12. The Future of Food

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There is no denying our food system is in crisis. Conventional agriculture, propelled by the agricultural innovations of the 1970s Green Revolution, has led to unprecedented global food production (Patel 2013). However, despite these advancements, hunger continues to afflict one in every ten people worldwide (UN News 2023). The expansion of mechanized, large-scale, corporate-driven agriculture has wrought havoc on society and the environment. Rural communities are contending with a burgeoning health crisis, exposed as they are to the toxic fallout of agrochemical spraying (Harrison 2011; Leguizamón 2020). The expansion of agricultural frontiers encroaches on peasant and Indigenous territories, instigating violent conflicts and dispossession. The toll on natural resources is alarming, resulting from contamination and depletion of water and soil and rampant deforestation. The global food system is responsible for a quarter of greenhouse gas emissions contributing to climate change (Lynch et al. 2021). To confront this crisis, we must rethink food provisioning on the local, regional, and world scales.

The future of food is already underway and is taking two divergent paths. One is the path of ecological modernization, advanced by corporations with cutting-edge technologies. The other is the agroecological movement, presented by Indigenous and peasant movements. As the chapters in this final section demonstrate, not all futures are equally possible—contemporary power structures, ideologies, and institutions constrain what paths we can take. Yet this chapter takes a stand for the agroecological way as a paradigm shift. I position myself alongside Latin American critical social scientists who make a theoretical and epistemological commitment to question and affirm the role of academics and higher education institutions in the social construction of knowledge (Lander 2000). As such, and in line

with the collective efforts presented in this volume, I present the agroecological movement as a future for social and ecological justice.

This chapter begins by explaining why food needs a future. The following section introduces the reader to how we got to where we are: the globalized, corporate food system. This will not be exhaustive, as it is not possible to summarize existing literature; nor is that this volume's goal. I do, however, provide citations that will guide the novice reader on the sociology of food and agriculture if they want to read more about this topic. Instead, I take a bird's-eye view looking over the long duration of the spread of capitalism through the expansion of agrarian frontiers. I highlight unequal power dynamics in decision-making over the control of natural resources and technological innovation, as well as defining the narratives, ideologies, and epistemological frameworks that sustain and legitimize them, in particular, a binary, hierarchic distinction that leads to the social control and conquering of nature. The following sections present the two paths for the future of food: one, of food grown in labs by robots, and two, of the agroecological movement. Finally, the conclusion summarizes and revisits the call for agroecology as a socially just and environmentally sustainable alternative to the corporate food system.

HOW WE GOT WHERE WE ARE

We need to take a world-historical view to understand the global food crisis. The transition from local farming cultures to large-scale commercial agriculture has its origins in the colonial division of labor (McMichael and Weber 2021). During the seventeenth and eighteenth centuries, European colonial powers (such as Spain, Portugal, and Britain) set a pattern of extraction across their colonies in the Americas, Asia, and Africa. The colonies specialized in extracting raw materials and producing primary goods, such as silver and gold, spices, cacao, sugar, and cotton, which were exported and exchanged for European manufactured goods and African slaves. In *Sweetness and Power*, Sidney Mintz (1986) traces the environmental history of sugar from a rare luxury to an everyday staple. He shows how the so-called "triangle of trade" fed British factory workers while providing an overseas market for their manufactured goods, creating a system of unequal ecological exchange, where the land and labor of the New World subsidized the Industrial Revolution, the rise of capitalism, and nineteenth-century British hegemony.

The imperial thirst for sugar, spices, and profits decimated people and places worldwide. Raj Patel and Jason Moore (2017) trace the historical

roots of the climate crisis to Madeira, a small African island in the Atlantic Ocean. In the 1500s, the Portuguese deforested the island, first for lumber and then for wood, to fuel a new system for sugar production and distribution. Amitav Ghosh (2022) traces it to the Banda Islands in the Indian Ocean, where, in the 1600s, the Dutch burned down towns and massacred their inhabitants to grow nutmeg as a commodity for the spice trade. These stories and their authors teach us to look for the historical roots of contemporary socio-ecological disruption in colonialism and the rise of capitalism. It is at this time that a pattern of extraction for capital accumulation through the expansion of frontiers is established (Patel and Moore 2017). There also arises a particular way of knowing and being in the world: A modern, Eurocentric mentality that established a hierarchic, dichotomic distinction between nature and society, which continues to justify and promote the conquest and domination of non-European peoples, cultures, and terrains (Ghosh 2022; Patel and Moore 2017).

These are the seeds of the modern commercial food economy. The colonies, later the Third World and presently the Global South, were reduced to specialized export monocultures (exemplified by sugar, bananas, and soybeans) to meet foreign needs. Plantation monocultures established agro-industrial logics—large in scale, reliant on constant investments in technological innovations to increase efficiency and productivity from labor and nature, with a relentless pursuit of homogenous, reliable (controllable) harvests—all of which aimed to grow food as a commodity for profit. It first happened in the sugar plantations in the British West Indies, with its innovative combination of field and factory under one authority, the organization of skilled and unskilled labor force around the productivity of the plantation, and a strict, time-conscious scheduling (Mintz 1986).

The banana plantation in twentieth-century Central America intensified these trends, becoming larger in scale, with a more complex division of labor, and operating at a quicker pace while incorporating substantial innovations: large, transnational corporations monopolizing land and transport routes (the origins of vertical integration) and an inclination to address the ecological problems resulting from industrial monocultures with further rounds of technological innovation, including fossil fuels and chemicals. In *Banana Cultures*, John Soluri (2005) presents the environmental history of the expansion of banana monocultures in Honduras. Bananas were grown for mass production and importation to the United States by a handful of companies that, with time and a series of mergers, would first become the United Fruit Company and later, Chiquita, currently one of the largest banana exporters in the world. In Honduras, fruit companies' engineers

drained swamplands and cut down forests in the name of modernity and progress to make room for banana export farms. In an effort to control plant disease epidemics, fruit companies funded expensive breeding programs to develop pest-resistant varieties of bananas. When those efforts failed, scientists depended on chemical treatments; as a last resort, they abandoned the infested farm and expanded the agrarian frontier.

In the twenty-first century, soybean monocultures have perfected agroindustrial dynamics. Soybeans are the darling crop of the **corporate food regime**, the dominant form of contemporary global food provisioning (McMichael 2013).[1] Transnational corporations source soybeans interchangeably from Argentina, Brazil, or Paraguay to feed intensive animal farming operations worldwide and increasingly in Asia (Oliveira and Hecht 2016). I study soybean production in Argentina, the third-largest grower and exporter of soybeans worldwide (Leguizamón 2014, 2020). During my fieldwork, soybean farmers told me the crops they grow are not to feed their families. They grow soybeans as a commodity for profit in fully mechanized large-scale farms. Soybean producers employ a technological package of genetically modified (GM) seeds, no-tilling machinery, and glyphosate herbicide to cut labor and input costs, simplify production practices, and increase profitability. Proponents of GM crops argue technological innovation will solve global hunger, poverty, and climate change. Yet, in practice, the expansion of the GM soybean frontier in Argentina has brought violent dispossession and displacement, deforestation, and illness and death owing to exposure to toxic agrochemicals.

Discourses and epistemologies are embedded in and legitimize the historical, global expansion of agrarian frontiers to establish export monocultures. Vandana Shiva (1993) presents "monocultures of the mind" as a metaphor to critique the dominant, narrow, and homogenizing ways of knowledge-and technology-transfer systems, which are promoted by corporations and institutions of the Global North over the agricultural systems and peoples of the Global South. Boaventura da Souza Santos (2014) speaks of "monocultures of knowledge" to critique the dominant Western epistemological framework, which tends to prioritize and valorize formal, instrumental, and economic rationality over other knowledges. Moving forward, I analyze the two emergent paths toward the future of food as they reproduce or challenge capitalist power dynamics over resource use and technological innovation (the relentless expansion of frontiers for capital accumulation) and the epistemic narratives that sustain it (the dominant, monoculture mentality that seeks to make nature "efficient" and profitable).

LABS AND ROBOTS

Technological innovation in food production promises to grow more food using fewer resources. As land and water become increasingly scarce and the world population grows, and as farmers and consumers grow concerned about toxic agrochemicals and animal cruelty, one alternative future path for food provisioning is the path of **ecological modernization**. This path aims to address the socio-environmental impacts of agro-industrial production with green technology (Buttel 2000). Let me show you what this looks like.

In a cotton field in Arkansas, a Silicon Valley engineer is testing a robot weeder (Little 2019:88–109). The robot is hitched to the back of a tractor, connected to eight computers, twenty-four live-feed video cameras, and three large tanks filled with agrochemicals. A software engineer perched in the tractor cab follows the live video of the ground beneath the robot. The robot scans the cotton plants and, in a split second, distinguishes the plant from the weed and applies a targeted dose of chemical herbicide. Thus, instead of applying lots of more toxic chemical herbicides—the conventional path of agro-industrial practices—the robot weeder is a form of precision agriculture that aims to lower chemical use, thus reducing the environmental impact and saving farmers money on expensive chemical inputs.

In California, scientists and engineers from UPSIDE Foods and GOOD Meat grow meat in laboratories (NPR 1A 2023). To make cultivated meat, scientists extract cells from an egg or living animal (mostly chicken).[2] The cell line is then placed into a steel tank bioreactor called the "cultivator," where cells are fed with amino acids, vitamins, fats, sugar, and salts. Two to six weeks later, the grown cells are "harvested." The final step is to give this mass of cells the shape, taste, and texture of meat (for example, to make it look and taste like a chicken breast)—a process achieved using 3-D printing, extrusion, and molding technologies. Cultivated meat promises to replace conventional animal farming, which is cruel to animals and harmful to the planet (animal farming releases methane and carbon dioxide in addition to the social and environmental costs of growing commercial crops like corn and soy to feed them).

Meanwhile, in Argentina, soybean producers and agribusiness leaders claim that knowledge holds the key to growing more food to address world hunger and poverty with minimum ecological impact (Leguizamón 2020). They argue that the future of agriculture and sustainable development lies in corporate-sponsored scientific and technological developments, like genetically modified crops and no-tilling machinery, and in novel arrange-

ments for land and labor. The new agricultural paradigm advanced by Los Grobo, one of the largest agribusinesses in Argentina and the world, is known as the "knowledge-based network model." The model is centered on building a network of input and service providers, including landowners, agronomists, contractors, and branch managers. Therefore, instead of owning land and machinery and hiring farm workers, the company operates through land leases and third-party contracting. In the agribusiness paradigm, the value of agriculture thus lies not in the material conditions that make it possible (land, labor, climate) but in the expert knowledge to manage and organize production and in the scientific knowledge to develop new agricultural technologies. As J.P. Sapinski demonstrates in chapter 10, corporations actively create and promote discourses that make their dominance appear natural and necessary. In agriculture, this includes presenting corporate-controlled technological and organizational "knowledge" as the only path to addressing global food challenges, while obscuring how this same corporate control perpetuates hunger and environmental degradation.

These examples share a vision for the future of food provisioning based on the promise of ecological modernization. Corporate leaders and scientific experts advance a model for agriculture that seeks to achieve food security in the most efficient, allegedly sustainable, and profitable manner. They seek to overcome the environmental exhaustion and pollution resulting from the centuries-old expansion of agro-industrial monocultures with yet more technological innovation. The discourse that sustains capitalist accumulation reproduces the monoculture mentality of Western modernity. Agribusiness leaders and experts seek to "feed the world" by making the natural conditions that support food production efficient, measurable, reliable, and profitable. What could be more rational and efficient than growing a chicken from a cell in a bioreactor or, as in Argentina, to farm with technocratic "knowledge"?

The digital technologies of precision agriculture (robot weeders and satellites, computers, and nanotechnology sensors, among others) allow the experts to monitor and manage fields from a distance (Leguizamón 2016, 2020). The distance between those who decide what is grown, the farm, and what is eaten, further increases with the financialization of the food system. We see it in the financialization of commodities (Clapp 2014), land (Fairbairn 2014), and the outpouring of venture capital to finance technological development in food production. For example, UPSIDE Foods raised funds from corporate tycoons Bill Gates and Richard Branson, the world's largest poultry producer, Tyson Foods, and investment companies like SoftBank Group, Norwest, and Temasek.[3]

A future of food characterized by increasing digitalization and financialization of the corporate food regime further exacerbates unequal power dynamics over decision-making and the uneven distribution of costs and benefits. As Holly Buck argues in chapter 11, environmental sociologists' concerns over technological innovations are not about the technologies themselves. The key question is about who controls them and to what ends. This future for food reliant on labs, robots, and venture capital continues to grow what Phil McMichael (2013) calls "food from nowhere" (18). The globalized nature of the food system persists, and the disconnect between food production and consumption increases. Consumers continue to be unaware of where their food comes from, how it is produced, and the social and environmental implications of its production. Food is only available for those who can pay for it. The cotton grown by robots in Arkansas and the soybeans grown with "knowledge" in Argentina continue to be grown as plantation monocultures for export. Lab-grown meat is currently produced on a small scale (and is neither profitable nor efficient), so UPSIDE and GOOD Food CEOs are actively seeking capital to scale up (NPR 1A 2023). Furthermore, not one of the examples I presented has replaced food conventionally grown by the corporate global food system—they have only added new products and technologies. Capital has efficiently expanded into new frontiers to accelerate accumulation.

THE AGROECOLOGICAL MOVEMENT

Agroecology is a science, a farming method, and a movement. As a science and method, agroecology seeks to integrate ecological concepts and principles into the design and management of sustainable farming systems (Altieri 2019). Agroecologists promote the diversification of farming systems to minimize dependence on external inputs and increase productivity and resilience. For example, polycultures, crop-livestock combinations, rotations, and agroforestry systems, among other management practices. For rural social movements in Latin America and beyond—as advanced by the transnational peasant movement, La Vía Campesina—agroecology is more than the technical dimensions of the farming method: it is a radical movement for social, environmental, and climate justice (Altieri and Toledo 2011; Martínez-Torres and Rosset 2014; Svampa and Viale 2020).

Agroecology as a scientific discipline had its origins between the 1930s and 1960s in Russia and Germany (Wezel et al. 2009). Agroecology as a science and a practice reemerged in Latin America in the 1980s (Altieri and Nicholls 2017). The field, traditionally dominated by agronomy and ecol-

ogy, was influenced by critical social sciences, such as anthropology, rural sociology, and development studies, which called to center the experiential agroecological knowledge of farmers. During the 1980s and 1990s, agroecology expanded across the region owing to nongovernmental organizations (NGOs) adopting agroecological methods to address the negative social and ecological impacts of the Green Revolution. The NGOs saw agroecology as an alternative to inefficient top-down approaches to address rural development, poverty, and land degradation. Since the turn of the twenty-first century, agroecology has expanded rapidly throughout Latin America thanks to new forms of collaborations between rural movements, NGOs, and academics that blend agroecological science and Indigenous knowledge systems (Altieri and Nicholls 2017; Altieri and Toledo 2011).

Agroecology as a movement emerges as a challenge to the expansion of the agribusiness frontier into Indigenous and peasant territories (Rosset and Martínez-Torres 2012). As Diana Stuart argues in chapter 14, while the global environmental crisis can feel overwhelming, falling into defeatism only serves to maintain the status quo. Movements like La Vía Campesina (LVC) demonstrate how local initiatives can effectively challenge corporate power while building real alternatives. LVC is an international movement composed of social movements and organizations of peasant and family farmers, Indigenous peoples, rural women and youth, landless peasants, and farm workers worldwide. By 2022, its thirtieth anniversary, LVC comprised 182 local and national organizations from eighty-one countries across Asia, Africa, Europe, and the Americas (La Vía Campesina 2023). LVC has been strategic in promoting agroecology as a farming method to recover soils degraded by industrial agriculture and regain peasant autonomy by minimizing dependence on external inputs. As Rosset and Martínez-Torres (2012, 2014) argue, LVC has been particularly strategic in promoting agroecology as a framing for collective action for Indigenous and peasant control over their territory and their ways of knowing and being in the world.

Agroecology as a movement thus encompasses concrete struggles over the natural resources that sustain life and a challenge to the "monocultures of knowledge." Compared to top-down, profit-motivated, expert approaches to farming imposed by the agribusiness model, agroecology as a movement advances a horizontal approach to sharing knowledge built on previously undervalued local and Indigenous knowledges and worldviews. Agroecology as a movement expands and is sustained through *diálogo de saberes* and *campesino-a-campesino* networks and processes. *Diálogo de saberes* is a concept and a method implemented by LVC member movements in Latin America that translates as "dialog among different knowledges and ways of

knowing" (Martínez-Torres and Rosset 2014, 980). As Enrique Leff (2011) argues, *diálogo de saberes* is central to environmental epistemology (that is, how we know and understand the environment), as it emphasizes the importance of bringing together different forms of knowledge, including scientific, traditional, Indigenous, and local knowledge, to address environmental challenges. It invites creating a space for dialogue and collaboration between diverse knowledge systems, recognizing the need to move beyond a purely scientific approach to environmental issues and incorporate the wisdom and knowledge embedded in different cultural, social, and ecological contexts. That is, as Michael Warren Murphy (chapter 7) argues, to emphasize insights gathered from subaltern standpoints. The *campesino-a-campesino*, or farmer-to-farmer, movement, is a peasant-driven process of technological innovation that originated in the highlands of Guatemala in the 1980s from Kaqchikel Mayans and Mexican farmers (Holt-Giménez 2006). This movement recognizes the expertise that farmers have gained through their own experiences and emphasizes the importance of a horizontal exchange of knowledge and skills. Since the 1980s, the *campesino-a-campesino* methodology has been strategic to disseminating and scaling up agroecological practices across Central America, Mexico, Cuba, and Brazil (Altieri and Toledo 2011; Bernal et al. 2023).

Diálogo de saberes, as a methodology, has served to promote agroecology as a farming method and for the collective construction of *food sovereignty* as a collective frame for resistance (Martínez-Torres and Rosset 2014). La Vía Campesina defined **food sovereignty** in the 2007 *Declaration of Nyéléni* as:

> the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations. It defends the interests and inclusion of the next generation. It offers a strategy to resist and dismantle the current corporate trade and food regime, and directions for food, farming, pastoral and fisheries systems determined by local producers and users. Food sovereignty prioritises local and national economies and markets and empowers peasant and family farmer-driven agriculture, artisanal—fishing, pastoralist-led grazing, and food production, distribution and consumption based on environmental, social and economic sustainability. Food sovereignty promotes transparent trade that guarantees just incomes to all peoples as well as the rights of consumers to control their food and nutrition. It ensures that the rights to use and

> manage lands, territories, waters, seeds, livestock and biodiversity are in the hands of those of us who produce food. Food sovereignty implies new social relations free of oppression and inequality between men and women, peoples, racial groups, social and economic classes and generations. (La Vía Campesina 2007)

Food sovereignty stands in opposition to the calls for food security advanced by corporate leaders, government officials, and international organizations like the United Nations. Food security refers to "access to sufficient, safe, and nutritious food," while food sovereignty explicitly targets the right to social control over the food system (Patel 2009). Food sovereignty challenges unequal power dynamics over the control of natural resources and the narratives that sustain those dynamics. In opposition to "food from nowhere," the call for food sovereignty shortens the distance between producers and consumers by relocating food production processes.

CONCLUSION

The future of food is at a crossroads, navigating divergent paths shaped by competing ideologies and approaches. The historical trajectory from the colonial origins of export monocultures to today's corporate-driven agriculture reveals the evolution of our food provisioning systems and the deep-seated inequalities and ecological ramifications resulting from the constant expansion of agrarian frontiers for capitalist accumulation.

The expansion of these agricultural frontiers, marked by the monoculture mentality of Western modernity, has given rise to a corporate food regime that prioritizes efficiency, profitability, and technological innovation. From robot weeders in Arkansas to lab-grown meat in California and the knowledge-based network model in Argentina, the narrative of ecological modernization claims to deliver a future where science and technology alleviate the environmental impacts of agro-industrial practices.

However, this path raises critical questions about unequal power dynamics in decision-making and the distribution of costs and benefits. The increasing digitalization and financialization of the food system, coupled with a growing disconnect between producers and consumers, underscore the need for a more just approach. As we consider the implications of a future reliant on labs, robots, and venture capital, it becomes apparent that efficiency alone cannot address the underlying issues of social justice, environmental sustainability, and global inequality embedded in our food system.

In contrast, the agroecological movement emerges as a beacon of hope and transformative potential. From its roots as a science and method in the

twentieth century, agroecology has evolved into a dynamic movement championed by Indigenous and peasant movements, challenging the relentless expansion of the agribusiness frontier and advocating for social, environmental, and climate justice. The integration of ecological principles, the emphasis on local and Indigenous knowledges, and the promotion of food sovereignty redefine the contours of a just and sustainable food future.

The agroecological movement, propelled by initiatives such as *diálogo de saberes* and *campesino-a-campesino* networks, not only seeks to recover degraded soils and promote resilient farming systems but also challenges the prevailing "monocultures of knowledge." The call for food sovereignty articulated by La Vía Campesina stands in stark contrast to the narrow focus on food security, advocating for the right to social control over the entire food system.

The chapters in this third and final section of this volume reveal how contemporary power structures, technological systems, and social inequalities are deeply intertwined in shaping our ecological relationships and possible futures. At stake is not just *who* controls institutions and technologies but *how* these shape our relationships with the environment and with each other. The divergent paths for the future of food exemplify these interconnections: ecological modernization represents the continued dominance of corporate institutions and their approach to technological innovation, while the agroecological movement offers an alternative that fundamentally challenges existing power structures while advancing different forms of knowledge and technology in service of social and ecological justice.

As we stand at the crossroads of these two divergent paths, the imperative is clear. The future of food necessitates a paradigm shift—one that moves beyond mere efficiency to embrace justice, sustainability, and inclusivity. By acknowledging the voices of those often marginalized in the current food discourse, fostering collaboration between different knowledge systems, and championing the principles of agroecology and food sovereignty, we can collectively forge a path toward a more resilient, more just, and more sustainable global food system.

NOTES

This chapter emerged from discussions with students in my Sociology of Food and Agriculture course at Tulane University, developed with support from the Rosenthal Blumenfeld Gulf South Food Studies Fellowship.

1. Harriet Friedmann and Philip McMichael (1989) developed Food Regime (FR) analysis as a theoretical framework to explain the rise and decline of national agricultures within the geopolitical history of capitalism. The framework emphasizes

the historical dimensions of how global food provisioning emerged and has changed substantially across time and space. The First FR was British-centered (1870s–1930s), combining colonial tropical imports to Europe with basic grains and livestock imports from settler colonies. The Second FR was US-centered (1950s–70). The United States gained hegemony via subsidizing key crops at home and rerouting surplus as food aid and exporting the agricultural technologies of the Green Revolution to strategic states on the Cold War perimeter. The Third Corporate FR (1980s onward) has been dominated by transnational corporations that have established a regime based on the commodification of food provisioning. For more details, see McMichael (2009, 2013).

2. I take from the companies' websites to describe the process of lab-grown meat. See "How We Make Meat," GOOD Meat, https://www.goodmeat.co/process; "Cultivated Meat. It's Science (but Not Rocket Science)," UPSIDE Foods, https://upsidefoods.com/innovation.

3. "We're Making Our Favorite Food a Force for Good," UPSIDE Foods, https://upsidefoods.com/company.

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