

# Plastics and Agriculture in the Desert Frontier

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In a warming, water-scarce planet, we are hearing again that the future lies in “greening the desert.”<sup>1</sup> A sustainable answer to the problem of food insecurity is to be found in turning semi-arid and desert areas into new centers of food production. Facing reignited fears of ecological limits to production under the specter of overpopulation, climate change, and peak oil, we are to be saved by such technical feats as solar-powered irrigation systems with desalinated water, hydroponic methods that grow crops without soil, and plastic mulches, greenhouses, and irrigation tubes.

Greening the desert narratives come at a time of growing public attention to the water crises that have been intensifying in arid and semi-arid regions from industrial agriculture production. Attention in the United States was particularly striking in 2015 as the state of California, the largest horticulture region in the country, if not the world, announced mandatory water restrictions in the face of a four-year drought.<sup>2</sup> Other examples abound: Facing rapid depletion of fossil aquifers, Saudi Arabia imposed limits on the extraction of groundwater—a restriction that has compelled Saudi investors and agribusinesses to acquire agricultural land in neighboring countries since the 2007–8 food-fuel-financial crises.<sup>3</sup> In 2010 the Royal Academy of Engineering produced a report warning that British demand for fresh fruits and vegetables is exacerbating water scarcity in producing countries in the global south.<sup>4</sup> Greening the desert narratives at a time of multiplying water crises seem contradictory: arid and semi-arid regions that have long been turned into sites of intensive agriculture production are now drying up, and yet these narratives promote the same set of processes that created the present-day crises, just in new lands and with the latest agritechnologies and practices.

Nonetheless, state development agencies and strands of the alternative food movement are promoting agritechnologies and on-farm practices that make greening the desert possible.<sup>5</sup> Greening the desert narratives have regained traction through explanations of the crises as a management or governance problem—for example, a tragedy of the commons or water-thirsty crops irresponsibly planted in dry lands.<sup>6</sup>

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1. For recent examples of “greening the desert” narratives, see Finley, “How to Make a Desert Bloom”; Margolis, “Growing Food in the Desert”; Holden, “Greening the Desert”; and Sitton, “Advanced Agriculture.”

2. See Boxall, “Overpumping of Central Valley Groundwater,” and Gillis and Richtel, “Beneath California Crops.”

3. See GRAIN, *Seized!*, and Pearce, “Saudi Arabia Stakes a Claim.”

4. On asparagus in Peru, see Lawrence, “Peru’s Wells Are Being Sucked Dry.”

5. On the alternative food movement, see Holden, “Greening the Desert,” and Margolis, “Growing Food in the Desert.” For state development in California, see Schrader, “Plasticulture in California Vegetable Production.” For Israel see Siegel, *Let There Be Water*. For Egypt see Sims, *Egypt’s Desert Dreams*.

6. “Deep Waters, Slowly Drying Up,” *Economist*, October 7, 2010, [www.economist.com/node/17199914](http://www.economist.com/node/17199914). See also Gillis and Richtel, “Beneath California Crops.”

As such, in these narratives the latest technical feats, coupled with proper management, hold the promise of solving the problem of food production in the face of imminent ecological crises as a result of desertification, depleted aquifers, soil salination, and on and on. Through a case study of greening the desert policies and practices in Egypt, I argue that the crises reflect rather than contradict the social and ecological relations of agriculture production in dry regions, and will not be resolved through better management practices or the next technical fix.

Egypt became an agroexporter of fresh fruits and vegetables (and a large-scale producer of industrial poultry) through the expansion of reclaimed lands farther into arid regions—and largely to the west and east of the Delta.<sup>7</sup> Land reclamation entails making cultivatable or developed for agriculture and food processing (and to a certain extent for human settlement) semidesert and desert lands that were not at all or recently cultivated intensively. The ever-present image of the country's population squeezed into a thin strip of arable land surrounded by a vast desert has long promoted the reclamation of these lands in Egypt. Reclamation has held the promise of expanding the total area of arable land—and permanently, through cultivation and settlement. And as reclaimed lands have expanded, the country's agrifood industry has grown.<sup>8</sup> The agroexport market (of fruits and vegetables, fresh and processed), which is one node in this formalized economic sector, is relatively small, but like most agroexporting regions is dominated by highly capitalized firms. As with other regions that have begun to face water crises, within just a few years of the country joining the World Trade Organization (WTO) (in 1995) and bilateral and multilateral trade agreements that followed, the water

table that irrigates a portion of reclaimed lands to the west of the Delta began dropping rapidly—at a rate of about 1 meter per year.<sup>9</sup>

Egypt can be classified as a New Agricultural Country (NAC)—a concept that the food regime literature introduced to capture the emergence of countries in the global north and global south that began to expand their agroexport markets and compete with the dominant agroexporting countries of the United States and Western Europe in global agrifood trade beginning in the 1970s and 1980s.<sup>10</sup> NACs came to constitute part of the emerging global food system.<sup>11</sup> A node in this regime, and a focus of this article and many greening the desert narratives and policies, is global horticulture—that is, places of specialization for the production of fruits and vegetables (as well as ornamentals like flowers), destined mostly for corporate food retail (supermarkets, hypermarkets, etcetera) and food service (restaurants, fast food franchises, hotels). A set of industry standards institutionalized within the WTO governs global horticulture, as all agrifood trade.<sup>12</sup>

The standards are made up of agritechnologies and protocols that seek to organize farm organization and on-farm practice in ways that gain greater control over the farm environment and that condition the participation of countries like Egypt in global agrifood trade. A central component of these controlled environment (or bio-secure) agriculture systems is plasticulture—or the extensive use of plastics in industrial horticulture. Plasticulture, and controlled environment agriculture more generally, has become increasingly coercive and capital-intensive, and corporations and the largest agroexporting states have gained greater control over global agrifood trade through this private governance system.

7. On the role of poultry in land reclamation in Egypt, see Dixon, "Making of the Corporate Agri-food System"; Dixon, "The Land Grab"; and Dixon, "Crises in the Egyptian Agri-food Industry."

8. See *ibid.*

9. Barnes, "Pumping Possibilities," 530. In order to save the farms that rely on the aquifer, the World Bank loaned Egypt over \$200 million for the West Delta Water Conservation and Irrigation Rehabilitation Project, which

would essentially build a western extension of the Nile Delta branches to irrigate 190,000 acres, despite protests among farmer groups in the Delta. This massive infrastructure project was closed after the World Bank determined in 2011 that the Egyptian government had not spent the loan money for the project. For details see Sims, *Egypt's Desert Dreams*.

10. For details see Friedmann, "Political Economy of Food," and McMichael, *Food Regimes and Agrarian Questions*.

11. The system is referred to in the food regime literature as the Corporate Food Regime—or Financial Food Regime or Corporate-Environmental Food Regime. See McMichael, *Food Regimes and Agrarian Questions*; Burch and Lawrence, "Towards a Third Food Regime"; and Friedmann, "From Colonialism to Green Capitalism."

12. See McMichael, *Food Regimes and Agrarian Questions*, and Busch and Bain, "New! Improved?"

The development of controlled environment agriculture systems like plasticulture represents processes of biosecuritization—that is, a movement toward ever more elaborate interventions, even at the molecular level of plant cells, to protect working capital from the increasing volatility of intensified production and biological simplification. A political economy analysis alone cannot capture the particular character of these changes, which have coincided with corporate consolidation of global horticulture. A political economy analysis tends to describe these changes as a strategy (of corporations, the largest agroexporting states) or an expression of consumer preference (for the near perfect fruit).<sup>13</sup> Following Jason Moore, Tony Weis, Liam Campling, and others, I introduce the concept of desert frontier to demonstrate that these changes must also be addressed through an analysis of the relations between nature and society.<sup>14</sup> The concept of the desert frontier captures the overlooked role of reclamation of lands in dry regions in the development of global horticulture. The concept, which is developed through a case study of industrial horticulture in Egypt's semi-arid and desert areas, addresses why the expansion and intensification of industrial horticulture has been synchronized with state- and private-led land reclamation in dry lands. The expansion of industrial horticulture into lands that had not been previously cultivated intensively (virgin soils), that are farther away from human settlement, and that are in arid climatic zones is constitutive of these processes of biosecuritization and was enabled by the intensive and extensive application of plastics. Through a combined political economy analysis and an analysis of nature-society relations, the desert frontier in Egypt captures how agroexport production in reclaimed lands (and its corporate consolidation) has occurred through the planned and the unwanted, unexpected and unintended.<sup>15</sup>

In the first section of this article, I analyze the geography, farm organization, and on-farm practice in the desert frontier in Egypt. Plasticulture, a biosecure set of agritechnologies and protocols, frames the interactions of capital, the state, labor, climate, parasites, seeds, and so on that make possible (and limit) expanded commodity production in reclaimed lands. In the second section, I weave together an analysis of frontier making in the neoliberal period in Egypt with an analysis of the development of plasticulture during this same period that made the expansion of industrial horticulture in reclaimed lands (in Egypt and beyond) possible.

### Corporate Food Regime and Frontiers

The concept of corporate food regime captures the restructuring of capitalist relations and the hegemonic state order in the 1970s and 1980s that led to agriculture and food changes worldwide.<sup>16</sup> This regime replaced the US-centered intensive food regime of the post-World War II era, characterized by the US state infrastructure that promoted and disseminated industrial agriculture and food aid. The food regime literature introduced the concept of NACs to help explain this shift: new countries in the global north and global south—particularly the CAIRNs group of second-rank agroexporters—began to compete with the transatlantic axis (United States, Western Europe) in an expanding global agrifood trade.<sup>17</sup> The CAIRNs group and agrifood transnational corporations (TNCs) pushed for agricultural liberalization in the General Agreement on Tariffs and Trade round of negotiations, which then became institutionalized in the WTO's Agreement on Agriculture protocol. The inclusion of agriculture in the WTO architecture enabled (and provided the ideological justification for) the growth of agroexport markets in new regions—and this devel-

13. In addition to the food regime literature cited, see Busch and Bain, "New! Improved?"; Watts and Goodman, "Agrarian Questions"; and Ponte, "Governing through Quality." For a critique of the consumer preferences thesis, see Bernstein and Campling, "Commodity Studies and Commodity Fetishism."

14. Moore, *Capitalism in the Web of Life*; Moore, "Environmental Crises and the Metabolic Rift"; Moore, "Transcending the Metabolic Rift"; Weis, *The Global Food Economy*; Weis, "Accelerating Biophysical Contradictions"; Weis, *Ecological Hoofprint*; and Campling, "The Tuna 'Commodity Frontier.'"

15. Mitchell, *Rule of Experts*.

16. McMichael, *Food Regimes and Agrarian Questions*.

17. Friedmann, "Political Economy of Food." The CAIRNs group represents a political coalition of nineteen agroexporting countries, not including the dominant agroexporters of the post-WWII period (the United States and Western Europe).

opment has been uneven. The core of the NACs tend to be competitive in high-value agriculture as well as animal feed grains and processed foods (for example, Brazilian soy, citrus, and chicken); an “underbelly” of the NACs has, for example, like much of sub-Saharan Africa returned to exporting colonial crops.<sup>18</sup> In between, there is a range of less significant agroexporting countries such as Kenya and Egypt that has developed industrial agrifood systems that represent a relatively small percentage of total food distributed nationally.

Corporate dominance of agriculture and food is multilayered: grain and food retail TNCs and multinational corporations in the global north have consolidated global food value chains, while national corporations, public corporations, investors, and the military in the NACs have consolidated national agrifood industries, even spreading regionally.<sup>19</sup> I focus here on the set of industry standards within the WTO free-trade architecture that retail TNCs (corporate food retailers) and their third-party certifiers (Codex standards, Good Agricultural Practices [GAP]) designed and that define and regulate production and trade.<sup>20</sup> This system—what is referred to as private governance or quality governance—determines the conditions of participation of countries and local suppliers in global agrifood trade by attempting to standardize what is grown (i.e., what varieties of fruits and vegetables), how it is grown (i.e., what kinds of inputs and how much of each input), and how it is processed (i.e., specifications of when and how it is moved from the field to the processing plant to—and out of—transport). Moreover, these standards have contributed to the consolidation of national agrifood industries, as only the most capitalized firms and investors can afford adopting the standards.<sup>21</sup>

If the food regime and related literature that offers a largely political economy analysis of agrifood-system change address nature in one way or another, the literature tends to focus on the effects of this change *on the* environment.<sup>22</sup> It highlights the impacts of agricultural industrialization, corporate consolidation, and global trade on global warming; soil erosion from monocultures and intensified cropping; dispossession of smallholders from livelihoods in the face of commodity price fluctuations, land market inflation, and environmental disasters; and on and on. Its focus on the environmental impacts of the global agrifood system and the resulting social costs raises vitally important questions about the sustainability of global horticulture and, in particular, the promise of greening the desert technical innovations to ensure future food security. However, by offering a singular analysis of how capital accumulation in agriculture degrades the environment, this literature tends to conceptualize nature “as an *effect* of power,” which is problematic in that ontologically nature and society are not separate.<sup>23</sup> Moreover, the explanation of corporate consolidation of global agrifood trade tends to conflate the outcomes of this new governance system with its causes, by assuming that the system is solely or largely the result of attempts by the largest agroexporting states and corporations to maintain dominance in global agrifood trade. While the WTO architecture clearly privileges the dominant states and corporations, these outcomes must also be explained by transcending this nature-society binary through an analysis of the relations between nature and society. In Moore’s terms I ask: How is global horticulture realized in nature (rather than by acting on nature)?<sup>24</sup> In other words, how are this particular human organization (of fruit/vegetable commod-

18. Watts and Goodman, “Agrarian Questions.”

19. On grain and retail TNCs, see Burch and Lawrence, “Towards a Third Food Regime,” and Fold and Pritchard, “Introduction.” For case studies of local and regional corporate retail, see Alvarado and Charmel, “Rapid Rise of Supermarkets in Costa Rica”; Faiguenbaum et al., “Rapid Rise of Supermarkets in Chile”; and Weatherspoon and Reardon, “Rise of Supermarkets in Africa.” For a case study of an agrifood sector, for example the pork industry in China, see Schneider, “Dragon Head En-

terprises.” For a case study of regional expansion, for example the dairy industry in Central America, see Hernández et al., “Globalization of Dairying in La Laguna, Mexico.”

20. Busch and Bain, “New! Improved?”

21. Ponte, “Governing through Quality”; Bernstein and Campling, “Commodity Studies and Commodity Fetishism”; and Ouma, “Global Standards, Local Realities.”

22. For food regime analysis, see Burch and Lawrence, “Towards a Third Food Regime”;

Friedmann, “From Colonialism to Green Capitalism”; and McMichael, *Food Regimes and Agrarian Questions*. For commodity studies (global value chains, especially), see Bair, “Global Commodity Chains”; Barndt, *Tangled Routes*; and Ponte, “Governing through Quality.” For social movement literature, see Alonso-Fradejas et al., “Food Sovereignty,” and Patel, “Food Sovereignty.”

23. Castree, “False Antitheses?,” 121.

24. Moore, “Transcending the Metabolic Rift.”

ity production in specialized zones for global agri-food trade) and nature (wind, parasites, soil, climate, water, etcetera) coproduced?<sup>25</sup>

I address this question with the concept of the desert frontier, which seeks to capture the overlooked role of land reclamation in dry regions in the development of global horticulture and the NACs in particular. The horticultural region of Egypt shares characteristics with two of the largest horticulture regions, the state of California's Central Valley and northeast Brazil's São Francisco River Valley, and a horticulture region of lesser significance, Peru's western coast.<sup>26</sup> Frontier making in all four regions has a long lineage that precedes the neoliberal period, with the Central Valley in many ways setting a precedent for the other regions, as I discuss in the last section of this article. The state was a central actor in claiming the land by force or cooptation from those who had been using the land. The state made the land cultivatable through, for example, extensive water works, land leveling, electricity grids, and transportation routes. In their common histories both small-scale agriculturalists and capitalized investors developed the land, but these regions are sites of extensive capitalization. What is more obscured in the literature on these frontier regions, and what this analysis of the desert frontier in Egypt seeks to highlight, are the ways in which frontier making and farm organization and on-farm practice in the frontier regions represent a movement to protect working capital from multiplying threats to production.<sup>27</sup>

The desert frontier concept departs from Weis's analysis of the ecological relations constituting what he calls the global food economy.<sup>28</sup> For Weis this economy is made through two mutually reinforcing processes of biological simplification, in which the diversity of crop species and the genetic diversity within species have been greatly reduced around the world, and of capitalization

(for example, genetically modified organizations, animal breeding, animal hormones, biosecure production systems), which responds to the vulnerabilities that arise as a result of biological simplification. The movement from temperate zones to semi-arid regions (to even drier climates) embodies, in Weis's terms, these reinforcing processes of biological simplification and capitalization.

Further, in order to build on this analysis of the relations between nature and society and to demonstrate the importance of frontiers to the corporate food regime, I draw on Moore's concept of commodity frontiers, of localized commodity production through the appropriation of nature's "free gifts"—soil, water, forests—with a small volume of capital and with the help of territorial power.<sup>29</sup> The commodity frontiers concept is useful for understanding how frontier making in the desert involves the appropriation of unpaid/work energy more broadly: states offer access to desert lands (through transportation routes), cheap labor regimes, and the ability to develop the lands (through leasing, state- and private-funded irrigation infrastructure, etcetera), at costs far below those in existing agricultural areas. The concept in effect helps explain the historical-relational character of the desert frontier: intensification of production in one place leads eventually to "relative exhaustion"—in terms of rising costs resulting from the degradation of the conditions of production relative to other places—which leads to the expansion of commodity production in new places.<sup>30</sup> Commodity frontiers have been central to acquiring the Big Four inputs (Four Cheaps) in capitalist history: food, labor power, energy, and raw materials.<sup>31</sup> And a question for Moore is whether the neoliberal period represents the terminal end of commodity frontiers as such (and thus the Four Cheaps)—and the desert frontier concept certainly raises this question. The desert frontier represents a clear departure from the commodity

25. Moore, *Capitalism in the Web of Life*.

26. For the Central Valley, see Nash, *Inescapable Ecologies*; Pisani, *Water and American Government*; and Stoll, *Fruits of Natural Advantage*. For the São Francisco River Valley, see Damiani, "Beyond Market Failures"; Marsden et al., "Globalisation, Regionalization, and Quality"; and Selwyn, "Export Grape Produc-

tion, North East Brazil." For the western coast of Peru, see Glover and Kusterer, *Small Farmers, Big Business*, and Meade et al., "Peru."

27. A notable exception is Marsden et al., "Globalisation, Regionalization, and Quality."

28. See Weis, *Global Food Economy*; Weis, "Accelerating Biophysical Contradictions"; and Weis, *Ecological Hoofprint*.

29. Marx, *Capital*, quoted in Moore, "Madeira, Sugar, and the Conquest of Nature," 4.

30. Moore, "Transcending the Metabolic Rift."

31. Moore, *Capitalism in the Web of Life*.

frontier in that it requires considerable capitalization and is therefore dominated by agribusiness. The desert frontier does not offer Cheap Food, in Moore's terms, of lowering the costs of reproduction in any systematic way. It embodies a tension of the corporate food regime: the costs and risks from the volatility of present-day industrial horticulture are simultaneously offset (in a perpetual sense) and continually multiplying through the WTO-enforced standards of global horticulture.

### Desert Frontier in Egypt

During the last few decades, an agrifood industry in Egypt has grown through the horizontal and to a lesser extent vertical expansion of cultivatable lands from existing agricultural areas in the Delta and Nile Valley. This expansion is typically referred to as occurring in the desert, but in technical terms it has, rather, been in arid lands that are farther from existing irrigation and settlement. As an agribusiness manager corrected me during a farm visit, the soils are silted, rather than sandy as in a desert, and have good water-absorption capacity.<sup>32</sup> These new lands are concentrated along the two main highways from Cairo that surround the Delta—the Alexandria-desert road to the west of the Delta and the Ismailia-desert road to the east of the Delta—but have also extended along the northern strip of the Delta, into the northern Sinai, and southward to the west of the Nile Valley. Today this desert frontier is for a domestic agrifood industry—namely, industrial horticulture (fruits, vegetables, ornamentals), an animal protein complex (of poultry and fish and, to a lesser extent, beef and dairy), and food processing. Frontier making has been part of the state desert-

development plan as well as initiatives of international development agencies, private investors, and various classes of subaltern settlers.<sup>33</sup>

Land reclamation that has expanded the cultivatable area in and around the Delta especially has a long history, from the turn of the eighteenth century if not before.<sup>34</sup> What distinguishes the desert frontier of the neoliberal era from previous waves of land reclamation is that commodity production in the frontier is for both domestic markets and export abroad. Also, commodity production is not only industrialized but organized by controlled environment agritechnologies and protocols, and as such has moved farther from existing residential areas. Although there are many actors involved in making the desert frontier, including smallholders and medium-sized agricultural entrepreneurs, a handful of corporate entities—Egyptian family business groups, MNCS, TNCS, financial firms—have a heavy presence in the reclaimed lands.<sup>35</sup> These investors have developed two types of reclaimed land: (1) irrigated land from the river Nile that is in or near to state or informal reclamation communities, and (2) nonirrigated land that is outward from reclamation communities and is irrigated by digging wells to the aquifer in the west of the Delta. The government had been leasing the irrigated land for a period of seven years and then selling the land to the leasee if a required percentage of the land had been cultivated. As investors have moved farther into the desert, they have been gaining usufruct rights to the nonirrigated land that Bedouin hold under *wad' yad* (squatter's rights, a type of customary land right).<sup>36</sup> Investors pay Bedouins "to lift the hand," which allows them to develop the land and provides their farms with

32. Farm visit by the author, South Tahrir, October 18, 2011.

33. The research on which this article is based is part of a larger mixed methods project; see Dixon, "Making of the Corporate Agri-food System." Of this larger project there are two lines of field research in Egypt that are most relevant to this article. The first line, from August 2009 through August 2010 in Cairo and Alexandria, involved in part communication and semistructured interviews with researchers, consultants, journalists, bureaucrats, international development agents, and others directly involved in and/or with knowledge about the country's agrifood industry and land

reclamation. The second directly relevant line of research, from August through November 2011, consisted mostly of semistructured interviews in Cairo with executives and managers of ten of the largest agribusiness corporations involved in horticulture; visits and tours of agroexport farms in the east and west of the Delta; and attendance at a food safety conference and an agriculture and food exhibition in Cairo. Both lines of field research involved the compilation of written material related to the desert frontier from industry, government, and international development agencies, as well as multilateral institutions. The section on the desert frontier in Egypt is directly

based on data gathered during the second line of field research. In this section citations from field research are used only for direct quotations and paraphrases.

34. *Ibid.*

35. I use the words *agribusiness* and *investor* interchangeably here. However, it should be noted that many highly capitalized firms in the desert frontier are agribusinesses that are an investment arm or investment of a more diversified, integrated firm or corporation.

36. For more on *wad' yad* see Cole and Altorki, *Bedouin, Settlers, and Holiday-Makers*, 202.

Bedouin protection. As in previous eras, these investors are drawing irrigation water, laborers, and crops on demand from nearby reclamation communities as well as neighboring Delta provinces.

There are three primary, interconnected nodes of the desert frontier: food processing, an animal protein complex, and horticulture farms. Food processing is located in the industrial zones of the new satellite cities that the state built in the 1980s and 1990s in greater Cairo and along the two main highways.<sup>37</sup> In terms of animal protein, aquaculture farms dominate cultivation north of the Damanhur-Kafr el Sheikh-Mansura strip of the Delta, but poultry (and beef and dairy) and horticulture farms are found throughout the desert frontier. Industrial poultry is the farthest from residential areas and has led the way to the south, especially around Minya in Middle Egypt. In terms of the scale of farming, in horticulture investors claimed farm holdings from 930 acres to as much 20,000 acres. The total holdings do not equate with farm size, as holdings are often spread out in different locations, but they do reflect the extent of commodity production and land consolidation in the desert frontier.<sup>38</sup>

In horticulture the labor force is gendered and trifurcated with well-paid male managers and supervisors, who live weekly or monthly on farms and who may or may not be from Egypt, daily laborers who come from nearby reclamation communities, and young female migrant, seasonal (*tarahil*) laborers, who are also pooled from nearby Delta governorates by contractors. Most of the seasonal laborers are unmarried girls, who are brought to the farms for half a day (so they return home before dark). A foreign agribusiness manager confided during a farm visit that contractors routinely bring children to work, and even though employing children violates the retail certifications, he feels morally obliged to accept them and at times has them do menial tasks for a wage so that, in his words, they do not face punishment at home or a mealless evening if he turns them away.<sup>39</sup> At the

time of my farm visits, agribusinesses were even enjoying the free labor of local high-school students through the USAID-funded Agriculture Exports and Rural Incomes (AERI) program, which was intended to train the students to become farm supervisors upon graduation.

The transportation routes of the desert frontier—highways, ports, airports—distribute the high-value commodities to the consumer markets of Cairo (and to other sizable domestic markets like in Alexandria, the tourist resorts, etcetera) as well as the supermarket and hypermarket shelves of Europe and the Middle East. While the animal protein complex is almost entirely for the domestic market, most fruits and vegetables are destined for markets abroad. Processed food is both for export and the domestic market, which covers a wide consumer-class spectrum—from low-end food retail and food service (e.g., snack kiosks) to middle end (e.g., discount supermarkets, fast food franchises) to high end (e.g., European hypermarkets, resorts).

This agrifood industry has grown in the neoliberal period as the desert frontier has expanded. Too, greater accessibility of and knowledge about greening the desert technologies and practices, particularly since the passage of the Economic Reform and Structural Adjustment Programme (ERSAP) in 1991 and Egypt joining the WTO in 1995, made this expansion possible. These technologies and practices make up the standards and certifications of corporate retailers and WTO protocols for agrifood trade, which have been adapted in Egypt through an institutional infrastructure that was built throughout the neoliberal period.<sup>40</sup> This infrastructure rests partially on the expertise (and knowledge sharing) of US agricultural extension and includes trainings, international trade shows, study tours, subsidies on imports, and on and on. In horticulture industry standards and certifications shape the geography of farms (in drier, more remote regions) as well as farm organization and on-farm practice—and are based on

37. The new satellite cities that are hubs of food processing are 10th Ramadan, 6th October, Sadat City, and Borg El Arab.

38. Any one holding in reclaimed lands is immense compared to holdings in the Delta and

Nile Valley, where a farm of fifty or more acres is considered large.

39. Foreign agribusiness manager, interview by the author, Ismailia, October 2, 2011.

40. See Dixon, "Making of the Corporate Agri-food System," and Dixon, "Crises of the Egyptian Agri-food Industry."

plasticulture, an controlled environment or bio-secure agriculture system designed toward securing production from the unwanted through the extensive use of plastics.

#### All That Wilts under the Sun

In 2011, during my field research, agribusiness directors and managers uniformly affirmed the importance for the agroexport market of funding and institutional support from state agencies like the Export Council, professional organizations like the USAID-funded Horticultural Export Improvement Association (HEIA) and the Chamber of Food Industries, and international development agencies. Through this support HEIA members attend trainings and international trade shows and participate in study tours (often at US land grant universities). In official terms, this institutional infrastructure is designed for Egyptian agribusiness to adopt “good agricultural practices” for food safety, part of the WTO’s Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and the resulting International Standards for Phytosanitary Measures (ISPMs), which outline biosecurity protocols for a broad range of species categorized as pests. However, from the point of view of the geography of the farms, farm organization, and on-farm practice, an overriding concern of agribusiness in attaining the certifications of corporate retailers (e.g., Global Gap) and achieving “best practices” of the SPS Agreement is dealing effectively with emergent and recurrent diseases in ways that both conform with industry standards and save working capital.

In my interviews with agribusiness managers and executives and during farm visits, the ecology of the desert frontier was repeatedly cited as ideal for horticulture production. The soils are largely virgin soils, and the distance between farms and from residential areas is great enough to offer some protections from traveling pathogens. The arid climate was cited as the best protection from molds; as one manager said, “This area is paradise

for agriculture. There is water, it is dry and there are no funguses.”<sup>41</sup> This manager was referring not to just any type of agriculture, but to a particular type—one that has become increasingly vulnerable and thus highly volatile.

It is not only the geography of farms but also plasticulture that seeks to control contact of the unwanted, the unruly Wild, with the inside of the production zone while simultaneously increasing labor productivity (for instance, the efficiency of production including the use of water, inputs, and the like). Plasticulture is usually defined as drip/spray irrigation (made of plastics) coupled with plastic mulches, greenhouses, and other plastic applications (such as tents and tarps). Plasticulture may involve soilless cultivation (in greenhouses) and often includes fertigation, or treated irrigation water (filtered and applied with fertilizers and other inputs).<sup>42</sup> Plastics were functional in all the fields that I visited—either placed directly on fields (as mulches) or above crops (as in greenhouses or with tarps), and weaving throughout fields in the form of irrigation hoses and tubes. The main plastic in these farms is low-density polyethylene (LDP), which is used extensively in industrial horticulture production worldwide. When asked what prompted their move into the desert, an agribusiness manager and executive attributed the greater accessibility of LDP following trade liberalization.<sup>43</sup>

There are different colors of LDP, which regulates the soil and air temperature depending on the color (see fig. 1). Opaque LDP sheets increase the soil temperature, while silver and white lower the temperature. Often greenhouses are in white and beds are covered in silver. Plastic mulch also reduces soil water evaporation, which is critical to intensive cultivation in semi-arid and arid areas, and other plastics are used as wind and sun breakers.

Plasticulture is considered a biosecure agriculture system in that it seeks to manage insect pests and soilborne disease pathogens while reducing weeding and enabling intensification (double/

41. Farm manager, interview by the author, Alex-desert road (near Sadat City), October 20, 2011.

42. Lament, “Plastic Mulches.”

43. Agribusiness executive, interview by the author, Cairo, October 12, 2011; farm visit by the author, South Tahrir, October 18, 2011.

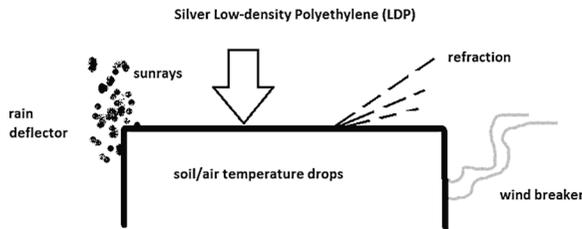


Figure 1. Silver Low-Density Polyethylene (LDP)

triple cropping).<sup>44</sup> As a result, plasticulture contributes to higher and quicker crop yields. In one study the combined application of plastic mulch, drip irrigation, and fertigation was reported to increase yields by as much as two to three times and to quicken crop growth by as much as twenty-one days.<sup>45</sup> The desert frontier also renders plasticulture more effective by reducing the risk of humidity in enclosure that can lead to molds and wilting. While plasticulture and greening the desert agritechologies and practices are not synonymous, as plasticulture is used in other environments, plasticulture broadly understood has heavily shaped greening the desert agritechologies and practices in industrial horticulture.

Consistent with greening the desert narratives, plasticulture is touted as sustainable in terms of more efficient water and fertilizer use.<sup>46</sup> However, such a claim belies the fact that plastics are energy intensive, produced by petroleum and imported over long distances. Further, plasticulture's set of controls—of water and nutrient flows, soil moisture, and the like—operates through other imports, including, most importantly, corporate-approved, high-yielding seed varieties. The seeds, in essence, respond to the conditions of production within this system, but it is no easy feat to create such a harmonious relationship. The imported seeds are tested and retested on the farms. Nearly all the farms that I visited had at least one field devoted to seed testing. Agribusiness managers reported to travel regularly through HEIA to learn about new varieties, often at US and European universities. The continual development of seed varieties should not be interpreted singularly as nego-

tiations or translations of international standards by local actors to attain a certain aesthetic. Rather, the trials and errors are necessarily involved in the high volatility of agroindustrial production, and in the case of the seed varieties, continual experimentation is essential in order to avoid genetic erosion, as present-day horticulture crops represent a small genetic pool and are extremely susceptible to pathogens.<sup>47</sup>

The high volatility of production is an overlooked driver in the development of increasingly coercive agritechologies and practices—toward the creation of ever more distinct ontological zones of humans and nonhumans. And a lens on the relations between nature and society focuses on an enduring tension of plasticulture: while plasticulture attempts to control the inside of the production zone, even at the level of biological material, attention and resources on farms and in business operations are devoted overwhelmingly to threatening situations due to the very blurring of the inside and the outside. Within this system even the wind and the sun potentially spell disaster. Plastic mulches and sheets act as a cover to block out and eliminate not just pests but also the wind and sun. On one banana farm I visited, the banana bunches that were being harvested were wrapped in plastic so as to slow ripening. On another farm a field was left fallow and the beds were covered with opaque LDP. I was told by the farm manager that the plastic mulch sterilizes the beds by raising the temperature of the soil above a certain threshold above which all organisms die, at which point the soil is sterilized and the beds replanted (a process called solarization). The greenhouses in which they were breeding the plants (the breeding rooms) are supposed to be controlled. Before entering the breeding rooms for strawberries I stepped into a sanitizer pool in front of the entrance and then again in the holding room (between the entrance and the plant area of the greenhouse). There I covered my shoes with plastic and sprayed my hands with Dettol (an antibiotic sanitizer). In the breeding rooms the strawberry plants were in artificial (or

44. See Jensen, "Controlled Environment Agriculture," and Schrader, "Plasticulture in California Vegetable Production."

45. Lament, "Plastic Mulches."

46. See Jensen, "Controlled Environment Agriculture," and Schrader, "Plasticulture in California Vegetable Production."

47. See Marsden et al., "Globalisation, Regionalization, and Quality," and Weis, "Accelerating Biophysical Contradictions."

soilless) soil, the soil's temperature and moisture measured regularly. The air temperature was supposed to be kept cool and constant.

These multiple, overlapping controls over production represent "biophysical overrides," in Weis's terms, agritechnologies and on-farm practices designed to minimize the damage caused by intensive cultivation, monocultures, genetic erosion, climate change, and on and on.<sup>48</sup> However, in attempting to create separate ontological zones of humans and nonhumans, these overrides amplify the monsters of industrial agriculture. Seed varieties are constantly vulnerable. On one thirty-acre greenhouse of sweet peppers, not one pepper survived from an infestation. On another of my visits to a farm there was an emergency as a plant pest (tomato leaf miner) that had been travelling regionally through southern Africa had begun to infest one tomato variety. The managers had to act quickly, as in monoculture fields pests like the tomato leaf miner can move easily, potentially infecting all crops in a field.

The high volatility of production illustrates that the work of separating controlled and uncontrolled zones leads to their blurring. The citrus becomes easily parched from the sun. On one farm nearly two hundred and fifty acres of grape vines collapsed in an unusual rain storm one year. When it rained, the plastic sheet over the orchard filled with water and broke, collapsing the vines underneath. Many farms that were built from the 1940s through roughly the 1980s are today lined with tall pine trees to serve as windbreakers, but in many of the newer farms there is no cover from common winds, and agribusiness managers described the wind as one of the farms' biggest enemies.

While Egyptian agribusiness representatives commonly referred to reclaimed lands as ideal for horticulture during my field research—in terms of the dry climate, virgin soil, distance between farms and human settlements, and so on—it is clear that only the most capitalized firms have been able to invest in the years of trial and error involved in frontier making. In terms of certification alone, it took one agribusiness seven years, another fifteen years, to attain the common certifications for agro-

exporters (such as Tesco Natural Choice, Global Gap, Field 2 Fork, Leaf and Tesco Natural Soil). Given the high levels of capitalization of production, however, the desert frontier can be ideal for industrial horticulture only through combinations of, in Moore's terms, the appropriation of unpaid work/energy (through large-scale state, private, and international investments in infrastructure and irrigation, as well as the state's facilitation of a cheap market in reclaimed lands), exploitation of labor power (through a feminized, contingent labor force), and what I have referred to as an institutional infrastructure (through which LDP and other agritechnologies became more accessible). Moreover, as the following section delineates, making the desert ideal (and plasticulture an industry standard) was not a mere design of state planners (and corporations) to expand capital accumulation in agriculture. Rather, avenues for expanded capital accumulation in the desert were forged through the degradation of the ecological conditions of production from high oil prices, the institutionalization of debt, the volatility of industrial horticulture production, and a host of additional factors that deactivated existing agricultural spaces.

#### **Historicizing the Desert Frontier and Global Horticulture**

The 1970s was a pivotal moment for global horticulture. Rising oil prices meant not only declining profits but also growing fears of limits to industrial horticulture production in given lands with existing technologies. This moment precipitated two reinforcing processes in this analysis: the moving frontier of industrial horticulture from temperate regions to semi-/arid regions on a global scale, and the movement of industrial horticulture from existing agricultural areas in the Delta to reclaimed lands in Egypt. With oil prices high, costs rose to maintain the production environment in temperate regions where greenhouses were used extensively. Further, in the United States there was growing recognition among agriculture extension and industry that frontiers for industrial horticulture were ending with the deactivation of agricultural

48. Weis, "Accelerating Biophysical Contradictions."

lands (through real estate development, soil erosion, etcetera)—representing, in Moore’s terms, limits to the appropriation of nature’s “free gifts.”<sup>49</sup> The development of US patents of controlled environment agritechnologies coupled with the beginnings of structural adjustment policies throughout the indebted world enabled the spatial center of industrial horticulture to move from temperate to semi-/arid regions. This movement on a global scale co-constituted the movement of industrial horticulture from the Delta to reclaimed lands. Privatization and liberalization were considerable forces in the “relative exhaustion” of existing agricultural lands in the Delta,<sup>50</sup> which contributed to the ideal conditions in the desert, in effect pushing and pulling investors from the Delta into reclaimed areas.

Transnational corporations and the agricultural sciences in the industrialized world began touting controlled environment agriculture (CEA) as a sustainable solution for horticulture production in temperate regions in the face of rising oil prices in the 1970s. *Sustainable* here has a double meaning: production that uses less energy and that is kept profitable relative to other regions. The promise of CEA technologies is in their ability to retain heat while preventing condensation and humidity. Thus, they conserve energy use (from heating, irrigation) and are even more effective in arid regions that are drier and hotter. Fears of limits to production with higher oil prices and the deactivation of existing agricultural areas from soil erosion, urbanization, and the like pushed the horticulture industry to develop and patent these CEA technologies, which began to multiply in the 1970s.<sup>51</sup> At the same time, these developments anticipated the expanding frontier of industrial horticulture. Among proponents of CEA technologies within the US agricultural sciences, there was an expressed inevitability of not only the development of increasingly coercive agritechnologies but also the spread of these innovations to new regions

south of the temperate zone. As one scientist proclaimed at the time, “The question is not one of whether we will have environmental controls, but rather, what types of controls and how much and where to practice the controls with the least cost in supplying the desired products. Fortunately, it is possible to practice environmental controls anywhere.”<sup>52</sup> The spread of US patented agritechnologies and on-farm practices to growing and emerging agroexport regions at home and abroad was not inevitable but, rather, was realized through a marriage between the US land grant university system (including agricultural extension services) and international development agencies (USAID, in particular).<sup>53</sup>

The US state infrastructure for the promotion of agricultural industrialization—the US land grant system, including agricultural extension services, being a main pillar—in fact emerged through state and private-initiated reclamation schemes in semi-arid regions at the turn of the twentieth century. The difficulties in developing and sustaining what was referred to as dry or rainfed farming—in the Great Plains and in the state of California’s Central Valley, in particular—spawned the growth of this infrastructure.<sup>54</sup> Also, the technologies and techniques for dry farming developed through the collaboration between scientists and administrators from the United States and other settler colonies.<sup>55</sup>

The use of plastics in industrial agriculture emerged simultaneously with the US state infrastructure, although this development was not necessarily related to the reclamation of dry lands. Plastics as an agritechnology did clearly develop out of the strength of the chemical industries at the turn of the twentieth century. The petrochemical industry found a way to create ethylene from petroleum—ethylene being a gas that contains a manufactured plant compound responsible for plant development, that is, the ripening of fruit, the opening of flowers, and the shedding of leaves.

49. Marx, *Capital*, quoted in Moore, “Madeira, Sugar, and the Conquest of Nature,” 4.

50. Moore, “Transcending the Metabolic Rift.”

51. See White, “Energy-Efficient Growing Structures,” and McGrath, “Controlled Environment Agriculture.”

52. White, “Energy-Efficient Growing Structures,” 158.

53. McMichael, *Development and Social Change*, 74.

54. On the Great Plains, see, for an introduction, Tesdell, “Drylands Science in Palestine and North America.” On the Central Valley, see Stoll, *Fruits of Natural Advantage*.

55. Tesdell, “Drylands Science in Palestine and North America.”

Then, in the 1930s Imperial Chemical Industries, one of the largest manufacturers of the British Empire, developed polyethylene, the type of plastic used in agriculture, which is the product of an energy-intensive manufacturing process that breaks down petroleum into smaller molecules. By the 1970s plastics were used in greenhouses throughout the temperate world, including US southern states.<sup>56</sup>

At this time plastics became incorporated into the nascent but growing field of controlled environment agriculture. The movement of CEA from a marginal practice within horticulture to an industry standard occurred simultaneously with the spread of industrial horticulture to new semi-arid and arid regions. Today CEA is found throughout the NACs—with a vast majority of plastic greenhouses (based on total area) in China and, to a much lesser extent, in the Mediterranean region.<sup>57</sup> Estimated world consumption of LDP more than doubled from 1985 to 1999.<sup>58</sup> In 1999 the estimated worldwide area of plasticulture included 121 300 km<sup>2</sup> of plastic mulch.<sup>59</sup> In semi-arid and arid regions, in particular, industrial horticulture production is attributed to plastic technologies—and not just in Egypt. For instance, an agriculture minister of Israel recently said that the country's plastics industry has been able to “make the desert bloom.”<sup>60</sup>

In Egypt land reclamation gained momentum through a state desert-development plan and concomitant liberalization and privatization policies beginning in the 1970s. A political economy analysis would highlight the land price differences between reclaimed lands and existing agricultural areas in particular as a push and pull factor from the Delta to the desert. Beginning with President Anwar Sadat's *Infitah* (open door) policies of the 1970s, land prices in the Nile Valley and Delta rose exponentially, precipitating intense social struggles over the land and a significant gap in production costs between the Delta and reclaimed

lands.<sup>61</sup> While liberalization and privatization policies led to land market inflation in agricultural areas in the Nile Valley and Delta, state farms in the desert frontier and large plots of state-owned reclaimed land were sold at bargain prices. During my field research, investors routinely cited land prices as a decisive factor in moving into the desert: As one executive said, “We were doing agriculture before—buying land in the Delta—but now land in the Delta is very expensive.”<sup>62</sup> The state also offered incentive packages of low taxes and nearly free land for the establishment of industrial zones in reclaimed areas. State desert development under the Hosni Mubarak regime beginning in the 1980s not only promoted agribusiness and industrial agriculture, but also continued the policy of repeasantization-through-reclamation by building new and expanding existing reclamation communities for various subaltern classes.<sup>63</sup>

Greening the desert narratives, which were ever-present during my field research, also played a role in pushing and pulling agricultural investments from existing agricultural areas to new lands. Despite the publicly recognized role of reclamation in the rapid depletion of the aquifer to the west of the Delta, state development agents, agricultural researchers, and smallholder advocates alike routinely expressed support for land reclamation to solve a host of social and environmental problems—landlessness, water scarcity, low production levels. Exemplifying the promise of reclamation is one executive's dramatic proclamation: “What happened in the desert is a miracle; it saved Egypt from starvation. The population increased by 45 million under Mubarak, doubling and more. Without the effort to reclaim land, Egypt would starve.”<sup>64</sup> These greening the desert narratives took many forms, including blanket comparisons of modern agriculture in the desert and traditional agriculture in the Delta and Nile Valley; the promise of water-efficient agritechnologies like drip irrigation solving the country's water crises;

56. White, “Energy-Efficient Growing Structures.”

57. Jensen, “Controlled Environment Agriculture.”

58. Levin et al., “Remote Sensing.”

59. Ibid.

60. Udasin, “Feed the World.”

61. Bush, “Food Security in Egypt.”

62. Agribusiness executive, interview by the author, Cairo, October 3, 2011.

63. Adriansen, “Land Reclamation in Egypt.”

64. Agribusiness executive, interview by the author, Cairo, November 29, 2011.

and the promise of state-held reclaimed lands to redistribute small land plots to the landless, former agrarian-reform beneficiaries who had lost their land and other subaltern classes.<sup>65</sup>

The value of reclaimed lands was determined not just by the pervasive ideology of greening the desert or even its low price, which a political economy perspective would emphasize, but by a host of factors that deactivated the Delta in particular as an agricultural region. The state program for desert development built on (and extended) the irrigation infrastructure that had developed largely after the construction of the Aswan High Dam in the postindependence period, in the early 1960s, which has since accelerated the degradation of the Delta ecosystem by salinating the soil, eroding the Mediterranean coast, and damaging the wetlands.<sup>66</sup> A rise in the sea level as a result of climate change has further exacerbated soil salination in the sunken Delta and has contributed to steady desertification.<sup>67</sup> These pressures combined with land market inflation turned these newly valuable lands into land for family (intergenerational) housing, real estate development, and industrial development, leading to the growth of small towns and villages throughout the Delta.<sup>68</sup> Rural urbanization further turned the Delta into a “flu epicentre,” and recurring disease within poultry, long before the outbreak of the Avian flu in 2006, led breeders to move into reclaimed lands, as disease containment is better assured with separation from other agricultural and residential areas.<sup>69</sup> These push and pull factors in effect created the relative exhaustion of existing agricultural areas in the Delta—costs of production rose relative to reclaimed lands because of the degradation of conditions of production in the Delta.

The development of agroexport farms in reclaimed lands in Egypt synchronized with the de-

velopment of CEA agritechnologies and protocols in a “race to the bottom.” This metaphor describes here, on the one hand, growing retailer control and how a growing number of exporters/suppliers worldwide have led to competition among suppliers that lowers the selling price of crops. On the other hand, it describes the growing capitalization of production—as CEA has moved toward more comprehensive controls over “air and root temperatures, light, water, humidity, carbon dioxide, and plant nutrition”—that has in turn put pressure on producers to lower costs.<sup>70</sup> These pressures from a “world-price-governed market” of the corporate food regime, applied through the institutionalization of debt in Egypt, and from the growing volatility of industrial horticulture production have in effect contributed to the relative exhaustion of the Delta.<sup>71</sup>

### Conclusions

Fears of future food insecurity, given ecological limits to production (climate change, peak oil, and soil erosion), have elevated once more the promise of greening the desert technologies and policies, within the food industry and among policy makers and environmentalists alike. Such narratives are framed as a novel response to the technical problem of food production—with the dissemination of the latest technological innovations that would enable this greening on a global scale (as with on-farm desalinization plants). As I have highlighted, these narratives have actually reemerged from an earlier era of rising fears of ecological limits to production—during the 1970s energy-financial crises—and in fact fueled the growth of existing, and the development of new, semi-arid and arid regions for the intensification of horticulture production, in part through the development, patenting, and dissemination of controlled environment

65. Gross generalizations of agriculture in the Delta/Nile Valley and agriculture in reclaimed lands would involve conflating flood irrigation with the Delta/Nile Valley and drip irrigation with reclaimed lands. While there is a concentration of drip (or spray) irrigation in the desert frontier, there is also flood irrigation (and vice versa).

66. Stanley and Warne, “Nile Delta.”

67. See Malm and Esmailian, “Ways In and Out of Vulnerability to Climate Change”; Syvitski, “Deltas at Risk”; and Kishk, “Land Degradation in the Nile Valley.”

68. Bayat and Denis, “Who Is Afraid of Ashwaiyyat?”

69. See Dixon, “Crises in the Egyptian Agri-food Industry.” According to Mike Davis, an epicentre is a breeding ground for influenza, with

dense human and animal populations, regular contact between different animal species, and chronic respiratory or immune disorders (*Monster at Our Door*, 59).

70. Jensen, “Controlled Environment Agriculture.”

71. For an explanation of the concept of the world-price-governed market, see McMichael, *Food Regimes and Agrarian Questions*, 8.

or biosecure agritechnologies and practices, especially plasticulture. Decades later, not only has the birth of global horticulture, in part through the reclamation of dry regions, not overcome the proposed ecological limits to production, but in fact the socioecological contradictions of industrial horticulture are now being expressed through the current heightening water crises and accelerating volatility of production.

In Egypt the expansion of reclaimed lands in the desert has long been touted as a solution to the country's water crises and food insecurity. For example, because drip or spray irrigation (as part of plasticulture) uses water more efficiently than flood irrigation, production via drip or spray irrigation in reclaimed lands is touted as sustainable—increasing the country's arable land with less water. This assumption fails to account for the socioecological relations of commodity production within the global food system or corporate food regime. Now that agroexport production in reclaimed lands in Egypt is facing exhaustion, with the depletion of the aquifer in the west of the Delta, as are other arid agroexporting regions, proponents of greening the desert policies point to a recurring problem of water-thirsty crops like banana and cotton being planted in arid regions. While I was conducting field research in Egypt, many claimed that the production of thirsty crops was a problem, but this governance problem does not explain the rapid exhaustion of irrigation water sources in arid regions.<sup>72</sup> The region of western Peru, for example, has been facing a water crisis from the large-scale production of asparagus, a “colonizing crop” that is bred to survive in sand with little water.<sup>73</sup> Large-scale commodity production, even if it is production of water-efficient crops using water-efficient technologies, requires considerable water if crops are to grow quickly and abundantly. As one agribusiness executive in Egypt put it, an olive tree may need water once a month if it is for local consumption, but an olive tree that produces lots of olives needs water every other day!<sup>74</sup> And as

the case study of Egypt highlights, intensified and expanded commodity production in arid regions where water does not readily replenish through rainfall has in fact relied on irrigation water being pulled from existing agricultural areas through state-built canals from the Nile and through cheap access to the aquifer via Bedouin lands.

Here I have introduced the concept of desert frontier, through a case study of industrial horticulture in Egypt's arid region, as a constitutive part of global horticulture. The concept does not seek to establish the relative importance of greening the desert policies and practices in global horticulture. Rather, the concept offers a methodological and analytical lens on the ecological relations through which agroexport regions (of fruits, vegetables) have been made and remade, and it is intended as an intervention in the food regime literature, which helps explain theoretically the growth of specialized production regions for global agrifood trade worldwide since the 1970s. The concept combines a political economy perspective with an analysis of nature-society relations to explain processes of standardization in industrial horticulture—and the character of standardization of agritechnologies and on-farm practices toward greater control of all units of production (from the genetic material of the plant cells to artificial soil)—through which corporations have gained greater control over the agrifood industry in Egypt and the global horticulture trade. While the food regime and related literature tends to explain the development of this WTO-led governance system as largely a design or strategy of corporations and the largest agroexporting states, an analysis of the desert frontier in Egypt demonstrates that the ecological foundations of biological simplification (and intensive cultivation) and the ecology of the desert have coproduced these agrifood industry standards to ensure a predictable, profitable supply of fruits and vegetables largely to the supermarket and hypermarket shelves of the global consumer class. ■■■■

72. In some cases production of water-thirsty crops was illegal, as in the case of a government ban on rice cultivation in parts of the Delta. In a banned area of the Delta (Borg el Arab) peasants had waged a campaign against

wealthy farmers who had illegally planted rice (interview by the author, Cairo, August 5, 2011).

73. See Glover and Kusterer, *Small Farmers, Big Business*, and Lawrence, “Peru's Wells Are Being Sucked Dry.”

74. Agribusiness executive, interview by the author, Cairo, August 15, 2011.

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