverse *milpa* agroecosystems. Mexican *campesinos* can tolerate and even benefit from weedy plants by integrating them into their agricultural systems. The *campesinos* I observed actively resisted the exclusionary logic of industrial agriculture by embracing the diversity of weedy species such as *quelites*, demonstrating that impurity can be a source of ecological resilience and cultural survival.

The contributions of Douglas and Shotwell help us understand how Western cultural notions of purity and danger have influenced agriculture, promoted monocultures, and led to the elimination of undesirable weedy plants. The following case studies illustrate how weeds are embraced for their ecological roles, such as nutrient cycling and pest management, in *milpa* agroecosystems.

The notion of ideal purity in agriculture raises critical questions because it implies a singular standard for crops and farming methods. However, recognizing the diverse needs of different crops offers an opportunity to explore various perspectives on food production and sustainability. The multi-species *milpa* exemplifies an alternative agricultural approach that prioritizes ecological diversity and values certain weedy plants.

NOMENCLATURE AND POWER

The categories of “weed,” “pest,” and “disease” are not neutral descriptors but carry the weight of an epistemological system that privileges control, purity, and predictability. Within dominant agronomic discourse, these terms function as technocratic eliminations—they name that which should not be there. Yet in the *milpa*, such classifications often clash with campesino epistemologies, where the presence of plants, insects, and fungi is evaluated not according to universal criteria but through situated judgments shaped by taste, use, season, and affect.

Describing quelites as weeds, chapulines as pests, or cuitlacoche as a fungal disease imposes a colonial grammar of loss—one that renders culturally and ecologically meaningful species as undesirable or aberrant. This naming constitutes a form of epistemological violence (Smith 1999; de la Cadena 2015), where systems of knowledge are overwritten or marginalized by the logics of agronomic simplification. Such violence does not only occur in labs or policy documents, but in field interventions, school curricula, and pesticide marketing campaigns that redefine what belongs and what does not.

To counter this, I adopt the vernacular terms used by campesinos—buen monte, mala hierba, arvences, quelites—not as synonyms for scientific categories, but as expressions of a different worlding practice. These terms do not classify plants according to taxonomic hierarchies but according to relationships: with maize, with people, with soil, with rain. They reflect an ethics of cohabitation, where value emerges through ongoing negotiation rather than fixed categorization.

By foregrounding campesino terms and resisting the flattening logic of Western agronomy, I aim to honor the knowledge systems that continue to sustain multi-species life in the milpa.

In the context of industrial agriculture, the elimination of weeds has become central to the project of simplification: the transformation of heterogeneous agroecosystems into standardized, legible, and profitable monocultures. Following James C. Scott's (1998) work on state legibility, we can understand weed eradication as part of a broader effort to render complex ecologies controllable and calculable—often at the expense of resilience, cultural knowledge, and multi-species coexistence.

Agroecologists such as Miguel Altieri and Víctor M. Toledo have long warned that this simplification undermines the very systems it aims to optimize. By suppressing “unplanned” biodiversity—what agroecology often terms spontaneous vegetation—industrial farming severs the relationships that support pest control, soil health, and local diets. In contrast, traditional milpa systems have historically tolerated or even valued the presence of non-crop species, many of which are edible, medicinal, or ecologically beneficial.

In campesino milpa systems, the line between crop and weed is not drawn by botanical categories or yield optimization, but by contextual judgment rooted in daily practice. Plants commonly referred to as *quelites*—such as *cenizo*, *romerito*, *pápalo*, *verdolaga*, and *quintonil*—are not considered *mala hierba* (bad weeds) in any absolute sense. Instead, they are part of what many farmers call *el buen monte*: edible or useful plants that grow spontaneously and are integrated into the seasonal rhythm of the milpa.

Terms like *hierbas*, *arvences*, and *hierbas silvestres* are used variably across regions. While *arvences* is occasionally adopted in NGO or agroecological training sessions influenced by technical vocabulary, most farmers describe their classification system through more grounded terms—“*monte que sirve*” and “*monte que estorba*.” This system is experiential, adaptive, and oral, shaped by local histories, family traditions, and sensory knowledge.

For instance, *quelites* may be pulled in one milpa but allowed to grow in another, depending on density, stage of maize growth, and household need. A single species might be a food crop, a nuisance, or an indicator—sometimes all in the same season.

This chapter explores weediness not as a fixed botanical trait but as a relational status: a situated judgment made by farmers based on context, utility, season, and interspecies relations. I argue that examining how quelites and other plants are framed—as food, weed, medicine, or nuisance—offers insight into the moral ecologies of the milpa and the tensions between agronomic purity and campesino tolerance.

This chapter examines cultural perceptions of purity and weediness in agricultural practices through the theoretical lenses of Douglas's (1966) concepts of purity and pollution, Tsing's (2015) articulation of weediness, and Shotwell's (2016) critique of purity. Employing a multi-species ethnographic approach, it explores the ecological and cultural roles of weediness within *milpa* agroecosystems, contrasting them with the purity-driven imperatives of industrial agriculture. Ethnographic fieldwork conducted in Mexican farming communities revealed how traditional agricultural practices incorporate weedy species, challenging dominant agricultural paradigms that seek to eliminate them. By foregrounding the ecological and cultural benefits of weediness, these systems articulate a multi-species ethics integral to sustainable agroecological practices. This analysis contributes to ongoing debates in environmental anthropology and agroecology by highlighting the ecological and cultural resilience embedded in specific *milpa* assemblages.

This chapter argues that diversified *milpa* agroecosystems resist the eradicationist logic of industrial agriculture by embracing weediness as an ecological and cultural asset, thereby reinforcing a multi-species ethics in the making and maintenance of *milpa* landscapes. Industrial agricultural models have long sought to eliminate weeds, perceiving them as competitors that reduce productivity and disrupt the production of uniform commodity crops. However, as

demonstrated by *campesinos* and Indigenous farmers in the case studies that follow, the very notion of purity stands in direct opposition to the lived realities of agroecological practice (Toledo and Barrera-Bassols 2008). The *milpa* is not merely a cultivated space for maize production, but a dynamic multi-species assemblage where plants, animals, fungi, and humans co-create a resilient ecological landscape (Barrera-Bassols and Toledo 2005).

Weeds in *milpa* agroecosystems are not merely unwanted intruders; rather, they are integral to the ecological and cultural processes that sustain traditional agriculture (Cruz-García and Price, 2011). Scholars in agroecology and environmental anthropology increasingly recognize that the categorization of plants as “weeds” is embedded in Western agronomic frameworks that prioritize monoculture, control, and uniformity over ecological diversity. By contrast, *campesinos* and Indigenous farmers frequently cultivate, tolerate, or selectively manage weedy plants—especially *quelites*—for their nutritional, medicinal, and soil-enhancing properties (Caballero and Mapes 1985; Bye 1993). These plants, often dismissed as weeds in industrial agricultural paradigms, contribute to biodiversity, food security, and soil fertility within the *milpa* system (Moreno-Calles et al. 2013).

Within theoretical frameworks that delve into purity and pollution, the discussion centers around situated knowledges (as discussed by Haraway, 1988) in the context of rural Mexican landscapes. Drawing insights from environmental anthropology, agroecology, and science and technology studies, this chapter presents six ethnographic case studies from Mexican farming communities. Each case study illustrates the distinct yet interconnected strategies that farmers employ to navigate the complexities of weediness. These cases demonstrate how *campesinos* and Indigenous farmers

negotiate the pressures of industrial agricultural demands while preserving traditional ecological knowledge (TEK). They also underscore the significance of multi-species interactions in shaping agroecosystem dynamics (Kimmerer, 2013).

Extending the discourse on purity in agricultural contexts, this chapter critically examines the categorization of weediness and the role of weedy-*quelites* within *milpa* agroecosystems. This analysis challenges dominant Western industrial agricultural paradigms that equate purity with the control, homogeneity, and exclusion of non-crop species. Through a reassessment from the perspective of *campesino* and Indigenous farmers, the *milpa* emerges as part of a broader landscape engineering project involving both living and non-living elements, a system that has endured for centuries despite significant ecological and sociopolitical transformations. Theoretically, this chapter argues that *milpa* landscapes are best understood as fluid and dynamic multi-species systems in which weedy plants, insects, and microorganisms engage symbiotically with staple crops, such as maize, beans, and squash. These so-called weeds are not passive elements within the landscape; rather, they actively contribute to agroecological stability. For instance, *quelites* help mitigate soil erosion, enhance nutrient cycling, and provide sustenance to both humans and beneficial insects (Montes-Hernández et al. 2022). By reframing the *milpa* as a multi-species assemblage, this chapter underscores how interspecies entanglements enhance ecological resilience in the *milpa* landscapes examined in the case studies.

Despite the relative scarcity of scholarship addressing the spatial and cultural significance of *quelites*, this research advances a more nuanced understanding of these edible wild flora within the broader agricultural landscapes of the central Mexican highlands. Western industrial agriculture,

driven by monocultural production, intensive agrochemical inputs, and the replacement of heirloom seeds with genetically uniform varieties introduced during the Green Revolution, perpetuates an ethos of purity that is both ecologically unsustainable and culturally disruptive (Shiva 1993; Patel 2013). A growing body of research has documented the adverse consequences of this model, highlighting the importance of agroecological practices that embrace, rather than eliminate, weediness. By centering *on campesino* and Indigenous epistemologies, this chapter contributes to ongoing discussions in environmental anthropology and agroecology, advocating for an agricultural model that values diversity, resilience, and the interdependence of human and more-than-human actors.

WEEDY TEACHERS

Another key agroecological strategy in Tzeltal Maya milpas involves the selective retention of trees that either sprout spontaneously or remain standing after weeding. According to Guillen-Pasillas et al. (2024), this practice is central to a preventive approach for managing spontaneous vegetation and enhancing soil fertility. By allowing certain trees to persist, Tzeltal farmers minimize labor-intensive weeding while maintaining key ecological functions. The shade provided by these trees suppressed the growth of weedy species, thereby reducing the need for repeated manual clearing. Additionally, leaf litter and root exudates from these trees contribute organic matter and nutrients to the soil, improving its structure and fertility over time. Certain species also support beneficial insects or mycorrhizal fungi, further reinforcing the resilience of the *milpa* system.

Rather than seeking to eliminate spontaneous vegetation entirely, Tzeltal farmers integrate these trees as part of an agroecological strategy that balances labor efficiency with long-term soil

productivity. This practice exemplifies the deeper ecological ethic of working with, rather than against, multi-species interactions in agricultural landscapes (Guillen-Pasillas et al. 2024). It also highlights a broader *campesino* approach to managing weediness—not as a problem to be eradicated, but as an opportunity to sustain biodiversity, regulate microclimates, and enhance soil fertility.

The Lacandón Maya of Chiapas maintain a unique agroforestry system that integrates tree species into their *milpa* landscapes, demonstrating an intricate knowledge of ecological relationships that sustain soil fertility, nutrient cycling, and biodiversity (Diemont et al. 2005a, 2005b). Unlike industrial agriculture, which prioritizes monocultures and seeks to eliminate non-crop species, Lacandón *milperos* selectively manage spontaneous vegetation, particularly tree species, to enhance agroecosystem resilience and productivity.

Diemont and Martin (2005) emphasize the role of Indigenous agroforestry in sustaining trophic diversity, particularly through the maintenance of beneficial nematode communities that contribute to soil fertility. Their research on Lacandón *milpas* showed that tree species left standing in the fields foster complex belowground interactions that regulate soil microbiota, mitigate erosion, and replenish organic matter (Diemont and Martin 2005). Tree species serve as nutrient pumps, drawing up minerals from deep soil layers and depositing them on the surface through leaf litter decomposition (Diemont and Martin, 2005).

Additionally, Diemont et al. (2005b) highlighted the role of these trees in restoring soil fertility through natural nitrogen fixation and organic matter accumulation. By managing rather than removing trees from their *milpas*, Lacandón farmers sustain soil fertility without relying on

synthetic fertilizers (Diemont et al. 2005b). This practice contrasts sharply with industrial agriculture's reliance on external inputs, illustrating an alternative ecological ethics rooted in relational agroecology.

CONCLUSION

This chapter has provided insights into the complex interplay between cultural perceptions of purity, weediness, and diverse agricultural practices within *milpa* agroecosystems. The relationships between *quelites*, insects, and crops are not incidental; they are integral to *milpa* agroecosystems. Assemblage theory helps us understand how these relationships form a dynamic and interdependent network where each species, including humans, plays a role in sustaining not just the ecosystem but also cultural practices. The inclusion of *quelites* and the symbiotic relationships they foster with insects and crops reflect deep ecological wisdom that contrasts sharply with the monocultural logic of industrial agriculture.

Milpa agroecosystems, with their inherent weediness, are a sustainable counterpoint to purity-focused industrialized agriculture. These insights contribute to broader debates in environmental anthropology, emphasizing the ethical and ecological importance of maintaining multi-species relationships within agroecosystems. The multi-species assemblages observed in *milpa* agroecosystems provide an empirical challenge to industrial models of purity, revealing that attempts to simplify and control agricultural environments often lead to increased vulnerability rather than enhanced productivity.

Campesinos and Indigenous farmers in the central highlands of Mexico navigate complex negotiations between traditional ecological ethics and the pressures of industrial agriculture. Their

continued embracing of weediness and multi-species relationships within the *milpa* reflects a deep commitment to ecological diversity. However, this commitment is challenged by the politics of purity that underpin industrial agricultural models. This chapter has argued that the multi-species assemblages observed in *milpa* agroecosystems offer a powerful counterpoint to the unsustainable pursuit of purity in industrial agriculture, while also revealing the contradictions embedded in attempts to control and commercialize biodiversity. Ultimately, these practices challenge the dominant agricultural paradigms that prioritize monocultures and purity, demonstrating the ecological and ethical benefits of embracing diversity over exclusion.

CHAPTER FIVE: PATCHY LANDSCAPES

AGRICULTURAL SIMPLIFICATIONS AND THE FERAL PROLIFERATION OF *CHAPULINES*

Telling stories of landscape requires getting to know the inhabitants of the landscape, human and non-human

— Anna Tsing (2015b, 159)

Landscapes, as Anna Tsing (2015) describes, are not merely scenes to be observed from a distance, framed as static vistas in paintings. Instead, they are active, contested, and dynamic spaces—places where patchy assemblages of human and non-human actors come together. Drawing on Kenneth Olwig’s alternative genealogy of the term, Tsing (2015, 304) reframes landscapes as sites of interaction and negotiation. In these landscapes, patches form the fabric of life, reflecting precarity, disturbances, and the possibility of collaborative survival.

For foragers, patches are more than ecological fragments; they are sources of livelihood and meaning. In woodland patches where matsutake mushrooms grow, human practices such as coppicing, grazing, and controlled burning create conditions for unexpected bounty. Tsing (2015, p.286) described how foragers navigate these landscapes, choosing what to gather while maintaining the openness of the woodland for other species. This work does not impose control but rather sustains a shared architecture that allows humans and non-humans to inhabit the space together. Here, patches become sites of mutual care, where life flourishes through ongoing collaboration.

If we look at the interactions across many acts of ecosystems engineering, patterns emerge, organizing assemblages: unintentional design. This is the sum of the

biotic and abiotic ecosystems engineering—intended and unintended; beneficial, harmful, and of no account—within a patch

— Anna Tsing (2015b, 162)

The dynamics of patches extend beyond the physical to the evolutionary. Within fungal patches, for instance, matsutake mushrooms evolve by discarding less competitive genomes and incorporating others, generating diversity within the patch itself (2015, p. 238). This adaptability mirrors the ways in which patches are constantly in flux: spreading, merging, mutating, or disappearing altogether (2015, p. 227). These shifting landscapes reveal that precarity is not only a condition to be endured but also a source of creativity and renewal.

Patches are also spaces of knowledge production. Tsing argues that “landscapes and landscape knowledge develop in patches” (2015, p. 227), emphasizing the situated and contingent nature of understanding. In the context of matsutake research, scientists engage with the patch—its fungi, soils, and histories—while also connecting their work to broader questions regarding evolution and ecology. Tsing likens this process to spores: fragments of knowledge that drift beyond the immediate patch, carrying the potential to revitalize other fields (2015, p. 239). Just as fungal spores traverse distances to create new possibilities, ideas generated in one patch can take root elsewhere, thus creating new assemblages of thought.

For Tsing, Mathews, and Bubandt (2019), the Anthropocene’s patches emerge when one pays attention to landscape simplifications and the resulting feral proliferations. Our attention to this relationship can show us just how and why the Anthropocene’s landscapes are so proliferous and so treacherous at the same time.

In intellectual work, as in the woodland, the patch requires care and collaboration. Tsing suggests that the shared labor of scholars resembles the work of sustaining a forest patch. Just as a forager depends on the common efforts of many species to produce a nest of mushrooms, intellectual breakthroughs arise from the collective work of a scholarly community (2015, p. 286). The patch then becomes both a metaphor and a method for thinking about landscapes, livelihoods, and knowledge as relational and emergent.

Ultimately, patchy landscapes challenge us to move beyond linear or homogenizing frameworks. They ask us to see life as it is lived: fragmented, yet connected, precarious, yet full of possibility. Whether in the ecological assemblages of disturbed forests or the collaborative networks of intellectual inquiry, patches remind us that survival and creativity are intertwined. Through patches, Tsing offers a vision of landscapes as sites of negotiation and renewal—places where the work of making worlds happens, one encounter at a time.

The agricultural landscape of Mesoamerica is patchy, a multi-species assemblage that creates a complex matrix of small-scale farms, protected areas, communally managed forests, and landscapes for hunting and foraging. Since the Green Revolution in the mid-20th century, increasingly mechanized and chemical-dependent medium- and large-scale monocultures have become dominant in the landscape. Monocultures in agriculture are examples of landscape simplifications in which only one species is valued, and “everything else becomes weeds or waste” (Tsing 2015b, 6).

Over the past five centuries, Mexico’s agricultural landscape has undergone significant transformations due to colonization, latifundia, the Green Revolution, economic liberalization, and

climate change. These changes have led to fewer but larger land holdings, increased technological investments, and genetic erosion of local crop varieties. By examining these historical shifts, this research contextualizes current agricultural practices within a broader framework of social, economic, and environmental change.

Landscape heterogeneity is often defined spatially, where the landscape is divided compositionally according to the number and types of patches that constitute a landscape (Escobedo-Kenefic et al. 2020; Urrutia et al. 2019; Rime et al. 2020; Legarreta-Miranda et al. 2021; Tavares, Uzêda, and Pires 2019; Ramos et al. 2018; Andersson et al. 2013; Fahrig et al. 2011; Bridgewater 1988; Goigel Turner 1987; Knight 1987). The compositional components can then be studied on a larger scale to understand how the patches are arranged in the landscape, frequently discussing landscape fragmentations in regard to the connectivity and compositional density of its patches (Fahrig et al. 2011).

Industrial agricultural matrixes can lead to landscape homogenization, culminating in losses of biodiversity and ecosystem services (Tavares, Uzêda, and Pires 2019). Highly heterogeneous landscapes dominated by small-scale or peasant agriculture tend to integrate agricultural and conservation activities better than landscapes dominated by large-scale monocultures (Perfecto, Vandermeer, and Wright 2009; Fahrig et al. 2011; Kremen and Merenlender 2018).

Fieldwork in agroecological systems reveals that agroecological models, whether rooted in

traditional *campesino* and Indigenous practices or from contemporary agroecological models,²⁴ offer pathways to maintain biodiversity while supporting human livelihoods. The work of *campesinos* exemplifies this approach, as their diverse practices cultivate agroecological matrixes that sustain both ecological complexity and cultural identity. Drawing on the frameworks of Perfecto, Vandermeer, and Wright (2009) and Altieri (1990), these systems thrive on heterogeneity, fostering interactions between cultivated fields, fallow lands, and surrounding ecosystems. Wes Jackson's contemporary models echo these insights, emphasizing that small-scale, diversified farming practices can generate landscapes rich in biodiversity and ecosystem services (2002).

For example, the *milpa* system practiced in Mesoamerica provides a vivid illustration of how spatial organization and traditional agricultural techniques influence biodiversity. By intercropping maize, beans, squash, and other species, *campesinos* not only produce food but also maintain ecological functions, such as soil fertility, pest regulation, and habitat provision. These systems align with Altieri's (1990) assertion that diversity within agroecological matrixes depends on both agricultural practices and the spatial arrangement of land uses within the landscape.

Observations from such systems highlight the dynamic interplay between humans and the environment, in which small-scale producers act as stewards of biodiversity. The spatial and functional diversity in these systems contrasts sharply with industrial monocultures, illustrating how the intentional integration of agriculture with conservation can create resilient landscapes. In these contexts, the matrix becomes more than a backdrop for farming; it is a living, evolving

²⁴ Here I am thinking of examples such as Natural Systems Agriculture as proposed and developed by Wes Jackson (2002).

framework in which ecological and cultural diversity converge.

These insights call for a re-evaluation of how agricultural landscapes are designed and managed. By centering on practices that embrace heterogeneity and foster biodiversity, agroecological systems cultivated by *campesinos* challenge the industrial paradigm. They remind us that agriculture, at its best, is not only about production but also about cultivating relationships—between people, plants, animals, and the broader environment—that sustain life in its myriad forms.

AGRICULTURAL SIMPLIFICATIONS AND THE FERAL PROLIFERATION IN THE PUEBLA–TLAXCALA VALLEY

The Puebla–Tlaxcala Valley, characterized by its fertile terrain, has long been a hub of agricultural activity in central Mexico. Over the past several decades, the region has experienced significant shifts in agricultural practices, largely driven by the adoption of Green Revolution technologies and the move toward mechanized farming (Appendini and Liverman 1994). These changes have transformed the landscape from traditional, diverse *milpa* agroecosystems—where maize, beans, and squash were cultivated in polyculture—to simplified monocultural practices that prioritize high-yield cash crops, such as wheat, barley, and hybrid maize (Toledo and Barrera-Bassols 2009; González-Jácome 2018).

At the heart of this discussion is the concept of agricultural simplification, which involves reducing crop diversity and implementing uniform farming practices (Perfecto et al. 2009; Altieri and Nicholls, 2017). Although these methods have been promoted for their efficiency and productivity, they have also created unintended ecological consequences. One such consequence is the increased

prevalence of *chapulines*, which thrive in the simplified landscapes created by monocultures.

Agricultural simplification alters trophic interactions and reduces natural biodiversity, which once helped regulate insect populations (Matson et al. 1997). In traditional *milpa* systems, a diversity of plant species supports a complex web of natural predators, including birds, amphibians, and arthropods, that help keep *chapulín* populations in check (Altieri, 1999). However, monocultures disrupt these ecological networks by eliminating habitat heterogeneity, leading to a decrease in predator species and an increase in herbivorous insect pests (Tscharntke et al. 2005; Vandermeer et al. 2010).

The widespread use of synthetic fertilizers and pesticides has further exacerbated this problem. Although these inputs initially suppressed some pest populations, they have also led to the selection of pesticide-resistant *chapulines* and disrupted soil microbial communities that contribute to natural pest control (Geiger et al. 2010; Ríos et al. 2021). In some cases, pesticides have inadvertently reduced the populations of *chapulines*' natural enemies, allowing these insects to proliferate unchecked (Desneux et al. 2007).

Thus, the proliferation of *chapulines* in the Puebla–Tlaxcala Valley exemplifies a broader ecological pattern observed in industrialized agricultural landscapes: simplification creates conditions for certain species to thrive in feral abundance, often at the expense of ecosystem balance (Weis 2010). The loss of traditional agroecological knowledge and pest management strategies has further intensified the problem, as farmers have become reliant on chemical solutions rather than diversified cropping systems that naturally mitigate pest outbreaks (Altieri and Toledo 2011; Perfecto et al. 2009).

This chapter delves into the multifaceted dynamics of *chapulines*, a grasshopper that has proliferated as a pest in simplified agricultural systems and a culinary feature across many parts of Mexico. It highlights the adaptive strategies of local *campesinos* and *chapulineros* [*chapulín* collectors], who have turned this ecological challenge into an economic opportunity while simultaneously presenting and posing significant environmental and ethical challenges. By examining these communities' local knowledge and innovative practices, this chapter provides insights into how agricultural simplifications have reshaped both the environment and local livelihoods.

Through an ethnographic and ecological lens, this chapter examines the following interrelated questions:

1. Why have chapulines only recently reached outbreak proportions in the Puebla–Tlaxcala Valley?

Outbreaks of *chapulines* are not merely biological phenomena but are deeply entangled with shifts in agricultural practices and environmental transformations. In the Puebla–Tlaxcala Valley, the increasing prevalence of monocultural plantations has disrupted ecological balances, creating conditions favorable to the grasshopper's rapid population growth. Changes in the temporal rhythms of farming, reductions in biodiversity, and heavy reliance on chemical inputs have collectively fostered an environment in which outbreaks thrive.

2. What is the relationship between monocultural agricultural plantations and recent outbreaks?

Monocultural plantations, along with their simplified ecosystems, provide fertile grounds for pest outbreaks. The cultivation of high-protein crops, such as alfalfa, which is essential for industrial

meat and dairy production, has inadvertently offered an abundant and consistent food source for *chapulines*. Additionally, the overuse of pesticides has reduced predator populations, undermining natural pest control. These plantations are not just sites of production, but also landscapes of ecological imbalance, where the absence of diversity amplifies vulnerabilities to pests.

3. How have campesinos managed chapulines in traditional milpa agroecosystems?

In contrast to monocultural plantations, *campesinos* working within traditional *milpa* agroecosystems have long developed sustainable methods to manage *chapulines*. By maintaining biodiversity and intercropping maize, beans, and squash, *milpas* can create complex ecological systems that naturally regulate pest populations. *Campesinos* often rely on trap crops, such as *Lupinus spp. (frijolillo)* or *Brassica campestris (colza)*, to divert grasshoppers from primary crops. These practices, rooted in TEK, exemplify how diversified farming systems foster resilience to outbreaks.

4. How have chapulines become the most consumed insects in Mexico across social classes?

The story of *chapulines* is not only about ecological management but also about its cultural and economic transformation. Once primarily collected for subsistence in rural areas, *chapulines* have evolved into a prized delicacy, transcending social classes and appearing on the menus of high-end urban restaurants. Its popularity reflects shifting perceptions of insects as sustainable and nutritious food sources, as well as the adaptability of *campesinos*, who have turned outbreaks into opportunities. The commercialization of *chapulines*, rooted in traditional practices but expanded through market demand, underscores how ecological challenges can intersect with cultural

innovation and economic survival.

Through these questions, this chapter illuminates the interconnectedness of ecology, agriculture, and culture in the Puebla–Tlaxcala Valley. It explores how disruptions in industrial agriculture have set the stage for outbreaks, while traditional systems offer lessons in resilience and adaptability. At the same time, the widespread consumption of *chapulines* highlights the cultural dynamism of *campesino* practices, which transform ecological pressures into opportunities for sustenance and identity.





FIGURE 35 AND 36. *CHUAPULINES* ON SQUASH LEAVES IN LA NEVERÍA, SIERRA NORTE OF OAXACA. (PHOTOS BY THE AUTHOR, OCTOBER 2017).

The *chapulín* (*Sphenarium purpurascens*) occupies a paradoxical role in contemporary milpa landscapes. On the one hand, it is framed by agricultural authorities and state institutions as a devastating pest—a species to be controlled, suppressed, or eradicated through insecticides, coordinated spraying campaigns, or biological control programs. On the other hand, *chapulines* are increasingly celebrated as a culinary delicacy and sustainable protein source—featured on restaurant menus, promoted by alternative food networks, and sold in growing urban markets. This contradiction—between the *chapulín* as threat and *chapulín* as value—reveals the instability of species classification within overlapping regimes of agriculture, gastronomy, and rural

development.

State pest-control programs, rooted in agronomic logics of yield maximization and monocultural purity, treat *chapulines* as a biological enemy.²⁵ Yet campesinos often adopt a more ambivalent or opportunistic stance. While infestations are feared—especially when late-stage swarms damage young plants—moderate populations are tolerated, and even welcomed, as a seasonal food source. Some households actively coordinate harvests during moonlit nights, transforming perceived threats into nutritional and economic resources. In these moments, *chapulines* shift from pest to protein, from surplus to sustenance.

However, the rise of *chapulines* in gourmet markets and value-added processing introduces new tensions. When the same insect is commodified for urban consumers and targeted for eradication by local authorities, farmers are caught between conflicting incentives: protect the crop, harvest the bug; spray the field, or keep it edible. This ambivalence challenges the binaries that underlie pest management and food security policies and calls for a more relational and flexible understanding of multi-species coexistence in agroecosystems.

This chapter traces the entanglement of agricultural simplifications and *chapulín* (grasshopper) proliferation in the Puebla–Tlaxcala Valley of central Mexico. The remaking of landscapes through

²⁵ For example, Mexico's *Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria* (SENASICA) implements coordinated surveillance and chemical control programs targeting grasshopper outbreaks through its *Campaña Nacional Contra Langosta y Chapulín*, often in collaboration with CONAFOR and state-level agencies. These programs treat *chapulines* as phytosanitary threats to maize and bean production and promote insecticide application across affected regions.

Green Revolution technologies has collapsed the diverse polycultural ecologies of *milpa* agroecosystems, replacing them with monocultural fields that create conditions of hyperabundance for *chapulines*. These transformations have unsettled established agrarian relations, shifting the balance between human cultivators, non-human actors, and the agrarian infrastructure that mediates their interactions.

Attending to the friction between modernization projects and locally embedded practices, this chapter foregrounds the tensions that arise as *chapulín* collectors (*chapulineros*) navigate contested agrarian spaces. Landholders, drawn into the circuits of industrial agriculture, increasingly frame *chapulines* as pests requiring chemical management. In contrast, *chapulineros*, often working clandestinely, articulate the alternative economies that emerge through the collection and commercialization of these insects. In this sense, *chapulines*' ecology becomes both a site of conflict and a space of opportunity where competing claims to land, labor, and knowledge unfold.

Drawing on historical analysis, ethnographic fieldwork, and case studies, this chapter examines how *chapulín* collection operates as both an ecological process and a sociopolitical act. This practice offers a form of natural pest control that challenges dominant agricultural paradigms; however, its informality situates it in a precarious legal and ethical terrain. How do *chapulineros* articulate their work within shifting agricultural economies? How do landholders justify control measures that simultaneously disrupt local foodways and knowledge systems? These questions animate a broader inquiry into the contradictions of industrial agriculture and the uneven distribution of risks and benefits embedded within it.

Grounded in ethnographic fieldwork conducted from June to August 2017 and March 2018 to

August 2019, this chapter draws on participant observation and dialogues with chefs, scientists, *campesinos*, Indigenous farmers, *hacendado* farmers, *chapulín* collectors (*chapulineros*), and food activists across Mexico City, Oaxaca City, the Puebla–Tlaxcala Valley, the Central Valleys of Oaxaca, and the Sierra Norte of Oaxaca. These actors engage in diverse and evolving relationships with maize and *chapulines*, forging new alliances that challenge the dominant paradigms of food productionist agricultural regimes.

By engaging with the lived realities of *chapulineros* and landholders alike, this chapter rethinks sustainability beyond its technocratic formulations, positioning it as a dynamic and contested process. The ethical stakes of land use, pesticide application, and agroecological futures demand reconsideration of agricultural policies that prioritize extractive modes of production over ecological resilience and economic justice. Moving forward, this chapter calls for an integrative approach that values TEK, fosters collaboration between stakeholders, and envisions agrarian landscapes as more-than-human assemblages shaped by histories of resistance, adaptation, and survival. This chapter examines the intersection of agricultural practices and *chapulín* ecologies through historical analysis, field observations, and case studies. It considers how monocultural farming has shaped new economic opportunities while simultaneously generating ethical and sustainability challenges. This discussion foregrounds the urgent need for ecologically sound and socially just agricultural models in the Puebla–Tlaxcala Valley and Central Oaxaca.



FIGURE 37. *CHAPULINES* OF DIFFERENT COLORS AND SIZES –ALL *SPHENARIUM PURPURASCENS*– FEEDING ON SQUASH LEAVES IN LA NEVERÍA, SIERRA NORTE DE OAXACA. (PHOTO BY THE AUTHOR, OCTOBER 2017).



FIGURE 38. AUTHOR HOLDING A GREEN *CHAPULÍN* IN LA NEVERÍA, SIERRA NORTE OF OAXACA. (PHOTO BY THE AUTHOR, OCTOBER 2017).



FIGURE 39. AUTHOR HOLDING ANOTHER COLORFUL *CHAPULÍN* MOMENTS LATER IN LA NEVERÍA, SIERRA NORTE OF OAXACA (PHOTO BY THE AUTHOR, OCTOBER 2017).

Employing participant observation, semi-structured interviews, and experimental methods, I explored how chapulineros, entrepreneurs, and academics engage with the more-than-human world of *chapulines*. The intensified harvesting of *chapulines* for urban markets has emerged within the degraded landscapes of capital-intensive agriculture in the Puebla–Tlaxcala Valley. By tracing the movements, techniques, and practices of *chapulineros*, this research brings into focus how knowledge about these insects is co-produced through human-insect encounters. This perspective not only highlights the agency of *chapulines* but also reveals the broader political entanglements that shape these multi-species interactions.

The *chapulín* trade in the Puebla–Tlaxcala region represents a dynamic confluence of economic opportunity, ecological adaptation, and shifting land use strategies. While the commodification of *chapulines* offers potential pathways for sustainable pest control and rural livelihoods, it also raises critical ethical and environmental concerns, particularly regarding land tenure, pesticide application, and biodiversity conservation. For large landholdings of *hacendados* that rely on chemical pesticides, collecting *chapulines* can cut the costs of supplying and applying pesticides while simultaneously mitigating the environmental toll associated with pesticide use. For the *chapulineros*, that collect the insects, the activity represents something far more personal: an unregulated avenue for cash income that sustains their livelihoods. Addressing these tensions requires careful analysis to ensure the long-term viability of this practice and its implications for both human and more-than-human communities.

THE WORLD OF *CHAPULÍN* ENTERPRISES: MAIZE, HUMAN, AND INSECT ALLIANCES

The act of making things as a human transformation of nature, such making is not the equivalent but the very opposite of production, just as artisanship is the opposite of agriculture.

—Tim Ingold (2000, 80–81)

SANTA MARÍA ZACATEPEC, PUEBLA

For the past thirty years, residents of Santa María Zacatepec have been scouring the fields of Puebla–Tlaxcala Valley to collect *chapulines*. In the pre-dawn hours, *chapulineros* gather in pickup trucks armed with homemade nets and empty fertilizer bags and head to fields where they expect to find an abundance of *chapulines*. Completing the task before sunrise is crucial, as *chapulines* become agile once sunlight warms the plants, where they rest at night after feeding on tender crops,

and sunlight makes capturing the increasingly active *chapulines* considerably more difficult.

Over the last decades, the price of the insects increased to a premium. The *campesinos* from Zacatepec, Puebla, and the surrounding villages (where *chapulines* were emerging as one of the most significant pests) would begin to organize themselves into teams to systematically collect *chapulines* and then take them to Oaxaca to sell in the markets.

In the 1990s, a few local *campesinos* who had traveled to Oaxaca and developed a liking for the flavors of *chapulines* sold in the markets started to notice the insects in their fields back home in Puebla. At that point, a few community members began collecting *chapulines* from nearby fallowed fields in Zacatepec for their household consumption. With the presence of the insects continuing to proliferate, they soon began to take the surplus insects to the nearby city of Cholula, where they were popular with tourists visiting the *Gran Pirámide de Cholula*²⁶ Having found success in Cholula and the abundance of the insects continuing to proliferate throughout the valley, eight of the *campesinos* from Zacatepec decided to venture into a co-operative enterprise dedicated to collecting, processing, and marketing *chapulines*.

In the early 2000s, culinary tourism surged in Oaxaca, increasing the demand for *chapulines*, which local vendors struggled to meet. Concurrently, these insects became less prevalent in Oaxaca's Central Valleys of Oaxaca, where they have traditionally been collected. Seizing this opportunity, Beto, from Zacatepec, engaged his community in collecting *chapulines* that had become a pest in

²⁶ *Gran Pirámide de Cholula* (Great Pyramid of Cholula) or *Tlachihualtepetl* in Náhuatl, meaning “mountain made by hand,” is an archaeological site located in Cholula, Puebla, which holds the largest pyramid by volume known to exist in the world today.

their local fields. He even brought back spices and recipes from Oaxaca to promote *chapulines* as a culinary resource. This led to the establishment of a formal enterprise named *Chapultitlan*, offering a line of healthy snacks branded as *Ricochap* that complied with quality, sanitation, and labeling standards. They have various points of sale in the state of Puebla, such as the airport, regional and state fairs, and convenience stores. I suggest that exchanges with Oaxacan communities that include not only collection and farming practices but also work with traditional cooks would result in a productive exchange.

Beto shared with me that in Puebla, *chapulines* were not collected or consumed locally until about three decades ago. It was in the 1990s that he learned about *chapulines* on one of his trips selling products in the *Centro de Abastos* in Oaxaca. Beginning in the first decade of the twenty-first century, culinary tourism began to explode in Oaxaca. The vendors at the *Centro de Abastos* complained that they could not keep up with demand, and further complicating the situation, there were multiple years when *chapulines* became practically non-existent in the fields of the Central Valleys of Oaxaca, where the insects had been conventionally collected for the Oaxaca markets. Upon hearing this, Beto saw an opportunity as he had noticed that the insect had increasingly become a nuisance in the fields he cultivated in the Puebla–Tlaxcala Valley. Beto knew that he could turn the problem of the *chapulines* in the Puebla–Tlaxcala region into an opportunity for his community. Beto started enticing his neighbors and other community members to reconsider the pests that had recently appeared and suggested that they collect them and use them as food. He would even regularly return from Oaxaca with spices and recipes in order to replicate the same flavors and preparation techniques that he had learned in Oaxaca.

In the 2010s, *Ricochap*'s production volume reached 50,000 packs per year in three flavors (plain, roasted with chile, and garlic). The *chapulines* are also ground into a powder form as a nutritional supplement. Ricochap was later sold to entrepreneurs in Michoacán.

CARNIVET

Ivette is the owner of her family's *carnicería* [butcher shop], named *Carnivet*, located in Nativitas, Tlaxcala. The source of most of their meat (including *chapulines* and other rare and specialty meats) comes from their ranch in Españita, Tlaxcala. I find it important to revise Ivette's initiation into the *chapulín* business and understand the insights, experiences, and challenges she faced along the way. She is someone who has always done things a little bit differently from other ranchers; she equates this to staying open-minded and turning problems into challenges, as illustrated in this case, opportunity. The late 1990s marked the inception of her journey, one that began on her family ranch amid fields of amaranth and burgeoned into an enterprise known for its commitment to ecological and ethical practices.

Ivette capitalized on the *chapulín* infestation in the late 1990s on her family ranch as an opportunity rather than a crisis. Opposing the workers' inclination to apply pesticides, she advocated for the commercialization of *chapulines*, thereby aligning with sustainable ecological practices. Her ranch's distinct geographic conditions and climatic challenges—from erratic rains to early freezes—impose unique constraints on her business. These climatic variabilities, particularly the episodes in 2019 and 2021, led to fluctuations in *chapulín* populations, with a notably truncated collection season in 2021. Still, Ivette perseveres, operating within a market rife with challenges ranging from low prices to competition from unethical *chapulineros*.

During those first years of trying to collect and sell *chapulines*, she relates that they had no idea about the *chapulín* business. Below is part of her account of how they started in the *chapulín* business:

*When we saw the amaranth, we realized that there were already too many chapulines. They wanted to fumigate it, but I intervened; I said I did not believe it was the right thing to fumigate the chapulín all the time. I thought, why don't we try to capture them? That is when we started doing something we knew absolutely nothing about: catching chapulines, simply because we knew that fumigating it would be too much. They had already eaten most of the amaranth.*²⁷

— Ivette, Owner of Carnivet in Nativitas, Tlaxcala

Ivette's ranch is in a remote hilly part of Tlaxcala, and thus, the crops rely on the seasonal rains rather than irrigation as in the valley below. Therefore, to attract *chapulines*, she quickly learned to plant particular crops. With just the experience of that first year's infestation, she quickly learned *chapulines* feast on the young broad-leaf plants, like amaranth. She told me that, while *chapulines* are occasionally found in other parts of the ranch where they have maize, wheat, barley, and other crops, "they grow biggest and are in greatest quantity on the broad-leaf crops." She assures me *chapulines* reproduce "like crazy" and "grow extra fat" when planted with broad-leaf plants like amaranth or squash. In the year that they first planted amaranth on the ranch, they collected five tons of *chapulines*. Now, rather than planting amaranth for their respective products, Ivette and her family grow them primarily to attract and capture *chapulines*. For her, this assures a quality product

²⁷ Por cuestiones de trabajo no se pudo acostumbrar mejor dicho a fumigar el campo no pero por tiempos sucedió que no se pudo trabajar como se debía el amaranto, entonces cuando vimos que ya era tiempo de trabajarlo pues nos percatamos de que ya había demasiado chapulín, entonces se pensó en fumigarlo pero allí yo intervine, dije no yo creo que no es lo correcto de estar fumigando siempre el chapulín, que vamos a intentar capturarlos e iniciamos hacer algo no sabíamos absolutamente nada de chapulín, y simplemente pues dijimos bueno pues fumigarlo sería demasiado, y ya se habían comido muchísimo amaranto no.

that does not have pesticide residues and is collected without entering other farmers' lands, which she considers to be a practice of questionable ethics.

She explains that the years 2019 and 2021 were especially challenging due to the climatic variability. In 2019, there was little rain, and many crops had not fully matured in the rain-fed fields. Then, in 2021, the rainfall was erratic; they would start and then stop unpredictably, coming in heavy waves of rain and wind that could damage the crops, followed by dry spells in which the crops began to dry out, leaving the insects to find greener fields. In 2021, Ivette and her family experienced an unseasonal early freeze at their high-elevation ranch in Tlaxcala. The early freeze resulted in a shortened collection season, in which most of the *chapulines* she had encouraged in their fields never developed fully in size. According to Ivette, in the 2021 season, there were only 20% of the *chapulines* they had in previous years.

Ivette faces multiple challenges in the *chapulín* business, such as low prices, competing with chapulineros who collect on others' farmland without permission, risk of contaminated products, and no market of distinction for her "cleaner" and "fairer" products. Because of the low prices offered by intermediaries and because she considers her *chapulines* to be "cleaner" and "fairer" than that of other *chapulineros*, she also seeks out specialty markets, which are principally selling directly to restaurants in Mexico City and Tlaxcala. However, these markets are inconsistent and require significant time to establish relationships with restaurateurs. Still, the restaurateurs nor their clients have come to give added value to locally sourced "cleaner" *chapulines*. Therefore, she primarily sells from her butcher shop Carnivet. People come to buy the specialty meat products she is known for producing at the ranch, and then she can sell the *chapulines* in a little *botecito* [bucket]

of *chapulines*.

Ivette grapples with an array of market-related challenges, including low prices offered by intermediaries and the influx of *chapulineros* who engage in unauthorized collection on other farmlands. Despite these challenges, she focuses on ethical sourcing and a “cleaner” product, seeking to penetrate specialty markets like restaurants in Mexico City and Tlaxcala. Nevertheless, the premium that one would expect for a more ethically sourced product remains elusive, as neither restaurateurs nor their clientele seem willing to pay a premium for her “cleaner” and “fairer” *chapulines*. Ivette’s primary sales outlet remains *Carnivet* in Nativitas, Tlaxcala, where she leverages her reputation for specialty meat products to introduce customers to her *chapulines*.

Ivette's journey in the *chapulín* industry is emblematic of resilience, innovation, and an unwavering commitment to ecological and ethical principles. While challenges, from climatic variabilities to market intricacies, persist, her story underscores the significance of adaptability in agribusiness. With *Carnivet* in Nativitas, Tlaxcala, as her primary outlet, Ivette not only champions a niche in specialty meat products but also introduces many to the distinctive taste of *chapulines*.

DON JAIME AND DOÑA ADRIANA

In the small community of Álvaro Obregón, Tlaxcala, Don Jaime, and Doña Adriana embody a delicate interplay between tradition and innovation in their agricultural practices. As stewards of agrobiodiversity, they have cultivated a unique approach to sustainability and food sovereignty rooted in the principles of the *milpa*—a traditional Mesoamerican system of agriculture that emphasizes ecological balance, diversity, and coexistence.

Unlike many *chapulín* collectors who source from contaminated monocultures in the lower parts of the valley, Don Jaime carefully curates his *chapulín* harvests from his own fields—fields left to go fallow near his home. These fields, free from agrochemical inputs, form the foundation of his certified organic farm, a certification achieved through a participatory process that values collaboration and community trust over bureaucratic oversight.

I would accompany Don Jaime early mornings as he set out with a bicycle rim rigged with a nylon sack, his tool of choice for gathering *chapulines*. Don Jaime's approach is significantly different from the other chapulineros I had followed into the fields. He only collects for an hour or so in the morning, just enough to sell directly at the local alternative market. Don Jaime's collects *chapulines* late in the season when their cycles are optimal, ensuring a full growth cycle and providing dedicated organic *acahuales* (fallowed fields) on his ranch primarily of diverse varieties of agaves for *pulque* (see Figure 40). Doña Adriana bakes the *chapulines* rather than fried to create a healthier product a choice that speaks to a commitment to quality and health consciousness (see Figure 41). In the afternoons, I would work with Doña Adriana, who skillfully prepared and packaged the insects for sale at the *Mercado Alternativo de Tlaxcala* (Tlaxcala Alternative Market), a vibrant hub of sustainable agriculture and culinary innovation (see Figure 42).

Don Jaime's and Doña Adriana's creativity does not stop at *chapulines*. Together with Don Jaime, she has expanded their repertoire to include seasonal insects, wild fruits, and other hard-to-find products. Their offerings reflect a passion for wild foods, *magueyes*, and *pulque*—hallmarks of a cultural identity deeply intertwined with the land. At the market, they are not only vendors but also educators, sharing the stories behind their products and advocating for sustainable practices.

Their approach to agriculture is deeply aligned with the principles of the *milpa*. The diversity of insects, volunteer plants, and weeds in their fields creates a microcosm of ecological balance, where each element plays a role in the larger system. This contrasts sharply with the industrial monocultures dependent on pesticides, where biodiversity is seen as a hindrance rather than a strength. Their methods, rooted in local knowledge and enhanced by participatory organic certification, echo Ingold's insight that such practices are acts of making—an engagement with nature that transforms and sustains, rather than exploits.

By integrating ecological principles with cultural and economic resilience, Don Jaime and Doña Adriana challenge the industrialized food system's emphasis on uniformity and productivity. Their participation in the *Mercado Alternativo de Tlaxcala* (Tlaxcala Alternative Market) connects them to a broader network of farmers, artisans, and consumers committed to reshaping foodways through collaboration and innovation. As custodians of agrobiodiversity, they demonstrate that the *milpa* methodology is not merely an agricultural system but a way of living—one that honors tradition while adapting to contemporary challenges.

Through their work, Don Jaime and Doña Adriana illuminate the profound potential of the *milpa* as a framework for environmental stewardship, cultural resistance, and community resilience. Their story serves as both an inspiration and a call to reimagine agriculture as a relational act—one that nurtures not just the land, but the connections between people, plants, and insects in an ever-evolving web of life.

VICENTE GUERRERO, TLAXCALA

Despite extensive reliance on chemical pesticides and biological controls, *chapulines* continue to

proliferate as pests, demonstrating the limitations of these interventions. Rather than mitigating the problem, chemical and biological controls have, in some cases, exacerbated it, underscoring the need to take local knowledge and practices seriously. In this context, the experience of the Grupo Vicente Guerrero in Tlaxcala provides an example of how agroecological knowledge systems engage with ecological challenges, including pest management, while fostering biodiversity and food sovereignty.

The GVG was founded in the 1970s in the largely *ejidatario* (collectively held) landscape of Vicente Guerrero, where *campesinos* continue to cultivate rain-fed *milpas*. Alongside maize, they rotate a variety of crops, including fava beans, dry beans, squash, tomato, wheat, and barley, intercropping with agave *pulquero* and fruit trees such as pears, apples, peaches, plums, *chapulín*, *tejocote*, and walnuts.

TABLE 5. METHODS TO MANAGE *CHAPULINES* IN VICENTE GUERRERO

Method	Description
Tolerance and planting	Plant appetizing species on field edges to attract <i>chapulines</i> away from the main crop.
Avoid burning	Prevent burning on field edges to encourage broad-leaf weed growth, which provides food for <i>chapulines</i> .
Collection for human consumption	Harvest <i>chapulines</i> for human food.
Predator introduction	Place chickens and turkeys in areas with heavy infestations to prey on <i>chapulines</i> .
Early sowing	Sow crops early to establish sturdy plants before <i>chapulín</i> populations peak.

With the *Campesino-a-Campesino* (CaC) method, GVG farmers learned from their Oaxacan counterparts how to incorporate *chapulines* into their diet. What initially appeared as a sudden pest invasion gradually transformed into a valuable source of income and nutrition for the community. During *chapulín* outbreaks, many community members now collect and prepare them as snacks for

social gatherings, recontextualizing the insect as a food resource rather than solely a threat to crops.

In managing *chapulines* and other insects, farmers employ agroecological strategies that involve regulating the growth of weedy plants along field edges. *Chapulines* tend to remain in these peripheral areas where the vegetation is young and tender. At this stage, *campesinos* face two primary choices: collect the insects for sale and consumption or apply pesticides to the field edges, which eradicates most insect populations. Effective pest management thus requires careful timing—clearing the edges of the field while the *milpa* is still developing ensures that *chapulines* are drawn toward the younger crops. However, by the time the *milpa* reaches full maturity, with thick, viscous leaves, the *chapulines* no longer pose a significant threat to production.

Beyond pest control, such workshops would also provide opportunities for culinary exploration. By introducing participants to the distinct flavors of *chapulines* that thrive on various crops and at different developmental stages, these gatherings could help normalize their consumption. Expanding knowledge about *chapulín*-based dishes and preparation methods could further encourage their integration into local diets, reinforcing a model of agroecological resilience that values biodiversity as both an ecological and a nutritional asset.

FLORENCIO: MULTI-SPECIES LANDSCAPE AGROECOLOGISTS

Florencio, an organic heirloom maize farmer in Vicente Guerrero, Tlaxcala, posits that the contemporary problem of *chapulines* as agricultural pests emerged in the last thirty years due to ecological imbalances, particularly those exacerbated by agrochemical use and monocropping. Counter to conventional agricultural methods, Florencio embraces a complex polyculture system, planting maize, beans, fava beans, and squash concurrently. Through his observations since the

1990s, Florencio has adapted his farming practices to cohabit with *chapulines*, recognizing them not as pests but as an economic resource. He strategically plants maize, beans, fava beans, and squash to mature before the *chapulines* hatch. This timeline ensures that the maize leaves are too coarse for the newly hatched *chapulines* to feed on, while weeds in the *milpa* serve as a preferred alternative for the insects. He uses certain wild plants as trap crops to dissuade the insects from entering his crops. Florencio asserts that the application of insecticides is primarily necessitated by monoculture farming, which leaves *chapulines* with no alternative but to feed on cash crops. He argues that these insects have been forced to feed on crops because capital-intensive farms have eradicated their natural food sources. He believes that local and traditional knowledge, encapsulated in the term *cosmovision*, provides a blueprint for a multi-species coexistence, fostering a nuanced interaction between humans, plants, and insects.

The concept of edge effects, derived from ecological studies, is central to Florencio's agricultural practice. The edge effect explains changes in population structures that occur at habitat boundaries, allowing Florencio to maintain a biodiverse agricultural landscape. These boundaries, rich in a variety of plants, dissuade *chapulines* from attacking the main crops in the *milpa*. Agriculture-induced fragmentation accentuates these edge effects, benefiting generalist species like *chapulines* at the expense of specialist species (Porensky and Young, 2013).

This principle underscores the symbiotic relationship between generalist and specialist species within fragmented landscapes. Florencio utilizes this idea to create a nuanced interplay between *chapulines* and various crops, allowing for controlled insect populations that do not compromise his yields. In fact, he has begun to perceive *chapulines* not as pests but as an economic resource,

collectible and marketable, thereby creating an additional income stream. This symbiotic perspective challenges traditional monocultural approaches that rely on chemical pesticides and disrupt local ecosystems.



FIGURE 40. A HAND REACHES INTO A DENSE CLUSTER OF BEAN PLANTS (FRIJOL), SELECTIVELY HARVESTING MATURE PODS (PHOTO BY THE AUTHOR, JUNE 2018).

THE IMAGE REFLECTS THE EMBODIED, LOW-TECH KNOWLEDGE PRACTICES THAT STRUCTURE SEASONAL FORAGING AND HARVESTING ROUTINES IN MILPA SYSTEMS.

Florencio's methods have socioeconomic ramifications that extend beyond his fields. His practices have influenced others in his community, transitioning them from chemical reliance to an appreciation for the benefits of IPM and the economic utility of *chapulines*. He acknowledges that the economic returns from selling *chapulines* can sometimes outweigh the costs of chemical inputs.

This community shift echoes findings by Boris Uvarov, the Russian-British entomologist, who suggested that food scarcity drives grasshoppers into a harmful, gregarious phase, thereby implicating monocultures and chemical use as factors that can worsen the *chapulín* problem. In this manner, Florencio's agricultural practices not only represent a viable model of sustainable agriculture but also signify a wider transformation within the community toward ecological resilience and sustainable livelihoods.

Florencio's case illustrates the intricate balance between agricultural practice, ecological health, and socioeconomic outcomes. It underscores the need to appreciate local, empirically-derived knowledge in shaping sustainable agricultural practices, challenging dominant paradigms that often overlook the interconnectedness of the ecological and social elements in agricultural landscapes.

Florencio also employs manual methods to control *chapulines*. He collects them from the field edges early in the morning using nets, an activity appreciated by his community. When abundant, he sells them for 40 MXN per kilo, transforming them from pests into a valuable resource. The GVG extends this perspective of harmonious coexistence with *chapulines* by advocating for the reduced use of chemical pesticides, promoting awareness not only for human health but also for broader environmental well-being.

As we walked through his fields, Florencio explained that “*chapulines* have only been a problem for the last thirty years due to an imbalance.” He concludes these imbalances are related to the use of agrochemicals and the planting of monocultures, among other factors. Florencio contends that “*chapulines* are only pests because capital-intensive farms have left them with no food other than the crops to feed on.” He tells me that when *chapulines* first arrived in the 1990s, problems arose

because the *campesinos* were not used to managing this insect. Still, he observed the insect's habits over time once they began cohabitating. He has also started to recognize *chapulines* as an economic resource. Florencio plants maize, beans, fava beans, and squash together in the same field before the *chapulines* hatch to reduce outbreaks. At first rains, the *chapulines* hatch, and by this time, the maize has already grown strong enough that the recently hatched *chapulines* cannot chew on maize's coarse, thick leaves. He leaves the weedy plants in the *milpa*, which the *chapulines* prefer; they may cause minor damage to tender emerging beans and squash but usually not enough to cause significant losses. He has observed that the *chapulines* feed on *acahuales rosillas* (*Bidens* spp.), and *jarillas*, and as long as these plants are left to form volunteer borders between fields, *chapulines* will not attack the *milpa*.

Before we did things wrong, we would sow the maize after the beans and squash, right before the first rain. As the maize and chapulines began to grow at the same time, the maize was still fragile and tender enough that the chapulín would eat it. In those times, most campesinos abandoned companion planting because they listened to the seed companies and started to grow only hybrid maize, tomatoes, barley, or squash.

—Florencio in Vicente Guerrero, Tlaxcala

Florencio tells me the only people who need to apply insecticides and herbicides are those who plant hybrid maize or other crops in monocultures, and that is because it leaves nothing for the *chapulín* to eat. Therefore, it must attack the cash crop. In the GVG, they consider the cosmovision of the *campesino* as the key to living with the insects because *campesinos* know how to coexist with the wild plants, medicinal plants, and insects that are part of agriculture. Florencio explains the importance of the edge effect in his fields. Edge effects refer to the changes observed in population or community structures where habitats meet. The edge is the border or transition zone

at the intersection of two or more habitats and exhibits higher levels of biodiversity than heterogeneous landscapes. In fragmented patchy landscapes, edge effects become more pronounced, are especially noticeable, and can influence the entire region.

Agriculture continuously fragments landscapes and thus increases the edge effect. In edges, generalist species (especially invasive ones, like *chapulines*) benefit from the landscape change, while specialist species suffer. In a particularly fragmented and patchy landscape, edges can become so numerous that their effects pervade the entire landscape (Porensky and Young, 2013).

For Florencio, another way to control the *chapulines* is to collect them from the edges of his fields early in the morning. Florencio uses nets. Community members appreciate him collecting the insects since this reduces the problem of *chapulines* in the community. He usually prepares the *chapulines* toasted and seasoned at home or shares them with others in the community. Sometimes when there are many *chapulines*, he collects enough to sell. “You can get 40 MXN [2 €] per kilo, so if you put together twenty kilos, that’s 800 MXN [40 €].” At this point, the “*chapulines* are a resource, not a pest.” He knows that many farmers use insecticides; the GVG works with neighboring communities to raise awareness of the dangers of chemical pesticides, not only for human health but for the environment and *animalitos* [little animals] like *chapulines*.²⁸

Years ago, members of a neighboring community would regularly fumigate their fields. They really believed in it, and they thought those of us who didn’t use pesticides were old-fashioned... Once they saw that you could sell chapulines, they said that instead of spending 100 MXN [5 €] on an insecticide, it’s better to collect ten kilos of chapulines and make 400 MXN [20 €]. Little by little, people are

becoming aware that the “animalitos” exist and that they are insects that we can learn to live together with; instead of harming us, they can help us.

—*Florencio in Vicente Guerrero, Tlaxcala*

I accompanied Florencio to work in his fields on a cloudy August day (the rainy season in central Mexico). I wanted to see how *chapulines* relate to the *milpa* and how pesticide applications affect the collection of *chapulines*. However, in August, the *chapulines* were still small in this highland community, and Florencio told me it would still be another few weeks before we could collect them.

As mentioned earlier, the land in Vicente Guerrero is both privately held and ejidatario. One private ranch is working to reforest the land for water conservation. Others have sold or bought their ejido land, and others have gotten titles for their ejido land. The land in Vicente Guerrero is now largely individually owned, and as Florencio says, “*cada quien hace su propia cosa*” [everyone does their own thing].

On our walk through the fields, Florencio showed me the different varieties of *quelites*. On this late August day, we found next to the fields, *quintonil*, *malva*, *aramao*, *perilla*, *cenizo*, and *nabo* (this last one mostly for the birds), in *los acahuales* (or *las plantas que nacen de la parcela* [the plants that grow on the plot]). As well as intercropped fields of *girasol* [sunflowers] and *amaranto* [amaranth]. This was his first year experimenting with amaranth. He got the amaranth seeds from Linda (pseudonym) from Nativitas, Tlaxcala, at the *Mercado Alternativo de Tlaxcala* (Tlaxcala Alternative Market), which they mutually take part in.

Nativitas and the San Juan de Milagro region are recognized as one of the few regions that never

relinquished the tradition of planting amaranth, even as it fell out of favor after colonization (Early 1977).

As we walked through the field, Florencio found a freshly killed rabbit. He says it was attacked by an *onza*—which I believe is *Herpailurus yagouaroundi*. He picks it up, noticing it is fresh kill, and plans to take it home for lunch (see **Figure 41**).



FIGURE 41. FLORENCIO HOLDS A FRESHLY KILLED RABBIT FOUND NEAR HIS MILPA, WHICH IS COLLECTED FOR FOOD. (PHOTO BY THE AUTHOR, JUNE 2018)

He explains the *milpa* as a system in which you plant maize, *calabaza* [squash], and *frijol* [beans] together. However, the exact systems have different interpretations, and the distance they are

planted from one another varies. How closely they are associated varies regionally and on the individual farmer's decisions; while planting together has advantages of association, planting in separate rows has advantages in the ease of harvesting the crops.

Florencio explained another system that was more common in the last decades in the period of agricultural modernization, in which it was more common to use crop rotations. This system is where the same crops are planted in a monoculture, but the crop gets rotated with a nitrogen-fixing crop each year. He mentioned that the *milpa* is an integral part of subsistence in the community, but the cash crops are *tomate* [husk tomatoes] and squash.

Florencio continued, “Keeping a section of the fields in *acahuales* [fallowed fields] is important because it is where pollinators are, as well as many medicinal plants, edible *quelites*, and insects such as *chapulines*. In the *acahuales*, he explains, there was a time the *chapulín* was really a problem, and they ate a lot of the crops.”

Florencio is now considering *chapulines* as a product he can sell at the markets. At the same time, he admits it used to be something he would only occasionally collect and share/trade within the community. He discusses how he could increase the population of *chapulines* and have a new product to sell at the market. He tells me that if he plants certain crops, there will be more *chapulines*. For example, in squash fields, you can find many *chapulines*. He has also noticed that *chapulines* like to eat *quintoniles*, and he thinks it would be something interesting to experiment with. He ponders the possibility of planting a field of *quintoniles* (something he has never tried, he notes). Either way, there is a commercial market for both *quintoniles* and *chapulines*, so if it doesn't work, he can harvest and sell *quintoniles*.

A PARTIAL ENVIRONMENTAL HISTORY OF *CHAPULINES* AND *MILPA*

Incorporating environmental history into this research helps us understand the ecological, economic, and cultural histories of ‘pests’ and the dynamics of collecting *chapulines*. Environmental histories offer critical insights into how human and non-human actors have co-evolved, revealing the intricate interplay between ecological change, human interventions, and social practices. By analyzing these histories, we can better understand how specific landscapes, species, and agricultural practices have come to be valued, utilized, or marginalized.

Here, I focus on the often-overlooked legacies of colonialism, modernization, and agricultural intensification that continue to influence local ecosystems and social dynamics. This historical lens underscores the importance of viewing agroecological practices not as static or ‘traditional’ but as dynamic processes shaped by ongoing adaptations to shifting environmental and sociopolitical contexts. As Raffles (2005) suggests, acknowledging that multiple ‘natures’ are woven into our shared histories allows for a more equitable and nuanced understanding of how societies engage with their environments. This perspective challenges simplistic binaries of “natural” vs. “human” influences, instead situating contemporary practices within a continuum of historical interactions and transformations.

This section, therefore, contributes to a nuanced understanding of landscape histories and the socioeconomic implications of the proliferation of *chapulines*. By situating these insects over space and time, we can reveal the complex socio-environmental processes that shape the present, ultimately fostering a deeper and more holistic understanding of agroecologies.

Studying environmental histories in contemporary discourse within the environmental humanities

has shed light on the intricate relationships between the spatial and temporal aspects of various productive endeavors. A comprehensive approach to environmental history necessitates equitable attention to both “natural” phenomena and their “historical” contexts. Acknowledging that multiple natures are fundamentally integrated into our shared histories is crucial (Raffles 2005, 375).

Chapulines belong to the *class Insecta* and the order Orthoptera. In the Puebla–Tlaxcala Valley, the most common genera were *Sphenarium*, *Brachystola*, and *Melanoplus*. The genus *Sphenarium* is complex, and the taxonomic nomenclature of *S. purpurascens* is not universally agreed upon (Sanabria-Urbán and Cueva del Castillo 2020). Much of the literature on the *Sphenarium* genus discusses *Sphenarium purpurascens* as a common edible insect in Mexican gastronomy or a significant pest in agronomic literature. Still, many other species of grasshoppers are also considered *chapulines*. They are commonly collected and consumed in the rural communities where they are collected, and sometimes other species get mixed in with the catch, as all grasshoppers are edible. However, most are not found to be culturally acceptable. Regardless of their taxonomy, the *chapulines* my investigation focuses on are the common wingless grasshoppers that have inhabited parts of the Mesoamerican region throughout recorded history.



FIGURE 42. THE GENUS *SPHENARIUM* COMPRISES THE MOST DIVERSE GROUP OF THE NEW WORLD PYRGOMORPHIDAE. (SANABRIA-URBÁN ET AL. 2017)

Today, in Mexico, *Sphenarium purpurascens* are often called *chapulín de la milpa*, as they are commonly associated with the presence of small-scale maize, bean, and squash polycultural agroecosystems that originated in this region.²⁹ It is widely thought that since pre-Columbian times, agriculturalists have noted *the presence of chapulines* in their fields, using the species as food. Traditionally, *chapulines* were manually harvested from fields for food when they began to affect crops. Evidence suggests that they are safe and nutritious to eat when uncontaminated. Many find them to be a tasty supplement to maize and beans, staples of the Mesoamerican diet.

Chapulines can also cause significant damage to crops. These insects feed on a variety of crops, including immature maize sprouts, beans, alfalfa, and vegetables, and consume foliage, flowers,

²⁹ I use the term agroecosystem to emphasize the complexity of the interactions of the living and nonliving components that make up *milpa* agriculture both inside and beyond the cultivated fields (Loucks 1977).

and tender shoots. In the interplay between large-scale plantation agriculture and small-scale *chapulín* collection, a dynamic emerges that highlights contrasting economic strategies and ecological impacts. For *hacendados*, whose plantations dominate the landscape with monocultural crops, manual collection of *chapulines* offers a pragmatic solution.

The proliferation of *chapulines* within these plantation-style systems is not coincidental, but is tied to specific characteristics inherent to monocultural agriculture. The temporal rhythms of farming are altered by irrigation practices, creating conditions favorable to the pests' life cycle. Additionally, the widespread application of chemical pesticides, while intended to control pests, has inadvertently reduced overall insect diversity, disrupting ecological balances that might otherwise limit *chapulín* populations. The expansion of high-protein crops, such as alfalfa, cultivated to support industrial meat and dairy production, further amplifies this issue, as these crops provide ideal habitats and food sources for *chapulines*. Finally, the mechanization and simplification of farming systems have led to a reduction in biodiversity, stripping the landscape of the ecological complexity that naturally regulates pest populations.

Ethnographic encounters reveal how *chapulineros* navigate this ecological and economic terrain, transforming the unintended consequences of industrial farming into opportunities for subsistence and resilience. In fields where biodiversity has diminished, *chapulineros* step into the ecological void, becoming agents in a landscape where monocultures reign but other rhythms of life persist. This duality, where plantation agriculture inadvertently creates spaces for peasant ingenuity, illuminates the complexities of coexistence and adaptation in rural economies shaped by industrial imperatives.

They are also known as a nutritious and environmentally sustainable food source, particularly with regard to their protein content, which can be wild collected, circumventing the disadvantages associated with livestock farming. Adult *chapulines* contain approximately 48.9% protein and significant amounts of fat (13.1%) and chitin (15.6%) in adults (Marín-Morales et al., 2022). Beyond their macronutrient profile, *Chapulines* are a potential source of bioactive compounds, such as phenolic acids and flavonoids, which are known for their antioxidant properties (Marín-Morales et al., 2022).

The cycle of *chapulines* is coordinated with the new plant growth that coincides with the onset of seasonal rains. They complete one generation per year, which begins in June when eggs are laid during the rainy season (Castellanos-Vargas and Cano-Santana, 2009). They deposit their eggs in the soil, where they remain for approximately seventeen weeks (about four months) before hatching (Vázquez Mora and Ramos-Elorduy 2008).

Sphenarium purpurascens undergoes incomplete metamorphosis, progressing through three main stages: egg, nymph (six nymphal stages), and adult (Limón and Ramos-Elorduy 1989). Its life cycle averages 252 days (Limón and Ramos-Elorduy, 1989). The eggs, which are oval, remain in a hibernation state for approximately 166 days. Females deposit these eggs in the soil, forming protective structures called *oothecae*. Each ootheca, buried within the top eight centimeters of soil, contains between 20 and 60 eggs (Limón and Ramos-Elorduy 1989). Increased temperature and humidity, typically brought on by rainfall in June and July, trigger egg hatching. From August to December, nymphs and adults feed voraciously, with adults reproducing during this period (Limón and Ramos-Elorduy 1989).

Numerous records and evidence from Codices indicate frequent locust or grasshopper outbreaks throughout Mesoamerican history (Cuevas-Cardona 2018; Rovirosa 1912; Ávila Hernández et al. 1988; Cuevas-Cardona and Rodríguez-López 2015).

According to historian Martha Few, the term *chapulín* is derived from the Náhuatl *chapolin*, meaning literally “*destructor por la boca*” (destroyer by mouth) or “devourer” (Few 2013, 66). Similarly, the Náhuatl term *acachapoli* contains the root *poloa*, meaning “to destroy,” highlighting the destructive nature attributed to these insects (*Instituto Nacional Indigenista* [Mexico] 2022). Few’s research further explores the ecological and cultural repercussions of locust swarms in colonial Guatemala, emphasizing their influence on agricultural practices and societal reactions (Few 2013, 66).

In the 16th-century’s *Florentine Codex: Book 11 on Earthly Things*, Franciscan friar Bernardino de Sahagún (2009) developed a natural history of animals, birds, insects, fish, and trees in the Valley of Mexico with the help of his local interlocutors. In the twelfth paragraph, Chapter V of Book XI, Sahagún’s Indigenous collaborators recorded six distinct varieties of locusts: *acachapoli*, *yectli chapoli*, *xopanchapoli*, *tlalchapoli* (or *ixpopoyo-chapoli*), *zolacachapoli*, and *zacatecuilichtli*.

There are many locusts in this land. They are like those in Spain. Some of them are called acachapoli. These are huge. Say aca-chapoli, which means “locusts like arrows,” because they go strong and roar like an arrow when they fly. Let them

—Bernardino de Sahagún, ([1577] 2009, 304)



³⁰ Hay muchas maneras de langostas en esta tierra. Son como las de España. Unas de ellas se llaman acachapoli. Estas son grandecillas. Dicense aca-chapoli, que quiere decir "langostas como saeta", porque cuando vuelan van recias y rugen como una saeta. Suélenlas comer.

FIGURE 43. FLORENTINE CODEX ILLUSTRATION, BOOK 11, FOL. 101V–102V. (ANDERSON AND DIBBLE 1953–1982; GETTY RESEARCH INSTITUTE 2023)



FIGURE 44. ANOTHER ILLUSTRATION FROM THE FLORENTINE CODEX, COMPILED BY BERNARDINO DE SAHAGÚN

IN THE 16TH CENTURY.³¹

Through drawings they account for the different grasshoppers found in Sahagún's adopted home (2009, 304-305). They specify that the *yectli chapoli* which seems the most likely candidate for *Sphenarium purpurascens*. In the Codex, Sahagún translates the corresponding Náhuatl description of *yectli chapoli* as: "They are medium, and they are red. In the time of picking the cornstalks [August-September], they walk. They are to eat" (Sahagún [1577] 2009, 303). *Yectli*, in Náhuatl, means something good and pure; hence, *yectli chapoli* is "the good *chapulín*" (Wood 2000). This leads me to believe that de Sahagún was likely referring to *Sphenarium purpurascens* because of his allusion to their appealing taste, being a wingless species, and association with the maize harvest. It is worth noting that many *chapulín* varieties develop a reddish hue after being boiled for consumption, which may complicate identification based solely on coloration.

This description does not fit the species *Sphenarium purpurascens*, which is a flightless grasshopper. His etymological interpretation of the word (although frequently recycled) also contradicts that of contemporary Náhuatl scholars.

There are others called tlalchapoli or ixpopoyo-chapoli, which means 'blind locusts.' Of these, there are many, and they are small, and they walk the roads and do not move away, even if they step on them. They are to eat

³¹ Anderson, Arthur J. O., and Charles E. Dibble, trans. 1953–1982. Florentine Codex: General History of the Things of New Spain. Book 11: Earthly Things, fol. 101v, 102v. Santa Fe, NM: School of American Research and University of Utah. Available at Digital Florentine Codex/Códice Florentino Digital, edited by Kim N. Richter and Alicia Maria Houtrouw, Spanish transcription (López Austin & García Quintana 2000). Getty Research Institute, 2023. <https://florentinecodex.getty.edu/en/book/11/folio/ir>. Accessed May 5, 2025.

—Sahagún [1577] 2002, 48)³²

In recent decades, *chapulines* have experienced a resurgence in popularity due to several interconnected factors. The rise of the global food movement, which champions sustainable, traditional, and Indigenous foods, has sparked new interest in edible insects. Migration and the exchange of cultural practices within and beyond Mexico have further reintroduced *chapulines* to broader audiences, positioning them as both a traditional food and a novel culinary experience. In Mexico's major cities, *chapulines* are now embraced by restaurateurs, foodies, and tourists, with chefs incorporating them into innovative dishes that celebrate their cultural heritage while appealing to modern tastes. This shift has also been driven by health trends that highlight insects as a sustainable protein source, leading to *chapulines*' inclusion in haute cuisine and packaged goods marketed to both national and international audiences.

As a result, *chapulín* consumption has transformed from a localized subsistence practice into a market-driven activity, reshaping the social and economic landscape of their production. Rural farmers and Indigenous communities who traditionally gathered *chapulines* for local consumption now engage in systemized large-scale collection for urban markets and tourist venues. This shift has changed the nature of harvesting practices; rather than collecting from their own *milpas*, farmers increasingly seek *chapulines* in the monocultures of alfalfa, beans, and squash that dominate the fertile Puebla–Tlaxcala Valley. However, these monocultures often rely on chemical pesticides, raising concerns about pesticide residues in commercially harvested *chapulines* and

³²*Hay otras que se llaman yectli chapoli. Son medianas y son coloradas. En el tiempo de coger los maizales andan. Son de comer.*

prompting debates regarding their safety and sustainability as food sources. Thus, the renewed interest in *chapulines* highlights both opportunities for economic benefit and new environmental and health challenges for the communities involved in their collection.

Chapulines can be found sold by vendors in city parks and markets throughout central and southern Mexico. Increasingly, they can also be found integrated into haute cuisine by chefs in Mexico's major cities and even sold packaged online for both national and international markets. With a quick Internet search, you will quickly find a plentiful assortment of recipes and magazine articles promoting chefs' new culinary creations with *chapulines*.

As *chapulines* have gained significant status among urbanites, restaurateurs, tourists, and foodies,³³ many *campesinos* and Indigenous farmers have begun to dedicate more time to their wild collection for sale in urban markets and tourist sites. The newly marketable insect changed the nature of collecting *chapulines*. Rather than collecting *chapulines* from *campesinos* and Indigenous farmers' *milpas* as a local food source, many enterprising *campesinos* have expanded into new territories of collection where the insect proliferates.

In recent years, many large land-owning *hacendado* farms in this region have adopted seed and chemical packages from agrochemical companies, leading to marked simplification in terms of species diversity structure. Such practices contrast the *milpa* agroecosystems maintained by *campesinos* and Indigenous farmers, which support a rich multi-species assemblage. This chapter

³³ In their book *Foodies: Democracy and Distinction in the Gourmet Foodscape*, Johnston and Baumann (2015, 1) discuss foodies as part of the self-selecting lifestyle that defines modern consumer societies. They define a "foodie as somebody who thinks about food not just as biological sustenance but also as a key part of their identity and a kind of lifestyle."

argues that the increased presence of *chapulines* in the Puebla–Tlaxcala Valley directly correlates with agricultural simplifications aimed at industrialization and commodification.

The adoption of Green Revolution technologies has significantly impacted local and agroecological knowledge systems, often displacing traditional farming practices that emphasize biodiversity, crop rotation, and Integrated Pest Management (IPM). The push for standardized, high-input farming methods has led to the erosion of *campesino* agroecological knowledge, which has historically been rooted in place-based experimentation and intergenerational learning (Altieri and Toledo, 2011).

The Green Revolution promoted the widespread use of hybrid seeds, synthetic fertilizers, and chemical pesticides, fundamentally altering traditional farming landscapes and reducing the diversity of locally adapted crops (Shiva, 1991). This technological package prioritized monocultures over diversified cropping systems, undermining traditional ecological principles that *campesinos* have relied on for centuries to maintain soil fertility, manage pests, and adapt to climatic variability (Perfecto et al. 2009).

The shift toward high-input farming has contributed to a decline in traditional seed-saving practices, as commercial seed varieties often require proprietary inputs and discourage on-farm genetic selection (Coomes et al. 2015). As a result, the knowledge associated with landrace cultivation and agroecological management strategies has become increasingly marginalized (Zimmerer 2010).

In many regions, the imposition of Green Revolution technologies has also weakened communal

forms of agricultural labor and knowledge-sharing networks, replacing them with market-driven approaches that prioritize efficiency and yield maximization over resilience and sustainability (Edelman, 2005; González-Jácome, 2018). This process has contributed to the erosion of *campesino* autonomy as farmers become dependent on external inputs and lose control over their own production systems (Van der Ploeg, 2009).

The Green Revolution's emphasis on industrialized agricultural models has led to the displacement of locally adapted agroecological knowledge, with long-term consequences for food sovereignty, environmental sustainability, and cultural heritage (Toledo and Barrera-Bassols, 2009). However, recent agroecological movements and grassroots organizations have sought to recover and revitalize traditional farming practices, advocating for the revalorization of *campesino* knowledge as a key component of sustainable food systems (Altieri and Nicholls 2017).

Traditional *milpa* agroecosystems, which involve intercropping maize, beans, squash, and other plants, are structured to replicate complex ecosystems. These systems support diverse flora and fauna, enhance soil fertility, and provide a stable food supply. However, the push toward monocultures

FOLLOWING *CHAPULINES* AND *CHAPULINEROS*

This section of the research began in the city of Oaxaca de Juárez in the summer of 2017 when I visited Oaxaca's *Centro de Abastos* (Oaxaca's bulk goods market selling primarily to retailers) with one of the city's renowned chefs, Celia Florián. The *Centro de Abastos* is a dynamic marketplace, a key node in the flow of foodstuffs through southern Mexico, where vendors from diverse cultural regions converge to sell their goods. Among the market's patrons are some of

Oaxaca's most esteemed chefs, who carefully select produce for the city's burgeoning gastronomic industry. Here, amid the fragrant chaos of spices, herbs, and freshly harvested produce, I stopped to speak with a vendor of *chapulines* (see Figure 53). Curious about the source of his abundant stock, I asked where he procured such quantities of *chapulines*. His answer surprised me: he had traveled from the neighboring state of Puebla, from the town of Zacatepec, more than six hours away by bus. Sensing my interest, he suggested that if I truly wished to understand the intricacies of *chapulín* collection, I should accompany him back to Puebla and witness the harvest firsthand.

Later that week, I arrived in Puebla. Excited by the opportunity, I texted him, and he instructed me to meet him at 4:00 a.m. in front of the OXXO³⁴ on the side of the highway in Zacatepec. When I arrived, Juan and four other *chapulineros* had already gathered. We climbed into the back of an old farm pickup truck and drove toward nearby bean and alfalfa fields in the states of Puebla and Tlaxcala. Working under the cover of night to avoid detection by the *hacendados*, we carried flashlights and empty *costales* (repurposed fertilizer bags), their openings held wide by bent rebar fashioned into oval shapes to function as nets. Organized into teams, we combed the fields, moving methodically through the rows of crops and sweeping up the *chapulines* while they remained cold and sluggish. Within hours, we amassed several full *costales*. Eventually, our bounty outstripped the capacity of the pickup bed, forcing us to reckon with the logistics of transport.

³⁴ OXXO is a widespread chain of convenience store in Mexico.



FIGURE 45. A *CHAPULÍN*-COLLECTING NET CONSTRUCTED FROM REPURPOSED FERTILIZER BAGS, REINFORCED AND HELD OPEN BY REBAR BENT INTO AN OVAL SHAPE. (PHOTO BY AUTHOR, 2017)

Each harvester gathered at least one full *costal*, with weights ranging from 10 to 25 kg (22–55 lb.). One seasoned *chapulinero* explained, “You can collect multiple *costales* in just a few hours.” He added, “You can do this every day for four to five months” (August–December). For many *campesinos*, this seasonal activity represents a crucial source of income, particularly when they prepare and sell the *chapulines* themselves.

Of the *chapulines* gathered, only a fraction is suitable for sale. The collection process inevitably includes plant material and other insects, and from my observations, only approximately half the weight of a *costal* is the insect. Once harvested, the insects are typically fasted for a day to *botar*

(eliminate) the contents of their digestive tracts. Next, they are placed in large plastic bags, sealed to induce asphyxiation, then submerged in water and rinsed. This process facilitates the removal of plant debris and extraneous matter. After the initial cleaning, they are briefly boiled until they turn red, then spread out on large tables where workers meticulously separate *chapulines* from remaining *basuritas* (detritus)—fragments of plastic, plant material, and other insects. separated from plastic debris, plant matter, and other insects unintentionally gathered during collection. From there which they are again spread out on the table, sorted removing unwanted debris, and sorted by size and quality.



FIGURE 46. A POT FILLED WITH *CHAPULINES* AT JUAN AND FAMILIES HOUSE. AFTER THE INITIAL CLEANING, THE *CHAPULINES* ARE BRIEFLY BOILED UNTIL THEY TURN RED (PHOTO BY AUTHOR, JUNE 2017).



FIGURE 47. AFTER THE INITIAL BOILING AFTER BOILING, JUAN'S FAMILY SORTS *CHAPULINES* BY HAND (PHOTO BY THE AUTHOR, JUNE 2017).

Once drained, the *chapulines* are spread out on a large table, where they are manually sorted into piles based on quality and size. Occasionally, other grasshopper species, such as *los voladores* (the flyers), get mixed in with the *Sphenarium* species. When I asked about this, I was assured that all *chapulín* species are edible. While most consumers might not notice if a different species is present in their purchase, the *chapulineros* make every effort to remove any out-of-place species during the two rounds of cleaning and sorting.

Even after collection and processing, the labor of preparing and transporting *chapulines* remains.

Before they reach the market, they are typically dry-roasted or fried on a *comal*,³⁵ often seasoned with various combinations of chili, garlic, salt, and lime juice. The most common preparations include *al-ajo* (garlic, lime juice, and salt), *chile-ajo* (chile, garlic, lime juice, and salt), *al limón* (lime juice and salt), and unseasoned. Those with access to refrigeration preserve their *chapulines* by freezing them, whereas others rely on traditional drying methods.

Over the past decade, *chapulines* have gained popularity in other Mexican states and even in the United States, where they are often consumed as a novelty or as a taste of home for members of the Mexican diaspora. The Puebla–Tlaxcala Valley has emerged as a primary supplier, with bulk collections funneled to major distribution hubs, such as Mexico City and Oaxaca de Juárez. At Oaxaca’s *Centro de Abastos*, a small serving of prepared *chapulines*, typically measured in an empty sardine can, sells for 10–15 MXN (€0.50–0.75). Restaurateurs purchasing in bulk pay approximately 90–110 MXN (€4–5) per kg. In contrast, fresh or prepared *chapulines* in Mexico City markets fetch around 150 MXN (€7) per kg.

Economic fluctuations have forced some *chapulinero* families in the Puebla–Tlaxcala Valley to adjust their methods. Since 2014, the price of limes has soared due to the increasing control of the lime industry by criminal cartels (García-Ponce and Lajous 2014). To offset costs, some have substituted fresh lime juice with citric acid. This practice has likely become even more widespread since the first quarter of 2022, when lime prices hit a record high (Rojas et al. 2022).

³⁵ A *comal* is a smooth, flat griddle made of cast iron or clay, used to roast various foods over an open flame and to heat tortillas. It is an essential fixture in Mesoamerican kitchens



FIGURE 48. *CHAPULÍN* VENDOR AT THE *CENTRO DE ABASTO* IN OAXACA. (PHOTO BY THE AUTHOR, 2017).

Often, chefs like Celia go directly to these wholesalers to buy the product in bulk and before seasoning is added. The market serves as a key site of exchange where *chapulines*, sourced from rural harvesters, enter the urban food economy.



FIGURE 49. DOÑA CHENCHA'S *CHAPULINES* STAND AT THE *CENTRO DE ABASTO* IN *OAXACA*. (PHOTO BY THE AUTHOR, 2019).



FIGURE 50. PACKAGED CHAPULINES (“CHAPURRINES”) FOR SALE AT THE OAXACA AIRPORT. (PHOTO BY THE AUTHOR, MAY 2015)

The label highlights their natural ingredients and lack of preservatives, emphasizing their authenticity and cultural significance. Branding and packaging practices such as these demonstrate the commodification of chapulines within regional and national markets, where they are marketed both as a traditional snack and a culinary delicacy.

COLLECTING AND CONSUMING *CHAPULINES*

The Puebla–Tlaxcala Basin, a tectonic depression surrounded by mountains, exhibits a mosaic of microclimates and soils shaped by altitude, exposure, and historical land use (Pfeifer 1966; Aepli and Schönhals 1975). The flat valley floor is irrigated year-round through a canal system fed by Río Atoyac and Río Zahuapan (Pfeifer 1966, 87), enabling intensive agriculture at elevations between 2,100 and 2,300 m above sea level. These conditions favor monocultures of alfalfa, beans, and squash cultivated on larger properties adapted to mechanized production environments, which

also promotes the proliferation of *chapulines*. *Chapulineros* focus their harvesting efforts on these irrigated plots, exploiting the insects thermoregulated behavior by sweeping them from the foliage after sunset, when they are sluggish and easier to capture.

Rather than viewing *chapulines* as agricultural pests, collectors interpret their presence in these agroecosystems as a foraging opportunity rooted in the long-standing entomological practices associated with *milpa* agriculture (Vibrans 1998; Alvarado-Beltrán et al. 2019). *Chapulín* collecting reflects not only ecological adaptation but also a continuity of highland subsistence strategies, repurposed in response to the socio-environmental changes brought about by the Green Revolution (Ávila Castañeda 2019; Bustamante Lara et al. 2017). These practices illustrate the dynamic interplay between ecological conditions and cultural knowledge within the transformed rural landscapes of Central Mexico. Wild collecting is not exclusive to hunters and gatherers; rather, as James C. Scott (2017) argues, livelihood strategies often coexist and alternate between being more sedentary and more subject to agriculture.

Whereas some *campesinos* only collect and consume *chapulines* locally, the specialized *chapulineros* in the Puebla–Tlaxcala Valley have learned the logic and movements of *chapulines* in different ways than *campesinos* that collect and consume *chapulines* locally. They have learned the preferred food of the *chapulines*, their movements, and their cycles, as well as avoiding detection and operating under the radar of formal markets, allowing them to develop for their commercialization and broader distribution. Monocultures and pesticides produce *chapulines*, in contrast to the skills involved in managing the delicate balance of humans, plants, and insects in the *milpa*.

In more remote mountainous regions, particularly in the state of Oaxaca, the practice of collecting and consuming *chapulines* persisted where the colonizers had less cultural influence. In these regions, *chapulines* have been controlled by manual collected, thereby reducing their populations and damage to the *milpa*, with the added advantage that these *chapulines* can be consumed by humans. In Oaxaca, *chapulines* continue to be collected, consumed, and marketed with great demand potential, developed for bars and restaurants serving innovative or Indigenous-style cuisines in many of Mexico's largest cities and tourist destinations. However, in order to meet the great demand for these insects, the Oaxacan populations of *chapulines* are no longer sufficiently plentiful, requiring their importation from the neighboring states of Tlaxcala and Puebla. In some investigations, the conservation status of *chapulines* in Oaxaca has been questioned regarding their overexploitation and local survival (Ramos-Elorduy et al., 2006).

Gustavo Esteva was the deprofessionalized intellectual and founder of the Universidad de la Tierra in the city of Oaxaca. In his now famous keynote address to *the Agriculture, Food, and Human Values Society* (1994), he relates that on a visit to San Andrés Chicahuaxtla in the mountains of Oaxaca, people from the Trique nation experienced a terrible pest of enormous grasshoppers that devastated whole areas of Oaxaca until they came to San Andrés, where the Triqui community saw the arrival of the insect differently:

They eat grasshoppers in a thousand forms and are experts in capturing them. The kids, particularly, know how to skillfully play the hat in the grass to capture them. An expert will compliantly agree that grasshoppers are rich in protein, but anyway, they are very tasty. When the pest of grasshoppers came to San Andrés, the Triquas ate them all. They now have a prayer begging for the pest to come back...

How can I describe to you an experience about which you have not even a word to name it and perhaps no element in your daily living to relate to it? When I mentioned the tasty grasshoppers of San Andrés, I was not trying to compare them with an American steak, reducing them, like an expert, to the number of proteins they have, or suggesting to try them in an exotic delicatessen... To have grasshoppers in the Mexican restaurant of State College is like inviting a penguin to this room. It will be so rare, so out of context, that it will surely inspire curiosity, interest, even affection...

I can document that [comida], among many peasants, still refers to a very complex cultural relationship with the earth and with the milpa, which is not equivalent to the technical activity of producing maize, as the milpa is usually described

— Gustavo Esteva (1994, 4-6).

The situation is different in other regions of Mexico, where *chapulines* have become a serious problem for farmers, often decimating their crops. Hacendado farmers frequently attempt to control *chapulin* outbreaks with pesticides, of which increasingly large quantities of chemicals are applied in order to mitigate the damage caused. These products are often applied without following the suggested safety measures or considering recommended intervals. Still, even with the increased availability and diversity of pesticides on the market, *chapulines* continue to cause significant damage to farmers' crops. Farmers told me that their populations are growing every year. They are common in agricultural areas and are observed in peri-urban areas and parks and gardens of cities (Cerritos Flores 2011). I have been told that, increasingly, they have been found feeding on and damaging plants that they previously would not attack. These observations made me question what motivated the territorial expansion and feral proliferation of *chapulines*.

Many pests already attack crops, so farmers use a lot of chemicals to fight them,

*and they also kill grasshoppers.*³⁶

— Tino, Miahuatlán, Oaxaca

That year, *chapulines* were absent in the Central Valleys of Oaxaca, which Tino attributed to chemical pesticide use and drought.



FIGURE 51. MILPA IN MIAHUATLÁN, OAXACA, DURING AN UNSUCCESSFUL ATTEMPT WITH TINO TO COLLECT *CHAPULINES* (PHOTO BY THE AUTHOR, OCTOBER 2018).

Over the last three decades, an increasing number of *campesinos* have turned to foraging

³⁶ *Es que hay ya muchas plagas que atacan a los cultivos; por lo tanto, usan muchos químicos para batallar las plagas, y de paso se llevan los chapulines también.* — Tino Miahuatlán, Oaxaca

chapulines from agricultural fields for cash income. In the Puebla–Tlaxcala Valley, *campesinos* working as *chapulineros* clandestinely gathered live grasshoppers from the fields of *hacendado* landowners. *Chapulines* have emerged as a key cash crop for this group. The presence of *chapulines* and *chapulineros* elicits varying reactions from the *hacendados*. Many *hacendados* farmers attempt to deter *chapulineros*, arguing that their methods cause considerable damage to the crops through the use of nets that can harm the crops. While some *campesinos* have found the collection of *chapulines* to be a profitable cash crop that reduces the occurrence of the insect in landowners' fields, without pesticide application, state and local governments are encouraging *hacendado* landholding farmers to apply pesticides to crops to keep populations of *chapulines* under control.

The state's agricultural agencies and the National Secretary of Agriculture (SADER), previously known as SAGARPA, have not been more sympathetic. They have yet to officially recognize the activity of collecting grasshoppers nor the issues that have arisen. Instead, their activities often benefit *hacendado* farmers of medium- and large-scale estates by sponsoring the distribution of uniform seeds and chemical applications. This allows farmers to grow alfalfa and other crops for animal feed, supplying consumers with proteins from livestock (cattle, horses, sheep, and goats) introduced from Europe (Crosby 2003). In this way, *chapulineros* survive in liminal spaces without legal recognition or regulation.

Conflicts often arise between *chapulineros* and landholders due to the collectors' lack of formal permission to access the land. This lack of communication can lead to misunderstandings, particularly regarding the timing of pesticide applications. Collectors who enter fields without

coordinating with landholders may unknowingly risk exposure to harmful pesticides, potentially contaminating the *chapulines* they collect and jeopardizing their own health.

Hacendado farmers generally prefer pesticides as the primary means of pest control because this approach eliminates the need for *chapulineros* to enter their fields at night. Collecting *chapulines* typically involves *chapulineros* combing through fields in the early hours, which can result in soil compaction and crop damage, factors that concern many farmers. This divergence in approaches to pest management underscores differing relationships with the land, as farmers prioritize crop protection, while *chapulineros* see the fields as sources of economic opportunity.

Unfortunately, there is little communication between hacendado farmers and *chapulineros*, or any form of regulation on their collection or commercialization. This forces *chapulineros* to collect covertly without knowing if the hacendado farmers have applied pesticides (Ramos-Elorduy, Pino Moreno, and Conconi 2006). Their practices are often met by scrutiny from hacendado farmers, even if they are helping them remove the pesty species from their crops. In one instance, a farmer even referred to the *chapulineros* as *una plaga más* [one more pest]. While I do not sympathize with his dehumanizing remarks referring to his neighbors as pests, I understand that he does have legitimate concern regarding damage to his crops and compacted soils, even if he could experience some benefits from the free manual removal of the pesty insect.

These relationships frequently lead to tension and conflict. *Chapulineros* often work under the cover of darkness, yet if they are discovered, landholders sometimes demand “*una mordida*” (a “cut” or “bite” of profits) from the *chapulineros*’ earnings. According to several *chapulineros* I spoke with, disagreements over collecting *chapulines* on private land have escalated to threats,

including those involving weapons.

Given the history of land tenure in the region, surrendering a portion of their earnings to landholders feels especially insulting for *chapulineros*. During the colonial period, *campesinos* were often required to work on land owned by large landholders, to whom they were forced to surrender part of their harvest. This historical dynamic of exploitation resonates in contemporary tensions, as *chapulineros* are once again expected to relinquish a share of the value of their labor.

has marginalized these practices, leading to biodiversity loss and a decline in soil health.

CHAPULINES AND MILPA AGROECOSYSTEMS

To better understand *chapulines*, it is essential to examine their relationship with the *milpa* system. The term *chapulín de la milpa* underscores the deep association between these insects and *milpa* agriculture, suggesting that *chapulines* may have co-evolved within this traditional agroecosystem.

A closer look at the plants *chapulines* inhabit—whether in fallow fields, monocultures, or along field edges—reveals additional layers of complexity. It is likely that *chapulines* co-evolved with a variety of plants central to *milpa* agriculture, including beans, squash, sunflowers, amaranths, and various broad-leafed “weedy” plants such as *quelites*. These relationships highlight the long-standing role of insects within these diverse agricultural landscapes.

Chapulines share a historical connection with maize, which has co-evolved with humans to shape and adapt to the landscapes they inhabit. However, they are no longer the grasshoppers of the past. Like humans, they now exist within fragmented, industrialized agricultural landscapes that reflect the violence and simplification inherent in modern farming practices. This context underscores

how *chapulines*, once integral to the ecological balance of the *milpa*, now navigate altered environments shaped by industrial agricultural systems.

During fieldwork in *milpas temporales*,³⁷ or rain-fed *milpas* of my identified field sites, I frequently observed *chapulines* actively foraging on the softer, tender leaves of weedy plants in the edges of the cultivated fields and especially in fields transitioning from cultivation to fallow. These observations align with the insights shared by my local interlocutors, who remarked that *chapulines* rarely damage maize plants beyond the seedling stage. Instead, the insects clustered around areas of denser weed growth within and on the periphery of *milpas*. My local guides mentioned that *chapulines* show a preference for weedy plants, such as the semi-domesticated *quelite*, *quintoniles* (a relative of domesticated seed amaranths), and *acahualli* (weedy sunflowers) from fallow fields, which act as *trampas* (traps) for *chapulines*, drawing their attention away from crops. Some weeds also maintain a certain level of neutral insects that may serve as an alternative food for predators or parasites (Altieri, van Schoonhoven, and Doll 1977, 197).

Together with my *campesino* interlocutors, I speculated that *chapulines* proliferate on monocultures of tender, young, protein-rich greens, including amaranth, beans, sunflowers, alfalfa, and squash, which they find highly palatable.

They consistently pointed out the interaction between *chapulines* and maize plants, emphasizing that “*los chapulines no molestan al maíz grande*” [*chapulines* do not bother mature maize]. In

³⁷ A rainfed *milpa* or *milpa temporal* relies on rainfall for water rather than irrigation. In Spanish, “temporal” in agriculture refers to rainfed farming, as it relates to the temporality of the seasons.

milpas under rain-fed conditions, the sequential planting and harvesting of diverse crops create overlapping microhabitats that encourage *chapulines* to feed on non-crop plants. For example, in Vicente Guerrero, I noted *chapulines* congregating around young amaranth plants growing voluntarily along field margins. These weedy plants provide an easily accessible food source, in contrast to the more fibrous and mature maize stalks. This avoidance is due to the overlapping temporal lifecycles of maize and the insect.

MILPA AND MONOCULTURES

Monocultures are a type of degraded landscape characterized by ecosystem simplifications resulting in feral proliferations (Kirksey, Shapiro, and Brodine 2013; Tsing 2014). In a conclusion similar to that of Tsing (2015b), I show that these degraded landscapes have presented opportunities for (some) communities and organizations. Most of them have, to an extent, displaced *campesino* food from Oaxaca with *chapulines* that are often contaminated with pesticide residue and collected under sometimes questionable circumstances. As a result, the collection and sales of *chapulines* have become a novel approach to a diversified income for many *campesinos* facing hardships under neoliberal policies that favor capital-intensive agriculture.

The transformation toward monoculture—planting expansive land tracts with a single crop, such as beans or alfalfa—appears to encourage *chapulin* proliferation. These insects prefer tender broad-leaf crops, which are now more abundant due to the extensive application of simplified agricultural methods.

Alfalfa is a high-protein, nitrogen-fixing crop with tender leaves, primarily grown to feed livestock, such as cows. Since the introduction of alfalfa and other soft-leaved plants, *chapulines* have started

to favor large-scale alfalfa fields cultivated for animal feed in the colonial landscape. As a result, these fields have become plentiful and easily accessible food sources for *chapulines*.

Despite the prevalence of monocultures, traditional *milpa* agroecosystems continue to coexist in this region. *Milpa* supports rich biodiversity and sustains the livelihoods of many *campesinos*. The coexistence of these two agricultural systems presents a unique dynamic, where traditional practices offer resilience and ecological benefits, whereas monocultures often prioritize short-term economic gains.

The simplification of agriculture through monocultures has stripped away these benefits, leaving the soil less fertile and more susceptible to erosion. Moreover, reliance on chemical inputs has further degraded soil and water quality, making it harder for traditional *milpa* practices to survive and thrive.

There is considerable confusion regarding how *chapulines* have become the most prolific edible insects in modern Mexican cuisine. While it has deep-rooted culinary use in Indigenous communities throughout Mesoamerica, it was not until the insect started appearing as a significant pest in the alfalfa fields in the Puebla–Tlaxcala Valley that its large-scale commercialization became possible.

Commercial collecting is done primarily in commodity-oriented monocultures of alfalfa, beans, squash, and other crops found in the fertile basin of the Puebla–Tlaxcala Valley, where monocultures have come to dominate. *Chapulines* are found in greater numbers in these monocultures, where chemical pesticides are often applied, leading some consumers to be

concerned about the potential of pesticide residues, causing them to be questionable for human consumption.

These dynamic interpretations also challenge the use of the term monoculture, which pertains to any field with only one primary commercial crop. While the multi-crop interpretation from the *chapulineros* finds them experts in covert operations—including driving with their lights off, wearing dark clothing, and finishing the collection before sunrise—to collect the *chapulines*, the monoculture advocates, large landowners say they can always tell when the *chapulineros* have been in their fields. While *chapulineros* do their best not to damage the plants, the occasional footprint and folding of the crop due to moving the nets through the fields can be found with a scrupulous eye.

RURAL LIVELIHOODS, *CHAPULÍN* COLLECTING, AND *MILPA* IN THE PUEBLA–TLAXCALA VALLEY

Over the course of the 20th century, *campesinos* in the Puebla–Tlaxcala Valley increasingly engaged in wage labor across various sectors, reflecting broader economic shifts that influenced rural livelihoods. Despite these changes, many families continue to maintain subsistence-oriented polycultural *milpas*, balancing the demands of market-oriented work with traditional agricultural practices. Activities like collecting *chapulines* offer a valuable source of cash income that complements the labor and care required for *milpa* agroecosystems, articulating the dual role of *campesino* households as both subsistence producers and participants in the market economy.

Milpas, as shifting maize polycultures, remain a cornerstone of household agricultural strategies in the region. These systems are primarily cultivated for household consumption, providing essential

staples such as maize and beans that form the foundation of local diets. While the size and productivity of *milpas* vary, they are typically maintained for several years before being left to fallow, allowing for soil regeneration and the regeneration of feral multi-species assemblages.

This persistence of *milpa* agroecosystems aligns with similar findings in other traditional agricultural systems, such as the *chacras* of the Ecuadorian Amazon, as analyzed by Perreault (2005). In his study, Perreault highlights how *chacras*, like *milpas*, persist not only for their material contributions to food security but also due to their cultural significance. Both systems illustrate the ways in which agrobiodiversity underpins the resilience of local food systems and reinforces cultural identity. Just as *chacras* support Indigenous families' ability to navigate economic and ecological challenges, *milpas* play a comparable role for *campesino* households in the Puebla–Tlaxcala Valley.

Ecology helps us to better understand how pest populations proliferate in overly simplified agroecosystems that lack diversity. Ecology is the study of interactions between organisms, and through the study of these interactions, we can conclude that the coexistence with the biodiversity of the agroecosystem is, in most cases, preferable to an attempt to eradicate a pesty species. Land managers can facilitate natural pest control and reduce reliance on pesticides by increasing biodiversity and creating habitat for natural enemies. One of the features of IPM comes from one of the lessons that Morales and Perfecto (2000) learned with *campesinos* in Guatemala, which is that it approaches pest management as preventive rather than reactive.

A complex system consists of many interdependent components. While analyzing each component and its relationships can enhance our understanding, this approach does not necessarily provide a

complete understanding of the system as a whole (Vandermeer and Perfecto 2017, 4).

An agroecosystem is composed of both wild and domesticated biodiversity. *Milpa* is a disturbed landscape where plants, animals, fungi, insects, and bacteria form complex ecological relationships. The traditional *milpa* is rain-fed and includes domesticated, semi-domesticated, and tolerated plant species that combine maize with a large variety of other crops, trees, or shrub species. The traditional *milpa* is low-input and low-tillage yet highly productive, providing rural families with diverse foods, medicines, and fodder for rural livelihoods. The *milpa* has been maintained over millennia in Indigenous communities throughout the diverse geographies of Mesoamerica.

With the spread of the Green Revolution, scientists and the chemical companies that sponsored them brought to the region a new vision of agriculture that used uniform seeds and pesticides. In doing so, it converted the *chapulín* from a food to a pest. The practice of collecting grasshoppers and planting heirloom seeds was replaced by applying pesticides and planting hybrid seeds. This resulted in a reduction of the diversity of many maize's companions, including its locally adapted kin.

While some insects harm crops, others benefit the agroecosystem by preying on potentially harmful species, thereby regulating insect populations and supporting biodiversity. An insect species typically only becomes a “pest” when it proliferates unchecked, often due to reduced plant diversity—such as in monocultures—or through pesticide use. In simplified monocultural agroecosystems, insects are provided an abundance of food propagated by humans. Then under a pesticide regime, the pesty insect may develop pesticide resistance while at the same time

eliminating their natural predators, allowing the pesty insect to proliferate.

Morales and Perfecto (2000, 52) were surprised while doing IPM research in Patzún, Guatemala, when they were told by their *campesino* interlocutors that “*la milpa no tiene plagas*” [The *milpa* doesn’t have pests]. “They suspected the problem was with the word *plaga* [plague]... (Morales and Perfecto 2000, 52).” Later, they reformulated their question and asked, “What kind of insects do you have?” They received several answers, including all the main insect pests of maize and beans in the region. She then asked the *campesinos* why these insects were not a problem. Their answers pertained to how *campesinos* prepare the *milpa* with skills developed from close observations of the crops and other species’ interactions with the insects. The *campesinos* understand the *milpa* as an assembled whole or ecosystem they help manage. They incorporate and work with high levels of diversity that may include species that agronomists see as pests. While agronomy departments teach students to see separate species, some of which can be eliminated, *campesinos* constantly learn and experiment with diversity to integrate pesty and weedy species (Morales and Perfecto 2000). This highlights a fundamental difference in how agronomists and *campesinos* think about or perceive the *milpa* (Perfecto, Vandermeer, and Wright 2009, 7).

These contrasting perspectives help us understand one way in which small-scale, *campesino*, and Indigenous farmers—both who encourage greater degrees of biodiversity in their fields—perceive, experience, and approach pest management differently than industrial-production agriculture.

The case studies explored in this chapter highlight the dynamic intersections of traditional agricultural practices, ecological sustainability, and contemporary economic pressures, offering insights into the resilience and adaptability of agroecosystems.

Beyond the material contributions to food security and sovereignty, *milpa* agroecosystems hold deep cultural and symbolic significance for *campesino* families. The cultivation of maize, in particular, is not only a practical necessity but also a cultural imperative, intimately tied to *campesino* identity and the reproduction of traditions. *Milpa* farming represents more than an agricultural practice; it is a way of life that reflects the values, knowledge, and history of rural communities.

Subsistence-oriented *milpa* agroecosystems also buffer against environmental and economic variability through their inherent agrobiodiversity, which enhances resilience in the face of changing conditions. During times of economic hardship, *milpa*-based diets have been a crucial safety net, providing reliable and nutritious food when external resources are scarce. This underscores relevance of agrobiodiversity in fostering resilience and sustaining rural livelihoods in diverse contexts. Despite trends of crop abandonment and declining interest in *milpa* farming among younger generations, the symbolic importance of the *milpa* endures, reinforcing its role in cultural reproduction and identity formation. As in Perreault's study, where the symbolic and material dimensions of chacras mutually reinforce their persistence, the dual significance of *milpas* continues to anchor them in the agricultural practices of the Puebla–Tlaxcala Valley.

Milpa agroecosystems stand as a compelling model of ecological balance and biodiversity, sustained through traditional practices that contrast sharply with the monocultural approaches of industrial agriculture. These systems integrate diverse crops and agroecological principles, maintaining soil fertility, enhancing food security, and supporting cultural identity. Their adaptability to both environmental and economic changes underscore their continued relevance as

a sustainable agricultural model.

The *chapulín* enterprise raises several challenges and ethical considerations, including land use tensions, pesticide application, and other environmental concerns. One concerning practice observed is the application of pesticides, which can stunt the development of the insects and make them easier to trap. While *chapulineros* do not always admit to this practice, it is often unclear where and when pesticides have been applied due to the lack of communication between landholders and *chapulineros*. Their activities go unregistered by any state agency, and any *chapulín* caught in a net is mixed into the nightly catch and sold at the market.

The current practices of *chapulín* collection and monocultural farming present both opportunities and challenges for sustainability. *chapulín* collection provides a natural form of pest control and an economic opportunity for local communities. However, the clandestine nature of these activities and the lack of formal agreements with landholders create social tensions and potential risks.

Ivette's *chapulín* business adds another dimension to this discussion, illustrating the complex relationship between ecology, entrepreneurship, and ethics. Her efforts to commercialize *chapulines* reflect the challenges of linking local knowledges with market demands while maintaining ethical harvesting practices and ecological sensitivity. Her experience sheds light on the need to navigate market pressures without compromising the ecological and cultural integrity of traditional practices.

The practices of *chapulineros* in Tlaxcala demonstrate the resilience of local knowledge in adapting to changing environmental and economic conditions. By reimagining *chapulines* not as pests but

as resources, *chapulineros* combine ecological sustainability with economic opportunity. This reframing highlights the potential for traditional practices to inspire innovative solutions to modern challenges.

The work of the GVG exemplifies how traditional systems like the *milpa* can be enhanced through agroecological innovations. Their integration of practices such as green manures, community seed banks, and IPM strategies—including the promotion of *chapulín* consumption—demonstrates how eco-innovation can strengthen both ecological and economic resilience.

Tackling the problem of communication with farmers, local and state government agencies, and the use of pesticides in neighboring fields should be addressed in the fight against the introduction of Genetical Modified (GM) crops. Thus, I also believe that the GVG can play an important role in engaging communities and governments in dialogues regarding how manual collection can be mutually beneficial to both farmer and *chapulinero*, as well as finding ways in which both *chapulineros* and consumers can be protected from pesticide residues.

These cases collectively underscore the synergies between biodiversity, cultural preservation, and economic adaptation. *Milpa* agroecosystems and their associated practices reveal the possibilities for integrating TEK into sustainable agricultural systems while responding to modern challenges. Whether through maintaining agrobiodiversity in *milpas*, reframing pests as resources, or connecting traditional practices to market economies, these examples illuminate the paths toward a resilient agricultural future. They emphasize the importance of preserving cultural and ecological heritage while fostering adaptive strategies that balance tradition and innovation, ecology and economy.

CHAPTER SIX: BECOMING FUNGI

EXPANDING THE RHIZOME

The lifeworld's of fungi remain understudied and have only recently gained attention from anthropologists. Michael J. Hathaway's ethnographic work on the agency of mushrooms in China demonstrates how fungi can drive economic and ecological transformations, suggesting similar potentials for *cuitlacoche* in Mesoamerican *milpas* (Hathaway 2022). Hathaway notes that European scientists have historically viewed fungi in a negative light, treating them as passive elements in agricultural systems rather than as active participants in worldmaking.

Social scientists today are faced with a fundamental dilemma of whether to conceive of the social world as consisting primarily of substances or processes, in static 'things,' or in dynamic, unfolding relations.

—Emirbayer (1997, 281)

Things and materials are not inert and passive; they are dynamic and may have active and productive agentic effects (Pyyhtinen 2016, 65). Bruno Latour's (2005) concept of the 'actant' helps us recognize that both human and non-human things exert agentic force. This is part of Latour's broader attempt to push social theory beyond human exceptionalism, acknowledging that things produce effects and alter the course of events (Bennett 2010).

Deleuze and Bennett explore the propensity for continuous variation in matter through the idea of 'vagabond' matter (Deleuze 1979; Bennett 2010, 50). In *Vagabond: The Trans-Species Ecologies of Plant/Human Encounters*, Hubert Alain (2017) examines how humans and maize form a reciprocal being that transgresses physiological boundaries.

What we eat, for instance, is a temporary congealment of different materials extracted from plants and animals that have traveled through food industries and supermarkets and via our refrigerator, stove, and plate to disintegrate again in our body; they get into our blood circulation, erode in our belly, mutate into flesh, make their journeys through the intestines, transform into energy and movement; and, finally, they come out as excrement usually to be flushed down the drain and processed at a water treatment plant.

—Pyyhtinen (2016, 66-67)

FUNGAL AGENCIES

A recent trend in studying fungal agencies helps us reconsider *cuitlacoche* and other mushrooms as more-than-human components of *milpa*-making. Anthropologist Anna Tsing's work on matsutake mushrooms illustrates how fungal agencies can reshape ecological and economic landscapes (Tsing 2015). As Tsing shows, fungi are not merely objects of human consumption or destruction but co-creators of worlds, shaping human and non-human lifeways through entanglements of labor, trade, and ecological adaptation. In a similar vein, we can use Tsing's example to reconsider *cuitlacoche* as a catalyst—or actant—in the renewed interest in *milpa* agroecosystems. Furthermore, the cosmopolitical approach considers how these intra-actions shape caring for and making *milpa* agroecosystems and cosmopolitical movements toward the promotion of *milpa*-based diets.



FIGURE 52. BOTANICAL ILLUSTRATION OF *CHARBON DU MAÏS* (FRENCH) OR CORN SMUT FROM BONAFOUS, MATTHIEU (1836), *HISTOIRE NATURELLE, AGRICOLE ET ÉCONOMIQUE DU MAÏS*.

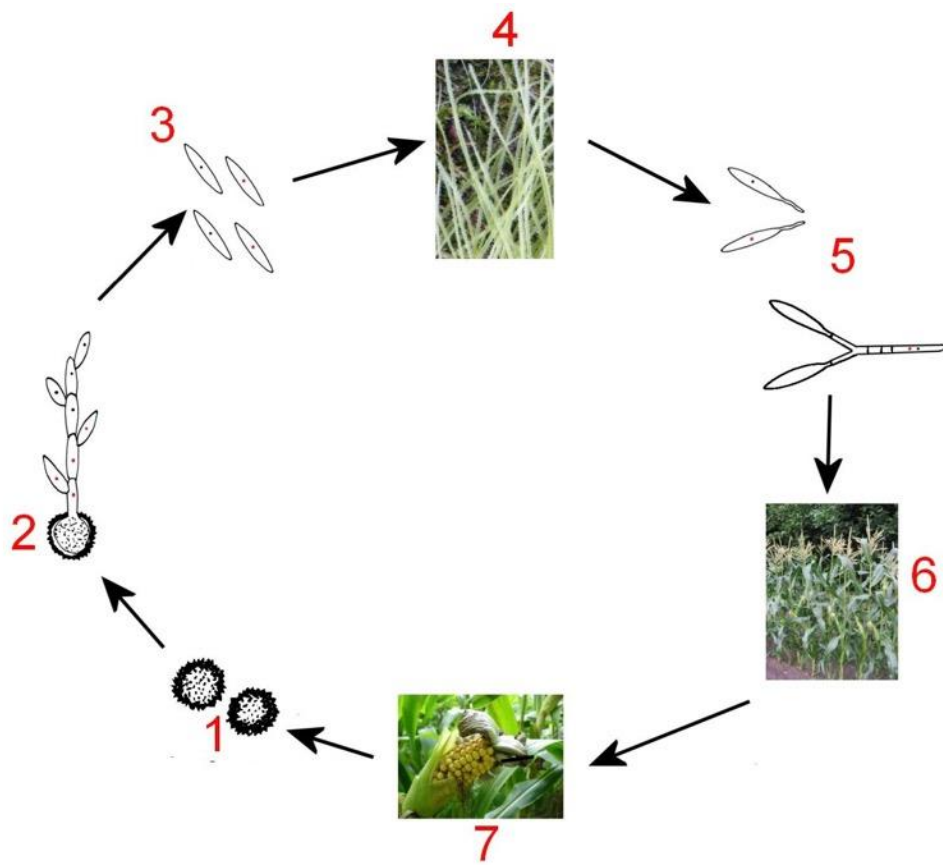


FIGURE 53. ILLUSTRATION OF CYCLE OF *CUITLACOCHÉ* REPRODUCTION.

ILLUSTRATION COURTESY OF KAI HIRDES, CC BY-SA 3.0 [HTTP://CREATIVECOMMONS.ORG/LICENSES/BY-SA/3.0/](http://creativecommons.org/licenses/by-sa/3.0/)



FIGURE 54. *MYCOSARCOMA MAYDIS* (SYN. *USTILAGO MAYDIS*), KNOWN AS *CUITLACOCH*E OR *HUITLACOCH*E. IMAGE COURTESY OF SARUMO74, WIKIMEDIA COMMONS.

The concept of fungal agency explores the idea that fungi, like *cuitlacoche*, are not merely passive elements in ecosystems but active agents that shape and transform their environments. This ontological perspective challenges traditional views of fungi as simple decomposers or agricultural pests and recognizes their vital roles in ecological and socioeconomic systems.

Michael J. Hathaway's ethnographic studies on mushrooms in China further illuminate the transformative power of fungi. Hathaway's research underscores how fungi drive both economic and ecological changes, reinforcing the idea that fungi possess their own agency and can significantly impact human and non-human communities alike (Hathaway 2022). His work resonates with Tsing's exploration of more-than-human entanglements and reveals how fungi

create openings for new multi-species histories.

In this chapter, I explore the lively powers of fungi as co-productive agents in *milpa* agriculture and contemporary *milpa*-based diets. By examining their role, this chapter highlights the transformative power of fungi in Mesoamerican food systems. Through detailed case studies, theoretical analysis, and exploration of socioeconomic impacts, we investigate the potential of integrating fungi into sustainable agricultural practices and the broader implications for food sovereignty.

The objectives of this chapter are threefold: first, to analyze the environmental history and cultural significance of *cuitlacoche*; second, to examine the role of fungi as active agents in *milpa* agriculture; and third, to explore the socioeconomic impacts and future potential of integrating fungi into sustainable agricultural practices. By addressing these objectives, the chapter aims to provide a deeper understanding of fungal agency in Mesoamerican food systems and its broader significance.

CASE STUDIES

Suppose the logic of actual farming is one of an inventive, practiced response to a highly variable environment. In that case, the logic of scientific agriculture is, by contrast, one of adapting the environment as much as possible to its centralizing and standardizing formulas

— James C. Scott (1998, 301)

During my fieldwork with *milpa* farmers in the Puebla–Tlaxcala Valley, I encountered stark contrasts in how farmers perceive *cuitlacoche*, depending on whether they come upon it serendipitously in their *milpas* or cultivate it intentionally for market production. This research

engages with the intersections of cultural heritage food initiatives and agricultural transformation, tracing how *cuitlacoche* emerges as both a traditional and novel food. Through this, I examine how contemporary mechanized *cuitlacoche* production enacts innovative modes of cultivation while simultaneously serving as a heritage food that strengthens territorial ties and is embedded within peasant moral economies and logics of production.

The research for this chapters was conducted with groups of *cuitlacoche* producers in three primary locations: San Mateo Ozolco, Puebla, Nativitas, Tlaxcala, and Atlixco, Puebla.

SAN MATEO OZOLCO, PUEBLA

The milpa is the basis of our people's diet and part of our culture.

— Celio, San Mateo Ozolco, Puebla

San Mateo Ozolco, a Nahua community nestled between the towering volcanoes Iztaccíhuatl and Popocatepetl, is home to the Milli co-operative, an initiative dedicated to preserving heirloom maize culture while creating economic alternatives for local youth. Through value-added production, the co-operative has integrated *cuitlacoche* into its local economy, producing blue maize tortillas and *cuitlacoche* quesadillas that are sold at their community-run restaurant and coffee shops. These enterprises not only generate sustainable livelihoods but also reinforce cultural heritage and promote biodiversity.

The *Milli* co-operative extends beyond local sales, operating a facility that processes blue maize-sesame tortilla chips, tostadas, and pinole. Additionally, it partners with the restaurant Milli in Cholula and two coffee shops specializing in maize-based ice creams. The co-operative emerged from a need to honor the community's deep-rooted maize culture while also seeking economic

opportunities that might counteract the pressures driving youth migration to the United States.

Most people from our community go to the city of Philadelphia, where the majority work in restaurants and gastronomic spaces. Many of us developed a passion for cooking there, and we began to think about how we could share the foods we missed from Ozolco. With Milli, we now have an outlet to teach people about our culture, our food, and our maíces.

— Celio, San Mateo Ozolco, Puebla

While participating in the *pisca*,³⁸ I frequently encountered *cuitlacoche*. By harvest time, much of it had already dried out. I asked Celio whether they used *cuitlacoche* in Ozolco. He explained that while they occasionally harvested it when inspecting their fields, it was not a primary product. Instead, when the restaurant in Cholula required it, they would selectively gather what was needed. Although they attempted to freeze *cuitlacoche* for off-season use, they occasionally had to supplement with market purchases. Nevertheless, *Milli* has managed to source nearly all its ingredients from *milpas* cultivated within the community.

In San Mateo Ozolco, *cuitlacoche* remains an artisanal ingredient, harvested only from healthy *milpas* after the rains. As such, it becomes a means of reinforcing organic, chemical-free agriculture and the use of heirloom seeds—practices that sustain community resilience against socioeconomic pressures. The cultivation and preparation of maize-based foods at *Milli* exemplify how food traditions are not static relics, but adaptive practices embedded in lived landscapes.

Ozolco is a campesino community dedicated to maize cultivation. We grew up learning from our parents in the milpa and among the magueyes. Yet, the work of the campesino was undervalued, and the low price of our maíces forced many

³⁸ *Piscar* (v.) from *pixca* in Náhuatl, meaning “to harvest” (in this case, maize).

young people to migrate to the United States. Simply being a campesino was seen as a disadvantage...

Some of us decided to return on our own; others were deported without justification. Upon returning, we resumed working the land, but the conditions remained unchanged. Some community members found jobs in nearby cities like Cholula or Puebla, but restaurant wages in Mexico are meager, and work opportunities are limited. Recognizing our need to sustain ourselves and honor our heritage, we formed Milli—a co-operative born out of necessity but also a project to value the milpa, our seeds, and our culture. We sought to protect our gastronomy, our Náhuatl language, and create employment for the community...

We want to be an example of keeping our traditions alive. For us, maize is a source of pride. Through the milpa, we work to respect the environment and contribute to biodiversity conservation...

We all collaborate. It is a way of being, a way of living.

— Celio, San Mateo Ozolco, Puebla

Celio describes the diversity of maize varieties cultivated in Ozolco, including *acecle* (*teosinte*), decorative types, and *cematzin*, which produces two ears resembling praying hands and is used as a kitchen ornament. Among these, *maíz-ajo*, a rare heirloom variety whose kernels remain enclosed in husks, lacks culinary use but is cherished across the Mexican highlands.

We grow blue maize (Yahuatl), red maize (Chilaoli) for tortillas and tamales, Cacahuacentli for pozole, and the white and yellow varieties, Ixtaktlaoli and Coxlaoli. While they are excellent food sources, they are now primarily used to feed animals...

Xochitzin are those varieties prized for their beauty, such as the spotted (pintos) Tlapalcenli and Chilayotic, which has a red stripe on each kernel. These varieties are being lost because the market prioritizes blue and white maize for their commercial appeal.

— Celio, San Mateo Ozolco, Puebla

NATÍVITAS, TLAXCALA

Nancy is a vendor I met at the Mercado Alternativo de Tlaxcala (Tlaxcala Alternative Market), where the entanglements of agroecology and commerce become visible through networks of goods and social relationships. Her family's agricultural practices reflect a deep engagement with local ecologies, notably through crop rotations involving amaranth, maize, fava beans, beans, and squash, methods consistent with traditional Mesoamerican polyculture known as *milpa* (Toledo and Barrera-Bassols 2008; Alcántara 2023). Anthropologists describe such systems as adaptive strategies enabling rural households to balance subsistence security with market integration (Wolf 1966; Scott 1976). Within these agroecological cycles emerges the naturally occurring fungus *cuitlacoche*, valued locally as a delicacy rather than treated as a pest. Nancy emphasizes its occurrence as ecologically contingent, stating, “*cuitlacoche* is just something that happens with the rain in good years,” illustrating a peasant subsistence logic attentive to environmental unpredictability (Scott 1976).

Nancy's primary product, however, is amaranth, from which she produces *alegrías*, traditional sweets typically made with honey. Yet, economic pressures have increasingly forced producers to substitute honey with syrup, reflecting structural tensions between agroecological practices and market constraints (Giraldo and Rosset 2023). Nancy's success at the *Mercado Alternativo de Tlaxcala* (Tlaxcala Alternative Market) underscores how small-scale farmers creatively maintain environmental health and biodiversity while navigating market economies, embodying agroecology's emancipatory potential (Rosset and Martínez-Torres 2012).

ATLIXCO, PUEBLA

Near Atlixco, Puebla, situated on the slopes of the active volcano Popocatepetl, *campesinos* have deliberately transformed *cuitlacoche* into a valued agroecological commodity. Their efforts illustrate processes of agroecological scaling and reterritorialization, embedding innovation within culturally meaningful contexts that unite traditional agricultural knowledge with scientific experimentation (Giraldo and Rosset 2023; Escalona-Victoria et al. 2021; Altieri and Nicholls 2020). Supported by *Fundación Produce* Puebla, producers from municipalities including Huejotzingo, San Martín Texmelucan, and Tochimilco have adopted controlled techniques for inoculating maize with *cuitlacoche* spores, significantly improving yields and economic returns compared to conventional maize cultivation (McCune et al. 2022).

This intentional cultivation exemplifies what scholars identify as *recampesinización* (re-peasantization), referring to the conscious reclamation of *campesino* autonomy and livelihoods disrupted by neoliberal policies and industrial agriculture (van der Ploeg 2018; Rosset and Martínez-Torres 2012). Anthropologists and rural sociologists emphasize that *recampesinización* is a contemporary and future-oriented process rather than merely a nostalgic return to traditional subsistence farming (van der Ploeg 2018; Giraldo and Rosset 2023). Rather, it involves redefining peasant agriculture as an economically viable, culturally significant mode of production within the capitalist marketplace (van der Ploeg 2018; Wolf 1966).

Atlixco's *cuitlacoche* project strengthens community resilience by prioritizing participatory farmer-to-farmer knowledge exchanges and locally adaptive technologies rooted in traditional ecological practices (Escalona-Victoria et al. 2021; Martínez-Torres and Rosset 2014). Recent

ethnographic studies document similar agroecological innovations elsewhere in Mexico, where *campesinos* leverage local ecological resources and knowledge to enhance food sovereignty and economic self-determination (Toledo and Barrera-Bassols 2017; McCune et al. 2022). These initiatives challenge dominant agricultural paradigms by integrating culturally relevant crops into profitable market systems, thus securing rural livelihoods without sacrificing ecological integrity or cultural identity (Altieri and Nicholls 2020; Toledo and Barrera-Bassols 2017).

In the case of Atlixco a technique of directly inoculating maize ears with spores, achieving remarkable infection rates of 98 percent. Anthropologically, this practice represents a deliberate effort by *campesinos* to leverage agroecological principles to enhance their economic autonomy and stability, aligning with James Scott's (1976) foundational concept of the moral economy, in which peasant communities actively manage economic risks through adaptive strategies. The controlled inoculation approach significantly increased *cuitlacoche* yields and economic predictability, transforming the maize economy of the region. Prior to these innovations, natural fungal occurrences unpredictably impacted around 5 percent of maize in Ciudad Serdán where controlled inoculation increased market values five to six times that of untreated maize (McCune et al. 2022).

Recent anthropological literature from Mexico emphasizes similar instances of agroecological innovation, highlighting how *campesinos* strategically integrate scientific knowledge with traditional practices to retain control over local production and enhance economic resilience (Giraldo and McCune 2019; Rosset and Altieri 2017). Thus, Atlixco's experience reflects broader anthropological understandings of agroecological scaling as a culturally rooted and territorially

specific process, central to contemporary *campesino* livelihoods and sustainable rural development strategies in Mexico (Giraldo and Rosset 2023; McCune et al. 2022).

The trajectory of *cuitlacoche* production in Atlixco aligns closely with what Giraldo and Rosset (2023) define as emancipatory agroecology—a transformative framework promoting social equity, ecological integrity, and political sovereignty. By actively countering industrial agriculture’s market pressures, Atlixco’s *campesinos* reinvest in local and traditional knowledge and collective action, furthering agrarian justice and food sovereignty (Martínez-Torres and Rosset 2014; Rosset and Altieri 2017). The ongoing exploration of new maize-based applications, such as medicinal uses of maize silk or utilizing maize stalks for livestock feed, highlights the dynamic, evolving nature of agroecological transitions, which continually reconfigure economic, ecological, and cultural relationships surrounding maize cultivation (Vega Álvarez et al. 2022).

As Juan, a farmer recently producing commercial *cuitlacoche* for supermarkets explains:

We began experimenting with cuitlacoche thirty-four years ago. Seeing the product’s success, we are more convinced than ever about its potential and are committed to continuing in this line of business.

— Atlixco, Puebla, 2023

This reflection encapsulates the proactive and adaptive nature of agroecological transformation. What originated as local experimentation with an ancestral food has evolved into a vibrant agroecological movement that integrates technological innovation, economic sustainability, and cultural resilience. Atlixco’s *cuitlacoche* initiative thus represents more than agricultural adaptation—it exemplifies how *campesinos* strategically navigate the tensions between tradition and modernity, sustainability and market integration, and local knowledge within global contexts

to realize food sovereignty and agrarian resilience.

Recognizing the agentic powers of fungi such as *cuitlacoche* and *ayonanácatl* does more than deepen our understanding of *milpa* agroecosystems, food sovereignty, and the revitalization of Mesoamerican diets. It shifts the frame of inquiry, unsettling human-centered agricultural narratives and foregrounding the entangled worldmaking of fungi, crops, and people. These fungi are not mere supplements to human subsistence but active participants in multi-species assemblages that cultivate more-than-human resilience. Their presence within the *milpa* challenges simplified notions of agricultural productivity, offering instead a vision of cultivation as an ongoing negotiation among diverse ecological actors.

CUITLACOCHÉ AND MAIZE: A FUNGAL ENCOUNTER

Cuitlacoche, often mythologized as a pre-Colombian food, emerges instead as a dynamic entanglement between fungal and human histories. Like the matsutake mushrooms in Anna Tsing's *The Mushroom at the End of the World* (2015), *cuitlacoche* embodies a story of interspecies livelihoods, where maize and its fungal companion co-shape each other's possibilities. Contrary to the popular belief that *cuitlacoche* was a staple of pre-Colombian cuisine, archaeological and historical evidence suggest otherwise. Valadez et al. (2011a) and Valadez Azúa (2012, 2019) argue that at the time preceding Spanish colonization, *cuitlacoche* was not a regular food source. However, archaeobotanical evidence from Pueblo Bonito in Chaco Canyon indicates its consumption (Battillo 2018; Dahl 2009; Smith et al. 2015).

The earliest textual reference to *cuitlacoche* appears in the sixteenth-century writings of Fray Bernardino de Sahagún, who briefly describes "*cujtlacochi*" as a dark smut that grows on maize

(Sahagún 1963). Nowhere does he explicitly name it as food, but his account gestures toward an alternative ontology, one in which maize and its fungal companion participate in divine processes. In this framing, *cuitlacoche* is less an ingredient than an event—an uncanny transformation of maize, shaped by the rhythms of rain and decay.

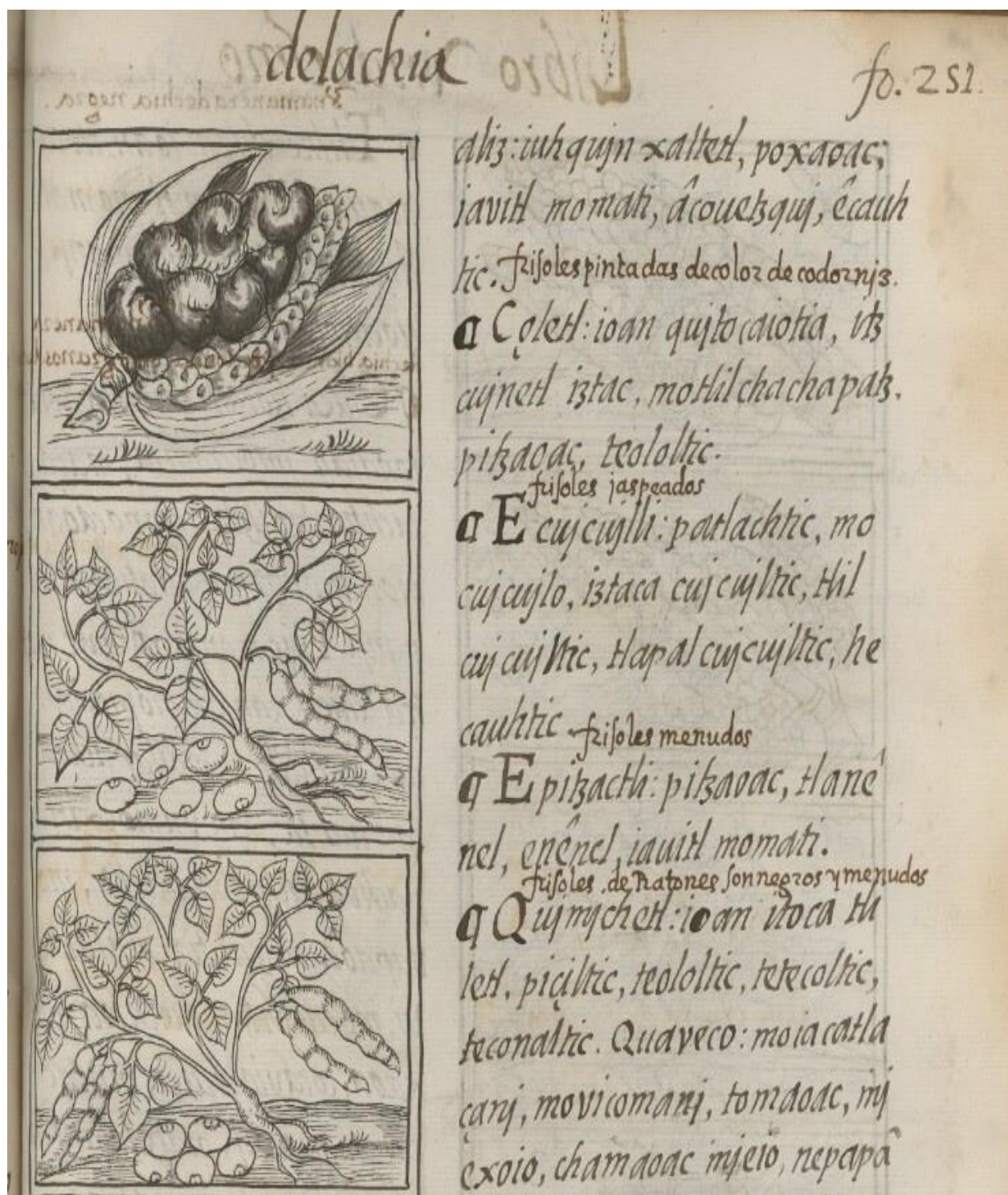


FIGURE 55. LITTLE IS MENTIONED REGARDING CUITLACOCHÉ IN THE FLORENTINE CODEX; ONE BRIEF PASSAGE VAGUELY SUGGESTS CUITLACOCHÉ “ITS APPEARANCE IS LIKE COARSE SAND; IT IS SPONGY, RESEMBLING BLACK MAIZE; IT IS LIGHT. IT CAN BE SCATTERED BY THE WIND (ANDERSON & DIBBLE 1953–1982).”

As in other colonial contexts where fungi have been reclassified and repurposed (see Paxson 2012; Tsing 2015), *cuitlacoche* underwent a radical shift in meaning. During the colonial period, the fungus came to be understood as a food of the poor, a classification that persisted well into the nineteenth and twentieth centuries. In the wake of the Mexican Revolution, when national cuisine was reimagined as an assertion of Indigenous heritage, *cuitlacoche* remained marginal, associated more with peasant subsistence than with culinary prestige. By the mid-twentieth century, its status began to change. French chefs, intrigued by its umami depth, incorporated *cuitlacoche* into haute cuisine, much as matsutake mushrooms had been absorbed into elite Japanese gastronomy (Tsing 2015).

UNESCO's 2010 designation of traditional Mexican cuisine as an intangible cultural heritage further solidified *cuitlacoche*'s rebranding. It was no longer just a *campesino* survival food but an ingredient with gourmet cachet. This shift exemplifies what Valadez Azúa et al. (2011a) describe as the conditions for food heritagization: territorial identity, food culture, and agroecological knowledge. However, as with other high-value fungi, such as truffles (Tsing 2015; Koyama 2021), the heritagization of *cuitlacoche* has produced new tensions, including its commodification for export markets.

A CULTURAL HISTORY OF *CUITLACOCHÉ*

Cuitlacoche proliferated across the world not as an incidental occurrence but as an unexpected companion to maize domestication. As maize spread, so too did this fungal symbiont, entangling itself within agricultural practices, human appetites, and microbial ecologies. In its unruly growth, *cuitlacoche* exposes the porous boundaries between cultivation and wildness, between food and

contagion—echoing the kinds of multi-species entanglements that Anna Tsing (2015) has so evocatively described. The mutual histories of maize and *cuitlacoche* do not simply follow a linear path of human control; rather, they unfold through what Tsing might call the “contaminated diversity” of agricultural landscapes—assemblages of human and non-human actors shaping one another’s possibilities for survival (Tsing 2015, 32).

In Mesoamerica, fungi like *cuitlacoche* have gathered renewed attention, particularly in their relationship to the *milpa* agricultural system and contemporary efforts to revitalize *milpa*-based diets. The fungus is not an isolated pathogen but an active participant in agroecological formations, a co-inhabitant of fields, kitchens, and markets. This perspective aligns with recent environmental anthropological approaches that consider fungi not simply as parasites but as agents of symbiosis, reshaping landscapes, livelihoods, and even cuisines (Ingold 2000; Tsing 2015; Ogden, Hall, and Tanita 2013).

Cuitlacoche (*cuitlacohtli* in Náhuatl) derives from *cuitla*, meaning dirt, garbage, or excrement, and *cochtli*, meaning sleeping. Thus, we might translate *cuitlacohtli* as “sleeping dirt” (del Campo 1968, 27). This etymology hints at the ambiguous status of the fungus—both abject and valuable, concealed and transformative. Much like the matsutake mushrooms that Tsing (2015) follows across ruined landscapes, *cuitlacoche* emerges in spaces of disturbance, unsettling conventional categories of agricultural purity.



FIGURE 56. CLOSE UP IMAGE OF *CUITLACOCHÉ*
COURTESY OF AMADA44. CC BY 4.0 <https://creativecommons.org/licenses/by/4.0>



FIGURE 57. MATURE *CUITLACOCHE* EMERGING FROM MAIZE HUSK. (PHOTO BY THE AUTHOR, NOVEMBER 2018)



FIGURE 58. DURING THE MAIZE HARVEST IN THE FALL, IT IS COMMON TO FIND EARS INFECTED WITH *CUITLACOCHÉ*. AT THIS LATE STAGE, THE FUNGUS HAS DRIED OUT AND BEGUN RELEASING SPORES (PHOTO BY AUTHOR, DECEMBER 2020).

Mycosarcoma maydis, commonly known in English as corn smut, is a fungal inhabitant of maize and its wild ancestor, *teosinte*. It belongs to the class *Ustilaginomycetes*, a group often characterized as parasitic because they draw upon the sugars of living plants to sustain their own

development. Yet, as Tsing's work reminds us, parasitism is an insufficient framework for understanding fungal agency (Tsing 2015). The classifications imposed by biologists have long relegated *cuitlacoche* to the margins, treating it as an undesirable aberration rather than an integral component of agricultural ecologies. These scientific narratives obscure the ways in which *cuitlacoche* has been actively cultivated, valued, and even celebrated by *milpa* farmers. For them, the appearance of *cuitlacoche* in a field is not a sign of contamination but a cause for rejoicing—a gift from the land, a marker of a thriving agroecosystem.

The story of *cuitlacoche*, then, is not one of simple biological invasion but of interspecies histories, culinary revaluations, and shifting human-fungal alliances. It offers a lens through which to reconsider domestication, not as a unilateral act of control but as an ongoing negotiation between species. In this sense, *cuitlacoche* thrives at the edges of cultivation, where the wild and the cultivated intertwine—as Tsing (2015) has so eloquently shown in her study of Matsutakes at the margins of global capitalism.

AN UNEXPECTED OUTCOME OF MAIZE DOMESTICATION

In the unruly entanglements of domestication, landscapes shift, and new relationships emerge between species, reshaping worlds in ways that exceed human intent. About 10,000 years ago, some populations of *teosinte*, a wiry grass of Mesoamerican landscapes, were drawn into human social worlds, selected and reshaped into the plant we now recognize as maize. This process, often heralded as one of humanity's most remarkable feats of plant breeding, cannot be understood in isolation. The domestication of maize was never simply a human achievement; rather, it was a multi-species event, involving plants, fungi, and microbes that co-constituted new forms of life

together. The proliferation of maize remade not just human subsistence strategies but also ecological assemblages, enabling unanticipated agents, such as *Mycosarcoma maydis*, to flourish alongside it.

As maize transformed—developing larger ears and grains better suited to human diets—the fungal world responded in kind. The swollen kernels provided an abundant substrate for *cuitlacoche*, a fungus that thrived in the interstices of this new human-plant relationship. The fungus, in turn, developed more expansive galls, spreading through maize husks in a multi-species choreography of infection and growth. The structural changes in maize, selected for by human hands, provided a generous stage for fungal proliferation, even as the fungus, in its own unruly way, reworked the maize into something beyond human control. Here, domestication was not a singular trajectory but rather a process of co-domestication, in which fungal agency was as much at play as human selection (Tsing 2015).

Fungal life refuses containment: it lives in the margins, erupting unpredictably. *Mycosarcoma maydis*, a shapeshifting symbiont, spends much of its existence nestled within maize and *teosinte*, waiting. Its infection triggers a transformation, swelling maize kernels into amorphous, tumorous galls, their surfaces shimmering in hues of purple, gray, and black. These bulbous forms, both grotesque and generative, mark the interpenetration of fungal and plant life, their hybrid materiality defying clear taxonomies. In the autumn, as the *cuitlacoche* dries and withers, it leaves behind a residue—a fine black powder—that veils the maize in soot-like traces. This is fungal agency at work: an insistence on presence, an unpredictable flourishing within the ecological ruins of domestication (Tsing 2015; Hébert 2021).

Rather than seeing domestication as a linear tale of human control, we might instead turn toward the unruly entanglements that make up the history of maize and *cuitlacoche*. The fungus was not simply an opportunistic parasite but an active participant in the reshaping of maize itself. In this multi-species landscape, plants, fungi, and humans exist in a state of ongoing negotiation, each responding to the others in ways that ripple beyond immediate intention (Tsing 2015; Paxson 2008). The proliferation of *cuitlacoche*, then, is not merely an outcome of maize domestication but rather a manifestation of fungal liveliness within the broader multi-species assemblages that shape and are shaped by human agriculture.

REPRODUCING SPORES: *CUITLACOCHÉ* GENOME PROJECT

German scientists initiated the “*cuitlacoche* genome project” precisely because this fungus, much like others that thrive in precarious ecologies, is easily cultivated in laboratory conditions. The study of its genetics has offered insights into the adaptability of fungi and their ability to thrive in human-made settings (Feldbrügge, Kellner, and Schipper 2013). But beyond laboratory control, *cuitlacoche*, like all fungi, does not submit entirely to human will. It spreads, intervenes, and participates in multi-species relations beyond commercial intent.

Researchers at various universities found that *cuitlacoche*’s reproductive ease could be harnessed to induce its growth beyond its seasonal cycles. Farmers with the necessary capital inject laboratory-cultivated spores into maize silk channels, creating a technoscientific system that promises near-total fungal infestation. In some cases, up to 90% of the ears develop *cuitlacoche* under these highly controlled conditions. Yet long before these laboratory studies, peasant farmers understood fungal emergence through observation and ancestral knowledge. The wind, much like

maize pollen, carries fungal spores, producing what *campesinos* recognized as an unexpected yet welcome harvest.

In the last two decades, the industrial production of *cuitlacoche* has expanded, mirroring Tsing's (2015) concept of "salvage accumulation," in which capitalists extract value from peasant practices without returning their epistemic or material wealth. *Cuitlacoche*, once harvested as a spontaneous emergence, is now industrially produced through the suspension of injectable spores, transforming its role from serendipitous occurrence to calculated commodity (Valverde and Paredes-López 1993; Valverde et al. 1995; Valverde, Hernández-Pérez, and Paredes-López 2012).

Yet the wildness of fungal agency remains. Sweet maize, highly susceptible to infection, is favored for *cuitlacoche* production (Pataky 1991; Valverde et al. 1993; Pataky 2002). Here, fungal vitality disrupts monocultural expectations, inserting itself into the agricultural landscape not as a pathogen to be eradicated, but as a valued resource to be cultivated.

Today, *cuitlacoche* circulates as a global commodity, packaged and preserved like the canned matsutake of Asian markets. It is sold fresh in Mexican supermarkets, exported frozen or canned, and increasingly sought after by chefs in the United States and Europe. Once considered a poor peasant's food, dismissed by colonial and urban elites, it is now esteemed in *haute* cuisine. The transformation is an uncanny echo of Tsing's (2015) matsutake story, where the same fungi that signify marginality for some become a luxury for others.

Cuitlacoche remains deeply embedded in the social fabric of Mesoamerican life. Its interdependence with maize and the *milpa* ensures that it is not merely a mushroom among many

but a vital manifestation of maize itself. Valadez Azúa et al. (2011a) describe how its Náhuatl name reflects this perception—an intimate relationship with maize rather than an external fungal intrusion. Depending on cultural context, *cuitlacoche* is seen as a disease, a curse, or a divine gift. Such ambiguity is familiar in the study of fungal agency; as anthropologist Michael Hathaway (2022) has argued, fungi challenge our categories of life and force us to reconsider distinctions between cultivation and wildness, domestication and ferality.

This paradoxical value shift is nowhere more evident than in the marketplace. While peasant families still gather *cuitlacoche* during the rainy season, it is increasingly captured by entrepreneurs who transport it to Mexico City, where it is sold at high prices or processed for export (Allen 1992, 226). The logic of peasant farming, grounded in multi-species care, contrasts sharply with the commodity chains that turn *cuitlacoche* into a prestige food. Still, the peasant logic prevails in unexpected ways: the joy of encountering an unplanned fungal emergence, a reminder that maize, like its fungal companion, remains entangled in multi-species worlds beyond control.

Nutritionally, *cuitlacoche* completes maize. Where maize lacks lysine and tryptophan, the fungus provides. The fungal agency here is not just economic but metabolic. It transforms maize from a carbohydrate-rich staple to a more nutritionally complete food, embodying the kind of interspecies reciprocity that Tsing describes in her ethnographic encounters with fungi.

Cuitlacoche's market value fluctuates depending on its mode of production. On the cob, fresh *cuitlacoche* can cost between 100-200 MXN/kg (€4-10), but its processed form commands even higher prices in international markets. In Mexico City, a *quesadilla de cuitlacoche* sells for 20-50 MXN (€1-2.5), while in high-end restaurants, its culinary prestige translates to dishes priced at 185

MXN (€8-10). This scaling-up of value mirrors the way matsutake shifts in worth as it moves from foragers to elite consumers.

But the expansion of *cuitlacoche* as a commodity is not without resistance. In the United States, farmers have spent decades trying to eradicate the fungus, deploying fungicides and monocultural strategies to control its spread. Agronomists recommend hybrid maize varieties as a defense, yet these hybrids paradoxically prove more susceptible to infection. The persistence of *cuitlacoche* defies agribusiness control, much like how Tsing's (2018) matsutake continues to flourish in human-disturbed landscapes. Fungi resist eradication; they find ways to thrive.

The contrast between peasant *milpas* and industrial monocultures is stark. The former embraces multi-species entanglements, while the latter seeks to isolate and control. *Campesinos* reject hybrid seeds not just for ecological reasons but for taste. As I was repeatedly told, "Maybe hybrid maize is okay for animal feed, but not for tortillas." The *milpa* remains a site of multi-species care, where *cuitlacoche* is a welcome actant rather than an invasive blight.

Thinking with *cuitlacoche* allows us to consider other fungal relationships. In Ozolco, the *ayonanácatl* practice—burying *chilacayote* squash to induce fungal growth—reveals an alternative mode of fungal-human collaboration. Like matsutake hunters in Japan or truffle foragers in France, Ozolco farmers cultivate fungal agency through local ecological knowledge, sustaining both community bonds and ecological diversity. These practices remind us of that fungal agency, as Tsing (2015) suggests, is not merely about economic extraction but about the ongoing, entangled improvisations of life itself.

CO-PRODUCTIVE POWERS OF *CUITLACOCHÉ*

In this chapter, I explore the lively powers of the fungus *cuitlacoche* as a co-productive agent in *milpa* agriculture and contemporary *milpa*-based diets. These diets have emerged as a form of resistance to the industrialized foods that have proliferated in Mexico over the past century. By integrating various species, including plants, fungi, and animals, *milpa*-based diets foster multi-species collaborations that sustain both ecological and cultural resilience. The mutualistic relationship between maize and *cuitlacoche*, for instance, not only enhances biodiversity but also contributes to soil health and crop adaptability.

Fungi have often been framed as passive decomposers or disease agents, but *cuitlacoche* challenges this limited perspective. The fungus has proliferated globally as an unintentional consequence of maize domestication, and in Mesoamerica, it has become an integral part of *milpa* agriculture and contemporary culinary practices. While there is no definitive evidence that *cuitlacoche* was consumed in pre-Columbian times, its recent incorporation into *milpa*-based diets suggests an actant role in reimagining both the *milpa* and the cuisines it sustains.

The growing interest in fungal agency fallows us to ask new questions about the agency of species diversity in agricultural systems and culinary landscapes. Engaging with *cuitlacoche* and other fungi within the *milpa* framework reveals how fungal collaborations shape agriculture and contemporary diets on a global scale.

Fungi are often described in negative terms, with *cuitlacoche* frequently labeled as an “infection” of maize. Infection is commonly understood as harm inflicted by one species upon another. However, emerging scientific research has highlighted numerous examples of symbiotic fungal

relationships that provide mutual benefits (Rojas-Sánchez et al. 2025; Ogwu et al. 2025; Chaudhary, Poudyal, and Kaundal 2025; Case et al. 2025; Berrios and Peay 2025; Morales 2024; Das et al. 2024; Roy and Choudhury 2022; Bastías, Johnson, and Card 2020; Bender et al. 2014; Fitter, Helgason, and Hodge 2011; Gobert and Plassard 2008; Ellouze et al. 2008; Lovelock and Ewel 2005; Harrier 2001; Edwards et al. 2000; Costa et al. 2025; Weber 1966). Nearly every organism, it is now recognized, depends on fungal interactions in some way. Still, *cuitlacoche*'s relationship with maize is predominantly perceived as parasitic. The fungus colonizes maize kernels, preventing their reproduction, while using the maize plant as a medium for spore dispersal. Given that many farmers rely on maize seeds for sustenance and income, it is understandable that they might view *cuitlacoche* as a threat rather than a collaborator.

Mushrooms elicit strong and contrasting reactions, from deep aversion to profound appreciation. Wasson and Wasson (1957b) introduced the terms *mycophilia* and *mycophobia* to describe these polarized attitudes. In Mesoamerica, highland cultures are often considered mycophiles, while lowland inhabitants are seen as *mycophobes*. Ruan-Soto et al. (2013), however, found that rather than a geographic-ecological correlation, *mycophilia* and *mycophobia* are more closely linked to ethnic-cultural factors, with member of Indigenous communities, being the most likely to be mycophiles. Hunn et al. (2015) note that in the Sierra de Miahuatlán of Oaxaca, fungi are treated as “animals” rather than plants because they are hunted rather than cultivated. This positioning of fungi outside the human domain further underscores their agentic power. Unlike cultivated plants, which require human care, fungi, like animals, follow their own trajectories and often behave unpredictably.

Early Mesoamerican cultures, renowned for their expertise in plant domestication, developed sophisticated breeding techniques for species that remain vital to global agriculture today. Yet, their efforts in domesticating animals were less pronounced. This divergence in domestication strategies raises intriguing questions about the human-fungal relationship within the *milpa*.

***CUITLACOCHÉ* IN GASTRONOMIC WORLDMAKING**

Most *cuitlacoche* available in urban markets today does not come from the *milpa*. Instead, it is cultivated in controlled greenhouse environments, where spores are suspended in an injectable solution to induce fungal growth. While this standardization simplifies production, the rhizomatic logic of fungi has inspired *campesino* communities to reconsider the micro-biopolitics of microbial life, fungal spores, fermentation, and decomposition.



FIGURE 59. PACKAGED CUITLACOCHES FOR SALE AT THE SAN JUAN MARKET, MEXICO CITY. (PHOTO BY THE AUTHOR, MAY 2018)



FIGURE 60. LABEL FROM ARTISANAL *HUITLACOCH*E PRODUCT DETAILING INGREDIENTS AND NUTRITIONAL CLAIMS PHOTO BY AUTHOR, MAY 2018)

LABEL READS: HUITLACOCHE OR CUITLACOCHE: EDIBLE FUNGUS THAT LIVES AS A PARASITE IN THE CORN COBS; IT PRESENTS AS GRAY TUMORS THAT WHEN THEY MATURE RELEASE SPORES. INGREDIENTS: HUITLACOCHE FROM HEIRLOOM CORN, EPAZOTE, ONION, OLIVE OIL, HEIRLOOM CORN STARCH, OCEAN SALT, AND SPICES. ARTISANAL PRODUCTION, NO CONSERVATIVES, 100% NATURAL, NET CONTENT: 225 GRAMS, DATE OF MANUFACTURE _____, DURATION OF THE BOTTLE BEFORE OPENING: 6 MONTHS, REFRIGERATE AFTER OPENING.

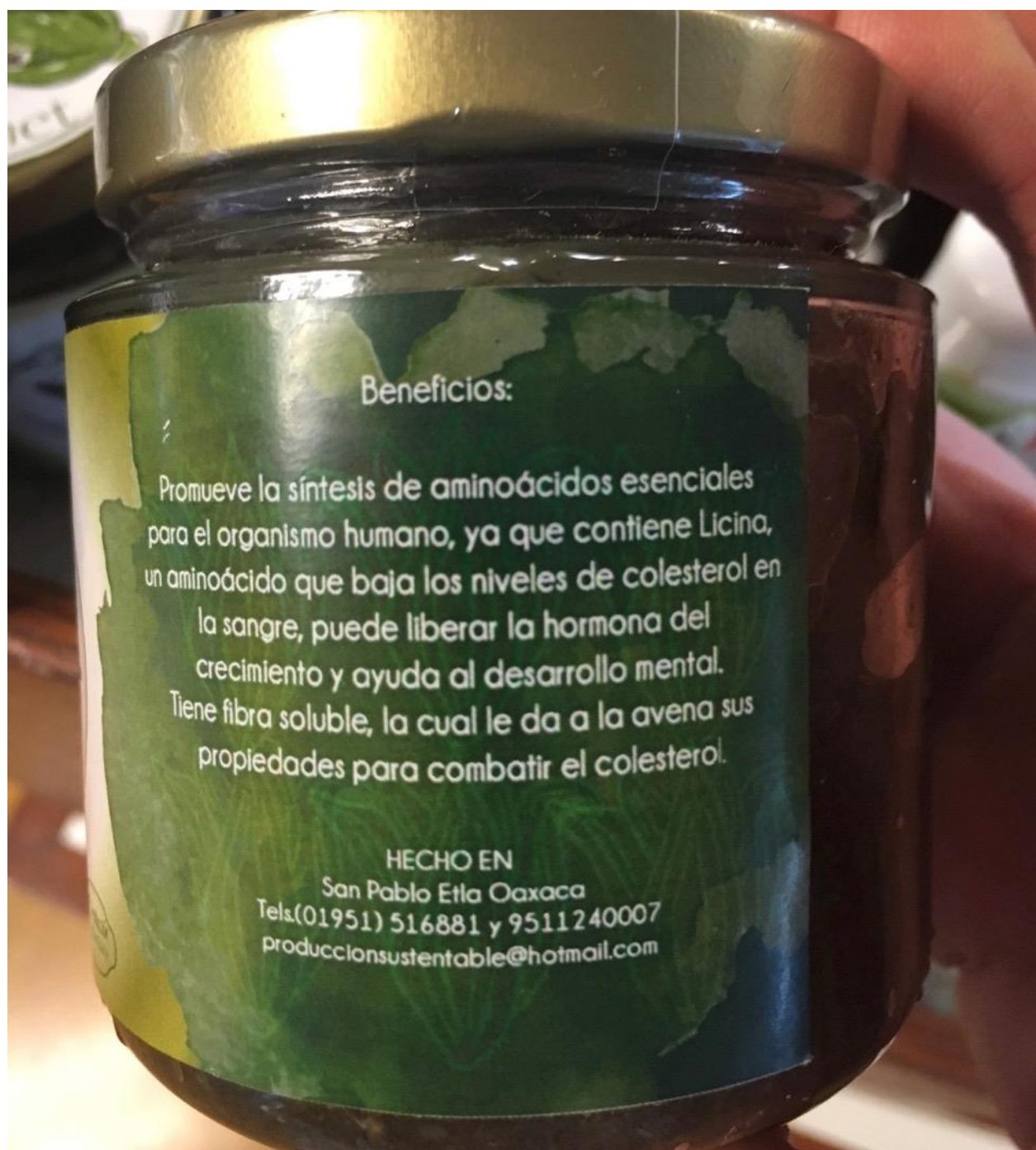


FIGURE 61. THE PRODUCT LABEL DESCRIBES THE NUTRITIONAL BENEFITS (PHOTO BY AUTHOR, MAY 2018).

LABEL READS: IT PROMOTES THE SYNTHESIS OF ESSENTIAL AMINO ACIDS FOR THE HUMAN BODY, SINCE IT CONTAINS LYSINE, AN AMINO ACID THAT LOWERS CHOLESTEROL LEVELS IN THE BLOOD, CAN RELEASE THE GROWTH HORMONE AND HELPS MENTAL DEVELOPMENT. IT HAS SOLUBLE FIBER, WHICH GIVES OATS ITS PROPERTIES TO FIGHT CHOLESTEROL. MADE IN SAN PABLO ETLA, OAXACA.

The commercial success of *cuitlacoche* has drawn attention from researchers and policymakers interested in its economic potential. The controlled cultivation of *cuitlacoche* has led to significant socioeconomic shifts. Farmers who produce *cuitlacoche* under these controlled conditions often earn higher incomes compared to those growing traditional maize. However, this shift also benefits agronomists and suppliers of specialized materials and technological inputs, reshaping the political economy of *cuitlacoche* production.

As the commodification of *cuitlacoche* expands, its integration into *milpa* systems raises important questions about the intersections of multi-species entanglements, Local and traditional agricultural knowledge, and market-driven transformations. The lively powers of *cuitlacoche* challenge dominant agricultural narratives, inviting us to rethink the agency of fungi in shaping the landscapes and cuisines of Mesoamerica and beyond.

MILPA ASSEMBLAGES AND FUNGI

The *milpa* was developed over eight millennia, with maize as its foundation. However, maize is not a plant that emerged organically on the planet. It was meticulously devised by generations of agriculturists long before the flourishing of European civilizations and the iconic ones of Mesoamerica. The capacity of Mesoamerican civilizations to cultivate this extraordinary plant has yielded one of the most crucial cereal crops for the subsistence of humanity, as well as for the sustenance of numerous animals.

Maize was never cultivated in isolation. Early Mesoamerican societies experimented with *teosinte*, carefully selecting terrains and ecosystems to shape maize into what it is today. Their ingenuity in intercropping maize with legumes represents a crucial scientific advancement. Legumes, as

nitrogen-fixing plants, assimilate nitrogen from the atmosphere and transfer it through their roots, providing a natural fertilizer that nourishes maize through the rhizome system. This subterranean network of roots interacts with both legumes and maize, facilitating nutrient exchange. Additionally, the cultivation of squash alongside maize and legumes was intentional: its broad leaves shield the soil, conserving moisture and preventing erosion. This polycultural system fostered the growth of maize while diversifying diets with edible squash flowers, nutrient-rich *quelites*, and the incorporation of chilies for flavor enhancement.

Despite the historical resilience of the *milpa*, contemporary pressures threaten its sustainability. Industrial agricultural models prioritize monocultures, leading to the simplification of these complex agroecosystems. The erosion of *milpa*-based diets not only diminishes nutritional diversity but also weakens the cultural and ecological significance of this food system. *Milpa* agroecosystems embody a critical site of resistance in struggles for food sovereignty, offering a pathway towards agroecological resilience and multi-species flourishing. As Tsing (2015) reminds us, human survival is bound up with the lively agencies of more-than-human worlds. To cultivate *milpa* is to cultivate relationships—between people, plants, and fungi—in an ongoing dance of ecological entanglements and transformation.

FUNGAL AGENCY AND THE FUTURE OF MAIZE

What happens when a fungus becomes more valuable than the maize it infects? This paradox, central to the recent history of *cuitlacoche*, challenges conventional agricultural logics. *Cuitlacoche* is neither a pest nor a mere ingredient; it is a collaborator, an agent of transformation. In *campesino* farming systems, maize is a multi-functional plant, its stalks, leaves, and roots repurposed for

fodder, mulch, and other uses. *Cuitlacoche*, far from destroying the maize plant, simply redirects its productive potential. As Tsing (2015) reminds us, fungi thrive in the ruins of capitalist agriculture, revealing alternative modes of growth and exchange. In this light, the rise of *cuitlacoche* in international markets—where frozen *cuitlacoche* can fetch \$30-40/kg (Tracy et al. 2007)—is not just a story of culinary rebranding but of fungal resilience in an era of industrial monoculture.

Contemporary framings of *cuitlacoche* oscillate between divergent epistemologies. Some celebrate it as a divine gift from the rain gods, while others brand it as “Mexican truffle” or “black gold” (Aguilar Romero 2016; Revoreda 2020; Valadez et al. 2011b). This multiplicity of meanings underscores what anthropologists have long observed about fungi: they defy easy classification (Tsing 2015; Paxson 2012; Koyama 2021).

Like matsutake and truffles, *cuitlacoche* emerges not only as a culinary delicacy but also as a figure of multi-species entanglement. Its story is one of co-dependence, where fungal agency and human economies shape one another in unpredictable ways. In an era of ecological and agricultural uncertainty, *cuitlacoche*—like other fungi—reminds us that alternative futures grow in the margins, thriving precisely where monocultures falter.

BEYOND CUITLACOCHÉ: PULQUE FERMENTATION AND ITS TRANSFORMATIONS

Other fungal agencies are also important in the milpa. Since 2012, San Mateo Ozolco has hosted an annual *Pulque* Fair, a gathering that reflects broader transformations within the pulque market and agropastoral systems. During the fair, local producers demonstrate their specialized knowledge

of traditional fermentation techniques, showcasing both natural and *curado* (cured) varieties, with the latter featuring infusions of regional fruits and flavors. Anthropological analyses emphasize how such events serve to reinforce cultural heritage, support local economies, and underscore the enduring significance of maguey cultivation within community livelihoods (Muñoz-Camacho et al. 2023; Rocha Robles 2013).

Simultaneously, urban “chic” *pulquerías* have emerged in major urban centers like Mexico City, Tlaxcala, and Puebla, attracting younger, urban consumers. Ethnographic studies illustrate the sharp contrast between these contemporary establishments and traditional *pulquerías*, historically spaces frequented predominantly by working-class men. Modern *pulquerías* have reinvented pulque's image, branding it as a gourmet, organic, and nutritious beverage through novel combinations with fruit juices, significantly reshaping its cultural status and market appeal (Blas-Yañez et al. 2018; Valadez Montes 2014). Although *curado* varieties have traditionally existed, historical preference leaned toward consuming pulque in its pure form. Despite a recent resurgence, production remains below historic levels (Katz and Lazos 2017, 40–41).

Parallel to these market shifts, San Mateo Ozolco has witnessed the rise of community-based initiatives like the Co-operative *Mazolco*, which promotes sustainable agricultural practices and biodiversity in maize production, aligning closely with food sovereignty objectives (Valdivieso Solís et al. 2021). By supporting agroecological cultivation, the co-operative plays a critical role in preserving heirloom maize varieties that constitute core elements of local identity and cuisine.

Milli: Cocina de Maíces, located in Cholula, exemplifies this commitment further by incorporating heirloom maize varieties into its culinary repertoire. This establishment resonates with broader

anthropological discourse regarding the necessity of safeguarding biocultural diversity against the pressures of industrial agriculture (Álvarez-Duarte et al. 2018; Rocha Robles 2013). Additionally, *Coyotitla Heladería y Cafetería* integrates Local and traditional flavors into its offerings, enriching the local gastronomic landscape and bolstering ancestral food traditions.

Collectively, these endeavors—the *Feria del Pulque* (Pulque Fair), Co-operative *Mazolco*, *Milli*, and *Coyotitla*—highlight the dynamic intersections among cultural heritage, food sovereignty, and economic revitalization within San Mateo Ozolco. They sustain community livelihoods and affirm the region’s prominent role in revitalizing traditional agro-food systems in central Mexico (Narváez Suárez, Martínez Saldaña, and Jiménez Velázquez 2016).

Pulque, a beverage arising from microbial fermentation processes, embodies complex multi-species interactions reflective of precarious agricultural livelihoods. Similar to *cuitlacoche*, pulque fermentation is intricately embedded within the *milpa* agroecosystem, fostering critical reflection on microbial and fungal agency. Contemporary scholarship increasingly recognizes these microbial dynamics, situating them within broader agricultural discourses on biopolitics, food security, and microbiopolitics (Foucault 1978; Paxson 2013). Historically central to diets in central Mexico, pulque faced significant decline following competition from industrial beer production (Escalante et al. 2016; Rocha-Arriaga and Cruz-Ramírez 2022).

Accounts from experienced *tlachiqueros*, such as Don Jaime and Doña Adriana from Tlaxcala, provide essential insights into historical maguey cultivation practices and pulque production processes (Gourmet de México 2021). Their *tinacal*—a traditional pulque fermentation facility—historically produced between 2,000 and 3,000 liters daily. The rapid fermentation process

exemplifies the volatile, ephemeral nature of pulque, deeply intertwined with specific rhythms of labor and microbial metabolism (Escalante et al. 2016; Rocha-Arriaga et al. 2020).

Thus, pulque exemplifies an emergent ecological framework where human and microbial agents collaborate, not only creating fermented beverages but also shaping complex ecological relationships characterized by potentiality and vulnerability. Such multi-species engagements invite deeper anthropological consideration of more-than-human worlds, encouraging scholars to attune themselves to slow, uncertain microbial transformations, and recognizing fermentation and decay as sites ripe with possibilities for new forms of life-making (Rocha-Arriaga and Cruz-Ramírez 2022; Paxson 2013).

AYONANÁCATL: EARTHLY ENTANGLEMENTS

Building on a growing scholarly interest in the lifeworlds of fungi across disciplines, this section explores fungal spores co-produced with maize in the *milpa* landscapes of the central Mexican highlands. I seek to uncover the lively powers of fungi as co-productive agents in *milpa* agroecosystems and contemporary *milpa*-based diets. While fungi have traditionally been viewed as passive decomposers, this discussion frames them as active agents—*actants*—in contemporary Mesoamerican cuisine (Tsing 2015; Ingold 2010; Kirksey and Helmreich 2010).

Ayonanācatl is known locally as a fungus emerging from *chilacayote* (*Cucurbita ficifolia*), though it arises from fungal properties formed through the decomposition of squash after being buried in the earth. This fungus emerges through practices that stitch together human and non-human collaboration, soil and fermentation, ritual and sustenance. In San Mateo Ozolco, community members assert that the tradition persists uniquely here (Castillo 2022). Thus, *ayonanācatl* is not

merely a culinary relic but an ongoing process in which land, fungal agency, and human care entwine, embodying possibilities of collaboration in a more-than-human world (Tsing 2015; Haraway 2016).

To prepare *ayonanácatl*, a medium-sized chilacayote is split in half with a machete and buried in the bone-dry soil of the late dry season. The Ozolco elder Don Carlos, performs a ritual known as *Tlalacochtli*, asking permission from distant volcanoes. He addresses the land directly, explaining his actions and petitioning its cooperation. Words in fragmented Náhuatl, heavy with meaning, blend with sacred place names: *Tonantzin*—Mother Earth—acknowledging the land’s animacy and role in transformation (González 2006; Sandstrom and Sandstrom 2022).

Celio, another local knowledge keeper, emphasizes the critical importance of timing: the preparation must align with the full moon, after maize sprouts but before the first rains. This temporal coordination resonates with cycles of agricultural and lunar rhythms, an ecological choreography where human intervention and non-human agency intersect (León-Portilla 1963; Ingold 2010). Once buried, the *chilacayote* begins its slow underground transformation under direct sunlight. For ten to fifteen days, this subterranean fermentation proceeds, contingent upon dryness; premature rains disrupt fungal development, reflecting how fungal agency is precariously tied to shifting climates and land uncertainties (Ingold 2010; González Rodrigo 2006).

When asked whether *ayonanácatl* is a mushroom or a fermentation, Celio and Alberto firmly state: “For us, it is a mushroom. For you, perhaps, you understand it in another way.” Their perspective challenges Western taxonomies that view fungi primarily through microbial decomposition rather than through relational ontologies held by the community (González 1982, 185). Guzmán (1978)

explains that “*ayo*” implies watery and juicy characteristics, highlighting fungi as generative agents that manifest culturally and ecologically beyond mere classification—*ayonanácatl* becomes an event indexing ongoing multi-species relationships (Tsing 2015; Kohn 2013).

After two weeks, a partially decomposed and fermented *chilacayote* is unearthed. The adhering soil is gently rinsed away, seeds are removed, and the transformed pulp remains. Preparation is yet another stage in this fungal-human collaboration. *Milli*’s chef simmers *ayonanácatl* with mint, *chile de árbol*, *guajillo*, garlic, and onion. Served on roasted *totomoxtle* leaves, wrapped in corn husks as tamales, or accompanied by *pipián*—a mole-like sauce thickened with squash seeds—the dish defies straightforward flavor description. Its taste is at once meaty, fishy, musty. Understanding *ayonanácatl*’s journey—its ritual emergence and fermentation—is crucial for appreciating this sensory complexity (Paxson 2013; Stoller 1989; Sutton 2010).

Making *ayonanácatl* requires skilled practice transmitted intergenerationally. One must possess “*buen mano*”—a good hand—to succeed. Celio explains children cannot perform this task; only those experienced enough may attempt it. He recalls his mother allowing him only minor tasks like scratching the earth during childhood: “If you’re not good at planting plants, you’re not good at planting *chilacayote*,” he asserts. Alberto adds, “Those with two cowlicks have the gift for making *ayonanácatl*.” Such embodied knowledges—tied intimately to personal attributes and connections with plants and soil—illustrate how fungal-human entanglements are cultivated within specific social relations and landscapes (Tsing 2020; Pink 2015; Chávez 2010).



FIGURE 62. PREPARING *AYONANÁCATL* FOR BURIAL IN DRY EARTH, OZOLCO, PUEBLA. (PHOTO BY THE AUTHOR, JANUARY 2018)



FIGURE 63. PREPARING *AYONANÁCATL*, AFTER CURING UNDERGROUND, *OZOLCO*. (PHOTO BY THE AUTHOR, JANUARY 2018)



FIGURE 64. *AYONÁNACATL* PREPARED AND PLATED AT MILLI RESTAURANT, CHOLULA, PUEBLA. (PHOTO BY THE AUTHOR, JANUARY 2025)

A cosmopolitical approach draws attention to the political dimensions of these ecological interactions, urging us to reconsider how agricultural policies and practices shape—and are shaped by—the non-human agencies they often seek to control. Integrating fungi into *milpa* systems not only enhances biodiversity but also contests dominant agro-industrial paradigms, advocating for practices that acknowledge the capacities of all beings within the field. Such an approach aligns with local and agroecological knowledge, fostering diversified agricultural systems that resist homogenization and cultivate forms of sovereignty beyond the human.

Future research must continue to explore the multifaceted *intra*-actions of fungi and other non-

human entities in agroecosystems, attending to the ways in which they contribute to sociocultural, economic, and ecological processes. What might emerge when we listen more carefully to fungal transformations, to their modes of survival, adaptation, and collaboration? How might their lifeworlds reshape our understanding of agriculture, consumption, and interspecies dependence? In following the threads of fungal agency, we might find ourselves in landscapes both familiar and strange places where the boundaries between cultivated and wild, edible and inedible, human and non-human blur into fertile terrain for new ways of thinking and growing.

CHAPTER SEVEN: CONCLUSIONS

TOWARD REASSEMBLING THE MILPA

Across the milpa landscapes of Tlaxcala, Puebla, and Oaxaca, the stories of quelites, chapulines, and cuitlacoche reveal how campesinos continually navigate and reshape the forces acting on their fields. Each of these species—herb, insect, fungus—sits at the threshold of agronomic discomfort: classified as weed, pest, and blight within industrial agriculture yet treated as food, opportunity, and companion within the everyday ecologies of campesino practice. Their presence brings into view the deterritorializing pressures that have long attempted to simplify, sanitize, and standardize highland agriculture: Green Revolution paradigms, pesticide campaigns, monoculture expansion, scientific narratives of contamination, and the economic logics that privilege uniformity over variability.

Yet these pressures never fully settle. In the hands of farmers who weed selectively, harvest at night, or coax fungal growth from damp husks, the milpa becomes a space of reterritorialization, where alternative relational orders are enacted not through resistance rhetoric but through pragmatic attention to seasonality, taste, risk, and multi-species vitality. Campesinos do not merely endure the disruptions of industrialization; they redirect them, absorbing certain elements while reasserting ecological relations that are grounded in local knowledge systems, aesthetic sensibilities, and livelihood needs. The result is a milpa that is continually reassembled—not restored to some idealized past, but made livable through improvisation, discernment, and care.

The three analytic chapters each illustrated a different mode of reassembly. Weediness, in Chapter Four: Weediness and the Politics of Purity, demonstrated how spontaneous

plants reconfigure the field through campesino judgment rather than agronomic purity. Industrial models cast these plants as contaminants, but farmers draw fine distinctions between edible *quelites* and *malezas*, thereby reterritorializing the field around use, taste, and seasonal cues instead of universalized botanical categories.

In Chapter Five: Patchy Landscapes the proliferation of *chapulines* exposed how landscape simplification—alfalfa monocultures, pesticide regimes—deterritorializes insect ecologies and accelerates the very outbreaks it seeks to control. Collectors, processors, and families respond not by rejecting these proliferations but by reworking them into economic and multi-species partnerships, transforming “pests” into seasonal livelihood strategies.

Chapter Six: Becoming Fungi revealed how fungi such as *cuilacoche* trouble dichotomies of contamination and value. Although industrial agriculture treats smut as a sign of failure, campesinos draw on sensory and experimental knowledge to cultivate fungal growth, thereby reterritorializing maize-fungal relations into food, income, and ecological pedagogy.

These cases show that reterritorialization is not a singular act but an ongoing political-ecological process distributed across milpa ecologies. It is enacted through gestures that may appear minor—a plant spared, a grasshopper separated from the morning dew, a fungal swelling left to ripen—but together reshape how landscapes function and how people inhabit them. Campesino practices emerge as negotiations that hold open the possibility of more-than-human coexistence within landscapes increasingly pressured by global agrarian transitions.

Taken as a whole, this dissertation argues that the milpa endures not because it resists industrial

agriculture in a frontal sense, but because it absorbs, redirects, and transforms its incursions. The milpa's resilience lies in its capacity to incorporate disturbance into new configurations of life, work, and meaning. This is not resilience as equilibrium but resilience as creative reassembly—an ongoing recalibration of relations among plants, insects, fungi, soils, and people. The concept of milpa reassembly thus offers a lens through which to understand how agroecosystems persist amid fragmentation, climate variability, market pressures, and shifting cultural economies.

These findings have implications for agroecological transitions. Much of contemporary policy discourse seeks to scale agroecology by replicating success stories or disseminating standardized techniques. The ethnographic material presented here suggests a different approach: one that recognizes agroecological transition as a territorial practice, emergent from the specific assemblages of place, species, and knowledge. Recampesinization—far from a nostalgic return to the past—can be understood as a process of reterritorializing landscapes through multi-species relations and local ecological knowledge, enabling communities to develop adaptive practices that are both culturally grounded and ecologically generative.

If the milpa offers any lesson for the future of agroecology, it is that transformations will be shaped not only by human intentions but also by the agencies of fungi, insects, spontaneous plants, and the ecological conditions they create. Attending to these multi-species negotiations foregrounds a more capacious understanding of agricultural possibility—one that sees diversity not as disorder but as an opening for new ecological, cultural, and ethical relations. In acknowledging these relations, we can move toward agroecological transitions that honor the complexity, creativity, and multiplicity that characterize milpa landscapes and the communities that sustain them.

THE FUTURE OF *MILPA* AGROECOSYSTEMS:

The future of milpa agroecosystems will not be determined by the linear spread of agroecological “best practices” or the top-down diffusion of technical packages. Instead, it will emerge from the same relational negotiations that shape the present milpa: the ongoing adjustments among farmers, plants, insects, fungi, soils, and institutions that continually recalibrate what agriculture is and what it might yet become. As climate variability intensifies and agricultural markets tighten their demands for uniformity, the milpa’s capacity to absorb disturbance—to reassemble itself through weeding, harvesting, experimentation, and sensory attention—will become increasingly essential.

The practices documented in this dissertation point to pathways for agricultural futures that are neither nostalgic returns to tradition nor wholesale rejections of scientific knowledge. Rather, they suggest a mode of agroecological transition grounded in **territorialized knowledge**, where campesinos, collectives, and local organizations rework external pressures through place-specific multi-species relations. Quelites, chapulines, and cuitlacoche reveal how resilience is generated through heterogeneity, not simplification; through improvisation, not standardization; through ecological multiplicity, not purity.

These findings have implications for policy and development. Supporting *milpa* agroecosystems requires strengthening the conditions under which campesino knowledge is reproduced—land tenure stability, community autonomy, intergenerational learning, and markets that value diversity rather than penalize it. It also requires acknowledging the agencies of nonhuman collaborators whose behaviors, cycles, and ecologies shape agricultural possibility. The future of the *milpa* will depend on how well institutions recognize that weeds, insects, and fungi are not merely obstacles

to production but active participants in agroecosystem health, nutrition, and adaptation.

In this light, *milpa* futures are best understood not as blueprints but as **living, multi-species projects**—patchy, creative, and always in motion. Whether confronting drought, pest cycles, disease pressures, or market volatility, campesinos will continue to negotiate the terms of cultivation in ways that exceed agronomic prescriptions. The *milpa*’s endurance lies in this capacity to reassemble itself through disturbance, drawing upon the ecological richness and moral ecologies that make it more than a cropping system. It is this generative, relational flexibility that holds the promise for sustaining biodiversity, food sovereignty, and cultural continuity in the decades to come.

The sustainability of *milpa* agroecosystems hinges on intergenerational knowledge transmission, youth engagement in farming, and supportive sociopolitical conditions. In Tlaxcala’s rural communities, elder *campesinos* stress that *milpa* cultivation is “*lo nuestro*” (“our way of life”), yet they face an aging workforce as many younger people migrate to cities. This generational shift threatens the continuity of ancestral farming knowledge. Ethnographic fieldwork in the Puebla–Tlaxcala Valley revealed both challenges and emergent strategies to secure the *milpa*’s future. For instance, in San Miguel de Milagro, Tlaxcala, an experienced farmer (Don Ramón) continues to intercrop heirloom maize, beans, and *quelites* in terraced fields much as his ancestors did. His use of saved seeds and polyculture defies the push toward commercial hybrids and monoculture, illustrating how local knowledge can endure despite modern pressures. At the same time, Don Ramón and his neighbors have innovated within tradition: they integrated amaranth as a cash crop for local cooperatives, cultivating it alongside maize rather than replacing the *milpa* system. This

adaptation allows them to earn income without abandoning biodiversity. Such local initiatives demonstrate the potential of *recampesinización* to keep *milpa* farming socially and economically viable (Rosset and Martínez-Torres 2016). In other words, the *recampesinización* of agrarian landscapes is not a nostalgic return to the past, but a forward-looking project in which *campesino* communities actively reassert control over land, seeds, and labor through agroecological practices (van der Ploeg 2018; 2008; Giraldo and Rosset 2023).

Crucially, agroecological scaling in *milpa* systems involves both ecological and social dimensions. On the ecological side, the *milpa*'s high agrobiodiversity – multiple varieties of corn, beans, squash, and *quelites* in one field, underpins its resilience to climate unpredictability. Seasoned farmers in Tlaxcala remark that “there’s always something to harvest” in a *milpa*, even in drought years or when a pest outbreak hits one crop, because other components compensate. This logic reflects a deep understanding of risk-spreading that has been passed down through generations (Toledo, Alarcón-Cháires, and Barrera-Bassols 2018). On the social side, community institutions and co-operative labor remain vital. In many Tlaxcalan villages, collective work parties still assemble to help plant or weed *milpa* plots, reinforcing social cohesion and ensuring that knowledge (such as the timing of sowing by lunar cycles, or identification of useful wild greens) is shared experientially with the younger members. Such practices align with moral economies of farming (Scott 2000), wherein subsistence security and community well-being are valued alongside market profit. Yet, sustaining these practices requires making farming a dignified livelihood for the next generation. One promising development is the formation of farmer cooperatives and alternative markets that reward agroecological produce. By participating in a regional amaranth co-operative, Tlaxcalan families have been able to sell products like *alegrías* (traditional amaranth and honey bars) at

premium prices in nearby cities. As a result, some youth in towns like Natívitas and Vicente Guerrero have shown renewed interest in farming, seeing that *milpa* agroecosystems can provide both income and cultural pride. This dynamic supports findings from the Andes that engaging younger generations in value-added traditional crops bolsters the persistence of agroecosystems (Perreault 2005).

Field observations across Tlaxcala, Puebla, and Oaxaca further indicate that integration into localized markets can reinforce rather than erode *milpa* diversity. In the Sierra Norte of Oaxaca, Zapotec farmers have introduced novel crops like watercress for sale, but they do so in ways that complement the *milpa* rather than displacing it. For example, in the village of La Nevería, community elders experimented with cultivating watercress in spring-fed pools on communal land. Younger farmers took up this idea, forming a small enterprise selling organic watercress to regional markets. Importantly, they scheduled watercress cultivation outside the main *milpa* growing season so as not to compete for land or labor. Income from this crop has, in turn, enabled some families to continue planting their *milpas* instead of seeking wage labor elsewhere. This case exemplifies how creative agroecological enterprises can scale-out – spreading within communities – and help fund the continuance of traditional agroecosystems. Similarly, near Atlixco, Puebla, *campesino* families have transformed what was once considered a blight, *cuitlacoche*, into a lucrative seasonal product through controlled inoculation techniques. With support from a state-backed program, they increased *cuitlacoche* yields and brought it to urban markets as a gourmet ingredient. This innovation shows that *milpa* products can gain new markets without compromising the integrity of the *milpa* system – in fact, it incentivizes farmers to keep planting diverse maize varieties needed for *cuitlacoche* production (Escalona-Victoria et al. 2021; McCune et al. 2022). Embracing such

opportunities allows *milpa* communities to reassert economic autonomy and invest back into sustainable farming practices (Rosset and Martínez-Torres 2016).

Significant challenges temper these hopeful trends. Many rural youths still view *milpa* farming as labor-intensive and economically precarious compared to urban jobs. In interviews, Oaxacan teenagers from farming families often expressed admiration for their elders' knowledge but doubted that "growing corn and beans" could secure their futures in a cash-based economy. Their ambivalence highlights the need for supportive public policies to make small-scale farming more remunerative. Recent agroecological policy efforts in Mexico – such as the recognition of maize as part of the nation's biocultural heritage and the prohibition of GM corn imports – are steps that may bolster *campesino* agriculture by valuing heirloom seed and local production. Likewise, the *Sembrando Vida* program, which pays rural residents to plant trees and agroforestry systems, has indirectly encouraged some families to incorporate fruit trees on *milpa* margins, blending traditional and new agroecosystems. While not without criticisms, such policies indicate a shifting policy landscape that could be leveraged to support *milpa* farmers (Altieri and Nicholls 2020). Ultimately, the future of *milpa* agroecosystems will depend on scaling-up these kinds of supports and innovations. It requires a multi-pronged approach: strengthening farmer-to-farmer networks for knowledge exchange, creating economic incentives for biodiverse production, and enacting policies that protect *campesino* land rights and seed sovereignty. The ethnographic evidence from Tlaxcala, Puebla, and Oaxaca suggests that when *campesino* communities are given the means to adapt on their own terms, they actively engage in what Martínez-Torres and Rosset (2015) describe as reterritorialization – reclaiming their territories through agroecology. This reterritorialization is a cornerstone of *recampesinización*, wherein peasant families revive and reimagine traditional

practices to sustain both their livelihoods and cultural landscapes. By anchoring agroecological scaling in local knowledge and social organization, *milpa* communities are charting a path toward a resilient future that resists the industrial agri-food regime and re-centers peasant autonomy. In sum, the *milpa*'s future will be secured not by any single technological fix, but by empowering the *campesino* ethos of cooperation, diversity, and adaptation to flourish at larger scales (Giraldo and Rosset 2018; Toledo and Barrera-Bassols 2017).

REASSEMBLING THE *MILPA*: SCALING-UP AGROECOLOGY

Milpa agroecosystems offer a compelling model for scaling-up agroecology, precisely because they function as a reassembled tapestry of crops, wild species, and cultural practices working in concert. The “*milpa* assemblage” – maize interplanted with beans and squash, interspersed with self-sown greens, insects, and fungi – encapsulates the core principles of agroecology on a small-scale. Scaling-up agroecology, then, does not mean reproducing the *milpa* identically everywhere; rather, it involves generalizing the *milpa*'s logic of biodiversity, synergy, and adaptability to broader contexts (Altieri and Nicholls 2017). Anthropological theory helps frame this process. Drawing on Bruno Latour's notion of assemblages, we can see the *milpa* as an assemblage of human and non-human actors whose interactions produce emergent properties (Latour 2005). These multi-species interactions ; corn stalks providing bean trellises, bean roots fixing nitrogen for the corn, squash leaves shading out weeds, *quelites* contributing vitamins to human diets and pollen for beneficial insects ; create a resilient agroecosystem greater than the sum of its parts. In practice, *campesino* and Indigenous farmers “reassemble” these elements each season, adapting to microclimate and community needs. Scaling-up agroecology means leveraging such *milpa* assemblages at larger scales (e.g. regional food systems or national policy) while maintaining their

diversity and reciprocal relationships (Giraldo and Rosset 2023).

Ethnographic evidence presented in this dissertation illustrates how *milpa* principles are being scaled out and translated into new settings. In the peri-urban fringes of Puebla city, for example, some enterprising urban gardeners have adopted *milpa* polycultures in community gardens and vacant lots. One co-operative garden project on Puebla's outskirts planted the "three sisters" of maize, beans, and squash in raised beds, and allowed *quelites* like *verdolagas*, *quintoniles* to grow voluntarily among them. Garden members reported fewer pest problems and richer soil compared to plots where they had previously grown single crops. Inspired by traditional *milpas*, they also began intercropping marigolds and other flowers to attract pollinators, creating a small-scale replica of the *milpa*'s complexity. This example shows how urban and peri-urban agriculture can reassemble elements of the *milpa*, effectively scaling agroecological practices into new socio-ecological contexts. It also highlights that scaling-up is not merely a technical endeavor but a cultural one: urban participants had to learn from rural knowledge, in some cases inviting *campesino* elders to share planting techniques and recipes for unfamiliar greens. Such dialogue of knowledges aligns with what Rosset and Martínez-Torres (2012) describe as *diálogo de saberes* a crucial process in agroecological movements that ensures scientific, local and traditional knowledge co-create sustainable practices.

Another dimension of scaling-up agroecology is massification; the horizontal spread of agroecological practices across communities and regions (Ferguson et al. 2019). The *milpa* has proven remarkably scalable because its components are locally accessible and low-cost. Seeds of corn, beans, and squash are traditionally saved and exchanged among families, and wild greens

and fungi propagate themselves. This self-organizing aspect allows farmers to expand milpa plots or help neighbors start their own with minimal external inputs. In practice, we see milpa expansion where social networks support it. In one case, a successful milpa cultivator in Tlaxcala shared her surplus seeds and seedlings with relatives in a nearby town who had lost their crop to erratic weather. The following season, those relatives not only replanted their milpa with the gifted seeds but also incorporated some of the donor's techniques (such as planting leguminous cover crops after the main harvest to restore soil fertility). Over time, such peer-to-peer sharing can lead to a patchwork of milpa fields revitalizing a landscape ; a scaled-up assemblage in which each farm is a node of agroecological knowledge. Indeed, historians of agriculture note that the milpa itself spread across Mesoamerica over centuries through Indigenous seed exchange and collective adaptation, rather than top-down mandate (Bellon et al. 2018). Contemporary agroecology movements seek to replicate this Campesino-a-Campesino diffusion model in speeding the adoption of sustainable farming (Rosset and Martínez-Torres 2012).

Scaling-up also involves integrating *milpa* agroecosystems into higher-level structures like markets and policy frameworks, without losing their ecological integrity. This is a delicate balance. On one hand, bringing *milpa* products into commercial circuits can enhance their value and reward farmers for biodiversity. The surge in popularity of *quelites* in trendy restaurants and farmers' markets, for example, has created niche income sources for *milpa* cultivators. In Oaxaca's central valleys, women who harvest seasonal *quelites* from their *milpas* now sell bunches in urban organic markets, educating consumers about these plants' culinary and nutritional virtues. Their success demonstrates that traditional agroforestry foods can gain broader appeal, encouraging the continuation of diverse cropping. On the other hand, ethnographic observation warns of potential

pitfalls: some producers, driven by market demand, start specializing in one or two commercial species at the expense of others. In Xochimilco, which has ancient chinampa agroecosystems akin to *milpas*, researchers noted that several farmers began monocropping *quintoniles* or verdolaga in response to high demand from farm-to-table restaurant suppliers. While economically profitable in the short-term, this practice reduced the polycultural nature of their chinampas and increased their vulnerability to pests and price fluctuations. This cautionary tale underscores that scaling-up agroecology must go hand-in-hand with preserving agricultural diversity and the ethos of the *milpa*. Policies and market arrangements should incentivize whole-system health (e.g., added value for agroecological products) rather than single crop yield (Giraldo and McCune 2019).

The project of “reassembling the *milpa*” invites a rethinking of human–environment relationships. It challenges the industrial paradigm that measures success in narrow yield or profit terms, proposing instead a vision of food systems as multi-species assemblages. As multi-species ethnographers have argued, sustainable futures depend on recognizing our interdependence with other lifeforms (Kirksey and Helmreich 2010; Haraway 2016). The *milpa* is a lived expression of this principle: farmers manage an ecosystem by collaborating with plants, insects, and microbes, not merely extracting from them. When agroecologists advocate scaling-up such an approach, they are also scaling-up an ethical stance that values co-production of food with the land. In field interviews, many *milpa* farmers expressed this ethic in practical terms. For example, farmers in Oaxaca described leaving a portion of their harvest in the field or on stalks for wildlife and soil organisms, a practice resonant with the idea of reciprocity in Indigenous cosmologies. One farmer said, “We feed the *milpa*, and the *milpa* feeds us,” encapsulating a non-anthropocentric mindset. Translating this to policy, governments and institutions must support practices that allow for such

reciprocity; for instance, by not penalizing farmers for maintaining hedgerows or fallows (which harbor biodiversity) as part of their cultivation cycle. Supporting agroforestry *milpa* systems, where fruit trees or forest patches are integrated, is another way to scale the assemblage idea into landscape-level planning (Altieri and Nicholls 2020).

Scaling-up agroecology through the lens of reassembling the *milpa* involves replicating the *milpa*'s diversity, knowledge-sharing networks, and ethical commitments on broader scales. It means empowering farmers as custodians of complex agroecosystems rather than as commodity producers. The cases from Puebla, Tlaxcala, and Oaxaca demonstrate that this is already happening in grassroots ways: cooperatives, seed exchanges, community markets, and participatory research projects are all part of enlarging the scope of *milpa* agroecology. Each new context; whether an urban garden or a regional policy; requires a careful “reassembly” of *milpa* elements tailored to that environment. By maintaining the flexibility and inclusivity of the *milpa* assemblage, agroecology can be scaled-up without losing its soul. Emancipatory agroecology, as Giraldo and Rosset (2023) argue, challenges capitalist agricultural regimes by reinforcing peasant autonomy, knowledge, and biodiversity. The *milpa*, with its open-ended assemblage of species and practices, exemplifies these principles and serves as a beacon for scaling agroecology in a way that remains rooted in social justice and ecological resilience (Santiago-Vera et al. 2021). In effect, every time a community garden plants a *milpa*, or a new region adopts *milpa*-inspired rotations, we witness a reassembling of the social and ecological relations of food production; a hopeful sign that the broader food system can move away from homogenization and toward a more rhizomatic, life-sustaining model.

AGROECOLOGICAL TRANSITIONS: *RECAMPESINIZACIÓN* AND THE REASSEMBLY OF THE *MILPA* LANDSCAPE

Agroecological transitions in Mexico are deeply intertwined with processes of *recampesinización* –the revitalization of peasant lifeways;– and the material reassembly of landscapes through *milpa* farming. From the volcanic slopes of Puebla to the highland plains of Tlaxcala and the cloud forests of Oaxaca, ethnographic evidence shows *campesino* communities actively reshaping their environments in response to ecological and economic pressures. This reassembly is not merely about crop choice; it involves reweaving social, spiritual, and territorial connections that industrial agriculture had frayed. Anthropologist Anna Tsing (2015) reminds us that landscapes are not static backdrops but emergent from interactions, what she calls “patchy assemblages” of life. The *milpa* landscape is one such assemblage – a patchwork of cultivated fields, fallows, hedgerows, and forests co-produced by humans and myriad other species. As communities undergo agroecological transitions, they effectively reassemble this patchwork, incorporating new elements and restoring old ones in pursuit of resilience.

Consider Vicente Guerrero, Tlaxcala, in which community members pointed out how portions of the landscape had “lost their *milpa*” in the 1990s and 2000s, resulting in more erosion and loss of soil fertility. Yet by 2019, a noticeable reassembly was underway: several families had returned to *milpa* farming on previously monocropped plots, aided by a local program promoting soil conservation and heirloom seed use. One plot, which had been a uniform swath of malting barley for a beer company contract, was now a diversified *milpa* with maize, beans, squash, and *cempoalxóchitl* flowers. The farmer, a middle-aged man who left a factory job to take over his father’s land, explained that he made the switch after the price to maintain the small-scale *milpa*

became unsustainable. By reviving the *milpa*, he not only regained subsistence food and a variety of secondary products (like fodder or *quelites*) but also saw improvements in soil structure within two seasons. His experience echoes Jan van der Ploeg's (2018) argument that re-peasantization is a future-oriented strategy: it involves embracing traditional methods as innovation to create more autonomy and sustainability, rather than a backward step. In this case, the transition was facilitated by the farmer's blending of old and new knowledge – he used composting techniques learned from an agroecology workshop with seed selection wisdom local and traditional knowledge. The outcome is a reassembled *milpa* landscape that is visibly more heterogeneous and robust, illustrating how *recampesinización* materializes on the ground as ecological complexity.

RHIZOMATIC RESEARCH DIRECTIONS

Future research should further investigate the intersections of *milpa* agroecosystems with global agroecological movements, particularly in the context of *recampesinization* and reterritorialization. Studies could explore how social movements and policy interventions influence the preservation and adaptation of *milpa*, examining the ways in which *campesino* communities negotiate land access, labor conditions, and environmental change.

A deeper engagement with the ecological dynamics of *milpa* systems could illuminate the long-term resilience of these assemblages under conditions of climate change. Investigating soil microbiota, pollination networks, and species interdependencies within *milpa* agroecosystems would provide a richer understanding of their ecological stability and adaptability.

Comparative research on multi-species interactions in other traditional agricultural systems worldwide could further contextualize the findings of this research. By examining analogous

polycultural farming practices in Latin America, Africa, and Asia, scholars could contribute to a more comprehensive framework for understanding the role of multi-species assemblages in agroecological sustainability.

Through these avenues of inquiry, future research can continue to build upon this research's empirical and theoretical contributions, reinforcing the relevance of *milpa* agroecosystems in shaping sustainable and just food systems for the future.

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APPENDICES

APPENDIX 1. ORIGINAL RESEARCH QUESTIONS

How have certain species emerged as socially and environmentally ‘good’ in *milpa* agricultural systems, and how are they imagined and desired differently by actors throughout the ‘foodscape’ in highland Mexico?

How does the ‘gourmandizing’ of certain species through culinary heritage initiatives modify the material practice of making *milpa* and its resulting agrobiodiversity, as well as its symbolic and cultural significance?

How can (re)conceptualizing *milpa* as an assemblage expand our understanding of the multiple connections and relationships among beings across time and space embodied in the *milpa*, and how might this influence the practices of various actors and institutions?

APPENDIX 2. EXAMPLES OF SEMI-STRUCTURED INTERVIEW QUESTIONS

QUESTIONS FOR CHEFS:

How do you feel about the production of this food?

How would you like to present this product to the consumer?

How do you think that the producer feels about how this is prepared/presented/consumed?

How do you feel about preparing and serving these species?

At what points do you come into contact with this food?

QUESTIONS FOR CONSUMERS:

How do you imagine where this food comes from?

What would be the way you would like this food to be produced?

How do you feel about eating insects, fungi, and wild food?

What do you consider good to eat? Wilder? More organic? Or more modern?

How do you feel these foods are connected to nature?

How do you feel food consumption affects the environment?

At what points do you come into contact with this food?

QUESTIONS FOR VENDORS:

How do you feel about the production of this food?

How do you feel about the people who produce it?

How do you feel about eating insects, fungi, and wild food?

At what points do you come into contact with this food?

QUESTIONS FOR PRODUCERS:

What do you imagine about the people who consume this product?

How is your relationship with the chefs/consumers/vendors?

How has your relationship with these foods (species, actors) changed?

How has your relationship with the *milpa* changed?

How do you feel about producing this food?

How do you feel connected to this place?

How would you like to see this food consumed?

During the species' life, at what points do you come into contact with it?

QUESTIONS FOR SCIENTISTS:

What has changed about the production of this food?

Who benefits from the production of this food?

How are the species different from fully domesticated species?

Are these wilder? Or more domesticated species?

How do these species act differently from other better-known domesticated species?

Who might benefit from the domestication of the species?

How might eating these species protect the climate/environment?

What is the appeal, and what is the barrier to making this species more widely available?

OBSERVATIONS OF SPECIES:

How do species interact with humans/nature?

How do species relate and change in place?

How is this related to the place/space of the *milpa*?

How are species produced in relation to science?

How are species relationships with culture?

How are species relationships with farmers?

How are species' relationships with vendors?

How are species' relationships with consumers?

APPENDIX 3. PANEL ON RESEARCH ETHICS TCPS 2: CORE CERTIFICATE OF COMPLETION

PANEL ON
RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE

Certificate of Completion

This document certifies that

Kyle Piispanen

*has completed the Tri-Council Policy Statement: Ethical Conduct
for Research Involving Humans Course on Research Ethics (TCPS 2:
CORE)*

Certificate # 0000421014 Date of Issue: 8 May, 2018