BORDER ASSEMBLAGES:

THE POLITICAL ECONOMY OF ASIAN REGIONAL VEGETABLE TRADE

by

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DISSERTATION ABSTRACT

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In my dissertation, I study the spatio-temporal variegation and transnational circulation of vegetable commodities using the case of edamame beans (the largest frozen vegetable sector in Asia). My dissertation shows that food production and trade in East Asia have fundamentally changed over the past several decades. Rapid development has lifted the region out of subsistence and into middle-class and luxury consumption. As a result, East Asia is quickly becoming the center of the global food economy. The development of edamame industries is central to explaining the transformation of the agriculture and food industries across the region. I employ a mixed methods approach that includes participant-observation, semi-structured interviews with 40 edamame farmers and entrepreneurs, and GIS mapping, alongside Social Network Analysis (SNA). In my analysis, I coin the concept of "border assemblages," arguing that edamame trade incorporates network and state-territorial characteristics. Building on this approach, my research bridges two social science sub-fields that scholars have often applied empirically but not theoretically: international politics and regional agrarian development. Three novel findings emerge from this research: First, my research adds to the literature on Asian colonialism by showing how the Japanese Empire and the post-World War Two (WWII) U.S. Cold War regime territorialized East Asia to develop a regulatory assemblage of regional agricultural production and trade. Second,

after the 1980s, a new type of food regime emerged in East Asia following the introduction of new World Trade Organization food safety regulations that reterritorialized the food production networks in Asia. My research conceptualizes the emergence of the new food regimes in an East Asian context according to the political economy and ecology of edamame trade among Taiwan, Japan, and China. Third, another strand of my research contributes to the geopolitical understanding of the edamame trade with regard to food scares and contract farming. I extend the definition of contract farming to encompass international regulatory bodies and argue that trade agreements and international food laws, such as the Codex Alimentarius, have significantly shaped the agrarian landscape in Asia.

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CHAPTER I

BORDER ASSEMBLAGES, ASIAN VEGETABLE TRADE

> The new science called "political economy" arises out of the perception of new networks of continuous and multiple relations between population, territory, and wealth; and this is accompanied by the formation of a type of intervention characteristic of government, namely, intervention in the field of economy and population.
> Foucault (1991[1978])

> The constant question when considering systemic phenomena has to be, when do changes in degree become changes in kind, and what are the effects of bioculturally, biotechnically, biopolitically, historically situated people (not Man) relative to, and combined with, the effects of other species assemblages and other biotic/abiotic forces?
> Haraway (2015, 159)

Introduction

Global trade is a complex process that goes beyond the simplified proposition of a free trade doctrine based on two countries, two characteristics, and two commodities (Sheppard 2016a, 2016b). Material attributes of commodities comingle with trade and commodity chains and are entangled with broader scale socio-natural processes. In this context, food production and trade in East Asia have fundamentally changed over the past several decades. Rapid development has lifted the region out of subsistence and into middle-class and luxury consumption, and the East Asian region is quickly becoming the center of the global food economy (McDonald 2000; Huang 2016). The agriculture and food industries across the region have been restructured since political entities joined the WTO after 2000. Moreover, the players have changed: Whereas Japan and the United States were the primary actors in the postwar period, the 1997 and 2008 economic crises served to re-organize regional food trade and reposition China as a powerful actor (McMichael and Kim 1994; McDonald 2000; McMichael 2000, 2013).

However, the literature on global food production and trade (McMichael and Kim 1994; McMichael 2000, 2013; Gereffi 2005) has not paid enough attention to the profound influence of WTO food safety and quality regulations in shaping the global food landscape. The influential food regime and global network approaches have represented the main frameworks for addressing global food production and trade. Highlighting the historical role of states in regulating food imports and exports, the food regime approach tends to focus on the state regime (Friedmann and McMichael 1987; McMichael 2009), thereby overlooking the detailed dynamics of production; furthermore, its focus on Western empires' (Britain and the United States in particular) exploitation of non-European markets obscures the region-specific geopolitics of food in Asia. As Eric Wolf (1982) famously put it, centering globalization on Europe's experiences and developmental trajectories renders people in other regions "without history." Regional food production and trade provide a lens through which to understand why and how inter-state and intra-state trade relations constitute food regimes in multiple regions. Such regimes are coterminous yet also divided by political and social boundaries due to food security, food safety, and food quality concerns.

The broadly defined production network approach, including global value chains (GVCs) and global production networks (GPNs), offers a more fine-grained analysis of the transnational organization of production (Gereffi 2005; Yeung and Coe 2015). Nevertheless, this focus can obscure the profound politicization of national food security and food safety. Authorities wield their power through the discourse and apparatus of food politics. Food politics not only involves food supply and demand to maintain food security, but is also an integral part of regional geopolitical strategies and discourses

related to food safety and quality.

Without fostering dialogue between these two approaches, research on the global food trade risks establishing a metaphorical dualism: territorial states *versus* global corporate networks. This dualism cannot capture how multi-scalar political entities, including local villages, nation-states, regional organizations, and global governance institutions, have interacted with each other to govern food production and trade, and how networked sites of food production are co-produced by farmers, traders, states, and food security apparatuses, all acting according to their own political and economic strategies. To avoid this dualism and capture these dynamics, I conceptualize the global food trade *through* one element that is key to each, albeit in obverse ways: border. Whereas food regimes highlight territories bound by borders, global networks foreground activities that cross borders. I build on new work that treats borders as constitutive and not just constituted, as proliferating rather than receding in the context of globalization (Jones 2009; Murphy 2012; Mezzadra and Neilson 2013; Cowen 2014; Sohn 2016).

In addition, I extend the concept of "assemblage" to treat the global food trade as an entanglement of socio-material networks in which multiple actors participate (DeLanda 2006; Sassen 2006; Dittmer 2014; Steinberg and Peters 2015). DeLanda's (2006) and Sassen's (2008) definitions of assemblages represent the neo-assemblage approach in the social sciences and humanities (Nail 2017), in which the network topology of assemblages that underlies the cross-border network of global cities has reigned over discussions on all kinds of assemblages. However, in Deleuze and Guattari's (1987) *A Thousand Plateaus*, the seminal work of the assemblage approach, the state assemblage is an important territorial segment of assemblages, forming "a vertical, hierarchized

aggregate that spans the horizontal lines in a dimension of depth" (478). State assemblages in this sense represent dynamics of power operated via filtering and differential inclusion—the folding in and stretching out of border relationships (Allen 2016). As a result, the concept of "border assemblages" highlights bordering processes as the topology of state assemblages through which state and other authorities wield their power spatially through the global food trade. The *fundamental goal/objective* of this research is to understand how a border is more than just a border—how a border comes to internalize regional histories of taste, food quality, food safety, and sovereignty, as well as the dynamics of capitalism.

The case of edamame beans provides a telling example of these dynamics. Edamame is an appetizer of immature soybeans frozen in their pods and then boiled before serving. Popularized in Japan in the 1970s and later spreading across Asia, edamame is a highly lucrative crop, with Japan's edamame market representing the largest segment of East Asia's frozen vegetable trade. In the 1970s and 1980s, Taiwan was the largest exporter of edamame until it was overtaken by China in the 1990s. In the 2000s, however, Taiwan was able to regain its market position in the WTO era—even as the rest of Taiwan's historically valuable vegetable export sector was collapsing, and China was growing to command half of the world's vegetable exports (see Tables 1 and 2, Figure 1, and FAOSTAT 2013[1]). In this context, the edamame story is a lens that demonstrates the Asian regional geopolitics and geo-economics of food security, food safety, and food

[1] This is a database maintained by the Food and Agriculture Organization of the United Nations. The database collects agro-trade data from 1986–2013. I calculated the value of the East Asian frozen vegetable trade (China, Hong Kong, Japan, Macau, South Korea, Taiwan) using the FAOSTAT database of the United Nations and compared it with the value of the edamame trade (between Taiwan, China, and Japan) based on statistics from the Japanese and Taiwanese governments. The value of the East Asian frozen vegetable trade in 2000–2013 was approximately USD 6 billion, and the edamame trade was USD 1.3 billion. Edamame was the single highest value frozen vegetable crop in East Asia.

quality in the WTO era, which evolves in the long trajectory of modernization of agriculture in the modern history. Hence, this research will seek to answer the following questions about the changing character of the edamame sector:

1) *How and why did a particular regional regulatory assemblage governing food and agriculture emerge alongside the development of edamame trade in East Asia?*
2) *How did that regional regulatory assemblage shape the development of edamame trade?*
3) *What new agricultural patterns are derived from that regional regulatory assemblage?*

In the next section, I will explain research questions and methodology in detail. I will then describe my research sites and establish the main theoretical arguments in terms of the extra-territorial reach of border assemblages. Finally, I will outline the chapter structure of this dissertation.

Table 1. Edamame export to Japan (from Taiwan and China) and Japan's edamame production

Year	Taiwan (mt)	China (mt)	Taiwan (value)	China (value)	Japan's Production (mt)
1990	38,824 (97%)	340 (0.85%)	1,263,352	6,708	61,900
2001	22,697 (29.4%)	44,958 (58.2%)	486,470	804,841	45,300
2015	30,300 (41.6%)	19,027 (28%)	820,342	414,957	44,500

Note. Annual Trade Data, according to the Ministry of Finance, Taiwan and Japan; Japan's Edamame Production, according to MAFF. mt (Metric Tons) value (10^4￥) %(Market Share)

Table 2. Five main vegetable exports from Taiwan

Vegetable Export	*1989–1999*		*2000–2010*	
	Weight (Kg)	Value (10^3 USD)	Weight (Kg)	Value (10^3 USD)
Edamame	365,264	640,392	308,184	523,051
Champignon	35,645	77,728	19,682	33,982
Radish and **Turnip**	263,030	55,279	115,094	28,670
Onion	94,419	38,781	10,071	4,205
Mushroom	2,610	17,472	559	1,482

Note: From Agricultural Trade Data (R.O.C.)

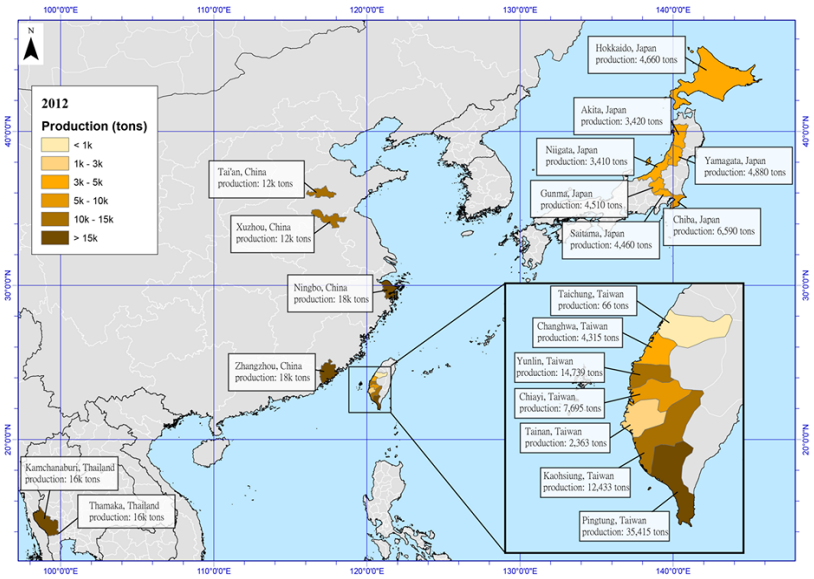

Figure 1. Production of edamame beans around the world

Research Questions and Methodology

In recent years, there have been many debates within the discipline of geography—and in academia more broadly—about the appropriate methodologies through which to transcend the binary between critical/interpretive perspectives and perspectives utilizing quantitative methods and Geographical Information Science (GIS) to analyze spatial patterns and processes (Kwan 2004; Sui 2004; Elwood 2006; Murphy 2006; Creswell 2013). This project investigated the discourses on the categorical differences characterizing the food trade among Taiwan, China, and Japan, as well as the different spatial patterns through which these forms of distinction are reproduced and performed. Accordingly, the research questions focused on understanding the extra-territorial reach of a particular regional regulatory assemblage marking the boundaries between the 'self' and the 'other' in the food production network, while examining a variety of food trade and production patterns. Because various methodologies can provide

different perspectives, I employed multiple strategies of inquiry that involved collecting numerical and textual data either simultaneously or sequentially in order to best understand the research problem at hand. Therefore, to answer these questions, I combined ethnographic, qualitative methods, such as interviews, participant observation, and discourse analysis (Sayer 1992; Burawoy et al. 2000), with quantitative methods, such as network analysis and GIS (Kwan 2004; Creswell 2013).

Question I: How and why did a particular regional regulatory assemblage governing food and agriculture emerge along with the development of edamame trade in East Asia?

Sub-question 1: How did the Japanese Empire territorialize East Asia and expand its influences in agriculture? I investigated the recently opened *Toward the South Archives* of the Japanese Colonial Official Governor at the Archives of the Institute of Taiwan History (ITH), Academia Sinica in Taipei. As I delved into this archive, I focused particularly on the ways in which the Japanese Empire positioned Taiwan and south China as part of the logistic apparatus of the Pacific War. As such, these colonies were tasked with producing food for the Japanese military and homeland. This included conducting extensive tropical agricultural research in order to optimize output. I have reported findings from the analysis of the primary archival data in Chapter 2.

Sub-question 2: How did the United States territorialize East Asia through postwar agrarian development projects? I investigated the journal *Harvest* and other official documents published by the Sino-America Joint Commission on Rural Reconstruction (JCRR, today's Commission of Agriculture in Taiwan) from 1951 to the present. During the postwar period, *Harvest* magazine was the main channel for transmitting agriculture-related knowledge from the United States to Asia. Other official

JCRR documents provided me with information related to the international politics surrounding agrarian development. The archive can be accessed at Academia Historica in Taipei. To explore this archive, I used discourse and narrative analysis to examine the dynamics of policy making (Jessop 2004; Fairclough 2013) with a particular focus on United States' postwar agrarian development plans designed to develop Taiwan and southeast Asia in the Cold War era. I have reported findings from the analysis of the primary archival data in Chapter 3.

Question II: How did that regional regulatory assemblage shape the development of edamame trade?

Sub-question 1: How did the WTO influence agricultural and food safety and quality policies in Japan, China, and Taiwan? I looked at policies from the highest levels of agricultural administration in Taiwan, China, and Japan, including the Council of Agriculture in Taiwan, the Department of Agriculture in China, and Japan's Ministry of Agriculture, Forestry, and Fisheries (MAFF). I examined those policies with a focus on the regulatory frameworks related to food safety and quality that have emerged, and how the WTO has influenced them since 2000. This material helped to explain how shifts in agricultural policies in postwar East Asia have influenced the development of the edamame and vegetable industries in the region. I have reported findings from the analysis of the primary and secondary data in Chapter 3.

Sub-question 2: What is the composition of edamame trade networks, and how has it changed as a result of the WTO regulations? I analyzed agricultural trade data (number of trade partners, import/export trade quantities, and food prices) from the FAOSTAT database at the United Nations for the years 1986–2013, focusing particularly on the 2000–2013 period when the WTO regulations were implemented. I first used

centrality analysis derived from the computational social network analysis of trade (De Benedictis and Tajoli 2011) to identify countries that occupied the central position in trading vegetables. This method is similar to the one I used to analyze the central actors in the papaya trade (Wang 2016). Next, I used the same method to analyze regional networks of vegetable trade in Asia and edamame trade among China, Taiwan, and Japan. Finally, I compared those results to assess the global and regional influences of the countries involved in the vegetable trade and the edamame trade, in particular. I have reported findings of my analysis in the Appendix chapter.

Question III: What new agricultural patterns are derived from that regional regulatory assemblage?

Sub-question 1: What are the new geo-spatial organizations and strategies of the vegetable industries in East Asia in the WTO era? I interviewed the owners of the two largest edamame firms in the world, with branch firms in Japan, the U.S., Taiwan, and China. I conducted semi-structured interviews with four interviewees. The list of interview questions focused on how edamame producers have changed their geographical strategies and production processes to (re)position themselves within the new edamame production network. The interviewees' responses helped to explain the geo-spatial organization and strategies implemented by the East Asian vegetable industries under the WTO regulations. I have reported findings from the analysis of the primary data in Chapter 2 and Chapter 3.

Sub-question 2: What are the modalities of agrarian society in East Asia after experiencing agricultural modernization to improve food quality and quantity in the WTO era; who has benefited and who has suffered from the process? To answer this question, I conducted a total of 40 semi-structured interviews with edamame farmers in

Taiwan and China and observed their labor processes. I recruited interviewees through snowball sampling facilitated by the owners of edamame processing plants. In Taiwan, Yunlin County (n=2) and Pingtung County (n=13), the farmers were mainly big farmers who utilized mechanized farming requiring heavy capital investment. In China, Zhangzhou City (Fujian Province; n=4) and Ningbo City (Zhejiang Province; n=11), my interviewees included migrant farmer laborers (n=6, all in Ningbo) who grew edamame beans using relatively primitive techniques. The interviews were designed to generate responses to the following questions: 1) What is your experience working in the edamame industry? 2) What is the contractual relationship between edamame farmers and edamame processing plants? 3) How have changes in food safety and quality regulations influenced edamame production? 4) How have Taiwanese and Chinese edamame producers competed or collaborated with each other? 5) What is the government's role in developing edamame and vegetable agriculture? The interviewees' responses shed light on the current state of the edamame industries with regard to agricultural modernization in East Asia. I have reported findings from the analysis of the primary data in Chapter 2, Chapter 3, and Chapter 4.

East Asian Edamame Flow

Japan is the largest consumer of edamame in the world, and its edamame market comprises the largest segment of East Asia's frozen vegetable trade (FAOSTAT 2013).[2]

[2] I calculated the value of the East Asian frozen vegetable trade (China, Hong Kong, Japan, Macau, South Korea, Taiwan) using the UN's FAOSTAT database and compared that value with the value of the edamame trade (between Taiwan, China, and Japan) derived from Japanese and Taiwanese government statistics. In 2000–2013, the value of the East Asian frozen vegetable trade was approximately USD 6 billion and the value of the edamame trade was USD 1.3 billion. Edamame was the single highest value frozen vegetable crop in East Asia.

Throughout the 1970s and 1980s, and into the 1990s, Yunlin County in central Taiwan produced as much as 90 percent of the world's edamame export, most of it destined for Japan. However, in the 1990s, the edamame industry in Yunlin County declined by about 80 percent, and much of that market share was taken over by China. Evidence collected from my interviews reveals that much of the edamame exported from China in the 1990s was produced by Taiwanese and Japanese edamame firms that had invested in growing operations in Fujian and Zhejiang Provinces, respectively. In the first decade of the twenty-first century, food industries in China faced new challenges as global vegetable markets demanded higher quality products in accordance with WTO food safety and quality regulations (Galt 2010).[3] Consequently, some of the Taiwanese edamame firms that had invested in China moved back to Taiwan where they could produce higher quality edamame.

However, when they relocated, the Taiwanese edamame firms did not move back to Yunlin County, but instead moved to Pingtung County in south Taiwan. Pingtung County is the southernmost prefecture of Taiwan. When Taiwan was a Japanese colony from 1895 to the end of the Pacific War in 1945, Japan used this southern region as the production base of the sugarcane industry. Japan also experimented with an agrarian developmental model that it later transplanted into its colonies in China in Southeast Asia (Ka 1995; Chung 2003; Moore 2013). In the postwar era, the Republic of China's government founded the Taiwan Sugar Corporation, a state-owned company, to take over the sugar industry built by the Japanese. As Taiwan's sugar industry failed in the 1970s, a

[3] In 2000, the Codex Alimentarius of the WTO was introduced into the food and health regulations of Japan—the largest vegetable importer in the world. Most relevant to this study is the introduction of MRLs (Maximum Chemical and Pesticide Residue Limits) (WTO: https://www.wto.org/english/thewto_e/coher_e/wto_codex_e.htm).

number of food industries emerged in its place, including the edamame industry, which today has 25 km^2 under cultivation. Pingtung County also hosts the only agricultural biotechnological industrial park in Taiwan, comprised of the Asia Vegetable Research and Development Center and the Kaohsiung District Agricultural Improvement and Extension Station. These centers have been tasked with developing a modern edamame agricultural cluster.

Zhangzhou was the first location in China that the Taiwanese and Japanese invested capital for edamame production in the early 1990s. Zhangzhou is also one of the pilot cities of Fujian Province, China, assigned to promote regional cooperation and the formation of the West Taiwan Strait Economic Zone (WTSEZ). Since the 1990s, Zhangzhou has developed an approximately 100 km^2 agricultural processing zone, in which the investment from Taiwanese edamame firms encompasses 50–70 km^2 of WTSEZ land.

Ningbo in Zhejiang Province is another important site of edamame production in China emerged in the 2000s. Of the 99 km^2 of modern agriculture production zones in Ningbo, about 50 km^2 serve as edamame production sites. Most significantly, Ningbo is the only production site in China experimenting with mechanized edamame production—the cutting edge of modern agriculture in China. Since the early 2000s, China's central government has implemented agricultural modernization reform with the aim of helping its farming sector to improve food quality and quantity. As a result, large-scale, mechanized and commercialized agricultural operators are replacing small-scale farming households.

This research seeks to disentangle the divergent sectoral trajectories in these four locales in order to determine and highlight which effects are produced by the "border assemblages," and to better understand the extra-territorial reach of the vegetable trade and production networks among East Asian countries.

The Conceptual Framework: Border Assemblages

To investigate the edamame trade in East Asia, the theoretical framework of the research pulls together literature on food regimes, production networks, territory/borders, and assemblages. My research extends the concept of "assemblages" (Deleuze and Guattari 1987; Collier and Ong 2005; DeLanda 2006; Sassen 2008) and builds on recent work on borders in human geography and other fields (Murphy 1991, 2012; Paasi 1998; Jones 2009; Mezzadra and Neilson 2013; Cowen 2014; Sohn 2016) to re-envision borders as "border assemblages"—a conceptual framework to illustrate the extra-territorial reach of the WTO food safety and quality regulations, operated through food production networks and contract farming. While food trade networks transgress traditional national borderlines and reach into the heart of local production systems (McMichael 2000), nation-states still play a critical role in perpetuating the global food regulations of the WTO (Kim 2010). As such, border assemblages can be seen as the governance of cross-border food networks, in which the scalar political entities that share authorities from local to global scales, and networked sites of production are (de-/re-) territorialized by multiple actors in a regional context (Brenner 2001).

Food Regimes

One of the most important paradigms for understanding food in the context of

modern nation-states is the food regime concept, which identifies a succession of structured moments—spatiotemporal, political-economic coherences—and transitions in the history and present of the global food trade (Friedmann and McMichael 1989). According to McMichael (2013), the food regime approach can be understood as a continuous "analysis of the political geography of the global food system" (1). Furthermore, he also identifies the food regime approach as "key to unlock not only structured moments and transition in the history of capitalist food relations, but also the history of capitalism itself" (24).

The first modern food regime emerged in the nineteenth and early twentieth centuries and was structured by the British Empire; growing industrial classes were increasingly provisioned by grain and meat from family farms in overseas settler colonies, and tropical crops from plantations in occupation colonies. The second food regime emerged out of the Depression and in the aftermath of World War II; nations around the world adopted the American model of highly protected and nationally articulated agricultural and industrial sectors, combined with international integration in some food sectors.

The transition from the second food regime to the third food regime has been the focus of food regime scholarship since the 1990s (Friedmann 1993, 2005; McMichael 2005). Multiple food and energy crises in the 1970s led to a decline in U.S. hegemony and the increasing neoliberalization of the government's managerial role, which was central to the national ideology of the Bretton Woods system. Following this trend, global food corporations became dominant and grew in scope and size by increasing the extent of their integration, both horizontally and vertically (McMichael 2009; Clapp 2016).

McMichael (2005) argues that a new "corporate food regime" characterized by the confrontation between global food corporations and peasants emerged in the third food regime, whereas Friedmann (2005, 2016) identifies an emerging "corporate-environmental food regime," incorporating multiple actors and constituent parts of the global food system into the third food regime conversation.

I delve deeper into the debates surrounding the emergent third food regime in the context of the empirical studies in Chapter 3 of this dissertation. Here, however, I highlight that such debates centered on globalized food trade and the reduced centrality of states overlook other dynamics taking place at other spatial scales. In line with Bernstein's (2016) suggestion that debates about the third food regime might be better assessed retrospectively than at present (a well-known phenomenon in social science theory), I argue that the concept of "regional food regimes" recently coined by McMichael (2013) might better capture the geographies of food production. This type of thinking encourages us to "raise questions of history, scale and meaning that might be left unexamined if spatial constructs are simply taken for granted" (Murphy 1991, 33). Efforts to develop a regional geography (Murphy 1991; Paasi 1998) suggest that the formation and evolution of regions is an important process in the construction of food regimes and food capitalism. Food regimes are not merely about modern state formation or the state system, but a process of (de-/re-) territorialization of political authority to control food and resource flows within a regional context.

In the East Asian context, Japanese colonial occupation in the early twentieth century created close agrarian connections between Japan, South Korea, China, and Taiwan, as the Japanese Empire became the center of agro-trade in Asia, controlling the

foodways in Asia. As a latecomer to imperialism with limited territory with which to expand, imperial Japan largely withdrew from the world system in the 1930s to pursue, along with its colonies of Korea, Taiwan, and Manchuria, a 'go-it-alone path' to development (Cumings 1984). This historical-material sediment continues to perpetuate the centrality of Japan in postwar Asian development (McMichael and Kim 1994; McMichael 2013; Tsing 2016).

The transition of food regimes that took place in the 1980s served to intensify the separation of Japan and other Asian countries from the 'Atlantic agro-food sector,' which in the Cold War geopolitical context had been centered on U.S. and European countries and food corporations (Friedmann 1993). Furthermore, the divide between Japan and the Atlantic agro-food sectors has stemmed in part from Japan's and other Asian countries' distinct style of food consumption and Japan's multiple outsourcing food networks (Friedmann 1993). As a result, the postcolonial, postwar, and post-Cold War dynamics and controversies of the region (Cumings 1984; Koo 1987; McMichael 2000; Ching 2001; Calder and Ye 2010; Glassman 2011) have deeply influenced the foodways of Japan's former colonies in Asia, and further the regionalization of East Asian food production and trade centered on Japan.

Drawing on the historical-material contexts of East Asia, my research follows Friedmann (2016) in broadening the food regime framework by incorporating spatial references and regional and class 'threads' that determine specific crops, regions, and types of farmers. Taking soy as an example, Friedmann (1993) notes that Japan adopted a strategy of food importation that differed from that of the U.S. and Europe. This strategy was based on Japanese food conventions of consuming soy products directly, as well as

economic concerns: Without significant domestic production, Japan's interest rested in the diversity of food supply, keeping food prices down, and reducing dependence on any one particular supplier. In a crucial sense, Friedmann (2005) also argues that the convergence of environmental politics, niche product lines, and retail-led reorganization of food supply chains has led to the emergence of a corporate-environmental food regime, in which national states play a key role in regulating food and agriculture for food safety and quality, alongside international organizations such as the WTO and UN institutions. Focusing on the regional food regime driven by global food corporations, along with Friedmann, McMichael highlights the Japan-centered East Asian food import complex (2000, 2013) as a consequential part of his regional food regime analysis (2013). McMichael argues that Japanese corporations' global food sourcing model has been a "key pillar" of the regional food regime in East Asia. He illuminates the rise of an alternative organizing principle that has conditioned the multi-centric restructuring of the corporate food regime, particularly with newly industrialized countries (NICs) in Asia joining the crowd of global food sourcing.

In this dissertation, building on the concept of the "regional food regime" and the human geography literature, this research adds to the current debates on food regimes by postulating the regionalization of East Asian food regimes and highlighting the multiplicities inherent in food regimes with the case study of edamame beans. The power that food regimes operate in and across time and space is not homogeneous; rather, the territorial power of food regimes operates contingently through bounded and relational, fixed and fluxed spatial patterns in a historical-material process of making a region. I extend Friedmann's (1993) early insight on the lack of 'integration' (1993, 11) between

Japan and the trans-Atlantic food sector in the post-Second World War (WWII) period, as well as McMichael's (2013) depiction of the Japan-centered East Asian food import complex. I argue that the East Asian food regime framework contributes to a better understanding of the 'inertia' of East Asian food regimes and its re-territorialization, as East Asian countries have repositioned themselves to re-regulate agro-food production and trade in the WTO era, especially under food safety and quality regulations.

Global Value Chains and Global Production Networks

The global network approach, which includes the global value chain (GVC) and global production network (GPN) approaches, places more emphasis on the sub-state regional embeddedness of transnational corporations, as corporations must adapt to regulatory constraints and refashion themselves within that new framework (Gereffi 2005; Coe 2012, 390). These approaches develop insights into "linked production processes" and thus represent important tools in the scholarship examining economic globalization (Wallerstein 2000). At the same time, some researchers have focused on the inter-firm relationships within outsourcing networks, led by transnational corporations (Gereffi 2005; Dicken 2011), while other scholars have focused on extra-firm relationships, especially the bargaining activities between global leading firms and nation-states (Yeung and Coe 2015). Together, this work shows that global connections are neither autonomous nor arbitrary patterns crossing the global economic landscape.

However, the literature on GPNs has overlooked the relationship between the processes of production and the natural environment, such as natural resources, food, and agriculture (Coe et al. 2008), while the GVC literature has paid more attention to natural resources (Daviron and Ponte 2000; Gereffi 2005; Patel-Campillo 2010). Over the past

two decades, the expanded linkages of food commodity chains between the global South and the global North have led to increased exports of high-value fresh produce and frozen vegetables (Gereffi 2005). This development has stemmed from structural adjustments intended to upgrade food commodity chains and increase exports from the global South in response to the debt crisis of the 1980s (Daviron and Ponte 2000). Ideologies of trade liberalization and export-oriented economy have encouraged developing countries to shift away from the production of basic food staples to the production of high-value cash crops, such as exotic fruits and fresh vegetables (Patel-Campillo 2010).

However, the agricultural trade between the global North and South as depicted by GVCs cannot convincingly explain the East Asian vegetable trade. Since the early 2000s, the border-crossing procedures for assuring food quality and safety have been considerably internalized by individual firms of food industries (Friedmann 2005; Galt 2010, 350), and the high-value vegetable industry in East Asia has been strongly influenced by the food safety standards mandated by both developing and developed countries.

For instance, after China delineated development zones in coastal areas and opened them to cross-border investments and production networks in the 1990s (Hsing 1998), Taiwanese and Japanese vegetable farmers and processors established new vegetable industrial clusters in south China. However, those clusters were restructured in the 2000s because global vegetable markets started to seek higher quality products in accordance with the WTO regulations (Wang 2018). Higher production standards exerted great pressure on profit margins that were already being compressed by steadily increasing labor costs and land rents. Thus, a more flexible way of accumulation was urgently

required.

The Taiwanese edamame firms that stayed in China decided to integrate into the vegetable industry clusters being formed by state-owned Chinese dragonhead companies, while others reduced their production in China and diversified their products (Wang 2018). Meanwhile, many of the Taiwanese firms returned to Taiwan and focused production on the new edamame cluster emerging in southern Taiwan that would be able to produce edamame to the exacting standards of the Japanese market (ibid 2018).

In terms of the kimchi industry, around 98% of Korea's imported kimchi had been from China, but health scares involving Chinese kimchi pushed the Korean government to leverage the WTO's Codex Alimentarius standards in order to inspect imported kimchi. In turn, the Chinese government sought revenge on Korea by implementing an embargo on kimchi exports using the exact same food safety and quality regulations (Han 2011). The ensuing "kimchi war" lasted for more than a decade, demonstrating the complexities of the regional food trade.[4]

In order to address East Asian food production and trade, and the broader dynamics of production networks, it is important to recapture the focus on spatio-historical trajectories. In addition, it is crucial to examine the rearrangement of trade rules and how such shifts can reconfigure the geo-economic space in terms of the existing "geopolitical social" (Cowen and Smith 2009). For example, relationship-specific investments or a socio-economic nexus can secure food safety and quality for specific geopolitical

[4] Japan has a very similar tradition of fermenting vegetables called kimuchi (the way kimchi was pronounced in Japanese). As such, Japan became the main competitor with South Korean kimchi in the global market. In 2001, however, the Codex Alimentarius Commission recognized kimchi as the traditional cuisine of South Korea, and kimuchi as just a Japanese imitation of Japan in 2001. The "kimchi war" between kimchi and kimuchi gradually receded and came to an end in 2015 when *kimjang*, the making and sharing of kimchi in South Korea, was recognized by UNESCO as an Intangible Cultural Heritage.

alliances. In this regard, this research highlights the need to tackle the bounded relations of regional socio-geographical alliances, wherein geo-economics and geopolitics territorialize and border regional agrarian development in significant ways. Moreover, to reconsider the broadly defined production network framework in regional food production and trade, it is important to draw on the literature on the organizational arrangements of value chains in the agricultural sector, such as contract farming (Watts 1994; Guthman 2017).

Although the contract farming literature and GVC literature share common ground in addressing "linked production processes," the contract farming literature focuses more on the contractual relationship between farmers and other firms that specify the conditions of agricultural production. Furthermore, the contractual arrangement is a part of the global food regulations, hence, contract farming is the governance structure to organize food supplies to meet the demands of national and/or regional food safety and quality concerns that satisfy citizen's diet (Freidberg 2004; Friedmann 2005; Guthman 2017). In other words, the spatial-material relation of property rights in the form of a contract presupposes the territorial power of the state, which should be brought to the fore when discussing the globalization of food production and trade.

In an Asian context, Tsing's studies on the Asian timber trade (2016) and mushroom trade (2015) highlight Japanese traders' dominant role in organizing the commodity chain of food and natural resources. These examples suggest that Japanese traders are driving contract farming and agricultural trade in Asia. However, the subcontracting of agricultural production is related not only to economic interests, but also to the regional geopolitics of food and agriculture. In this case, Japanese agricultural regulations expand

throughout Asia, assembling many actors at various levels to form a contract farming system.

Borders as Assemblages

I have argued that although the food regime and network approaches provide crucial lenses through which to investigate global food and resource production, it is insufficient to conceptualize the phenomenon of global food production and trade in terms of a dualism: territorial states *versus* global corporate networks. Instead, by developing the conceptual framework of border assemblages, this study proposes a methodological stance that deconstructs such dualisms by acknowledging the territorial-material "stickiness" (Murphy 2012) of production networks. In addition, I build on work that adds complexity to the understanding of borders, suggesting that they are not only constituted by, but also constitutive of, social-political-spatial practices (Paasi 1998; Sturgeon 2007; Jones 2009; Mezzadra and Neilson 2013; Castree 2014; Cowen 2014; Sohn 2016).

According to the concept of border assemblages (see Figure 2), this research agrees that it is crucial to be sensitive to the questions of geographic region and the scale of food regimes, in a way that incorporates the global, regional, national, sub-national, local and so forth as different spaces through which the reach of food regimes is territorialized, regulated, and contested. John Allen's (2016) concept of "topologies of power" helps us to reconsider food regimes not in the sense of pre-given boundaries that separate distinct geographic units from one another, but rather in the sense of how topologies of power are always related in the context of territorialization. In effect, territorial power operates through bounded and relational-networked processes, and is contingent on a historical

material process (Murphy 2012). Therefore, the political boundaries of food regimes are more or less constantly changing shape, extended throughout society and often remote from which food regimes draw their legitimacy and power.

This research proposes that border assemblages are realized through the plurality of actors and their mixed motives (Gopinath and Itskhoki 2008; Carter and Goemans 2011, 2014). The construction of borders delineates relevant jurisdictions and coordinates political, economic, social, and military interactions, culminating in the extra-territorial reach of global food and resource governance. The extra-territorial reach of border assemblages acknowledges the continued existence of manifestly "hard" borders, such as the maritime border of the U.S., which is operated through the Customs–Trade Partnership Against Terrorism (C–TPAT) initiative (Cowen 2014), while illuminating a more fluid understanding of "bordering" practices—the categorical practices rooted in identities and memories (Jones 2009). Hence, border assemblages incorporate the strategic relations of nation-states and the (re)articulation of transnational space in bordering processes to govern global commodity chains and networks.

Furthermore, border assemblages are not merely zones where the interests of agrofood corporations and nation-states overlap, but spaces where resource producers, such as smallholders and peasants, and local politicians continue to mediate and constitute the new border spaces of globalization through contractual arrangement of food and agriculture. In this context, border assemblages are also the variable associations of human and non-human actors and intermediaries in processes of heterogeneous coupling (Goodman 2001). Local, regional, national, and global scales of production and resource exchange are interwoven with narratives, memories, and social institutions, such as

contract farming.

The concept of border assemblages aligns with the neo-assemblage theory of Sassen (2008) and DeLanda (2006), yet it steps further to deploy Deleuze and Guattari's (1987) definition in *A Thousand Plateaus* that emphasizes borders as a crucial territorial segment of the state's assemblage and signifies the state-territorial topology, alongside the network topology, characterizing both the current and potential states of the global food system. According to Deleuze and Guattari (1987), the state assemblage

> In retaining given elements, it necessarily cuts off their relations with other elements, which become exterior, it inhibits, slows down, or controls those relations; if the State has a circuit of its own, it is an internal circuit dependent primarily upon resonance, it is a zone of recurrence that isolates itself from the remainder of the network, even if in order to do so it must exert even stricter controls over its relations with that remainder. (478)

Hence, this approach suggests that, rather than minimizing the importance of borders, the rise of global food markets is producing the multiplicity of borders through the extra-territoriality of trade networks. In these networks, the attempt to secure food supply chains employs discourses and political strategies to govern food networks and construct a "seam space" of the global food trade (Mezzadra and Neilson 2013; Cowen 2014; Sohn 2016).

The concept of border assemblages is also characterized by polyphonic assemblages (Tsing 2015), with an emphasis on "patterns of unintentional coordination" (Tsing 2015, 23), as "they result from world making projects, human and not human" (24). Border assemblages address such patterns by observing the interplay of temporal rhythms and scales in the multiple lifeways that gather the materiality of security infrastructures and industries, agrofood and resources, and state regimes in the global food trade.

Finally, border assemblages become territorialized and reified through the historical processes that form the assemblage at multiple scales. Anna Tsing (2015) describes the geographies of the Matsutake economy as "patches" that have spread, mutated, and merged with other patterns of agriculture and species at multiple scales of the Matsutake landscape for decades. The concept of border assemblages provides a framework and methodology to investigate the scalar processes involved in forming those food and agriculture "patches." For example, the agglomeration of small- and medium-sized edamame processing plants in Taiwan, supported by the government's rural industrialization policy and Japanese and American capital and technologies in the postwar era, is an example of the territorialization and regionalization of edamame patches. The processes of (de-/re-) territorialization and (de-/re-) bordering refer to the intervention or disruption of the components that results in the distortion of border assemblages, thereby forming new assemblages and re-articulating edamame patches across Asia. For instance, when the WTO and Japan began to enforce new food safety and quality regulations, though edamame suppliers in Taiwan and China reorganized their agrofood production networks through designing new contract farming to ensure food safety and quality, and to meet global food trade standards, multiple edamame agricultural patterns emerged accordingly.

Overall, the framework of border assemblages highlights the regionalization process of political authority to control global food and resource flows. In this dissertation, I propose a regional food regime approach focused on East Asia, in which the framework of border assemblages highlights the interplay of historical tendencies and geopolitical

strategies in the operation of food production networks. I use the case of edamame to address the dynamics of the geopolitics of contract farming in East Asia.

Chapter Structure

In addressing its research questions with the framework of border assemblages, this dissertation offers an analysis of the regional food and agricultural trade networks in East Asia, as well as a partial and situated perspective on the local experiences of agricultural production in China and Taiwan. Highlighting the case of edamame beans, this dissertation also explores the ways in which these two forces—regionalization and localization, converge within the context of globalization. To do so, I trace the tension between the globalization of food trade and production, and the desire for borders and organization, which allow for calculations and appropriations, and for power to be exercised. The chapters are structured in such a way that each chapter can be read individually as a detailed case study of a particular facet situated within the larger story of the extra-territorial reach of global food trade and its governance. When considered as a whole, the chapters reveal the broader picture of the food and agricultural political economy and ecology that has characterized East Asia over the past hundred years.

Chapter Two considers the historical geography of East Asian agrarian development, focusing on the ways in which the Japanese Empire and the post-WWII U.S. Cold War Regime territorialized East Asia and extend its power through agrarian development projects. These projects contributed to the establishment of a regulatory assemblage guiding regional agricultural production and trade. This chapter also brings to the fore the rarely acknowledged colonial entanglements of knowledge production and exchange in

the field of agriculture in East Asia. It begins by showing the importance of agrarian science institutions and agronomists in expanding the Japanese Empire and then goes on to reveal the colonial logics underpinning the scholarship of two of the founding figures of agrarian science in postwar East Asia: Ding Ying in China and Sun Shou-kung in Taiwan. The chapter concludes that these colonial logics gained legitimacy through the Cold War geopolitical and geo-economic contexts that shaped the modern agrarian science regimes and subsequent East Asian agrarian development.

Chapter Three establishes the main theoretical arguments in terms of East Asian food regimes and draws on the case of edamame beans to demonstrate how a regional food regime has emerged. In recent years, food regimes have been the topic of substantial research, and a burgeoning body of work has begun to think differently about food regimes. This chapter addresses this trend by drawing on the concepts of the corporate food regime and corporate-environmental food regime with a regionalization perspective. The first part of this chapter addresses the role played by agrarian-scientific institutions and agronomists in this transition; specifically, it investigates the spatial topologies, political economy, histories, and socio-cultural contexts of agrarian knowledge production and practices that have conditioned East Asia's transition to a corporate-environmental food regime. The second part offers an analysis of a specific food commodity—edamame beans—to illustrate how East Asian food regimes have changed as they have been incorporated into the emerging WTO food safety and quality regime; specifically, I analyze how edamame production and trade has been reorganized under East Asian food regimes, which to some extent demonstrate the multiplicity of the corporate-environmental food regime. The chapter concludes that broadening the

conversation about the food regimes approach requires a regional-geographic perspective in order to understand the spatial topologies, uneven development, and socio-cultural-ecological differentiation characteristic of food regimes.

Chapter Four investigates the extra-territorial reach of food safety regulations within the context of East Asian food regimes. This chapter examines how the proliferation of the new Japanese food-safety regime has influenced the edamame industries of China and Taiwan—the two largest producers of edamame beans in the world. The chapter addresses how the interaction between geopolitical realities and the subcontracting of edamame crops has created an access regime governing the vegetable trade in East Asia. By addressing the complexity of the geopolitics related to contract farming, this chapter concludes that under East Asian food regimes, the Japanese edamame trade has subordinated edamame producers in multiple places in Asia, while Taiwan's edamame industry has positioned itself to obtain preferential access to the edamame flow between Japan, Taiwan, and China.

Chapter Five considers recent applications of the concept of rent in the fields of agrarian studies and geography, and acknowledges the usefulness of this concept for understanding the political economy of East Asian food regimes. Although the concept of rent has been discussed in geography and related fields for decades, its definition remains convoluted and contested. Recently, critical geography and agrarian studies have begun to reconsider rent as an important conceptual framework through which to understand how the circulation of capital in search of rent plays a particular role in the management of land property that results in a spatial reorganization of activities. By addressing the edamame trade and production in East Asia, in particular the role of entrepreneurs, this

chapter argues that the production and the appropriation of rent are commensurate in the construction of a resource regime that results in edamame rents.

Chapter Six returns to the larger questions of production networks, territorialization, and bordering practices in the global food trade (what I call border assemblages). After reviewing the findings and conclusions from each chapter of this dissertation, this final chapter considers the theoretical and practical implications of the research. Each chapter points to the conclusion that the geopolitics and geo-economics of East Asian food regimes illustrated by the edamame case cannot be fully grasped through the dichotomy of either territorial-state or global corporation network fallacy. Instead, territorial power operates contingently through bounded and relational, fixed and fluxed spatial patterns in a historical-material process. Hence, the appreciation of the spatial topologies of food regimes (such as networked, centralized, and/or scalar topologies) holds implications not only for how a regional food regime itself is interpreted and measured, but also for how social and spatial relations of food production and trade are conceived of and change within and across space.

The Appendix Chapter presents a geo-network method that contributes to the network approach in geography. Utilizing Asian regional vegetable trade as a case, I conduct geo-network analysis by mapping out the general picture of the Asian vegetable trade to answer the following questions: Does the Asian vegetable trade demonstrate the same dynamics as edamame agriculture? If not, how has Asian vegetable trade been organized and shaped by this historical material context, especially after 2000 when Taiwan and China joined the WTO? According to the import and export numbers of the vegetable trade in Asia provided by FAO in 1986–2013, my finding is that China has

strengthened its role as the leading regional supplier of vegetables, and Japan has maintained its role as the most important buyer. Korea has become a significant importer of Chinese frozen vegetables since 2000. However, in terms of the betweenness and closeness measures of social network analysis, Thailand and Malaysia have grown rapidly to occupy the central position in the Asian vegetable trade networks.

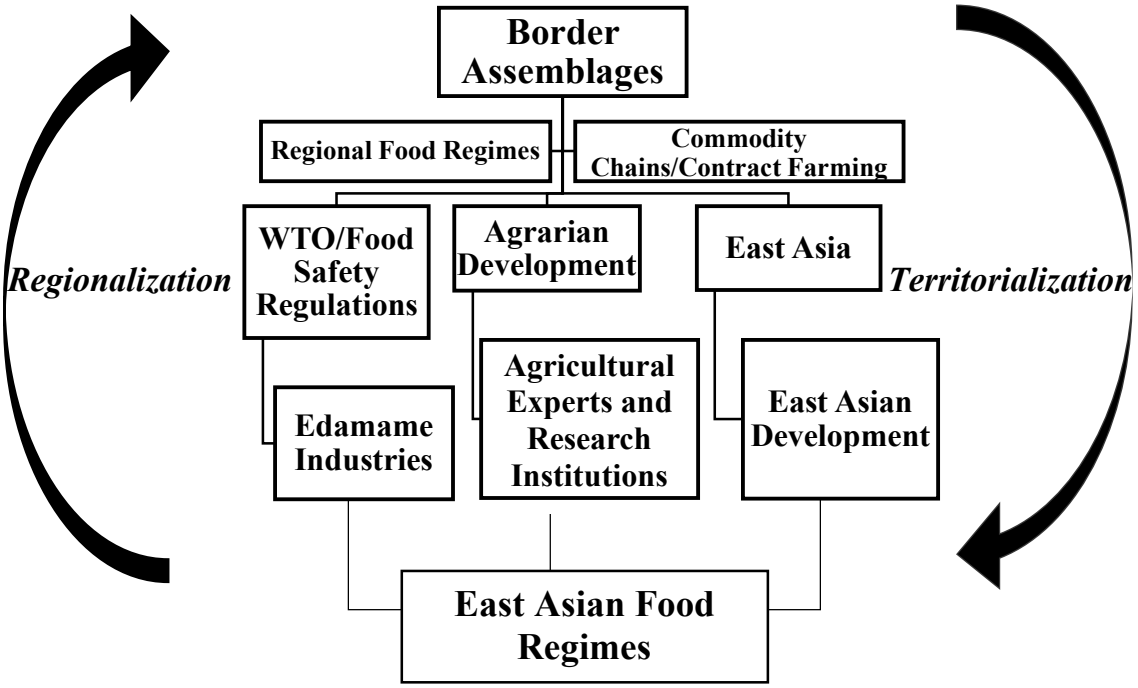

Figure 2. The analytical framework of the dissertation

CHAPTER II

THE REGIONALIZATION OF MODERN AGRARIAN REGIMES IN EAST ASIA

> Chinese modernism departs further from the usual binary models of the non-West's confrontation with the West—"China versus the West" or "East versus West." Most significant in this regard was the prominent role played by Japan as the mediating transmitter of Western culture and a potent force in the formation of Chinese modernism.
> Shih (2001, 4)

Introduction

During the first half of the twentieth century, the Japanese Empire took control of large swathes of East Asia, and most of these territories experienced agricultural modernization for the first time. After the Pacific War ended in 1945, Japan was occupied by Allied forces, and along with its former colonial territories fell under the umbrella of the postwar and Cold War U.S. imperial hegemony. China was the exception: large parts of China had been controlled and influenced by the Japanese Empire until 1945, but after 1949 it cut off American influence and pursued an autarkic, Soviet Union-oriented path. In this chapter, I argue that the origins of divergent trajectories of postwar agrarian development in Taiwan and China can be traced back to the hegemony of colonial regimes in Asia led by Japan and the United States. In particular, this chapter brings to the fore colonial entanglements of knowledge production and exchange, and demonstrates how they shaped agricultural modernization in East Asia.

As previous studies have shown, the Japanese Colonial Governor-General's Office (CGO) and the Development Company Limited in both Taiwan and Korea played leading roles in developing rice and sugar agriculture as the foundation of the colonial economy (Yanaihara 1929; Chang and Myers 1963; Cumings 1984; Ka 1995; Myers 1984; Myers

and Yamada 1984). Other scholars have focused on the influence of Japan's regional power on the development of the East Asian rice and sugar industries between 1937 and 1945, as the Japanese Empire expanded into the south of China and Southeast Asia. McMichael (2013) highlights the central role of the Japan Empire in constructing a regional food regime in East Asia; Chang (2007) discusses how Taiwan played a strategic role in the expansion of the Japanese colonial regime, as the Japanese Empire promoted an "agricultural Taiwan and industrial Japan" discourse that shaped the colonial economy.

Human resources were just as important to agricultural development as any other resource. As Japanese-Taiwanese agrarian volunteer teams were organized and dispatched to China and Southeast Asia (Chang 2007), Taiwanese agricultural experts were trained in the context of the military mobilization of Taiwan. In the meantime, the "Kominka Movement" (Japanization movement) was aimed at the modernization of agriculture (Taiwan Farmers' Association 1941) and the application of official agrarian knowledge to people's daily lives. Research has shown, for example, how Japanese colonists used the scientific investigation of farmland and peasants during this period to control the colonial society in Taiwan (Yao 2006).

Agrarian development in colonial Taiwan resonates with what Ruth Rogaski stresses in her *Hygienic Modernity* (2004). Rogaski notes that the presence of Japan facilitated the adoption of the modern hygienic idea, providing a bridge between China and the West under colonialism. Japanese colonial administrators worked together with Western agricultural specialists and the colonies' native elites to exercise material and symbolic power over colonial societies, thus coproducing a colonial modernity. Similarly, I emphasize local actors' agency in the processes of translating and performing Western

knowledge systems, depicting people from both China and Taiwan who had studied modern agriculture in both Japan and Western countries and who played significant roles not only as modern agrarian scientists, but also as active participants in producing the postwar order of agrarian development. This research also highlights that Japanese and Western imperialism was not simply organized from the top down, but vigorously coproduced from the bottom up through a whole array of local institutions and people, especially devoted intellectuals, scientists, farmers, and engineers. This study examines the microcosm of Japanese and Western imperialism to emphasize the power dynamics between state and society during this specific phase of agricultural development. In order to reconsider agrarian development in East Asia in the twentieth century and address the complexities of colonial knowledge production and exchange in the field of agriculture, my inquiries are how and in what ways, did Japan, along with the Western powers, utilize agrarian development to reinforce the imperial imaginary and exert influence over the colonial societies in East Asia to form a regional food regime.

To explore these dynamics, I draw on Aaron Moore's (2013) concept of the Japanese imperial "technological imaginary." This "technological imaginary" was an integral part of the colonial expansion and rule. Applied to the context of the development of colonial regimes, "technological imaginary" was realized through social-technological engineering at different scales, alongside the desire to regionalize the Japanese war regime. Moore (2013), for example, borrowed the term "scientific colonialism" from Goto Shinpei, colonial Taiwan's head of civilian affairs, to argue that the Japanese colonial regime was articulated through a practical and inventive notion of technology "whereby different areas of life were rationally planned and mobilized to

exhibit their maximum potential and creativity" (Moore 2013, 7). In addition, the construction of the "technological imaginary" in the colonies was synonymous with the simultaneous self-formation of the colonial subject and the emergence of a colonial modernity.

The concept of the "technological imaginary" contributes to recent literature highlighting the convoluted developmental processes characterizing the Japanese Empire during the Pacific War (Hotta 2014) and the expansion of U.S. hegemony in the early Cold War period (Lin 2016). Therefore, I also analyze the discourses concerning the political-technological-military machinery used to embed the Imperial imaginary into the military and educational system (including agricultural education) during the war (Ohnuki-Tierney 2002). As Emiko Ohnuki-Tierney (2002) highlights, through the mobilization of certain political, cultural, and ideological practices during the war (e.g., the tea ceremony, flower arranging, kendo, martial arts, and agrarian practices), "soldiers were told to think of their lives as being as light as a feather and their responsibility to the nation [and emperor] as heavy as mountains" (301). Agrarian development thus operated more likely in the form of coordinating individuals to form Japanese colonial society in the context of war-time discipline.

In this Chapter, I argue that the origins of modern agrarian development in both Taiwan and China can be traced back to the hegemony of colonial regimes in Asia led by Japan and the United States. As Perry Anderson (2017) notes, hegemony can be a kind of leadership, acquired through valor and intelligence, not command. Analyzing the case of agrarian science institutions and agronomists in East Asia, this chapter addresses the

regional hegemony of Japan and the United States in East Asia, searching for conflict and negotiation within the complexity of agrarian technological imaginary.

In doing so, I reconsider the "technological imaginary" in light of the term *modern agrarian regime*. I have coined the latter term against the backdrop of Foucault's (1991[1978]) "art of governance," which refers to both practical statecraft and aesthetic sensibility. In the context of East Asian colonialism, the modern agrarian regime, as invented for economic and agrarian development, was always a material ground that shaped the culture and transformed individuals in the colonial society into an object that had not previously existed. These dynamics reflect Timothy Mitchell's (2002) discussion of how the division and formation of disciplines of knowledge are inextricable from relations of colonial power. Once they acquire positions of power, colonial elites lay claim to the "truth" through the systematization and modernization of environmental and agrarian knowledge. As Foucault (1994[1970]) notes, the modernization of knowledge is intrinsically connected to the management of natural resources in the modern world, where the discourse of statecraft can help to compensate for a lack of resources. Furthermore, the "modern agrarian regime" is inspired by Friedmann's (2005, 234) definition of a food regime, emphasizing that food regimes emerge out of a hegemonic process among social movements and powerful institutions, through which the food regime reflects a negotiated frame for instituting new rules. Meanwhile, in considering food production and circulation to be a material expression of the modern agrarian regime, Foucault's work provides a bridge between the food regime literature and work that studies the political strategies regulating biological life.

Finally, the emergence of a modern agrarian regime as the colonial scientific knowledge regime was a regional phenomenon in East Asia. Although many colonial regimes shared unifying characteristics, the modern agrarian regime in East Asia held specific meanings for colonial societies. Accordingly, the circulation of modern scientific knowledge was not merely the communication between two monolithic cultures, but rather a complex process that emerged at specific spatial moments (Rogaski 2004). The moment of emergence highlights patterns of cooperation as well as coercion, and "looks at the sometimes intimate collaborations between multiple 'colonizers' and various members of 'the colonized'" (Rogaski 2004, 8–9). Drawing from recent studies on colonial modernity in China (Goodman and Goodman 2012), modern agrarian regimes emerged as a consequence of the presence of multiple imperialists and hence, they were also a part of the production of multiple models of colonial modernity. In effect, extra-territoriality and the coexistence of different foreign colonies and settlements of the Japanese Empire and the United States served to create multiple modern agrarian regimes.

Modern agrarian regimes provide a lens to explain the divergence of Taiwan and China in developing modern agriculture. Against the background of the Cold War in the 1950s, in collaboration with the Sino-America Joint Commission on Rural Reconstruction and the U.S. Agency for International Development (USAID), the main agricultural research and development units in Taiwan—the Agricultural Research & Extension Station and the Tropical Horticultural Experiment Branch, founded by Japanese colonists (Table 3)[5]—were rebuilt and expanded to allocate resources to high

[5] I highlight the agricultural research institution to demonstrate the inertia of food regimes that affects institutions in the historical process. The agricultural research institutes in Table 3 were also training centers for agricultural experts with different interests and goals across the Japanese colonial period, the postwar period, and currently, the neoliberal period. In this chapter, my analysis also includes other training

value vegetables and fruits production (JCRR 1969). In contrast to Taiwan's experience, agricultural output, such as grains and cotton in China was collectivized and extracted to feed industrial laborers and facilitate the development of heavy industries in urban areas, in line with the path to socialist modernization initiated by Mao (Naughton 2006).

To achieve these aims and address the formation of modern agrarian regimes in East Asia, I use archives related to the Japanese colonial regime and discuss how the colonial regime influenced the postwar development of agriculture in both Taiwan and China, utilizing diaries, memoirs, biographies, interviews, academic works, and state-produced materials. These resources allow me to examine the distinct agrarian development of China and Taiwan through the lens of the life stories of Ding Ying, the founding father of modern rice research in China, and Sun Shou-kung, one of the founders of the discipline of plant pathology and rice research in Taiwan during the postwar period.

Agrarian Warriors and Modern Agrarian Knowledge in Asia Before 1945

Following a military clash between China and Japan in northern China on September 18, 1931 (the so-called Mukden Incident), Japan formally invaded China. The Japanese government became militarized and Taiwan took on a critical role in the process, as Japan drew on its political, economic, and cultural experiences in colonial Taiwan to inform its military occupations of southern China and Southeast Asia (Chang 2007). The colonial government of Taiwan, in turn, was eager to highlight its importance in developing the new territories (Taiwan Colonial Governor-General's Office (TCGO)

centers with different titles. Yet only the Agricultural Research & Extension Station and the Tropical Horticultural Experiment Branch endured long enough to identify changes between different time periods.

1943). On December 8, 1937, Kobayashi Seizo, the Governor-General of Taiwan, outlined his "Approaches to Govern China" for the Japanese Empire after which the TCGO gradually proposed plans to develop southern China based on Taiwan's experience (Chang 2007). These plans included "The Outline of Industrial Development in South China," "The Guangzhou Policy," "The Shantou Policy," and "The Hainan Policy." In August 1938, the TCGO founded the Provisional South China Agency to re-design the colonial policies for governing southern China, and to promote the reconstruction and industrial development of the region (Chang 2007). The main goal of this Agency was to integrate the Taiwan Development Company into the military practices of the Japanese military in south China and Southeast Asia. On April 1, 1938, the Japanese army in central China formally requested that the TCGO dispatch agricultural experts and about 1,000 farmers to plant vegetables for the army near Shanghai (Chang 2007). Called the Taiwanese Agricultural Volunteer Team, this group became pioneers of agricultural development in China (see Figure 3).

During the Pacific War (1941-1945), Japan's main goal was to extend its limited territory and acquire natural resources throughout Asia in order to compensate for its lack of plentiful indigenous resources (Hotta 2014). At the beginning of the Pacific War, the Japanese military occupied Singapore, Yangon, Java, and Borneo. In order to promptly extract the resources from its new colonial territories, the Japanese Empire generated "The Outline of Economic Policy in the South" (1941). In the document, Japan stated that the purpose of occupying Southeast Asia was to acquire sufficient key resources (mainly petroleum) (Hotta 2014) to ensure the self-sufficiency of the Great East Asia Co-

Prosperity Sphere. To this end, Japan made a considerable effort to increase food production and restructure the pattern of agricultural production in the colonies.

When the Japanese military first arrived in Southeast Asia, it demanded that local rice production sustain its occupation. However, Vietnam, Myanmar, and Thailand were net exporters of rice, while Malaya, Sumatra, and Borneo were net importers (Chang 2007). It became evident that food supply would be a major obstacle to Japan's control of Southeast Asia. Before the Pacific War, northern China and Korea served as the Japanese Empire's main production bases for cotton (The Taiwan Development Co. 1939; Noguchi 1942); however, northern China had to take on an increased responsibility for the wheat crop production for the Empire, as Japan lost control of Australia and its wheat imports in the Pacific War. In turn, cotton production was shifted to Southeast Asia, Taiwan, and Hainan in order to ensure cotton self-sufficiency in the Great East Asia Co-Prosperity Sphere. As a result, agriculture in Southeast Asia and south China were restructured to facilitate the expansion of the Japanese Empire.

As the Japanese Empire expanded, the demand for military supply, such as rice and cotton significantly increased. As a result, there was a shortage of agrarian experts to facilitate food production. To solve this problem, the TCGO authorized Taiwan's agricultural experiment centers to establish Pioneer Rites and regional training centers for training agrarian warriors/agrarian settlers. From 1937 to 1945, these institutions offering formal agricultural education recruited fifty to one hundred teenagers annually (Chang 2007). The Japanese Civilization Association and farmers' associations in Taiwan also assumed responsibility for the basic and short-term training of agrarian settlers. These young agricultural experts were the first cohort of Taiwanese to directly experience the

Kominka Movement (the Japanization campaign) during the Pacific War (Chang 2007). The TCGO sought to aid the expansion of the Japanese Imperial military by utilizing its experience with tropical agriculture and transferring agricultural techniques and experts from Taiwan to the colonies to produce food crops.

Taiwan was Japan's first colony and the only tropical colony before the outbreak of the Pacific War. The Japanese army depended on a successful colonial experience in Taiwan prior to occupying south China and Southeast Asia. Tropical agriculture in Taiwan was particularly important to the expansion of the Japanese Empire in the Asia-Pacific region; as such, it was ceaselessly emphasized by the TCGO in the reconstruction of the occupied territories, helping to increase food production to support the army. The Japanese war regime transplanted the agricultural experiences of colonial Taiwan into China and Southeast Asia. For example, in Hainan (a small island in south China), the rice and sugar agriculture that developed during the Japanese colonial period was based on Taiwan's "rice and sugar economy" (Chung 2003). Other examples include the significant economic influence of agricultural experts from Taiwan, such as the agrarian volunteer teams in China and Southeast Asia (Chang 2007).

However, agriculture in Taiwan under Japanese colonial rule was not transformed simply through the provision of agricultural human resources and related techniques and experiences. As Japan developed its colonial agriculture in order to support the expansion of its Empire, the colonial regime sought to modernize and define agrarian knowledge in the colonies. To do so, Japan engaged in a process of agrarian education and governance. The modern colonial agrarian education system originally privileged Japanese citizens in Taiwan, yet gradually opened to Taiwanese students during the Pacific War. The colonial

government also institutionalized agricultural experimental stations and training centers to train Taiwanese famers and local villagers as agricultural experts.

Agricultural education and training were part of the social reform underpinning Japan's national spirit. For instance, the architecture of the agrarian training institutions included a shrine to Amaterasu, the god representing the Japanese Empire. Taiwanese students learned Japanese martial arts and kendo at the shrine, and volunteered to participate in the cleaning and renovation of the shrine; other Taiwanese, by contrast, were not allowed access (Taiwan Farmers' Association 1941). When the TCGO dispatched agrarian settlers and related experts to the Japanese colonies in order to implement modern agriculture locally, Taiwanese agrarian experts were recruited as agrarian warriors/agrarian settlers to assist with the production of military crops. The agrarian regime determined the division of labor in Japan's colonial economy and served to identify Taiwan as a southern territory of Japan.

Highlighting Taiwan's prominent role in developing China's agriculture, and that of Asia more broadly, for Imperial Japan does not mean to imply that Japan had no influence on China's agriculture before the war. In fact, Japan had provided an important model for China in its pursuit of agricultural modernization. Especially in the late Qing and the early period of the Republic of China (1912–1920), Japan exerted a great influence on the early stage of agrarian modernization in China. Agricultural experts and scientists who were trained in Japanese universities returned to China, transplanting the approaches and techniques of Japanese agrarian science (British and American influence gradually increased after 1920, albeit limited to northern China) (Dong 1997).

Prior to the Pacific War, modern agrarian education in Taiwan was the domain of the Japanese; the Taiwanese had little chance to gain modern agrarian knowledge and education (Ka 1995), despite the fact that the United States had introduced modern agriculture to Japan in the late nineteenth century (Duke 2009). During the Pacific War, however, knowledge of food crop cultivation became central to the colonial education system (Sugai 1943).

For example, in 1940, the TCGO founded the Taiwanese Governor-General's Official Pioneer Rite in Taichung, Taiwan, which planned to recruit 100 participants every year for a one-year training program. This training was aimed at familiarizing participants with cultivation techniques appropriate for tropical agriculture. Recruitment for the Pioneer Rite started in early November 1940, and candidates were categorized into types A and B. Type A trainees were healthy Japanese men from Japan (except for Hokkaido), who were between the ages of 21 and 35 years old and had worked in agriculture, or had related experience and had graduated from public school. Type B trainees were healthy and well-mannered (civilized) Taiwanese men from western Taiwan, who were 15 to 30 years old and had worked in agriculture, or had related experience and also held a primary school diploma.[6] In order to be an agrarian warrior/settler[7], students had to complete training in Japanese Imperial spirit, physical strength, knowledge of tropical agriculture, business, and the languages of Southeast Asia.[8] The training was designed to familiarize agrarian warriors/settlers with agrarian

[6] *Taiwan Times*. 1940. 南方發展への人才拓士訓練道場. December, pp. 152-153.

[7] The term '拓士' means settler or pioneer. Because of their unique agricultural mission and training in the Pacific War, this study uses the term agrarian warriors/agrarian settlers to emphasize their special position.

[8] Please refer to footnote 6.

life, enable them to flexibly use tropical cultivation techniques, and encourage them to promote Japanese national identity in the occupied territories.

Concurrently, the TCGO also authorized agricultural experiment stations to train agrarian warriors/settlers. In 1942, by combining Taiwanese agricultural experiment stations and cotton institutes, the TCGO founded the Tropical Agricultural Technique Institute. The Institute's aim was to appropriate the rich agricultural resources of Southeast Asia and southern China through the use of the advanced agrarian techniques and experiences available in Taiwan (Chang 2007).

In addition, during the Pacific War, the Japanese Civilization Association organized the Facing South Agricultural Pioneer Institute around Taiwan to train tropical agriculture technicians, particularly in the cultivation of military crops, such as rice, cotton, and fiber. Participants were mainly Taiwanese young people around 20 years of age who had graduated from public school. In each period, there were around 500 trainees, with the training lasting for three months (Japanese Civilization Association 1943; Taiwan Farmers' Association 1941). Subjects of the training included tropical agriculture and knowledge related to Southeast Asia, as well as civil education, cultivation training, and voluntary labor work.

After receiving their training, all of these agrarian warriors/settlers went to the frontlines. However, after a short period of time, they were forced to retreat from the Japanese-occupied territories as Japan lost the Pacific War to the United States, bringing WWII to an end in Asia. With the end of the war, the recruitment projects for agrarian warriors/settlers that had been initiated by the Japanese Empire were stopped.

After 1945

After the war, the circulation of agrarian knowledge and its socioeconomic and institutional conditions became embedded within a complex network, in which the colonial ties of the Japanese wartime regime were interwoven with the extra-territorial Cold War regime under the influence of the United States via USAID and other rural development projects (such as the green revolution). At the same time, agriculture in the region was influenced by the emergence of the socialist Chinese state and its experiments in socialist agricultural development, the so-called red revolution (Schmalzer 2016).

When Japan withdrew from Taiwan, the agricultural experiment stations and other related agricultural institutions became official institutes of the Guomindang (GMD) government, and their associated agricultural researchers and laborers were recruited as public officials (Huang 1991)[9]. With the support of the U.S. Agency for International Development (USAID), the GMD government and the U.S. government co-founded the Joint Commission on Rural Reconstruction, which sent Taiwan's agricultural talent to train and study at American universities.[10]

Starting in 1948, in enacting the Foreign Assistance Act of 1948, USAID and the Guomintang Government (GMD) collaborated to form the Sino-America Joint Committee of Rural Reconstruction (JCRR) in Nanjing. Based on the JCRR's summary statement of its plan in 1949, it is doubtful that the JCRR had a comprehensive plan to develop agriculture in Taiwan, as the project only focused on improving agricultural productivity in Guangdong, Guangxi, Sichuan, Fujian, and Hunan provinces (JCRR

[9] Also see the biography of Wen-yu Chen on Wikipedia.
[10] Including the University of Wisconsin, the University of Hawaii, the University of Florida, and Cornell University. Author interview with Dennis Gonsalves, Emeritus Professor of Plant Pathology at Cornell University, July 2014.

1949). But after the year 1949, when JCRR moved to Taiwan, one of its missions was to maintain the colonial agrarian science institutions founded during the Japanese colonial period (see Table 3). Therefore, in the postwar period, the JCRR preserved most of the experimental stations and agricultural schools founded during the Japanese colonial period, and those agrarian warriors/settlers who survived the war became government employees (Huang 1991).

Meanwhile, USAID and the Asia Development Bank positioned Taiwan as the breeding center of Asian food crops and a crucial part of the postwar order to enhance Asian food security by setting the Asia Vegetable Center (1971). The mission of the Asia Vegetable Center, founded by the Asia Development Bank in Taiwan (the only official vegetable research center in East Asia, today renamed the World Vegetable Center), states that it is "committed to alleviating poverty and malnutrition in the developing world through the increased production and consumption of nutritious and health-promoting vegetables" (Asia Vegetable Center 1971).[11] The Asia Vegetable Center founded a seed database to collect fruit and vegetable species in 1975, and since then, it has become the largest seed database of fruits and vegetables in the world. In the 1950s and the 1960s, East Asian agro-food policy focused mainly on food crops such as rice and wheat to increase agricultural productivity (McMichael and Kim 1994). By the end of the 1960s, the U.S. government incorporated Taiwan into the military logistics supply chain of the Vietnam War (Lee 1968). As a result, the Asia Vegetable Center and the Sino-America Joint Commission on Rural Reconstruction both helped to modernize the Taiwanese vegetable and fruit industries in order to better supply U.S. military demands. However, once the United States broke diplomatic relations with Taiwan (R.O.C) in 1979,

[11] http://avrdc.org/about-avrdc/our-mission/

Japan became one of the main suppliers of equipment and machinery to upgrade the agro-food industries in Taiwan.[12]

Agrarian Regimes in the Postwar Period

Although it is difficult to recover personal information about individual agrarian settlers due to the considerable amount of time that has passed, oral histories reveal that the settlers' self-identity as Taiwanese-Japanese settlers/warriors was complex (Tsai 1997). On the one hand, they took pride in having been warriors for the Japanese Empire; yet, on the other hand, in a postwar society they were no longer recognized as Japanese, nor permitted to be proud of their status. In fact, under the GMD government, being a Japanese warrior implied that one was an enemy of the Chinese army, making their former identity a great shame rather than an honor. The complexities of this experience have been preserved in the oral accounts of agrarian warriors for the Japanese Empire:

> I held the belief that as a Japanese citizen I should sacrifice myself to the war because Japan, our country, was in difficulties. So it is a self-evident truth for me that I should sacrifice for it…, but now it seems that my Japanese education cheated me. (Mr. Houng, H. 1997: 215–16, qtd in Tsai 1997)

> Because of my Japanese education, after I had survived the war I still identified myself as Japanese. But now I wanted to be Taiwanese. We needed our own nation to maintain our dignity. (Mr. Houng, K. 1997: 244, qtd in Tsai 1997)

In a more general context, a similar identity crisis also affected surviving Japanese soldiers in the postwar era. In *Evil Men*, James Dawes (2013) uses the term "vertigo" to describe the mentality of the convicted Japanese war criminals who fought in the Second Sino-Japanese War and the Pacific War. These men did unspeakable things, torturing, raping, and killing civilians, mainly in China. Yet their postwar experience restructured

[12] Author interview with Mr. C. C. Tsai, President of Tai Mei Food Co., Ltd., July 2014.

their identity. For the people in Asia who had been involved in the war, the transition from WWII to the postwar period signified a new stage of modernization. This was the moment for Asian countries to become equals with the Western powers and to throw off the burden of colonization. A newly created intelligentsia critiqued former regimes and old elites (Bodden 2016). Agrarian development was no exception in this modernizing fervor. Yet the influence of modernity and modernization on agrarian development in postwar Asia was not simply a one-way road due to the convoluted histories and geographies in the region. In order to contextualize this dynamic, in the next section, I utilize two representative figures, Ding Ying in China and Sun Shou-kung in Taiwan, to show the complexity of East Asian agrarian development in the postwar era.

Ding Ying in China

The colonial experience of mainland China differed from that of Taiwan and Korea, in that, it was only temporarily and partially occupied by the Japanese Empire during WWII. However, agrarian development—a vital field of political and intellectual practice—was made possible by the ongoing contact between Japan and China in this period through agricultural education (Dong 1997). In this section, I use the life story of Ding Ying (1888–1964, see Figure 4), the founding father of modern rice research in China and founder of the Guangdong Academy of Agricultural Sciences-Rice Research Institute, to shed light on the tangled agrarian relationships between China and Japan in the postwar period.

Ding Ying was one of the last generation of students to be sponsored by the Qing government to study abroad in Japan. However, in 1919, Ding Ying joined the May Fourth Movement protest organized by Chinese students in Tokyo, which was violently

repressed by Japanese policies. This radical experience fueled Ding Ying's decision to return to China with the modern knowledge that he had acquired, in order to save his country (Ding 1983[1962]).

However, strongly believing that "only modern agriculture can save China" (Ding 1983[1942], 479), Ding Ying returned to Japan once again in 1921–1924, enrolling in the Agriculture Department of Tokyo Imperial University (now Tokyo University) and becoming the first Chinese student to study modern rice cultivation at the university (Ding 1983[1962]). Once he graduated, Ding returned to China where, in 1927, he established the first rice research institute, Southern Road Breeding Farm (Nan Lu Dao Zuo Yu Chong Chang, now the Guangdong Academy of Agricultural Sciences-Rice Research Institute) in Guangdong, China. The aim of the research institute was to select superior rice seeds and improve cultivation techniques in order to increase rice production. In the ten years preceding the Japanese occupation of Guangdong in 1938, Ding Ying not only expanded the scale of the research institution without much governmental support, but also laid the foundation for the scientific study of agriculture, especially rice crops (Ding 1983[1962]).

The only collection of Ding Ying's research and personal biography (*The Collection of Ding Ying's Research on Rice*) makes it clear that he conducted his research on rice crops for "his own country" (*wo guo*) (Ding 1983[1962]). Although his Chinese national identity had a strong state-based, anti-imperialistic character, an alternative discourse on "China" can also be found in his research—one that is rooted in practices that are not

centered on nation-states but derived from the identity of "native place,"[13] the flux of the rice species, and agrarian scientific practices in Asia (Ding 1983[1933]).

For example, one of Ding's contributions to modern rice research was the discovery of indigenous rice species in southwest China (e.g., *O. meyeriana* Baill., *Oryza perennis* Moench., *O.officinalis* Wall.). He also cross-bred and hybridized these species to create new species of rice. His discovery was inspired by two ancient Chinese classics—Xu Shen's *Interpretation of Chinese Characters* (*Shuo Wen Jie Zi*) and *Lius' Commentaries of History* (*Lu Shi Chun Qiu)* compiled by Lu Buwei—in which he discovered that China's indigenous rice species were introduced from *Nan Hai* (today's South China Sea) (Ding 1983[1933]). Believing that Guangdong, his native land, was the corridor that connected China, Southeast Asia, and India, he conducted intensive fieldwork and discovered Rhino's Tail Wild Rice (*Xi Niu Wei Ye Dao*) in Guangdong in 1926. This became the indigenous species of "Zhongshan No.1," which was bred successfully in 1933 (Ding 1983[1933]).

Furthermore, Ding also engaged in dialogue with Kato Shigemoto, a famous Japanese rice researcher, on his advanced research into rice crops. Ding Ying's goal was to differentiate Chinese indigenous rice species from *japonica* Kato and *indica* Kato species. Though deeply influenced by Kato's (1930) work "On the Affinity of the Cultivated Varieties of Rice Plants," Ding Ying came to a different conclusion from Kato. He found that the indigenous Chinese rice species had a close affinity to rice species from southern China and Southeast Asia (Ding 1983[1933]). In "The Discussion of China's Ancient *indica* and *japonica* Rice Cultivation and Distribution" (Ding 1983[1949]), Ding drew on China's historical archive and archeological data to argue that *japonica* should

[13] I borrow the concept from Bryna Goodman (1995).

be *keng* (a species rooted and domesticated in south China and Southeast Asia), and *indica* should be *hsien* (a species that evolved from *keng* and was distributed in northern China and in temperate zones of Asia, including Japan) (Ding 1983[1949]).

In his research on indigenous Chinese rice species and distribution, Ding Ying embraced a wide range of Japanese scholarship. As such, Ding's research not only demonstrates the Japanese influence on Chinese rice research, but also shows how he appropriated Japanese agrarian knowledge to create a local Chinese agrarian knowledge system. Through his contact with the Japanese Empire, Ding Ying was shaped by Japan's modern scientific agrarian educational system. However, the modern agrarian knowledge that emerged from this process was not fully determined by the Japanese Empire. Ding Ying's translocal experiences enabled him to integrate Japanese agrarian knowledge and generate an agrarian knowledge system that would support a broader imagination of Asia, going beyond the territorial constraints of the nation-state. Indeed, Ding was very much focused on China and the nation-state, as revealed in the non-Western discourse embedded in his agrarian studies; yet, that discourse was also mixed with non-state-produced modes of being as he highlighted southern China and Southeast Asia as the native environment for Chinese indigenous species of rice.

Sun Shou-kung in Taiwan

Sun Shou-kung (1918–2015, see Figure 5) was one of the founders of modern agricultural science in Taiwan. Although Sun was younger than Ding, like Ding, he was also educated as a modern agricultural scientist during the Republic of China. At the same time, Sun is considered the founder of modern agricultural science, including orange and rice studies in Taiwan, and his career as a tropical agricultural expert was

built on the Japanese agrarian research and scientific institutions in Taiwan. Sun also represented Taiwan's government in coordinating agrarian projects supported by the USAID-JCRR program, which later supported the expansion of agricultural research institutions in Taiwan in the 1970s and the 1980s. Therefore, the comparison between Ding and Sun is useful for understanding the multiple trajectories of modern agrarian development in Asia.

Sun pursued an undergraduate degree in the Agriculture Department at Sichuan University, China from 1941 to 1945. According to his biography, Sun's decision to become a plant pathologist was deeply influenced by Professor Lin Kong-xiang, a professor of orange pathology in the Agriculture Department at Sichuan University and graduate of Cornell University (Sun 2015a). After WWII, as the civil war escalated in northern China, Sun decided to move to Taiwan to continue his career as an agrarian scientist (Sun 2015a). Between 1948 and 1957, Sun was an assistant researcher at the Fengshan Tropical Horticultural Experimental Station (FTHES) in southern Taiwan. FTHES was founded during the Japanese colonial period and has since become the leading center for tropical agricultural research in Taiwan. During his time at FTHES, Sun's main area of research was fruit pathology, focusing on orange, pineapple, and banana diseases. With the support of the JCRR, he had the opportunity to visit the University of California (1956), the University of Florida and the University of Hawaii (1964) to conduct research on wilt disease in pineapples and bananas. In 1964–1965, Sun was a visiting scholar at the University of Wisconsin (Madison). Through this experience, Sun was able to build international collaborative networks for agrarian research and

access cutting edge technical reports and publications on modern agriculture in the United States (Sun 2015a).

Sun subsequently moved to the Plant Pathology Department at National Chung Hsing University (a top-ranking agriculture research university in Taiwan—originally the Office of the Governor-General's Agriculture and Forest College—founded during the Japanese colonial period). Recalling this period, Sun highlighted the influential experience of his time as a visiting scholar at the University of Wisconsin (Madison) (Sun 2015a, 2015b). In his account of his time in Madison, Sun detailed the courses he took (plant pathology, soil disease, dissertation writing, and bacteriology), scholars he worked with (G.S. Pound, J.E. Mitchell, and J.C. Walker), and his admiration for the modern American educational system (Sun 2015a). Influenced by his "Madison Experience," Sun's research in plant pathology closely followed the American paradigm.

Soon after his return to Taiwan, Sun was promoted to full professor. During this period, Sun gradually extended his teaching and advising to encompass fields beyond plant pathology (Lin 2015). Sun collaborated with W. C. Snyder (J. C. Walker's student and a professor at University of California Berkeley) to conduct research on rice pathology and soil-borne plant diseases, with the support of the JCRR and the National Science Foundation in Taiwan and the United States. Sun also actively engaged in a series of commentaries in the flagship journal for Taiwanese agrarian research, *The Agricultural World Magazine*. Sun contributed 14 articles to this commentary, which highlights fungi as a key topic (zhen jun cang sang lu, "The Long Way of Fungi Research") (Sun 2002a–2002f, 2003a–2003c, 2004a–2004c, 2005a, 2005b).

Due to Sun's newfound interest in fungi, the Plant Pathology Department in the National Chung Hsing University began to focus more on the fungi subfield than on other fields in the design of its graduate program. Until the end of the 1980s, when bacteria and virus research became important subfields in the Department as new scholars arrived from the United States and Japan, research into fungi was the only focus of the program. During this period, Sun transplanted what he had learned at the University of Wisconsin (Madison), including the textbooks, syllabi, pedagogy, and so on, to his students. Most important of all, he represented the JCRR program to select qualified students to study agriculture and related disciplines in the United States under the support of USAID.

In contrast to Ding Ying, Sun barely mentioned mainland China in his research and teaching, even in his personal documents, (e.g., his correspondence and autobiography). Some of his students have suggested that this was because his hometown was Shantung rather than Fujian or other southern provinces like most of the other scholars in the department, who thus had better connections with mainland China (Sun 2015a). A more convincing reason is that the anti-communist campaign, reinforced in the period of Martial Law under the GMD between 1949 and 1987, disrupted any possible connection between Taiwan and China.

Examining Sun's writings on popular science, Sun's constant point of reference is American scholarship. In an article entitled "Plant Pathology Can Solve Famine," Sun (1975) addresses global famine issues, highlighting in particular the 1845 Irish potato famine, and discussing other momentous famines throughout human history that have been caused by plant diseases. These include the 1935 wheat stem rust epidemic in North America and the Great Bengal Famine of 1942, partially caused by the epidemic that

destroyed rice crops in India. For Sun, his solution to famine was the plant pathology founded by Western scientists who developed the discipline based upon related experiences of dealing with these ecological crises. In his later article, "The Advanced American Agriculture," Sun (2004a) emphasizes the leadership of the United States in the plant pathology field, highlighting the role of the agro-scientists of the U.S. Department of Agriculture, such as Thomas Galloway and his colleagues, who Sun considered to be the founders of modern plant pathology.

Summary

Since Taiwan was Japan's first colony and its only tropical colony prior to the Pacific War, the Japanese army drew heavily on its colonial experience in Taiwan when it occupied southern China and Southeast Asia. Taiwan's experience in tropical agriculture was particularly important for the Japanese Empire in helping to develop the agrarian regime in the new colonies. The TCGO was key to these endeavors, actively participating in the reconstruction of the occupied territories and aiming to increase food production. Concurrently, the scientific practice of a modern agrarian regime emerged in China, facilitated by the intellectual contact between China and the Japanese Empire.

The modern agrarian knowledge regime in China was derived from the agro-scientists' experiences of a non-Western space of discourse and struggle, and the combination of both state-produced and non-state-produced modes of being (Karl 1998). In this context, Ding Ying's indigenous rice research highlights the regionalization of Asia in the development of agrarian knowledge. The indigenous rice species of China were dispersed and cross-bred through the translocal flows of Chinese people in Asia.

These dynamics indicate that the relationships between power, agriculture, culture, and the concept of space were crucial to the formation of the modern agrarian regime in China and its positionality in terms of regional hegemony.

The modern agrarian regime derived from the practices of Taiwan's agro-scientists was deeply embedded in the Cold War context, through which the U.S. and the GMD government preserved Japanese colonial agrarian science institutions and tropical agriculture researchers. Sun Shou-kung's experiences illustrate how a generation of Taiwanese agro-scientists in the postwar era embraced the colonial modern agrarian science scholarship subordinated by the American-led Cold War regime. This regime gained legitimacy through the Cold War geopolitical and geo-economic contexts, shaping the subsequent developmental trajectories of Asian agriculture.

Against differing historical-geographic backdrops, colonial modernization and the development of modern agrarian regimes in China and Taiwan exhibited distinct patterns. My analysis of Ding resonates with Schmalzer's (2016) argument that, in the Mao era of China, no clear distinction could be drawn between the green revolution, with its application of modern agrarian technologies, and the red revolution, with the application of local-traditional agrarian knowledge, as both were guided by Mao's socialist ideology.

Although Taiwan was considered the model of the green revolution due to its extraordinary performance in increasing agricultural production in the postwar era (Cumings 1984), Taiwan's agrarian development must be interpreted within the context of both its unique local conditions and the translocal agrarian networks influenced by the U.S. military aid, the Japanese colonial legacy, the GMD government, and agricultural experts who moved from China before 1949. My analysis of Sun's life history as the

representative agronomist in Taiwan shows that Taiwan's leading role in modern tropical agriculture can be traced back to the Japanese colonial period (Chang and Myers 1963; Cumings 1984; Ka 1995), while its evolution in the Cold War period was part of the story of the formation of the accidental island state of Taiwan, when the island-rooted Nationalist state officially aligned itself with the United States by signing a mutual defense pact (Lin 2016).

This study compares the complexities of agrarian development in China and Taiwan that unfolded in disconnected contexts, while pursuing transnational/regional lines of argument with regard to the circulation of modern agrarian knowledge in East Asia. In considering the regionalization of the modern agrarian regimes in East Asia, I question the view that modern agrarian science institutions and agronomists in different parts of Asia were pursuing similar patterns of development (Kuznets 1988; McMichael 2013), and rather attribute regional geopolitical and geo-economic variation to the historical geography of colonial knowledge's production and exchange, which latter emerges as East Asian food regimes. In this context, the agrarian warriors/settlers occasionally felt the influence of a colonial doctrine in the technological imaginary, yet most often that imaginary represented the conditions shaping agricultural institutions and underlying the variation in the formation of modern agrarian regimes in East Asia.

Finally, this study on the formation of modern agrarian regimes in East Asia bridges the food regime literature (Friedmann and McMichael 1989; McMichael 2009) and studies on modern Asian development, in particular with the description of the emergence of the first food regime in the context of European colonialism in 1870–1930s. Like this first food regime centered on the British Empire, the modern East Asian agrarian regimes

dominated by the Japanese Empire combined colonial tropical imports to Japan with basic grain and livestock imports from settler colonies at a relatively low price that facilitated the industrialization of Japan. However, in the food regime literature, colonial powers such as the British and Dutch operated their power in a bilateral way to manipulate food imports from colonies. The food regime literature has barely addressed the strategic role played by colonies, as in Taiwan's management of the Japanese military's logistics networks during WWII. Furthermore, the role of agricultural knowledge production and exchange has not received enough attention in the food regime literature (Friedmann 2005, 2016). The emergence of modern agrarian regimes in East Asia shows that the Japanese colonial food regime was embedded in a web of practices underlying agrarian knowledge production and exchange. The institutionalization of agrarian knowledge in the Japanese colonial food regimes perpetuated the development of modern agriculture in East Asia.

In subsequent chapters, I extend these discussions on the evolution of modern agrarian regimes in East Asia and how they emerged in the postwar period. Ding and Sun represent two patterns of modern agrarian development in East Asia, divided by the U.S. Cold War Regime in the postwar period. The former focused on the production and research of grains, whereas the latter focused on high-value fruits and vegetables. I use the edamame case to illustrate how the divergence of these modern agrarian regimes (which later evolved into the East Asian food regimes) consolidated Taiwan's advantage in terms of its agriculture in the WTO era. Under the new WTO food safety and quality regulations, the East Asian market has become more integrated and food networks are further assembled internationally.

Figure 3. The Taiwanese Agricultural Volunteer Team. Source: *The Taiwanese Agricultural Volunteer Team Photo Album* (1939)[14]

[14] This is an unpublished and unclassified archive collected by the author from Kaohsiung Museum of History in Kaohsiung City, Taiwan.

Figure 4. Ding Ying. Source: *On the 120 Anniversary of Ding Ying's Birth* (2008)

Figure 5. Sun Shou-kung (left) and Walter P. McConaughy (right), United States Ambassador to R.O. China. (Author's Collection)

Table 3. Agricultural training stations for 'agrarian warriors'

Name	Training Institution	No. of Trainees	Subjects of Training	Current Institution
Training Station 1	Cotton Agriculture Guidance Center, TCGO	160	Cotton Agriculture	Abolished
Training Station 2	Central Agricultural Research Institute, TCGO	80	Livestock Agriculture	Taiwan Agricultural Research Institute
Training Station 3	Chiayi Agricultural Experiment Station, TCGO	60	Agriculture	Chiayi Agricultural Experiment Station
Training Station 4	Fengshan Tropical Horticultural Experimental Branch, TCGO	60	Fruit, Vegetable, Horticulture, and Technologies of Processing	Fengshan Tropical Horticultural Experimental Branch (Kaohsiung City)
Training Station 5	Taipei District Agricultural Research and Extension Station	70	General Agriculture	Taoyuan District Agricultural Research and Extension Station
Training Station 6	Hsinchu District Agricultural Research and Extension Station	70	General Agriculture	Taoyuan District Agricultural Research and Extension Station
Training Station 7	Taichung District Agricultural Research and Extension Station	90	General Agriculture	Taichung District Agricultural Research and Extension Station
Training Station 8	Tainan District Agricultural Research and Extension Station	150	Jute Agriculture	Tainan District Agricultural Research and Extension Station
Training Station 9	Kaohsiung District Agricultural Research and Extension Station	50	Ramie Agriculture	Kaohsiung District Agricultural Research and Extension Station
Total		**790**		

Source: Taiwan Governor-General Government (1943, 5, 20–21; tai wan zong du fu re dai nong ye ji shu lian cheng suyao lan), and author's analysis.

CHAPTER III

EAST ASIAN FOOD REGIMES: AGRARIAN WARRIORS, EDAMAME BEANS, AND SPATIAL TOPOLOGIES OF FOOD REGIMES IN EAST ASIA

> The central assertion of this book is that the world of humankind constitutes a manifold, a totality of interconnected processes, and inquiries that disassemble this totality into bits and then fail to reassemble it falsify reality. Concepts like "nation," "society," and "culture" name bits and threaten to turn names into things. Only by understanding these names as bundles of relationships, and by placing them back into the field from which they were abstracted, can we hope to avoid misleading inferences and increase our share of understanding.
>
> Wolf (1982, 4)

Introduction

In Chapter Two of this dissertation, I showed that modern agrarian regimes emerged in East Asia in the last century due to the region's particular historical geography. In this chapter, my findings contribute to the burgeoning body of work thinking differently about food regimes. Building on the food regimes literature, this chapter highlights the constituent parts of East Asian food regimes and the transition that has taken place from modern agrarian regimes to East Asian food regimes.

The first part of the chapter addresses the role played by agrarian-scientific institutions in this transition; specifically, it investigates the spatial topologies, political economy, histories, and socio-cultural contexts of agrarian knowledge production and practices in the context of postwar Asian development. This forms the background for the second part of this chapter, which offers an analysis of a specific food commodity—edamame beans—to illustrate the dynamics and the divergences of the emerging East Asian food regimes. In investigating the evolution of edamame production and trade, I analyze how edamame production and trade has been reorganized under this new food

regime. My study argues that broadening the conversation about the food regimes approach requires a regional-geographic perspective in order to understand the spatial topologies, uneven development, and socio-cultural-ecological differentiation characteristic of food regimes.

Drawing from the historical geography of East Asia, as I have discussed in Chapter Two, Japanese colonial occupation in the early twentieth century created close agrarian connections between Japan, South Korea, China, and Taiwan, as the Japanese Empire became the center of agro-trade in Asia, controlling the foodways of sugarcane, rice, cotton, and small portion of high-value fruits and vegetables. As a latecomer to imperialism with limited territory with which to expand, imperial Japan largely withdrew from the world system in 1930s to pursue, along with its colonies of Korea, Taiwan, and Manchuria, a 'go-it-alone path' to development (Cumings 1984). This historical-material sediment continues to perpetuate the centrality of Japan in the food regime and resource flows in East Asia (McMichael and Kim 1994; McMichael 2012; Tsing 2016).

The shifts that took place in the 1980s served to intensify the separation of Japan and other Asian countries from the 'Atlantic agro-food sector,' which in the Cold War geopolitical context had been centered on American and European countries and food corporations (Friedmann 1993). Furthermore, the divide between Japan and the Atlantic agro-food sectors has stemmed in part from Japan's and other Asian countries' distinct style of food consumption (Friedmann 1993). Overall, the postcolonial, postwar, and post-Cold War dynamics and controversies of the region (Cumings 1984; Koo 1987; McMichael 2000; Ching 2001; Calder and Ye 2010; Glassman 2011) have deeply influenced the foodways of Japan's former colonies in Asia.

To examine these transitions, I first conceptualize the historical geography of colonial food trade in East Asia and reconsider the typical role ascribed to states in the food regime literature. This chapter highlights the constituent parts of East Asian food regimes, particularly the role of agricultural science, which includes technocrats, agribusiness, and experimental fields. Along with Friedmann (2005, 2009, 2016), I recognize the importance of the new constellation of life science industries (including chemical, pharmaceutical, and seed industries) that gradually arose in the 1980s and 1990s, with corporate organizations embracing agriculture and food as a direct source of profit. It is crucial to investigate the continuing imbrication of the science and politics of agricultural scientific practices in the varied spatial contexts of food regimes.

The second part of this chapter includes an analysis of a specific food commodity: edamame beans[15]. I use the flow of edamame beans in East Asia as an illustrative example to highlight the important regional divergencies in the formation of food regimes in East Asia. As I stressed in the introduction, edamame's shifting geography of production and trade has been due in part to Japanese citizens' demand for higher food quality and safety measures. However, the WTO's food safety and quality regulations and their influence through food commodity chains have not received enough attention (Hall 2006, 2010). Specifically, I explain how "agrarian warriors" and their related agricultural research institutions in Taiwan have contributed to the development of the edamame industries under the WTO food safety and quality regulations.

[15] Edamame is a preparation of immature soybeans in the pod, found in the cuisine of Asian-Pacific countries. The pods are boiled or steamed and garnished with salt. According to the Food and Agriculture Organization (FAO) and other state and local government statistics, Japan, Taiwan, and China place edamame in the category of frozen vegetable rather than in the category of soybean due to the differences in usage and consumption patterns. Accordingly, my study focuses more on the archives and statistics related to frozen vegetables and less on those related to the soybean.

Building on my findings in Chapter Two, this chapter develops a framework for East Asian food regimes by drawing on the literature of food regimes, political geography, new economic geography, and regional geography. In particular, I draw on the concepts of the "corporate-environmental food regime" (Friedmann 2005) and "regional food regime" analysis (McMichael 2013), as both concepts provide fine-grained frameworks with which to understand the changes in the food regimes in East Asia and how regional food production and trade have been reorganized. Overall, this study addresses questions regarding the geographical patterns, histories, political economy, and socio-cultural contexts of regional food production and trade that have conditioned East Asia in its transition to a corporate-environmental food regime.

Corporate Food Regime and Corporate-Environmental Food Regime

Recent discussions on the food regimes approach have focused on McMichael's (2005) "corporate food regime" argument (Bernstein 2016; Friedmann 2016; McMichael 2016). This concept refers to the neoliberal agro-food relations institutionalized in the contemporary food regime centered on global food corporations. The grassroots counter-movement has inspired the alter-globalization movement through food sovereignty discourses and movements. Food sovereignty movements aim to radically unmake the undemocratic and impoverishing free trade food regime driven by corporations (McMichael 2016).

A recent dialogue surrounding the "corporate food regime" argument, published in the *Journal of Peasant Studies* (Vol. 43, 2016), involved important scholars in contemporary food regime scholarship: Philip McMichael, Harriet Friedmann, and Henry

Bernstein. In this dissertation, I follow Friedmann's contribution to this dialogue in asking, "Does the food regime approach remain useful for interpreting present contradictions [in the global food political economy and ecology]? If so, how?" (2016, 672). In interrogating the complexity of food regimes, Friedmann's (2016) comments on the "corporate food regime" speak to a broader audience. She incorporates spatial references and regional and class "threads" that determine specific crops, regions, and types of farmers. As Friedmann notes, "The 'corporate food regime' substitutes for 'procedure'—guiding questions—an answer, which does not allow for 'parts' (crops, regions, forms of state) to emerge and disappear as the totality transforms" (2016, 674).

Friedmann's (2016) comments are consistent with her early studies on food regimes. In "International Political Economy of Food: A Global Crisis," Friedmann (1993) highlights that when the second food regime faced a crisis in the 1980s due to declining American hegemony and the over-production of food crops, the regionalization trend of global foodways emerged around the world. Taking soy as an example, she notes that Japan adopted a strategy of food importation that differed from that of the United States and Europe. This strategy was based on Japanese food conventions of consuming soy products directly, as well as economic concerns: Without significant domestic production, Japan's interest rested in the diversity of food supply, keeping food prices down, and reducing dependence on any one particular supplier.

Friedmann (1993) also points out that food regimes in different regions can coexist with mutual preconditions in the same period. She argues that the food regimes approach captures the extent to which spatial patterns of the food trade intertwine with the production, exchange, governance, and regional and local conventions of food

commodities. Approaching her concept of the "corporate-environmental food regime," Friedmann explains how changing class, sectorial, and regional organizations of agricultural capital shape and reshape food, land, and farming systems (Friedmann 2005, 2009, 2016). Friedmann (2005) refers to a "region" as a local place or metropolis; for instance, she uses the *convivia* slow food movement to exemplify the revival or creation of a regional food culture (Hong Kong, Macau, Beijing, Shanghai, and Jinghong—the capital of Xishuanbanna are five hubs of the movement in China). Friedmann's conceptual region also refers to subcontinental regions that are spatially organized by either nation-states or global retailers for territorial-regulatory purposes, or the command centers of global food corporation networks.

In a crucial sense, Friedmann (2005) describes the "corporate-environmental food regime" as a mode of the neoliberal order associated with capitalism's tendency to commoditize "freshness" and "healthiness," while creating a polarized food market overseen by state and regulatory authorities. She argues that the convergence of environmental politics, niche product lines, and retail-led reorganization of food supply chains has led to the emergence of a "corporate-environmental food regime." Recent food safety scares in East Asia resonate with Friedmann's observations on this type of food regime:

> National states continue to play a key role in regulating food and agriculture—private capital alone cannot regulate conditions of production, such as land use and labor markets, or of consumption, such as food safety. As agrofood systems restructure transnationally, international organizations such as the WTO and UN institutions are proving indispensable even as their role is subordinated to the private sector. (2005, 257)

For instance, based on the WTO food safety standard and the Codex Alimentarius, South Korea halted kimchi imports from China in 2005 due to the presence of

roundworm eggs—a move that resulted in a "kimchi war" between the two countries (Han 2011). Taiwan's government initiated a new food safety law due to a cooking oil scandal in 2014, when adulterated oil exported from China was found to contain recycled waste oil and animal feed oil.

Focusing on the regional food regime driven by global food corporations, along with Friedmann, McMichael highlights the Japan-centered East Asian food import complex (2000, 2013) as a consequential part of his regional food regime analysis (2012). McMichael argues that Japanese corporations' global food sourcing model has been a "key pillar" of East Asian food regimes. He illuminates the rise of an alternative organizing principle that has conditioned the multi-centric restructuring of the corporate food regime, particularly with newly industrialized countries (NICs) in Asia joining the crowd of global food sourcing. In this dissertation, I extend Friedmann's (1993) early insight on the lack of "integration" (1993: 11) between Japan and the trans-Atlantic food sector in the post-WWII period, as well as McMichael's (2012) depiction of the Japan-centered East Asian food import complex. In doing so, I develop a framework which contributes to a better understanding of the "inertia" of East Asian food regimes and its re-territorialization as Japan has repositioned itself to re-regulate agro-food production and trade.

Also drawing on Pritchard et al.'s (2016) study on the "Right to Food" initiative in current food regimes, I argue that the role of the state needs to be reinserted into current food regime debates. While states have continued to opt out of regulatory roles in agro-food systems in the neoliberal era, they are "stepping in" in other arenas via various institutional and legal mechanisms. Yet, as Friedmann (2016) reminds us, examining the

institutional apparatus of food regimes requires the researcher to place the same weight on analyzing the histories of the innovations, conflicts, and multiple trajectories of the transitions in food regimes. To this extent, this research highlights the importance of public agricultural research institutions and agricultural scientists and agronomists connecting the past and present in the formation of East Asian food regimes.

Reconsidering the Spatial Topologies of Food Regimes

Regional food politics and economies are important factors to the formation of food regimes (McMichael 2013). In a crucial sense, highlighting the concept of 'region' in food regime studies suggests what geographer Alexander Murphy highlights: "It encourages us to raise questions of history, scale and meaning that might be left unexamined if spatial constructs are simply taken for granted" (1991, 33). As part of the effort to develop a regional geography (Smith 1988; Murphy 1991; Paasi 1991, 1998; Murphy et al. 2015), Murphy's point reminds us that the formation and evolution of a region is an important process in the construction of food regimes.

In reconsidering the food regime approach, this study agrees that it is crucial to be sensitive to questions of geographic region and scale (Murphy 1991; Smith 1993; Swyngedouw 1997; Brenner 2001); any analysis of food regimes should incorporate the global, regional, national, sub-national, local, and so forth as different spaces through which the reach of food regimes is territorialized, regulated, and contested. I draw on John Allen's (2016) notion of "topologies of power," which emphasizes that the operation of power across time and space is never settled in a given topology, such as a network, territory, or scale; instead, these spatial topologies of power operate

concurrently in multiple forms of spatiality. In a similar context, Alexander Murphy's (2012) incisive concept of "territorial-material stickiness" reminds us that spatial topologies of power—in particular the territorialization of global networks—have an inertia that has structuralized in historical material processes. Hence, the spatial topologies of power in which food regimes historically operate should not be understood simply in the sense of pre-given boundaries that separate distinct geographic units from one another. Food regimes always operate contingently through bounded and relational, fixed and fluxed spatial patterns in a historical-material process of making space and place.

Hence, the regionalization of food regimes requires an understanding of food regimes' spatial topologies as the power of food regimes in practice across space. An appreciation of the spatial topologies of food regimes (such as networked, centralized, and/or scalar topologies) holds implications not only for how a regional food regime itself is interpreted and measured, but also for how the social and spatial relations of food production and trade are conceived of and change within and across space.

Accordingly, reconsidering the multiple spatial topologies of food regimes can shed new light on how food regimes emerged in East Asia amidst the expansion of imperial Japan in the early twentieth century. The developmental path of East Asian food regimes during the postwar era was entangled with the reach of Japanese food sourcing (McMichael 2013) and the American military supply chain constructed specifically for the Korean War and the Vietnam War. Against this backdrop, Japan specialized in the pursuit of profit in the East Asian region, and as such, the United States maintained its status as the military superpower in Asia (Arrighi 2010[1994]).

Historical Geographies of East Asian Food Regimes

The Postwar Japanese Food Regime

As I have stressed in Chapter Two, the Japanese colonial period was a time when East Asian countries experienced agricultural modernization. Past studies have analyzed the contributions of rice and sugar agriculture to the Taiwanese and Korean economies and the leading role played by Japanese officials during the colonial period (Yanaihara 1929; Chang and Myers 1963; Myers 1984; Myers and Yamada 1984; Ka 1995). During WWII the Japanese Empire expanded into south China and Southeast Asia. At that time, the Japanese highly valued the agricultural experience of Taiwan and positioned Taiwan as the agricultural base from which Japan could expand its territory into the Asia-Pacific region. As a result, a modern agrarian regime emerged in the context of Japan's growing imperialism in East Asia. In addition, scholars have recognized the important role of Japan's economic bureaucracies in shaping the development of postwar Japan. These bureaucracies, such as the Ministry of International Trade and Industry of Japan (MITI), today known as the Ministry of Economy, Trade and Industry (METI), and the Ministry of Agriculture, Forestry, and Fishery (MAFF) (Johnson 1982; Mulgan 2005), played a key role in engineering and modernizing Japanese society to achieve the so-called "one-mind" Japan (Garon 1994; Moore 2013). These bureaucracies stemmed partially from the pre-war samurai group (the warrior class) and thus were integral to the process of militarization and the rise of Japanese nationalism in the twentieth century (Garon 1994; Surak 2013).

In the postwar period, the legacy of the Japanese Empire's administrative region has manifested itself in two key aspects: its official development assistance (ODA) and the growth of its agro-food outsourcing network in Asia. In 1954, after Japan signed the Colombo Plan, ODA was allocated to support the development of the economic and social infrastructure for industrialization in Asia. The ODA and related Japanese aid organizations operating in postwar Japan leveraged Japanese influence in Asia with exclusive contracts for infrastructure construction between Japanese companies and beneficiary countries (Hatch 2010); meanwhile, the social infrastructure, such as education, health care, and water and sewerage, generally comprised the second biggest part of the ODA distribution (20–25 percent; economic infrastructure comprised 40–50 percent). From the end of the 1970s to 1990, the Japanese government supplied USD 69.5 billion to support ODA (Ministry of Foreign Affairs of Japan 2016),[16] of which Asian countries were the primary recipients. One function of Japanese ODA was to provide scholarships for the training and education of foreign students and experts in various fields; about 7.5 percent of Taiwanese students who received scholarships specifically participated in agricultural education programs (ranking third next to medical education and engineering; Zhuo 1998). After 1972, however, when Japan broke diplomatic relations with the Republic of China, the Japan Interchange Association in Taiwan and other non-official organizations took over most of the functions of the ODA, including the scholarship program[17].

In addition to ODA, the sourcing network of Japanese corporations further reflects the legacy of the Japanese Empire's administrative region. The Japanese sourcing

[16] http://www.mofa.go.jp/mofaj/gaiko/oda/shiryo/yosan.html

[17] Rotary Yoneyama Memorial Foundation and Interchange Association of Japan are two of the main organizations providing scholarships for Taiwanese students to study in Japan.

network was significantly expanded in the 1970s and 1980s, accompanying the expansion of the scale of ODA in Asia (Hatch 2010). In particular, the sourcing network of Japanese food industries has grown in influence as the center of Asian food trade since the 1960s (McDonald 2000; McMichael 2000, 2012). Japanese oligopolistic food industries supported by the state regime expanded significantly during this period. Most of the industries were clustered around coastal areas in Japan, especially around important harbors, where they could more easily process imported raw materials from the United States and efficiently distribute the final products to market (McDonald 2000). At the same time, the links between Japanese domestic farmers and food processors weakened, giving rise to a pattern of dependence on the import of raw materials through outsourcing networks (ibid 2000).

The Japanese food-sourcing network was reconfigured dramatically at the end of the 1980s and the beginning of the 1990s. The turning point for this reconfiguration was the 1985 Plaza Accord and the decision to weaken the dollar in comparison to the yen. Because the strong yen jeopardized the competitiveness of Japanese exports, the scale of Japan's foreign direct investment (FDI) increased by five; the Japanese were reluctant to invest in domestic industries due to the higher production costs. In the 1990s, more than half of Japanese FDI was invested in Asia. The amount of ODA Japan provided to other countries also achieved its highest rate during this period, ensuring the smooth functioning of Japanese investment in Asian host countries (Hatch 2010). With the decentralization of the Japanese economy, NICs in East Asia benefited from a regional division of labor shaped by rapidly rising levels of technology and expanding industrial infrastructure (Castells 1992). Meanwhile, the colonial legacy and postwar development

in East Asia repositioned Taiwan as a critical supplier for the world market and the Japanese agro-food market in particular.

In the 1960s and early 1970s, Taiwan was still the main supplier to meet Japanese sugar consumption (Annual Statistics of the Council of Agriculture in Taiwan). To reach the goal of agro-export specialization and to improve farmers' income in rural Taiwan, in 1969, the Taiwanese government collaborated with the JCRR to initiate the "Agricultural Modernization Plan: 12 Strategies" (Huang 1991). As a part of this plan, the public agricultural research institutions and experimental stations in Taiwan transferred productive and disease-resilient hybrid seeds of cash crops to farmers and assisted them in implementing the agribusiness model for export. Much of the research on these cash crops can be traced back to the scientific farming foundation established during the Japanese colonial period (Hsieh and Chen 2017). In the 1960s and 1970s, Taiwan's main cash crops for export were asparagus (no. 1 supplier to the world and the Japanese market in 1971), banana (no. 1 supplier to the Japanese market in the 1960s and early 1970s), button mushroom (no. 1 supplier to the world market in the 1970s), pineapple (no.1 supplier to the world market and Japanese market in the 1960s and the early 1970s), and edamame (no. 1 supplier to the Japanese market in the 1970s and the 1980s) (Annual Statistics of the Council of Agriculture in Taiwan). However, with the exception of edamame beans, most of these export cash crops declined in the late 1970s and were later produced only for Taiwanese domestic consumption.

East Asian Food Regimes

Regional food production and trade, intertwined with the agrarian-research institution, have played significant roles in shaping East Asian food regimes. The

Japanese Empire, and later both Japanese food corporations and the U.S. Cold War regime, territorialized the East Asian food regimes through food production networks, military logistics chains, and translocal flows of agricultural scientists and research.

Since the 1990s, however, multiple crises have transformed the food regimes in East Asia, generating alternative production methods and products. In the following analysis, I utilize edamame production and trade to explain the emerge of East Asian food regimes.

The history of the cultivation of edamame dates back to the year 1275 (Shurtleff and Aoyagi 2009). However, it was not until the Japanese economic boom in the late 1960s and 1970s that Japanese restaurants started serving edamame free of charge to accompany beer. Accordingly, the demand for edamame beans increased significantly during this period (Shurtleff and Aoyagi 2009). In this context, contracted edamame crops were first introduced to Taiwan by Japanese traders, as Japanese contractors sought foreign bases to grow edamame in the 1970s when the production cost in Japan had fast increased. As a result, Japanese food industries constructed an edamame supply chain in central and south Taiwan, and Taiwan became the main foreign supplier of frozen edamame to Japan from 1970 to 1993.[18]

At the end of the 1990s, China's coastal areas became enclaves of the Japanese electronics, machinery, and automobile industries, yet very little research has focused on the importance of the growing agricultural sector (with investments from Taiwan and Japan) in China during this time. Based on FAOSTAT, Takayanagi has revealed that in terms of the fresh fruit and vegetable trade in East Asia in 2002, Taiwan and South Korea are ranked first and second, respectively, as the main exporters to Japan (Takayanagi

[18] Author interview with Mr Kuo-Lung Chou, Director of Crop Improvement Section, Kaohsiung Agricultural Research and Extension Station, June 2013. Also see footnote 19.

2006). Since 2001, however, when China became a formal member of the WTO, both the output value and quantity of agro-exports from China to Japan increased almost twofold in the 1990s (FAOSTAT 2013). In 2001, Japan's vegetable imports from China reached a historical high of 1.38 million tons (Chen, Chen, and Shi 2005). Farmers and owners of process factories in central and south China were the main actors contracted by Japanese trading companies. Shandong was one of the first regions in China where Japanese trading companies carried out the commercial agricultural development of vegetable crops (Chen, Chen, and Shi 2005). The edamame industry shifted in the 1990s, with China replacing Taiwan as the main supplier to the Japanese market (Table 1).

Although agro-trade boomed between China and Japan, a number of reports revealed pesticide residues and toxic feeds contaminating duck, pork, eel, and vegetables imported from China. Meanwhile, Japan's regulation of agro-trade in terms of food health and safety issues shifted significantly (Hall 2010). Specifically, in 2006, the Council of Agriculture in Taiwan (CAT) outlined the new regulations of Japan's Ministry of Agriculture, Forestry, and Fisheries (MAFF)—more than 50,000 categories of drug and pesticide residue benchmarks to be included in the official standards (Figure 6). Due to the proliferation of new Japanese food safety and quality regulations, the economic locus of the vegetable industries in East Asia was once again reconfigured.

Because of its privileged position with respect to Japan, Taiwan was able to address the new Japanese food standards even prior to their implementation. The social network operating mainly through the shared cold chain logistics infrastructure between Taiwan

and Japan (mostly for aquaculture and frozen vegetable trade)[19] allowed Taiwanese edamame farmers and processing plants in south Taiwan to receive early information about a year before the enforcing of new food safety standards (see Figure 7). In addition, the public agricultural research institutions and laboratories in Taiwan played an important role in facilitating the edamame industry to create its own trace-back system for inspecting pesticide residues. The system for food safety in Taiwan has its historical roots in the Vietnam War, when Taiwan's government developed hygienic standards to regulate the vegetable supply chain according to the demands and standards of the U.S. military (Lee 1968).

In the context of the postwar agrarian development I described in Chapter Two, the partnership between Taiwanese famers, Taiwanese public agricultural experts, and Japanese buyers improved the ability of Taiwan's edamame industry to adopt the Japanese food safety regulations.

By contrast, China's edamame production has required Japanese contractors to monitor and inspect on site (Chen, Chen, and Shi 2005). In my interviews, the owners of edamame processing plants (who must deal with both local edamame growers and Japanese traders) noted that the Japanese food safety regulations have increased the production cost to Chinese edamame producers as Japanese contractors disrupted the

[19] Author interview with Mr. C. C. Tsai, President of Tai Mei Food Co., Ltd. and currently the Chair of the Taiwan Regional Association of Frozen Vegetable and Fruit Manufacturers, July 2014. For example, Maruha Nichiro Corporation, one of the biggest Japanese seafood companies, has been the main buyer of Taiwanese frozen vegetable and seafood since 1970. The owner of the company Shigeru Ito has very close personal relationships with Taiwanese suppliers of seafood, convincing them to invest in edamame and other frozen vegetable industries because they share the same cold chain infrastructures. The Taiwanese suppliers organized the Taiwan Regional Association of Frozen Vegetable and Fruit Manufacturers in 1974 to negotiate with Japanese buyers and coordinate local production for export in order to maintain profit rate. The Association also holds the Japan–Taiwan Frozen Agricultural Product Trade Symposium annually in Japan (see Figure 7) to exchange information on the supply and demand of frozen agricultural products—particularly edamame beans.

production processes in field. The result is that each processing plant requires a team of independent advisors to audit the production process in order to ensure the quality of the products.[20] In addition, production costs such as land rent and wages have increased five times and four times, respectively, since 2000, while the market price of edamame beans has dropped by 10 percent. All of these factors have resulted in a crisis for the Chinese edamame industry.[21]

Accordingly, this crisis has transformed the Chinese edamame industry: Only a few large, state-owned vegetable trading companies in China have been able to upgrade their edamame commodity chains to incorporate new elements into production (e.g., laboratories, trace-back systems, and mechanized production) so as to secure their share of exports to Japan. Small edamame plants, on the other hand, have re-directed their products away from Japan toward the growing domestic and overseas edamame markets.[22]

In addition, many Taiwanese edamame firms in China have returned to Taiwan and created a new edamame cluster in south Taiwan. After 2000, Taiwanese public research institutions and agrarian experts (notably the Kaohsiung Agricultural Research and Extension Station, founded in the Japanese colonial period) guided the Taiwanese edamame industry on how to cope with Japan's food safety regulations. The increased role played by public research institutions in regulating the food safety and quality of the

[20] Author interview with Mr. C. C. Tsai, President of Tai Mei Food Co., Ltd., July 2014; Author interview with Mrs Mei-Su Huang Liao, Vegetable Processing Plant Owner, Donghai Frozen Foods Co., Ltd., July 2015; Author interview with Mr. Kuei-Ping Liu, President of Young Sun Frozen Food Co., Ltd., Oct 2016.
[21] Author interview with Mr. Kuei-Ping Liu, President of Young Sun Frozen Food Co., Ltd, Oct 2016.
[22] Author interview with Mrs. Na-Na Liu, Assistant Manager of Young Tern International Trading Co., Ltd and Mrs. Katsube Yukiko, Acting Manager of Maruha Nichiro Corporation, Oct 2016.

edamame industry has restructured both the public agricultural scientific institutions and the edamame industry in Taiwan.

As WTO food safety and quality regulations have proliferated, the legal structure for food production has changed. These regulations include the WTO's trade-related aspects of intellectual property rights (TRIPS), the Codex Alimentarius, and the International Union for the Protection of New Varieties of Plants (UPOV), along with a series of intellectual property protection (IPP) reforms in Taiwan.

Consequently, in 2004, Taiwan mandated a reform to the seed and plant law, based on TRIPS. The reform states that public legal persons can transfer their innovations in bio-agriculture to the private sector, and individual researchers and inventors can claim their patents through the institution to which they belong. Specified proportions of profit-sharing stemming from technology transfers are also stipulated and enforced through agricultural industries. As a result, Taiwan's public agricultural research institutions and researchers have played a significant role as entrepreneurs in the edamame agribusiness.

Furthermore, most of the scientists who have been in charge of rebuilding the edamame industry in Taiwan can trace their scientific training back to Japanese or American research institutions of horticulture and tropical agriculture. For example, Taiwan's main breeder of a new edamame species was trained by a mentor who was educated by the Japanese colonial government. This lineage has helped the breeder to anticipate the market trends of Japanese edamame consumption in order to breed edamame species that correspond to the most popular tastes in Japan at the time. As he put it,

> It is a kind of mission for me to develop Taiwanese agricultural industries…, my mentor was trained by Japanese, and later worked for [GMD] government. I was

> trained by him and getting familiar with edamame trade between Taiwan and Japan. The information flow facilitates my research to breed specific edamame species that Japanese desired. Japanese traders [of edamame] visit me at least three times annually to gain information on edamame production, and I visited them in Japan to investigate edamame market twice a year. We are building the connection between Japan and Taiwan via edamame.[23]

Another interview with Japanese traders and a Taiwanese edamame grower revealed how this transnational edamame production network operates:

> Trader: Edamame from Taiwan is just better (than Chinese edamame) –its sweetness rate is higher with strict food safety standards, and the size of edamame fruit is bigger in a relatively standardized shape [means three fruits in a pod].[24]
>
> Taiwanese grower: We are fortunate to have Kao 9 species to grow…as she [the Japanese trader] said, this edamame species fits Japanese taste. For us, this species is more productive than other edamame species—the per unit area yield of Kao 9 is 30 percent higher than other species. Mr. Chou (the breeder) provided mechanization and other helps secure the quality and safety of our product.[25]

In addition, agro-scientist-directed farmers and edamame firms have created a cluster of farms growing new hybrid species of edamame beans in south Taiwan. Pointing to examples of large farms in the American Midwest, agro-scientists in the Kaohsiung Agricultural Research and Extension Station have convinced edamame dealers to play the role of large farmers by providing them with new species of edamame crops, large swathes of land in the name of agricultural field experiments[26], technologies for mechanized production, and a standard food safety audit system. There are now ten large farms operating in south Taiwan, managing 20 km^2 of fields. This area has become

[23] Author interview with Mr Kuo-Lung Chou, Director of Crop Improvement Section, Kaohsiung Agricultural Research and Extension Station, June 2013.
[24] Author interview with Mrs. Na-Na Liu, Assistant Manager of Young Tern International Trading Co., Ltd and Mrs. Katsube Yukiko, Acting Manager of Maruha Nichiro Corporation, Oct 2016.
[25] Author interview with Mr. Kuei-Ping Liu, President of Young Sun Frozen Food Co., Ltd, Oct 2016.
[26] The Kaohsiung Agricultural Research and Extension Station used the state-owned land of the Taiwan Sugar Company for free for the purposes of field experiments. The allocation of large areas of land to edamame agriculture in Taiwan was initiated as field experiments for the Kaohsiung Agricultural Research and Extension Station.

the production base for 80 percent of the Taiwanese edamame grown for export to Japan. In contrast to the crisis affecting the industry in China, the Taiwanese edamame industry has benefited from its alliance with Japanese firms, built on networks rooted in the colonial and postwar developments in East Asia. As such, it has managed to regain its primacy in the Japanese edamame market.

The WTO food safety and quality regulation that enforced through the Japanese government and food corporations have imposed unrecompensed costs on the Chinese and Taiwanese edamame industries, yet with different results. The shifting edamame foodways that underlie the edamame commodity chain and production networks must adhere to the food quality and safety regulations of the Japanese government; this has been beneficial to Taiwan's edamame industry, but harmful to China's. The Chinese edamame industry's failure to align itself with the emerging corporate-environmental food regime has reinforced Japanese consumers' perception of Chinese food as a low-quality product (Cwiertka 2006).[27]

Consequently, the boundary between Taiwanese edamame and Chinese edamame has become heuristic, in that, structures of feeling derived from food safety scares have caused Japanese consumers to be anxious about where their edamame is originally grown and processed—Taiwan or China.

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[27] Chinese and Western cuisines were embedded in the process of building Japan's food identity, which developed gradually during and after WWII and into the 1980s. During the postwar period, Japanese-Western and Japanese-Chinese cuisines were integrated into the hierarchy of the Japanese food industry and acquired positions as components of the Japanese national cuisine. However, since then, Japanese consumers have categorized Chinese food as being of inferior quality and having an unpleasant flavor. These perceptions have been heavily influenced by unsanitary dining environments. Integrated information related to Chinese food and poisons can be easily accessed on the internet: http://blog.goo.ne.jp/humon007/e/cfc2a0c4589fc95c47d5b4eba796682c. Also, one can easily find reports and critiques of poison found in Chinese food by reading local newspapers in Japan.

Summary

Drawing from the food regime frameworks developed by Friedmann (2005, 2009, 2016) and McMichael (2005, 2012), I argue that the recent transition of the East Asian food regimes has been characterized by new strategies for capital accumulation and the incorporation of food safety and quality standards, which have given rise to multiple trajectories of agrarian development. The transformation of the edamame industries in East Asia provides a useful illustration of these shifts. Edamame production and trade have been structured by the coevolution of East Asian agrarian development and the regional political economy.

The re-territorialization of edamame production and trade shows that the emergence of a corporate-environmental food regime in East Asia has been shaped by the dynamics of the global food trade and governance, while embodying the geographical metaphor of "food from somewhere" (Campell 2009): Multiple production sites and producers under different food governance structures eventually alter the food supply chains and hence create multiple food regimes. This metaphor is synonymous with Ching's claim that "Japanese or Japaneseness, Taiwanese or Taiwaneseness, aborigines or aboriginality, and Chinese and Chineseness—as embodied in compartmentalized national, racial, or cultural categories—do not exist outside the temporality and spatiality of colonial modernity, but are instead enabled by it" (2001, 11). In other words, East Asian food regimes have been (de-/re-) territorialized by the space–time rhythms of the regionalization processes shaped by colonialization, postcolonialism, the Cold War, and post-Cold War dynamics. In the next chapter, I focus on the regionalization processes of

edamame production and trade in East Asia and the multiple agrarian patterns that it has produced in China and Taiwan.

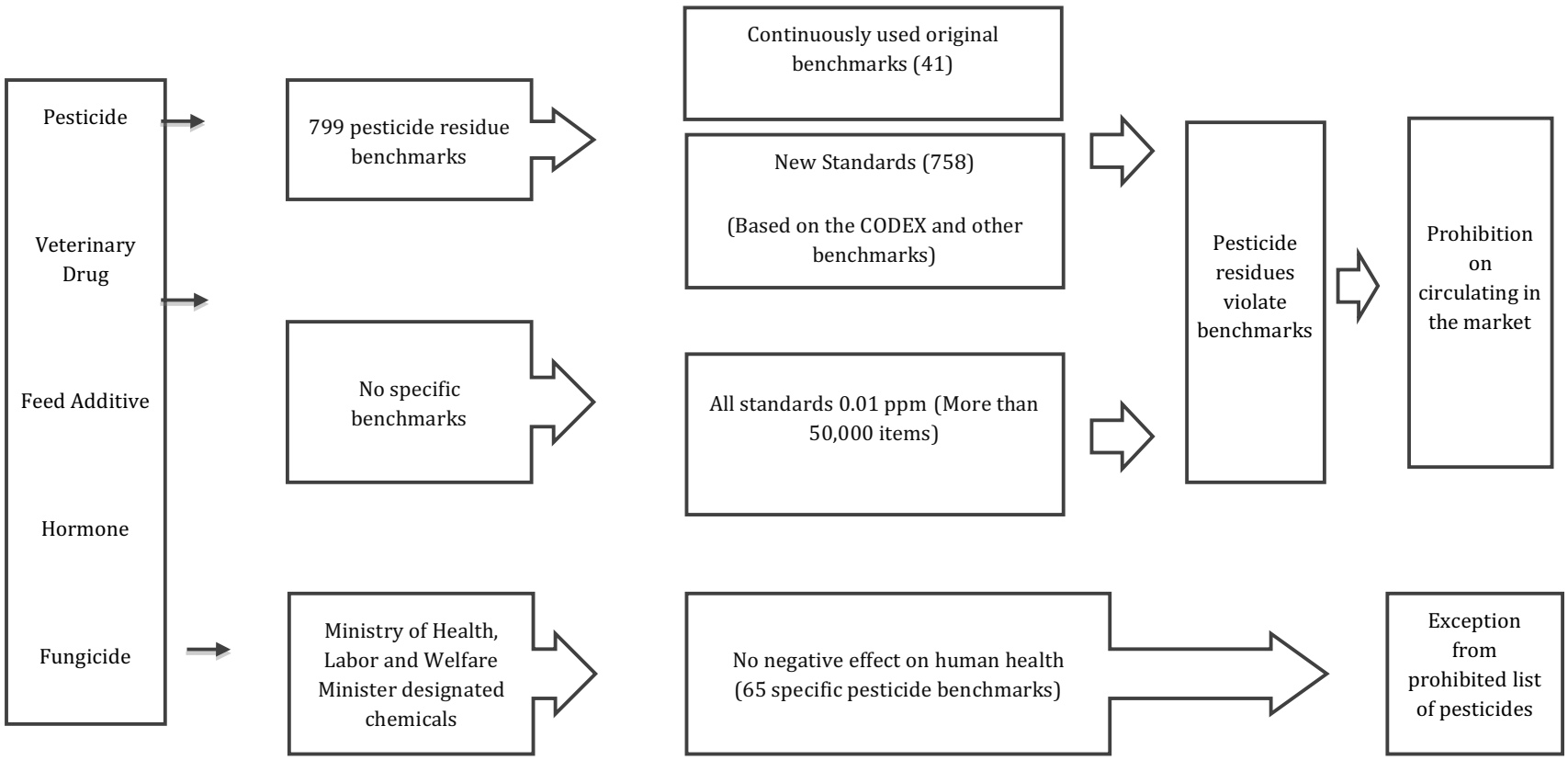

Figure 6. Japanese agriculture chemical residue benchmarks and the positive list system. Source: 2006 CAT report, and author interview with vegetable exporters.

平成30年(2018年)3月26日　冷　凍　食　品　新　聞

2018年 日台冷凍農産品貿易懇談会

関係深め共に発展を誓う

蔡理事長 日台交流の架け橋に
川﨑会長 衛生管理の強化検討

台湾冷凍蔬果工業同業公会（蔡敬慶理事長）と輸入冷凍野菜品質安全協議会（川﨑順司会長）は8日、千葉県千葉市のホテルグリーンタワー幕張で「2018年日台冷凍農産品貿易懇談会及び懇親会」を開催、台湾側から62人、日本側から85人が参加した。17年台湾枝豆の対日供給実績は16年を上回り堅調に推移。今後も協力関係を強固にし、一層の需要拡大に努めていくことを確認した。

台湾側から62人、日本側から85人が参加

蔡理事長

懇談会では台湾側から、呉俊澤台湾貿易センター東京事務所所長、蔡理事長があいさつに立った。

蔡理事長は「2017年を振り返ると、台湾産冷凍枝豆の日本への輸出総量は3万2000tとなり、2016年より1000t程上回った。日本への輸出総量の41・4%を占め、競争相手である中国、タイを大幅にリードして台湾産が連続1位となった。皆さんに感謝申し上げる。枝豆という特殊な商品を活かして日台の架け橋になり、産業の永続的発展のため、また消費者の最大満足のため頑張っていきたい」とした。

川﨑会長

日本側からは川﨑会長があいさつに立ち、「今後の課題として衛生管理の強化を凍菜協で検討していきたい。2017年は冷凍野菜の輸入量が100万tを突破した。異常気象による日本野菜の価格高騰を受けたことも一因だが、下処理が不要なことなど簡便性も評価された。加えて品質の良さも理解していただけたものと考えている。日本では15年ぶりに食品衛生法の見直しが通常国会で検討される方向で動いている。凍菜協では必要な情報を収集し皆様と共有するとともに適切な対応をしていく」とした。

その後、洪忠修行政院農業委員会国際処処長、周立台北駐日経済文化代表処経済部部長が来賓あいさつ、日本側、台湾側から講演が行われた（詳細別掲）。

続いて、魏東啓台湾区冷凍蔬果工業同業公会冷凍豆類小組招集人が台湾冷凍枝豆・ほうれん草の生産・供給状況を報告。2017年の対日供給実績では枝豆が3万1346t（2016年3万1751t）、ほうれん草が840t（同909t）となった。作付け予想は枝豆の春作が4500ha（2017年春作4201ha）、ほうれん草150ha（2017年150ha）を見込むことが発表された。

閉会に当たっては松島和浩日本水産執行役員業務用食品部部長が「冷凍農産品は日本で大変大きく伸長している。当懇談会を通じてますます拡大していきたい」と述べ、林滄智前理事長が「この会は大変意義あるもの。今後、50回、100回と続けていきたい」と締めくくった。

Figure 7. 2018 Japan-Taiwan Frozen Agricultural Product Trade Symposium, Source: *Frozen Food News* (in Japanese, 03/26/2018)

CHAPTER IV

FOOD SAFETY AND CONTRACT EDAMAME: THE GEOPOLITICS OF THE VEGETABLE TRADE IN EAST ASIA

> The incredible adulteration of bread, especially in London, was first revealed by the House of Commons Committee "on the adulteration of articles of food" (1855-56), and Dr. Hassall's work, "Adulterations detected." The consequence of these revelations was the Act of August 6th, 1860, "for preventing the adulteration of articles of food and drink," an inoperative law, as it naturally buying or selling of adulterated commodities "to turn an honest penny." The Committee itself formulated more or less naïvely its conviction that Free-trade meant essentially trade with adulterated, or as the English ingeniously put it, "sophisticated" goods. In fact this kind of sophistry knows better than Protagoras how to make white black, and black white, and better than the Eleatics how to demonstrate ad oculos [before your own eyes] that everything is only appearance.
>
> Marx (1992[1860], 248–49)

> The potentially most fundamental adoption that is suggested is the addition of an external dimension into the institutional research agenda. If this sphere is incorporated, more coherent propositions are established regarding the trajectory of settler economies and, eventually, a larger country sample.
>
> Schlueter (2014, 211)

Introduction

Following with my analysis in Chapter Three and building on the East Asian food regimes concept that I have proposed, this chapter goes further and explains the proliferation of the new regional food safety regulations that has influenced the edamame industries of China and Taiwan—the two largest producers of edamame beans in the world. Edamame is not only a popular cuisine in the Asia-Pacific region; it is also responsible for the largest-scale frozen vegetable flow in East Asia. This study demonstrates how the interaction between geopolitical realities and the subcontracting of edamame crops has created an access regime governing the vegetable trade in East Asia. By addressing the complexity of the geopolitics related to contract farming, this study

considers the extent to which the Japanese edamame trade has subordinated edamame producers in multiple places in Asia, while Taiwan's edamame industry has positioned itself to obtain preferential access to the edamame flow between Japan, Taiwan, and China.

In this chapter, I argue for the importance of contract farming in the regional dynamics of food production and trade in East Asia. Given that agriculture and food production in Asia have mainly been characterized by smallholders and small commodity production (Thapa and Gaiha 2011), international agencies have turned to contract farming to tackle the challenges and opportunities faced by Asian small farms in diversifying into high-value agricultural commodity production (Thapa and Gaiha 2011; Asian Development Bank 2012; Zhang 2012).

Contract farming also defines the legal right to access certain spaces and places for the commodification of food and agricultural products at varied scales (Watts 1992, 1994; Guthman 2017). In this sense, contract farming includes legal agreements established among states, political and economic institutions, and other actors that reconfigure the political economic structure to limit specific actors from participating in contractual relationships. Contract farming thus structures the "spatial accessibility," as discussed by Eric Sheppard (2011, 2016a), in order to realize profits from the flow and connectivity of food trade. Contract farming also intersects with food geopolitics and geo-economics to regulate agriculture and food production (Vandergeest, Ponte, and Bush 2015). Accordingly, investigating the "contextual embeddedness" (Brenner and Theodore 2002, 351) of contract farming in East Asian geopolitics can shed light on the

integral production process of agriculture and food in the historical geographies of East Asia.

To explore these issues, I focus on the contracting of edamame beans (a preparation of immature soybeans in the pod) not only because it is a popular appetizer in the cuisines of the Asia-Pacific region, but also because it is the dominant crop of the East Asian frozen vegetable trade (FAOSTAT 2013). Japan's highly lucrative edamame market is the largest in the world. For the past two decades, Taiwan and China have been competing with each other to gain export advantage in the Japanese market. In the 1970s, Taiwan became the largest contract-producer of edamame for Japan, but it lost its market share to China in the 1990s. Taiwan subsequently regained market leadership in the 2000s, at a time when China was responsible for the production of half of the global vegetable trade (Tables 1 and see FAOSTAT 2013). These market shifts occurred among other agricultural products (see Table 4 and Figure 8), in part, because of changes in Japanese import restrictions and controls (Hall 2006, 2010), Japanese consumer tastes, and relative production costs in China and Taiwan.

Food trade is a complex process. Scholarly works on the emergence of regional food regimes that focus on globalized trade and the reduced centrality of states have overlooked other dynamics taking place at other spatial scales (Tsing 2015). Beyond the simplified proposition of free trade between two countries, two characteristics, and two commodities assumed by the global trade literature (Sheppard 2016a), the material attributes of commodities comingle with contractual arrangements and are entangled with broader-scale socio-natural processes. I argue that thinking in terms of a regionalized food regime might better capture the geographies of food production and governance in

order to "raise questions of history, scale and meaning that might be left unexamined if spatial constructs are simply taken for granted" (Murphy 1991, 33). In effect, as I have argued in Chapter Three, food regimes are reshaped in the process of a political authority's regional territorialization in order to control food and resource trade. Accordingly, to examine the case of edamame trade between Taiwan, China, and Japan, this study poses the following question: How have the East Asian food regimes regionalized contract farming in East Asia, while reconfiguring local food production?

Table 4. Chinese agricultural exports to Japan, 1995–2015

Year	Exports to Japan (output value USD 100 million)	Total Exports (output value USD 100 million)	Proportion of Japanese Market
1995	45.4	143.6	31.59%
1996	49.8	142.5	34.91%
1997	47	149.4	31.45%
1998	44.1	138.4	31.88%
1999	47.3	135.4	34.96%
2000	54.1	156.2	34.65%
2001	57.2	159.8	35.79%
2002	57.2	180.2	31.73%
2003	60.4	212.4	28.45%
2004	73.9	230.9	32.02%
2005	79.3	271.8	29.16%
2006	82.1	310.3	26.45%
2007	83.5	366.2	22.80%
2008	77.0	402.2	19.39%
2009	76.9	392.1	19.61%
2010	91.4	488.8	18.70%
2011	109.9	601.3	18.28%
2012	119.7	625.0	19.15%
2013	112.3	671.0	16.74%
2014	111.2	713.4	15.58%
2015	101.9	701.8	14.51%

Source: Foreign Trade Division, Ministry of Commerce, China, calculated by this research

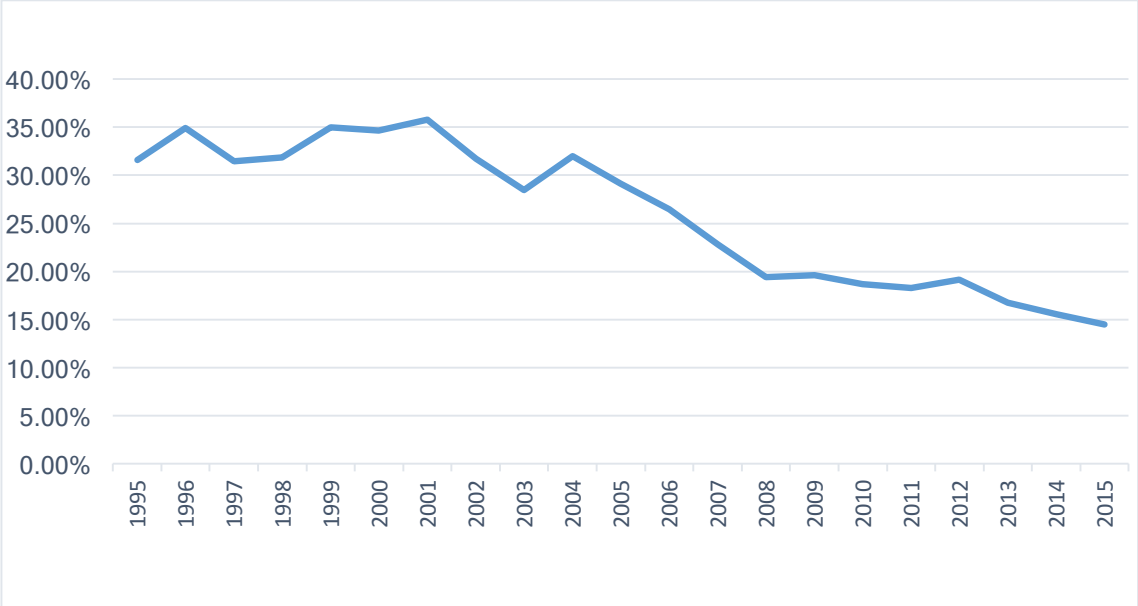

Figure 8. 1994–2015 China's agricultural export rate to Japan. *Source: Foreign Trade Division, Ministry of Commerce, China, calculated by this research*

In the first section of this chapter, I highlight how food safety has been legally constitutive, surpassing the current territorial limits of East Asian states to govern the regional food trade. I then explain how contractual arrangements have played a significant role in facilitating the extra-territorial reach of food safety and quality regulations, and present a case study of edamame trade. The final section provides a summary.

Agrarian Development in East Asia

Food production and trade in East Asia have fundamentally changed over the past several decades; rapid development has lifted the region out of subsistence and into middle-class and luxury consumption, and East Asia is quickly becoming the largest pole of the global food economy (McMichael 2000, 2012). Since the 1990s, scholars have paid greater attention to agricultural restructuring in East Asia, as Japan, South Korea,

and Taiwan became formal members of the WTO and the region negotiated new developmental strategies for agrarian change under neoliberalism (McDonald 2000; McMichael 2000; Pritchard and Curtis 2004; Barclay and Koh 2008; Kim 2006; Kim and Wainwright 2010; Lee, Kim, and Wainwright 2010; Tsing 2016). The players have also changed: although Japan and the United States were the primary actors in the post-WWII period (McMichael and Kim 1994; McDonald 2000; McMichael 2000, 2012), the rise of China has increased and restructured intra-regional food trade significantly (Calder and Ye 2010; Huang 2016). The WTO has sought to integrate scientific knowledge and expert rationality through the Codex Alimentarius, Trade-Related Aspects of Intellectual Property Rights (TRIPS)[28] agreements, and other related agreements (Winickoff and Bushey 2010). Along with the East Asian food regimes emerging in East Asia, these WTO agreements have played a crucial role in controlling food production and contract farming in the region (Pritchard 1998, 2009; McMichael 2005, 2012; Takayanagi 2006).

In order to understand how agricultural trade in East Asia has been restructured, one must acknowledge "entanglements with the more-than economic" aspects of trade (Sheppard 2012, 2016a). As Sheppard (2012, 60) notes, "Nation states also are territorially and socially differentiated into subnational, and transcended by transnational, regions, which also shape, and are shaped by, national-scale trade." In the East Asian context, stakeholders, including Japan, South Korea, China, and Taiwan, historically developed closer relationships through the Japanese colonial regime (Cumings 1984). As a result of this colonial heritage, the food and resource trade in East Asia has continued to

[28] Based on the definition of the WTO, the TRIPS agreement covers areas of intellectual property including the following: copyright and related rights (i.e., the rights of performers, producers of sound recordings and broadcasting organizations); trademarks including service marks; geographical indications including appellations of origin; industrial designs; patents including the protection of new varieties of plants; the layout-designs of integrated circuits; and undisclosed information, including trade secrets and test data.

center on Japan in the neoliberal era (Tsing 2016).[29] As the most important overseas market for foodstuffs in Northeast and East Asia (McMichael 2000, 2012; Takayanagi 2006), Japan's food and health safety regulations have had a great influence on this region. Although researchers have begun to emphasize the importance of the agricultural trade in Asia (McDonald 2000; McMichael 2000, 2012; Thompson and Cowan 2000; Pritchard and Curtis 2004; Faier 2011; Tsing 2016), there is still a dearth of scholarship addressing Japanese food and health safety regulations and their significant influence on regional food trade patterns (Hall 2010).

Although the official ties between Taiwan, China, and Japan were ruptured after WWII, shared historical and economic ties have created multifaceted relationships between them, particularly in the second half of the twentieth century once China embarked on market reform policies opening it to the outside world (Hsing 1998). Just as the coastal areas of China have become enclaves of the Japanese and Taiwanese electronics, machinery, and automobile industries, Taiwan and other Asian countries' food sectors have also played significant roles in the context of China's economic restructuring (McMichael 2012). Even though Taiwan has been categorized as an unrecognized state (Caspersen 2012), its geopolitical position has always been bolstered by its economic success and geo-economic relations with Japan, China, the United States, and a few international organizations in the international political economy. This position has enabled Taiwan to create new rules of engagement for international agriculture, as well as food production and governance.

[29] As I have mentioned in Chapter Two, the intellectual work carried out by Takayanagi has revealed that in terms of the fresh fruit and vegetable trade in East Asia, Taiwan and South Korea are ranked first and second, respectively, as the main exporters to Japan (Takayanagi 2006). Both of these countries were colonies of Japan in the first half of the twentieth century. For another insightful work with a similar focus addressing the case of Africa, please refer to Susanne Freidberg's *French Beans and Food Scares*.

In the following analysis, the case of contract edamame shows that the geopolitics of East Asian development in the post-WWII period has ensured that contract farming arrangements are more than simply institutional arrangements for agribusiness and food trade (Glassman 2011; Glassman and Choi 2014); rather, derived from Asia's post-WWII experiences, contract farming arrangements mediate and constitute a geopolitical mechanism. Contract farming highlights the historical shift of the food trade from local production sites to the territoriality of states and global regulatory frameworks. Furthermore, East Asian contract farming does not merely consist of zones of mutual interest for principle contractors, local entrepreneurs, and small commodity producers; it also involves sites of influential political and economic actors with distinct capacities.

Geopolitics of Contract Farming

Since the nineteenth century, the processes of globalization and financialization have incorporated agricultural contracts as a crucial constituent part of the political and economic mechanisms necessary to maintain the flow of capital. In *Nature's Metropolis*, William Cronon (1991) dedicates a whole chapter to explaining how the Chicago Board of Trade was founded on grain elevators, the grading system, and hedge-to-arrive and futures contracts, transmuting wheat and corn into monetary abstractions at the end of the nineteenth century. In an international development context, Judith Carney's research (1988, 1996) addresses colonial rice production in West Africa's upper Guinea coast and the southern United States. She identifies contract farming as an institution designed to control agricultural production, infused with development ideologies. She further argues that contract farming has created complex cultivation systems related to colonial regimes,

patterns of labor utilization, and technological changes in rice cultivation that have controversially transformed the agricultural landscape and social relationships.

Broadly defined contracts in the financial industry, as a type of trade agreement, have often had geopolitical and geo-economic implications (Clark and Monk 2014). For example, Jim Glassman and Young-Jin Choi (2014) highlight the important roles of U.S. military offshore procurement contracts (OSP) in the rapid industrial transformation of South Korea against the backdrop of regional geopolitical maneuvering and military conflicts in the Cold War era.

Contract farming is defined as "contractual arrangements between farmers and other firms, whether oral or written, specifying one or more conditions of production and marketing of an agricultural product" (Roy 1972, 3). The contract in contract farming functions in two ways. First, resource contracts determine the use of labor and land in the agricultural production process. Such contracts have commonly been used in capitalistic agriculture to control agricultural production. Positioned between spot market transactions and production within a firm organization, the flexibility of resource contracts often exacerbates the subordination of small commodity producers (Watts 1992; Zhang 2012).

Second, the contract as applied in contract farming also refers to the formal or the informal institution promulgating particular agricultural production conventions or ideologies (Watts 1994; Guthman 2017), and is synonymous with the legal and technical innovations of agreements in trading agro-products. Michael Fakhri's (2014) study on the history of international economic laws related to sugar demonstrates the territorial power of contract farming. He argues that the earliest free trade agreement—the 1902 Brussels

Convention on sugar—helped to buttress the power of the British Empire over global trade. Today, contract farming is commonly aligned with the state-territorial system to legitimize the consensual standards of food production under the WTO agricultural regulations (e.g., the quota system, Codex Alimentarius, and TRIPS) (Fakhri 2014). As such, contract farming can simultaneously be seen as an international food trade agreement and as a key mechanism for capitalist states to utilize modern knowledge and discourse that make bio-physical reality, such as land and natural resources, economically legible and accessible in a territorialization process (Parenti 2015).

In effect, contractual arrangements organize the food political economy for development, as global food regulations territorialize the relationships between territories, food, people, and corporations. Considering contract farming in the context of global food politics, food and environmental security appear to be relegated to the domain of environmental degradation or scarcity of natural resources, emphasizing the impotence of non-state actors in effectively addressing such crises (Dalby 1992, 2013). However, scholars have highlighted the profound effects of global food security on food geopolitics (Margulis 2014). At a time when food supplies are being restructured to meet the demands of food security, food sovereignty movements have begun contesting big food corporations' control of food security at the local level (McMichael 2005). Yet, food "security" can also refer to national and/or regional food safety and quality concerns that satisfy a specific class's diet (Freidberg 2004; Friedmann 2005; Guthman 2017). States and local governments continue to play a key role in regulating food and agriculture (Guthman 2017), designating and enforcing contracts to certificate food for consumption according to territorial-material relationships and flows of specific commodities

(Vandergeest, Ponte, and Bush 2015). In other words, the spatial-material relation of property rights in the form of a contract presupposes the territorial power of the state, which should be brought to the fore when discussing the globalization of food production and trade.

In an Asian context, Qian Forrest Zhang (2012) considers the case of the contract production of Japanese horseradish (the raw material of *wasabi*) in Yunnan, China, arguing that, in the villages of China, former local officials turned entrepreneurs have played an important role in connecting Japanese traders and local farmers who hold the tenure of arable farmland. These new entrepreneurs provide equipment and technical training, while at the same time deepening the local farmers' dependence on the company in terms of supplied capital, inputs, and market access. Parallel cases can be found in Tsing's studies on the Asian timber trade (2016) and mushroom trade (2015), in which Japanese traders play a dominant role in organizing the commodity chain of food and natural resources in Asia. These examples suggest that Japanese traders are driving contract farming and agricultural trade in Asia. However, the subcontracting of agricultural production is related not only to economic interests, but also to the regional geopolitics of food and agriculture. In this case, Japanese agricultural regulations expand throughout Asia, assembling many actors at various levels to form a contract farming system. Given the complexity of these connections, there is an urgent need to conduct a comparative analysis of contract farming practices and their impact on the international political economy.

Geopolitics of Contract Edamame

The Missing Agrarian History in Post-WWII East Asia

Against the background of the Cold War in the 1950s, the Sino-America Joint Commission on Rural Reconstruction and the U.S. Agency for International Development (USAID) regularly dispatched talent from Taiwan to the United States for training and/or doctoral degree programs—a practice that continued until the 1990s.[30] Under Japanese colonial rule in Taiwan, Taiwanese college students were limited to studying medicine, education, or agriculture (and related business) (Chu 2010). This meant that officials—particularly the first generation of Taiwan's agricultural officials and technicians—mainly received their higher education in the United States, in addition to basic training in Japan.

In collaboration with USAID, the main agricultural research and development units in Taiwan—the Agricultural Research & Extension Station and the Tropical Horticultural Experiment Branch, founded by Japanese colonists—were rebuilt and expanded (JCRR 1969).[31] In contrast to Taiwan's experience, agricultural output in China was collectivized and extracted to feed industrial laborers and facilitate the development of heavy industries in urban areas, in line with the path to socialist modernization initiated by Mao (Naughton 2006). To this end, the Chinese Academy of Agricultural Sciences (CAAS)—the most important agricultural research administration in China—was founded in 1957. The CAAS strictly practiced a "grain-first policy" in its research, seeking to improve the productivity of food crops accordingly. It was in the post-Mao era that high-value vegetable and fruit products were included in the CAAS's research

[30] Author interview with Mr Kuo-Lung Chou, Director of Crop Improvement Section, Kaohsiung Agricultural Research and Extension Station, June 2013.
[31] Joint Commission on Rural Reconstruction Report Archive (1969).

program, as China's agricultural sectors began to be privatized in the context of market economy (Schmalzer 2016, 210).

In the post-WWII context, the impact of the Taiwanese agronomists and technocrats cultivated by USAID cannot be ignored. As noted by Hagen Koo (1987), the Chinese Nationalist Party (GMD) has never forgotten that it lost the Chinese Civil War to the Chinese Communist Party in the 1940s precisely because it had lost the trust of peasants in rural China. As a result, when the GMD retreated from mainland China to Taiwan, its ultimate goals were successful land reform and rural community development, for which agronomists and technocrats were crucial (Huang 1991). As I have discussed in Chapter Three, analyzing the transition of the role of agronomists in the public sector can shed light on broadly defined agricultural contractual arrangements. Given the conflicts of interest and issues of fairness in market-oriented technology transfer programs, privatization is imperative for industrial policy. Taiwan, for instance, began to erect a legal and regulatory infrastructure for biotechnology transfer in the 1990s; this platform included a series of reforms mandating intellectual property protection laws (IPP; Wong 2005). In order to bring this legal structure in line with the WTO's TRIPS and UPOV[32] agreements, in 2004, a reform seed and plant law was mandated in Taiwan based on TRIPS. Under this new law, public legal persons can transfer their innovations in bio-agriculture to the private sector, and individual researchers and inventors can claim their patents with the institution to which they belong. In effect, scientists who have invented a new species of plant or made seeds available in public species databases are able to claim their patents and authorize third parties for contract farming. Specified proportions of

[32] The International Union for the Protection of New Varieties of Plants.

profit-sharing stemming from technology transfers are also stipulated and enforced through agricultural contracts.

Although public-private partnerships may be the most widely accepted programs among neoliberal reforms (Harvey 2001), diverse approaches have been implemented in practice. For instance, when South Korea was struggling following the 1997–1998 financial crisis, it opened approximately 70 percent of its seed industry to foreign investment (Kim 2006). However, the Taiwanese government's response to globalizing trends in commercializing agriculture has differed from that of South Korea. Rather than promoting foreign direct investment (FDI) and the entry of foreign seed companies as South Korea did, Taiwan has promoted an agricultural bio-business model in which the private sector and public agencies partner with the legal system. These new partnerships have provided flexibility and reinforced entrepreneurship.

Contract Edamame under the Food Safety Regime

Since the 1990s, both the output value and quantity of agricultural exports from China to Japan have increased almost twofold (FAOSTAT 2013). In 2001, Japan's vegetable imports from China reached a record high of 1.38 million tons (Chen, Chen, and Shi 2003). Farmers and the owners of processing factories in coastal China have been the main actors negotiating contract farming with Japan's principal trading companies. However, in the context of the booming agricultural trade between China and Japan, Japan's regulation of agricultural exports has contrasted starkly with the country's previous attitude toward issues of health and food safety (Hall 2010). Several reports of problematic food imports from China have revealed pesticide residues and toxic feeds impacting imported duck, pork, eel, and vegetables (Dong and Jensen 2007).

I argue that these developments have had two major effects on the edamame industry. First, Japan introduced the WTO's Codex Alimentarius into its food safety regulations, which then saturated the agricultural subcontracting systems. According to a technical report of the Council of Agriculture in Taiwan (CAT) and Japan's Ministry of Agriculture, Forestry, and Fisheries (MAFF), the Food Sanitation Law implemented by Japan in 2003 and the Maximum Residue Limits (MRLs) of the Codex Alimentarius have created more than 50,000 categories of drug and pesticide residue benchmarks that Japan will turn into official standards.

Second, Japan has established the so-called "all standards" rule of 0.01 mg/kg. Instead of establishing a specific standard for residues, as in international practice, this rule is based on the results of toxicological evaluations using the standards of Acceptable Daily Intake and Good Agricultural Practices. In 2004, the "all standards" rule was enforced in vegetable crops for 47 types of pesticide benchmarks; this number increased to more than 500 benchmarks in 2010. Furthermore, according to Article 27 of Japan's Food Sanitation Law, 13 quarantine offices are planned for the main airports and harbors of the country, with 300 inspectors to monitor imported vegetables. Table 2 and Figure 1 show the significant decrease in the export rate of agricultural products from China to Japan from 2004 to 2015 as these food safety-pesticide residue regulations were implemented.

The food safety standards for the edamame industry are usually higher than for other vegetables. In Japanese diet, eating edamame usually brings the edamame pod to consumers' mouth directly, hence the food safety regulation on the process of growing, harvesting, and freezing edamame is stricter than other vegetable products. In Taiwan,

China, and Japan, the edamame crop is the most significant object of regulation. While the edamame industry in China has been negatively affected by this regulatory trend, Taiwan's edamame industry has taken advantage of China's struggles, to a certain extent recovering its market share of edamame exports to Japan.

When contract edamame from China violated the "all standards" rule in 2003, principal edamame contractors from Japan—such as the AIC group (one of the biggest trade companies and retailers in Japan), and Monteroza and Yoronotaki (the two biggest *izakaya*, or Japanese-style pub, groups in Japan)—suffered dramatically. Since then, these contractors have strictly imposed the new food and health standards on the Chinese edamame industry (with contractors directly involved in local production to monitor the process). Experiencing this transition in the edamame industry personally, an edamame processing plant owner notes:

> The AIC group, Monteroza and Yoronotaki, and Toyo Suisan Kaisha, Ltd. lost their edamame because of violating the food safety regulations of Japan in 2003 and 2004. Japanese [customs] found one cargo shipment containing illegal edamame beans and then checked every single shipment; it took about 10 days to go through this process. Afterward, these edamame beans became waste.
>
> Japanese traders started auditing our edamame and vegetable production in 2004. They disrupted our harvesting process to check for residues of pesticides and chemical fertilizer. The quality standards edamame processing plants set as the contractual conditions to purchase beans have gotten strict since then. (Mrs. Huang Liao, O&M)[33]

During this period, as the food safety regulations proliferated, many Taiwanese edamame processing plant owners returned to south Taiwan, forming the new edamame production cluster. While these food safety regulations significantly re-shaped the agricultural landscape of China and Taiwan (see the subsequent section for a more

[33] Author interview with Mrs Mei-Su Huang Liao, Vegetable Processing Plant Owner, Donghai Frozen Foods Co., Ltd., July 2015.

detailed discussion of the regulations' influence on contract edamame agriculture in both countries), the shifting geography of the edamame industry occurred partially against the backdrop of Taiwanese edamame firms repositioning themselves within the edamame production network.

Another important aspect of these developments was the broad changes to the role of the state in East Asian agriculture. At the end of the 1990s, the government of Japan adopted neoliberal reforms, restructuring MAFF into a comparatively small organization and outsourcing MAFF's rice (trade) inspection responsibility to private registered organizations.

MAFF regained its power as a result of a BSE outbreak in 2001. In the 2000s, the core administration of MAFF transferred its regulatory functions (mainly regarding rice) to its progeny, the Food Safety and Consumer Affairs Bureau, which became the main food safety inspector for Japanese citizens (Mulgan 2005). This coincided with an increase in food imports from foreign countries aligned with the WTO food safety regulations. Within this context, MAFF's functions were actually expanded, forcing Japan's two main food exporters, Taiwan, and China, to reform their respective agricultural policies in line with MAFF's regulations.

Around 2002, Taiwan revised its seed and plant laws related to the standards of export agriculture in order to adopt the Japanese and WTO regulations (mainly TRIPS and the Codex Alimentarius). In the process, the concept of "food safety" was first entered into official Taiwanese agricultural administration documents. One year later, in 2003, China established the State Food and Drug Administration (SFDA) as the harbinger of food safety regulation in China. In 2011, the SFDA was incorporated into

the China Food and Drug Administration (CFDA), under the direct supervision of the State Council of the People's Republic of China. As the most recent development, CFDA, along with Ministry of Agriculture of the People's Republic of China, has issued 926 national food safety standards, with another 130 items to follow. The new national food safety standards will include almost 1,100 items with about 20,000 criteria, covering almost all kinds of food and major hazard factors.[34]

The new food safety regime operating in East Asia represents an agricultural transition in the region; urban consumers' growing demand for higher-value food products in East Asia, alongside the repositioning of state regimes in regional food production, has transformed the agricultural modality of East Asia, ushering in a new wave of agricultural modernization and industrialization in both China (Zhang 2012) and Taiwan (Chou 2012). Moreover, the specialized production of high-value agricultural products has mainly been enforced through contract farming in the region (Huang 2011, 2016; Zhang 2012). Variations in patterns of contract farming are characterized by geographical differences, different technologized species, and diverse agrarian systems.

Contract Edamame in China and Taiwan

The regulations that comprise East Asian food safety regimes have shaped the development of the edamame industries in Taiwan and China. In the face of the proliferation of the food safety regime, the historical-geographical differences between Taiwan and China in terms of their post-WWII agricultural development have shaped the contract edamame industry in both countries.

[34] "China to establish comprehensive food safety standard system." Dec 27, 2016: http://english.agri.gov.cn/news/dqnf/201612/t20161227_246128.htm

Contract Edamame in China

Many studies on Chinese agriculture have highlighted the growth of contract farming as part of China's "hidden agricultural revolution"—a new wave of agricultural modernization and industrialization that has emerged since the end of the 1990s (Huang 2010, 2011, 2016; Zhang 2012). The new trend encourages small producers to shift from grain production to the specialized production of high-value commodities. The Chinese government has played a significant role in this agricultural transition, although other socio-economic factors have had an impact (e.g., the rising land-to-labor ratio due to the declining rural birth rate, and massive labor migration from rural areas to urban regions (Zhang 2012)). In increasing the output value of vegetable products by approximately sevenfold, China's vegetable industries demonstrate the outcome of this transition, with China producing more than half of vegetable exports worldwide over the past two decades (see Table 4 and Figure 8, and FAOSTAT 2013).

However, the introduction of food safety regulations has also constrained the agricultural transition. As revealed in my interviews with farmers in villages around Ningbo and Zhangzhou in 2015, contract farmers of edamame beans set up the "company + base + household + village" model[35] to adapt to the new food safety regulations. Under this model, the edamame processing company collaborated with the local government to

[35] I distinguish between a "company + base + household + village" model of contract edamame in China and a "company + base + household + agricultural scientist" model of contract edamame in Taiwan based on my fieldwork in China and Taiwan in 2012–2016. During that time, I conducted semi-structured interviews with three major groups of interviewees. One group was comprised of the owners and managers of the two largest edamame firms in the world, with branch firms in Japan, the United States, Taiwan, and China (O&M, n=4, 1 female, 3 male). The questions for this group focused on how edamame producers have changed their geographical strategies and production processes to (re)position themselves within the new edamame network. The second group consisted of local farmers (n=6, all male) and farm laborers (n=25, 8 female, 17 male). I also observed their labor processes in Yunlin and Pingtung Counties in Taiwan and Zhangzhou and Ningbo Counties in China—four areas responsible for the production of 80–90 percent of exported edamame beans. Aiming to better understand the production process of the edamame species, the third interview group was made up of four breeders working on edamame species in Taiwan (n=4, male).

plan the edamame production base in order to control the quality of edamame production, and the village- and township-level government leased out land in the production base to the households or villagers capable of producing edamame at a large scale. Migrant labor has been the main source of labor power, mainly coming from the poorer provinces nearby. As a large-scale farmer notes:

> I leased about 100–150 hectares of land from the village, and we hired about 50–70 workers to grow and harvest edamame. We used to have full-time employees, but now, most of them are migrant workers. In order to secure the quality of edamame beans, using a large swath of land to build a production base is required; otherwise, your products will be influenced by [the pesticide used by] other fields. (Mr. Zou)

However, the new production model has become controversial, as inspectors face the limited capabilities of local farm laborers to comply with the new production standards, such as using only a certain amount of pesticides and fertilizers in a given period of time. Placing further strain on farmers, the rent on the land that large-scale farmers (i.e., capitalist farmers) lease from the villages and townships for edamame production has increased three to fivefold since 2006, while the contract price of edamame has decreased by approximately 10 percent. In addition, farm laborers' salaries have increased by approximately fourfold. With these rising costs, local farmers and large-scale farmers have been reluctant to cooperate with the government and Japanese contractors, and some have even opposed Japanese traders' inspection because of the extra cost involved. The central government has also reduced its compensation for the cost of certifying high-quality agricultural products, further eroding the profits of contract edamame in China. As two of the large-scale farmers note:

> I don't think agriculture in China has a bright future; why do I say this? Ten years ago, it only cost $100 RMB to lease 1 mu of land, $0.1 RMB to hire people to harvest 1 kg of edamame, and $70 RMB for a bag of fertilizer, and the market price of 1 kg of edamame was $1.5 RMB; now the lease of land costs $500 RMB, $200

> RMB for the fertilizer, $0.5 RMB for harvesting, but the market price of edamame is still the same, even 10 percent lower in this year [2015]. (Mr. Zou)[36]
>
> There were conflicts between us and traders and edamame firms at the beginning [2004–2005] when the new food safety standard was implemented. Therefore, I have been producing less edamame beans since then—only about 40 percent. (Mr. Kuo)

As the production cost of edamame in China increased, some small edamame producers sold their edamame factory equipment to other local plants or allowed the local government to confiscate their land with compensation; others integrated into the local production network of vegetables for the domestic market (particularly as vegetable consumption began to increase in China in the 2000s. See Huang 2016). Approximately 80 percent of the Taiwanese edamame producers (16 out of 20 edamame plants) returned to Taiwan to join the new edamame production cluster in the south and adopt the new food safety regulations for the edamame trade.[37]

Contract Edamame in Taiwan

In contrast to China's declining edamame industry, the historical role played by agricultural scientific practices in Taiwan has helped Taiwanese contract edamame to flourish under the food safety regime. Since 2000, Taiwanese public research institutions and agrarian experts in southern Taiwan (e.g., the Kaohsiung Agricultural Research & Extension Station, a public institution founded in the Japanese colonial period) have directed the edamame industry on how to cope with the new food safety regulations. Stakeholders in Taiwan set up a "company + base + household + agricultural scientist" model[38] of contract farming to develop the edamame industry.

[36] 1 RMB=0.15 USD, 1 mu = 0.07 hectare.
[37] Author interview with Mr. C. C. Tsai, President of Tai Mei Food Co., Ltd., July 2014.
[38] See footnote 34.

The original edamame seed was collected by the Asia Vegetable Center founded by the Asian Development Bank (ADB) (the only official site in East Asia) and produced at the Kaohsiung Agricultural Research & Extension Station in southern Taiwan.[39] From 2004 to 2015, nine species of edamame were developed by the Kaohsiung Agricultural Research & Extension Station. These contract edamame crops were bred with a specific appearance, taste, and shape, and specific safety considerations (e.g., traceability) in order to appeal to the Japanese market (Chou 2012).

Furthermore, as public roles in Taiwan have changed since 2000 under WTO regulations, becoming more commercialized, the agronomists at the public experimental station have functioned as entrepreneurs in the agribusiness. The main edamame breeder at the Kaohsiung Agricultural Research & Extension Station has co-claimed patents for the nine new species bred in the past 13 years. Under the new rules, the breeder and the research institution have the right to authorize the use of their seeds by other edamame producers.[40] The transfer of patents for new edamame species via contract farming has helped large-scale farmers and processing plants to form a new cluster of edamame production in Pingtung County in southern Taiwan.[41]

The land that forms the base of edamame production in Pingtung County was leased from the Taiwan Sugar Corporation (TSC), a state-owned company that took over the sugar industry built by the Japanese. As such, this region is unique in Taiwan, as it includes large swathes of state-owned land. When the breeders of the Kaohsiung Agricultural Research & Extension Station first transferred the patent for a new edamame

[39] Author interview with Mr. Kuo-Lung Chou, Chief of the Crop Improvement Department, Kaohsiung Agricultural Research and Extension Station, June 2013.
[40] Author interview with Mr. Kuo-Lung Chou, Chief of the Crop Improvement Department, Kaohsiung Agricultural Research and Extension Station, June 2013.
[41] Author interview with Mr. C. C. Tsai, President of Tai Mei Food Co., Ltd., July 2014.

species to edamame producers in 2006, they also granted the producers the opportunity to access land to experiment with a new agribusiness model of edamame production in the name of conducting field experiments.[42] As the edamame industry has succeeded in this region, edamame producers have accessed 20 km^2 of land with privileged tenure in the special edamame production zone.[43] In addition to providing seedlings for edamame production, the agronomists have introduced mechanization technologies from Japan and France to edamame producers in order to address the labor shortage in rural Taiwan (see Table 5).[44]

The agronomists and their research institutions have also authorized foreigners and foreign corporations to claim patents through contract farming. My interviews with the agronomists indicated that, from 2004 to 2015, they authorized exclusive foreign patents for Taiwanese edamame to the Snow Brand Seed Cooperation, one of the largest seed companies in Japan.[45] In hindsight, this act established an innovative cooperative relationship between Taiwan and Japan that was especially favorable for the Taiwanese producers who could take advantage of their control over exclusive patents transferred to

[42] Author interview with Mr. Kuo-Lung Chou, Chief of the Crop Improvement Department, Kaohsiung Agricultural Research and Extension Station, June 2013. The state-owned land is free for public use, including for field experiment use by the public agricultural research institute. Also see footnote 27.

[43] In the special production zone, edamame producers established contracts with the government for the long-term use of the public land (usually three years), with the rent lower than the average for similar types of land in the area. However, the most important incentive for securing privileged tenure is that it guarantees the land supply for edamame production.

[44] Author interview with Mr. Kuo-Lung Chou, Chief of the Crop Improvement Department, Kaohsiung Agricultural Research and Extension Station and Mr. C. C. Tsai, President of Tai Mei Food Co., Ltd., July 2014. The mechanization of the edamame industry in Taiwan is still in the experimentation phase. As part of the research for this study, there was discussion of some of the most innovative agrarian commercial practices in East Asia, yet due to privacy issues, I have not been able to provide details.

[45] Author interview with Mr. Kuo-Lung Chou, Chief of the Crop Improvement Department, and Hau-Ping Chou, Principle Investigator of the Department of Plant Protection, both at Kaohsiung Agricultural Research and Extension Station, July 2013. Due to the lack of permission to reveal commerical secrets of this patent transfer, I can only touch upon the case briefly.

foreign users in order to solidify their connection to the Japanese market. Through this connection, they were also able to enhance the efficacy of their communication with Japanese consumers.

Table 5. The investment in mechanization for Taiwanese edamame production/100 (hectare)

Machine	Number	Price (Million)	Machine Producer
Farm Tractor	1	5	Taiwan
Medium Farm Tractor	1	1.8	Taiwan
Vacuum Seed Planter	1	0.6	Taiwan
Auto Fertilizer Spreaders	1	0.4	Taiwan
Multifunctional Field Management Machine	2	24	Japan
Weeding Row Crop Cultivator	1	0.35	Taiwan
Boom-type Sprayer Machine	1	0.55	Taiwan
FMC7100 Harvest Machine	1	13	France
Seed Harvest Machine	1	1.8	Japan
Seed Separator Machine	1	0.6	Japan
Seed Drier Machine	2	0.5	Japan

Summary

In this chapter, I have discussed how contract farming has taken shape, historically and geographically, at the intersection of geopolitics and economics in East Asia by considering the case of contract edamame (Figure 9). I have shown that as food and health safety became a primary focus of the emerging food safety regime in East Asia, the legacy of colonial and post-WWII political economic structures gave Taiwanese

agriculture certain advantages. Through contract farming, agronomists and their institutions became central players in the transition of Taiwan's edamame agribusiness through the "company + base + household + agronomists" model of contract edamame in Taiwan. The growth of China's edamame industry, among other contract agriculture in China, has halted in recent years, revealing the relative instability of China's agrarian development compared to the agriculture in Taiwan (Zhang 2012). The "company + base + household + village" model has not been able to sustain China's advantage in contract edamame, which has been negatively affected by rising production costs and the failure to innovate in contractual arrangements and agricultural bio-technologies.

However, the decline of contract edamame in China and its growth in Taiwan cannot be explained solely by contract farming in China (Zhang 2012) or the economic miracle of Taiwanese edamame agriculture (Chou 2012). Instead, I argue that edamame contract farming's entanglement with the geopolitics of East Asia has subordinated edamame producers in multiple places in Asia, while Taiwan's edamame industry has positioned itself to obtain preferential access to the edamame flow between Japan, Taiwan, and China. The geopolitics of the post-WWII Cold War regime has conditioned the regionalization of the edamame trade in a way that has benefited the commercial alliance between Taiwan and Japan.

Finally, the geopolitics of contract farming illustrated by the edamame case may help to shed light on other commodities and/or agrarian developments in other parts of the world. The legal geography of contract farming in the context of international food safety regulations shifts the focus from internal states to the international and transnational dimensions of food regulation. This shift resonates with some scholars'

recent efforts to bring together various strands of geographic research and international legal scholarship, such as work examining the inter-legality of state systems in defining property rights (Blomley 2016), the global trade governance in the economic geography literature (Sheppard 2016a), and the historical-material role of the environment as an intrinsic part of the state's regulatory actions (Delaney 2015). In line with this scholarship, the edamame case highlights how the exterritorial reach of food regimes is realized through the territorialization of food production networks, in which both territorial states and networked corporations, along with the historical-materiality of food, are constitutive elements of the contractual relationships that shape and reshape global agrarian development. In the next chapter, I will focus on the global political economy dimension of edamame production and trade by applying the concept of "rent".

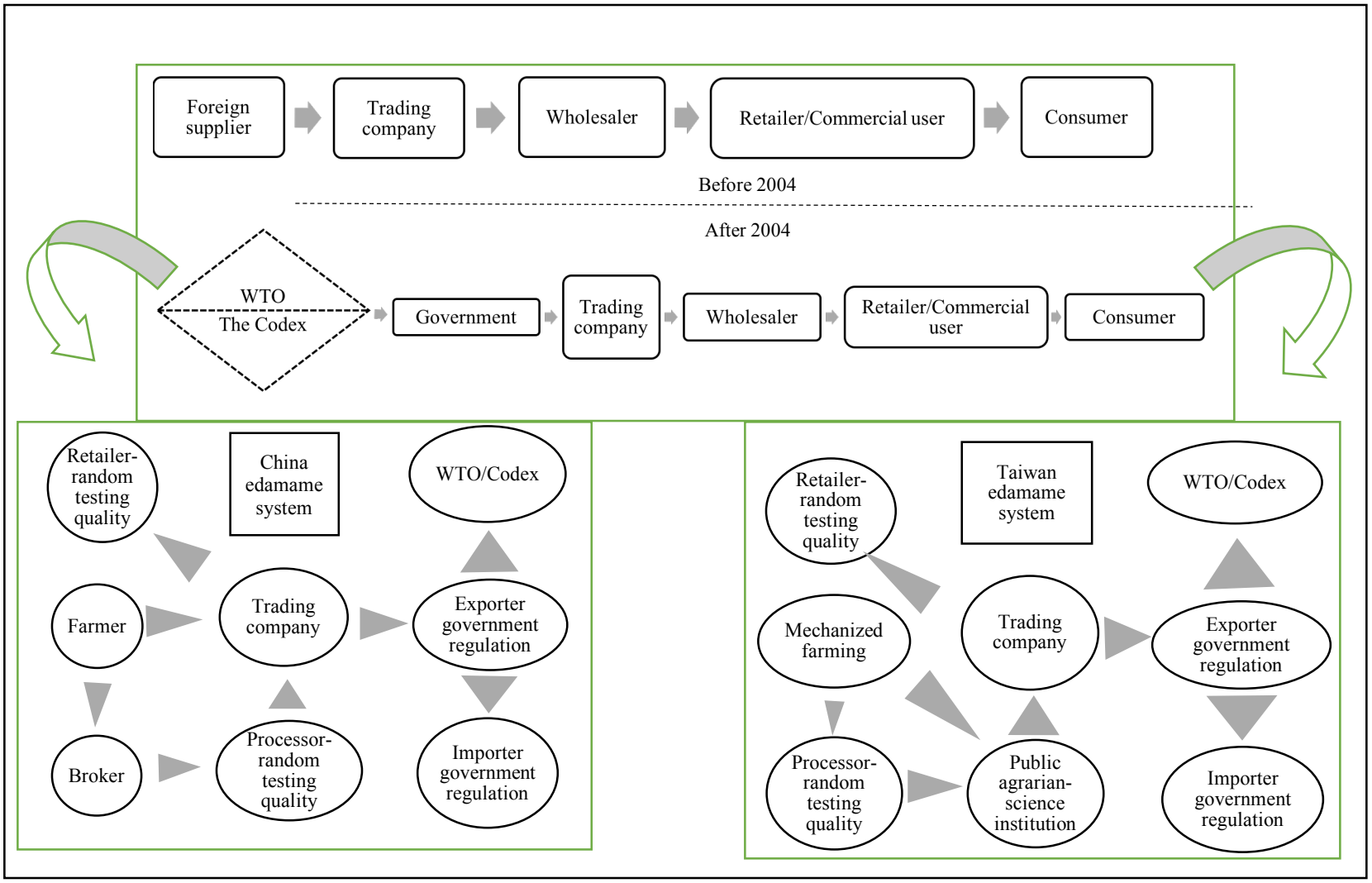

Figure 9. Edamame agricultural systems in East Asia
Source: Exporters' interviews by the researcher

CHAPTER V

THE RENT OF CHEAP NATURE: EDAMAME RENT IN EAST ASIA

> The inner logic that governs the laws of motion of capitalism is cold, ruthless and inexorable, responsive only to the law of value. Yet value is a social relation, a product of a particular historical process. Human beings were organizers, creators and participants in that history.
>
> Harvey (2016a, 203)

> …communication sciences and modern biologies are constructed by a common move—*the translation of the world into a problem of coding,* a search for a common language in which all resistance to instrumental control disappears and all heterogeneity can be submitted to disassembly, reassembly, investment and exchange.
>
> Haraway (1991, 302)

Introduction

This chapter considers recent applications of the concept of rent in the fields of agrarian studies and geography, and acknowledges the usefulness of this concept for understanding the global political economy. It argues that the production and appropriation of rents are embodied in the construction of a resource regime that is established to capture extra surplus in the form of rent under capitalism. This chapter goes on to explore this argument in relation to a case study of edamame rents in East Asia.

Previous chapters have argued that edamame provides a salient example of how agrarian production and trade in Asia have been restructured in recent years. A highly lucrative crop, Japan's edamame market is the largest segment of East Asia's frozen vegetable trade. Taiwan was the largest exporter in the 1970s and 1980s, until it was overtaken by China in the 1990s. But then, puzzlingly, Taiwan regained its market position in the 2000s—even as the rest of Taiwan's historically valuable vegetable export

sector was collapsing, and China was growing to command half of the world's vegetable exports.

Throughout the 1970s and 1980s, and into the 1990s, Yunlin County in central Taiwan produced as much as 90 percent of the world's edamame, most of it destined for export to Japan. However, in the 1990s, the edamame industry in Yunlin County declined by about 80 percent, and much of that market share was taken over by China. My field research revealed that much of the edamame exported from China was in fact produced by Taiwanese and Japanese edamame firms that had invested in growing operations in Zhangzhou and Ningbo (Fujian and Zhejiang provinces, respectively).

In the first decade of the twenty-first century, the edamame industry and other agrofood industries in China faced new challenges, including the demand for higher quality products in accordance with WTO regulations (Galt 2010). To meet this demand, some of the Taiwanese edamame firms that had invested in China moved back to Taiwan where they could produce higher quality edamame. However, rather than moving back to Yunlin County, the Taiwanese edamame firms moved instead to Pingtung County in south Taiwan. Pingtung County is the southernmost prefecture of Taiwan. Pingtung County's weather, as well as its coastal plain acreage, provides a unique physical environment for tropical agriculture. During Japan's colonization of Taiwan from 1895 until the end of the Pacific War in 1945, Japanese colonists used this region as the production base for the sugarcane industry, experimenting with an agrarian developmental model that it later transplanted to its colonies in Southeast Asia (Ka 1995; Moore 201).

Pingtung County also hosts the only agricultural biotechnological industrial park in Taiwan, founded by the Taiwanese government in 2006. The park is comprised of the World Vegetable Research and Development Center (originally the Asian Vegetable Research and Development Center, founded by the Asian Development Bank (ADB)), and the Kaohsiung District Agricultural Improvement and Extension Station. The World Vegetable Center collects edamame seed and is obligated by the ADB and the U.S. to enlarge its database of tropical fruit and vegetable seeds by collecting species from Asia.[46] Meanwhile, the Kaohsiung District Agricultural Improvement and Extension Station is involved in producing edamame seeds.

In Chapter Four, I addressed Taiwan's leading role in the global edamame industries, particularly in terms of its institutional innovations to overcome various market failures, such as missing or incomplete input and output markets and factor markets, and its capacity to upgrade supply chains in contract farming of edamame. I highlighted the institutional arrangement of Taiwan's edamame industry, in particular the producer organizations and contract farming coordinated by Taiwanese agronomists in public agricultural research institutions, which is an alternative but successful institutional arrangement for marketing edamame beans in East Asia. However, to understand the logic of the superior market value of Taiwan's edamame beans relative to China's "cheap" edamame beans requires both a micro-level and a macro-level analysis of the production and reproduction of the socio-nature of edamame. The production and trade of edamame beans requires the institutional arrangements of production, brokerage, and consumption described in Chapter Four; this chapter will show how edamame beans also gain value

[46] Author interview with Mr. Kuo-Lung Chou, Chief of Crop Improvement Department, the Kaohsiung Agricultural Research and Extension Station, June 2013.

through a recursive form of manipulation that traces back and forth between the hybridization of edamame species at specific locations, and edamame trade flows between Taiwan, China, and Japan. I argue that the extra value created by these latter processes are a form of rent, drawing on the way rent has been conceptualized in critical human geography and agrarian studies (Andreucci et al. 2017; Swyngedouw 2012).

I am particularly concerned with how the forces of appropriation and production have operated in seeking edamame rents, which, I argue, are outputs of embodied processes. In terms of appropriation (Moore 2015; Andreucci et al. 2017), such processes include the occupation of indigenous edamame species and patenting to monopolize the production and hybridization of new edamame species. With production (Harvey 2006a), I focus on the labor power invested in growing and hybridizing edamame species, and developing technological efficiency by building a seed database of edamame beans. These embodied processes of rent relations are synonymous with what Jason Moore (2018) terms "accumulation by appropriation," in that, the exploitation of labor power and nature for the survival of capitalist society relies on the capacity of state–capital–science complexes to produce "Cheap Natures" that are located, or reproduce themselves, largely outside the circuit of capital.

In the following section, I describe how edamame rents have been co-produced through the processes of appropriation and production carried out by agronomists and edamame traders, interacting with the complex and specific biological nature of edamame as a plant species. To do so, I first re-examine the concept of rent in critical human geography, and then present a case study of the appropriation and production of edamame rents.

The Rent Relation of Cheap Nature

Rent is typically understood as the price of non-reproducible resources, e.g., land and natural resources. That price "can be determined as a rent whose magnitude depends upon the relations of production and distribution" (Sheppard and Barnes 2015 [1990], 136). Accordingly, rent-seeking often involves the attempt to capture one's share of existing wealth via redistribution. Scholars have generally recognized that rent-seeking or rent-extraction behavior is not solely an economic activity; a rent regime provides legalities to private property and regulates the flow of capital across different sectors and scales (Harvey 2006a; Sheppard 2016a, 2016b). Even in neoclassical economics, which focuses on rational economic agents under perfect market competition, rent refers to the profit gained by those who benefit from favorable legal regulations to obtain privileged access to resources (Sheppard and Barnes 2015 [1990]). Legal innovations such as contracts and trade agreements, as well as transportation and communication, have been necessary to make certain spaces and places accessible for the commodification of resources (Sheppard 2016a, 2016b; Watts 1992). In this context, both the national and economic processes of regulating land and land-based resources are complicated by the geographical reconfiguration of extracting surplus.

The concept of rent has been discussed in geography and related fields for decades (Walker 1974; Smith 1979; Harvey 2001; Bridge 2008; Swyngedouw 2012; Sheppard and Barnes 2015 [1990]; Slater 2015). Recently, critical human geography and agrarian

studies have begun to reconsider Marxian rent as an important conceptual framework (Swyngedouw 2012) with which to understand how the circulation of capital in search of rent plays a particular role in managing land property that results in a spatial reorganization of capitalist activities (Harvey 2006a). David Harvey (2010), for example, recently argued that ground rent "has to be brought forward into the forefront of analysis … [to] bring together an understanding of the ongoing production of space and geography and the circulation and accumulation of capital" (183). Rent influences not only the relocation of capital, but also the spatial strategies of capitalists to invest and produce globally (Harvey 2001, 2006a; Sheppard and Barnes 2015 [1990]).

Marx (1991[1894]) was intrigued by the function of rent in the capitalistic relations of production and reproduction. Viewing landlords as a social class (Katz 1986; Lefebvre 1991), Marx emphasized landowners' monopoly power as a means of "enclosure" by both capitalists and landlords to the set of non-produced commodities (Sheppard and Barnes 2015 [1990]). Marx considered four types of rent: "Differential I" (the result of equal quantities of capital applied to different plots of land), "Differential II" (the intensification of investment in a single plot of land in which the surplus is derived from technical efficiency), "monopolistic" (associated with the unique character of land or location), and "absolute" (related to the land property rights of landlords) (Marx 1991[1894]).

The concept of Marxian monopoly rent has gained more attention recently. Building on Marx's ideas, Sheppard and Barnes (2015 [1990]) categorized monopoly rent as either rent 1 or 2, with rent 1 referring to "excess profits accruing to a monopolistic activity that occupies a given site… it is therefore the monopoly held by the firm/sector itself" (133).

Drawing on David Harvey's (1974) work, Sheppard and Barnes (2015 [1990]) described rent 2 as "a result of the monopolistic characteristics of land ownership rather than of those of the enterprise occupying a site" (133). They argued that monopoly rent 2 is the "purest expression of the social power of landlords to create scarcity" (133).

Harvey (2001) combined these two definitions of monopoly rent to explain the heterogeneous strategies of globalized capitalism in extracting profit from diverse places and natural environments, and how certain regions are striving to produce characteristic 'distinctions' in order to capture the flow of capital. In other words, monopoly rent derives from the distinct taste (or certificated quality) of a specific commodity and the special location of industry that facilitates the extraction of monopoly profits. Harvey (2001) further explained that monopoly rent is realized through centralized capital (as in the retailer and seed industries), as well as through international commercial laws that establish monopoly rights through patents—intellectual property rights. By this account, public wealth is the source of accumulation, and so monopoly rent is established in places where capitalism emerged through the extensive destruction of common property; in fact, resource scarcity is a necessary requirement for a commodity to have value in exchange and to augment "private riches" (Foster et al. 2010, 55) in the acquisition of monopoly rent. This trend is inseparable from capitalistic mechanisms and entrepreneurial institutions, such as private property registration, contractual arrangements, market-oriented institutions, and innovation—all of which facilitate the production of monopoly rent in commodifying "pseudo-commodities" (Andreucci et al. 2017).

Marxian rent has contributed greatly to the understanding of the appropriation of capitalists and landowners, which is integral to the framework of value theory itself

(Harvey 1982, 332). However, Sheppard and Barnes (1990), for example, criticized Marxian monopoly rent, arguing that the social relations of production and distribution that determine specific levels of scarcity and rent do not apply equally to all of the industries incorporating natural resources. In their words, "the level of rent is also dependent upon such factors as the productivity of capital and even the land plot or resource site itself" (Sheppard and Barnes 1990, 135-136). As such, the materiality of nature, including the specific locality of agricultural production and socionature, enacts the capitalistic rent relations, and a more abstract financial value is derived from the production of a material output or service (Ouma et al. 2018).

Furthermore, Marxian monopoly rent implies a unique situation in which natural resources are not produced by labor, but are sold for a price determined by the balance of supply and demand. One who controls the supply and monopolizes the resources is also the one who captures the extra surplus in the form of rent. For instance, a particular piece of land has a higher natural fertility and hence it can generate higher productivity through cultivation. Yet, the increasing productivity can only be valorized in the form of rent or price (due to the ownership of land), not in the form of surplus value, because capital cannot create land from its own resources (Burkett 1999).[47] Even though the theme of enclosure—the private property right control established over natural resources—has been strongly emphasized in Marx's account of primitive accumulation which as a moment of transition in capitalism for Marx, and hence the appropriation of rent should be viewed as a continuous historical material and socionatural process in which the capitalization process of un- or undercapitalized nature is not alchemy (Moore 2010).

[47] Also see the waterfall example in Marx's Capital Vol. 3, p. 784.

In this context, first, the rent relation is co-implicated in the more-than-human world (Cook et al. 2004, 2006; Whatmore 2002), and intertwined with the materiality of socionatural resources. The value wrested or hoarded from the velocity of the circulation weighted by capital's transitions, and hence "socionature," can to a certain extent be incorporated into the production and reproduction of capital. The rent relation illustrates that particular natural resources at certain historical moments can have an exchange value under capitalism in the form of a rent or a price. Second, as capitalism is relentlessly propelling itself forward into new technological frameworks and across space under capitalist competition (Buck 2007), rent is complicated and entangled within a socio-technological system under capitalism, in which the appropriation and production of rent are driven by highly creative entrepreneurs and innovators. In a similar context, Neil Smith's (2007) note on "nature as accumulation strategy" reveals the capitalist strategic control over unintended consequences through the vertical integration of nature into capital, facilitated by technologies and institutional innovations in creating a regime for rent extraction. Third, Parenti (2016) uses the term *geopower* to focus more on the way capitalist states utilize modern knowledge and discourse as statecraft to transform the use value of nature into exchange value, and territorialize nature in line with the interests of capitalist society. Rent derives from the operation of geopower domestically and internationally and the attempt to maintain the low value-composition of capital, while cheapening nature in order to create greater profit potential.

Jason Moore's (2015) concept of "Cheap Nature" from his "World Ecology" framework presents a possible approach for synthesizing the above discussion and reconsidering the capitalist rent in food production. Within this framework, "'Cheap' is a

[capitalist] strategy, a practice, a violence that mobilizes all kinds of work—human and animal, botanical, and geological—with as little compensation as possible" (Moore and Patel 2017, 22). To illustrate how this "strategy" functions, Moore traces the major turning points of capitalism over the past 500 years as a recursive process of confronting crises due to limitations of raw materials, energy, and land. In effect, capitalism has reacted to resource limitations by expanding geographically and technically alongside imperialism in order to appropriate uncapitalized nature, such as food, energy, labor power, and raw materials, and thus create Cheap Nature. According to Moore, capitalism maintains its function by raising productivity, essentially increasing the technical composition of capital (i.e., the ratio of physical means of production and labor power), and appropriating resources with low or even zero cost. In doing so, the rate of profit is protected. Therefore, expanding the frontier of appropriation is central to capitalism's accumulation and world power.

If we apply Moore's Cheap Nature to the discussion of Marxian rent, which seems to be missing from Moore's framework (Foster 2016)[48], we cannot ignore the question of how and in what way Cheap Nature can exist in the processes of the appropriation and production of rent. In turn, the concept of Cheap Nature helps us to investigate the empirical questions of who appropriates and produces the monopoly rent, from whom, and with what strategies. To create Cheap Nature is not only the operation of the law of value for capitalist survival, but also the socio-geographical and socio-technical strategies of capitalist competition, once we consider the theme of enclosure and accessibility to

[48] In Defense of Ecological Marxism: John Bellamy Foster responds to a critic (June 6, 2016): http://climateandcapitalism.com/2016/06/06/in-defense-of-ecological-marxism-john-bellamy-foster-responds-to-a-critic/

natural resources. In other words, both production and appropriation are relevant components in the embodied rent relation of achieving Cheap Nature.

Accordingly, this study stresses the rent concept in the Marxist tradition, while recognizing the contributions of scholars from critical human geography, who have identified some of the less explored dimensions of Marxian rent. It is impossible to talk about the appropriation and production of Cheap Nature without considering the capture of rent. Moore's concept of Cheap Nature also asks us to look at the significance of the capitalist appropriation of unpaid labor and nature. To this extent, Marxian monopoly rent again emerges as a central idea, along with the idea that socio-technological breakthroughs under capitalism are in fact paving new ways to internalize new commons and terrains outside of the circuits of capital to create Cheap Nature.

Hybridizing Edamame

Edamame is a preparation of young soybeans in the pod. Most commercial soybean varieties, including edamame, are the result of reasonably homozygous lines selected from the hybridization of strains. As a legume species and self-fertilizing crop, edamame is a perfect flowering plant, in that, its flowers contain both male and female reproductive organs. To create a new species of edamame, the flowers of the edamame must be artificially emasculated in order to prevent self-pollination. Accordingly, the effectiveness of selection for edamame seed yield is one of the foremost problems in the breeding of edamame beans.

During the Cold War, the U.S. led its allies to follow scientific farming principles, hybridizing grain and vegetable seeds to satisfy farmers' needs in order to address

emerging issues of international food security (Clapp 2016). The hybridization of indigenous edamame varieties started in Japan's Hokkaido area in the 1970s, using a soybean variety from the U.S. (Maturity group 00-III (USA)) and local varieties. Edamame bean breeding was accomplished through hybridization and pedigree selection, and through mutation by radiation (Takahashi 1991). In Japan, private seed companies produced almost all edamame varieties, with a few varieties produced through national or prefectural experimental stations (public) (Takahashi 1991).

In the same period, due to the lucrative demand from Japan in the early 1970s, the frozen food manufacturers and their intermediaries in Taiwan introduced a number of edamame varieties (primarily from Japan) and evaluated them for their adaptability specifically to the southern rural area of Taiwan. The variety Tzurunoko (commonly referred to by farmers as 205) performed satisfactorily. A few years later, another variety, Ryokkoh (popularly referred to by farmers as 305), was also acceptable to the farmers, processors, and the importers. The seeds of both varieties were imported from Japan, and after processing, Taiwan edamame firms exported the frozen pods back to Japan. From 1970–1999, the Kaohsiung Agricultural Research and Extension Station cross-bred Tzurunoko, Ryokkoh, and other Taiwanese local varieties to generate five varieties of edamame beans.[49]

From 2004–2015, however, as China entered the edamame market as the main supplier, the Kaohsiung Agricultural Research and Extension Station bred nine new species, many of which were designed to be exported to Japan through contract farming. Unlike the former species, these contract edamame crops had to compete with products

[49] Author interview with Mr. Kuo-Lung Chou, Chief of Crop Improvement Department, the Kaohsiung Agricultural Research and Extension Station, June 2013.

from China. As a result, the new species were specifically bred according to the appearance, taste, shape, and safety considerations that would differentiate Taiwanese edamame from Chinese edamame, and ensure that Taiwanese edamame was desirable to Japanese traders. The new Taiwanese edamame species that satisfied Japanese demand in terms of their flavor and fragrance were able to charge at least 30 percent more than the price of edamame beans from China.[50]

Breeding new edamame species to satisfy Japanese tastes (for example the taro-flavor edamame) required extra effort to stabilize the quality of hybrid-bred lines. For this reason, the agronomists at the Kaohsiung District Agricultural Research and Extension Station utilized some Japanese varieties to propagate newly bred (hybrid) edamame for 6–12 generations (see Table 6, the schematic breeding procedure of edamame beans). Each new species cost USD 10,000–15,000 to breed. The Taiwanese Government covered the costs for the time and money spent on these operations, considering the effort to be a public service (see Figure 10).

The government support not only stabilized the unpredictable nature of the species, but also offset the cost of producing qualified species for the edamame industry. This had two outcomes: making the price of the raw material of edamame production as low as possible, and making edamame production "cheap." Another aspect of edamame's Cheap Nature stems from the natural characteristic of edamame beans to self-pollinate. This made it possible for growers to keep the seed for their own use. Although the inferior quality of the seed can negatively affect the production process, it actually facilitated the introduction of lower quality edamame crops from Taiwan to China through the network

[50] Author interview with Mr. Kuo-Lung Chou, Chief of Crop Improvement Department, and Hau-Ping Chou, Principle Investigator of the Department of Plant Protection, both in the Kaohsiung Agricultural Research and Extension Station, July 2013.

of Taiwan edamame producers, thus solidifying the ranking system of edamame beans co-produced by Taiwan and China.

Agronomists in the Kaohsiung District Agricultural Research and Extension Station transferred new edamame species to Taiwanese edamame farmers and industries free of charge under the title of "experimental use" before the seed patent law was officially enforced in 2009. Even under the regulations of the seed patent law, producers in Taiwan's edamame industry can easily obtain the right to use new edamame species at a reasonable price. Therefore, by claiming a higher price for new edamame species relative to China's edamame beans, Taiwan's edamame industry has appropriated rent derived from the artificial hybridization-production of edamame beans and agricultural innovation. This dynamic was reflected in the experiences of edamame producers in China in competing with Taiwan edamame:

> I never considered myself as the competitor of Taiwan edamame for a very long period of time. Why do I say so? Because there is no way to compete with Taiwan. But that doesn't mean that our edamame is valueless. Losing Japanese market to Taiwan is not the end of the world as the domestic market of here [China] is booming and I can export my beans to the US and other places of the world, though the profit of exporting to other places might be lower comparing than exporting to Japan…the variety of edamame beans that we are using is still quite unstable and not very productive. Adding on that we can't operate mechanization for edamame farming as what Taiwan edamame industries are doing, so we won't compare ourselves with Taiwanese edamame producers. (Mrs. Huang Liao, O&M)[51]

Alongside this intensive process of generating edamame monopoly rent by incorporating edamame varieties into Taiwan's edamame industry, the industry has undergone a re-territorialization process. For decades, edamame production sites in Taiwan were mainly located in central and south Taiwan where there is a sub-tropical climate. Since 2015, however, the Taiwanese government has reorganized the farmland

[51] Author interview with Mrs Mei-Su Huang Liao, Vegetable Processing Plant Owner, Donghai Frozen Foods Co., Ltd., July 2015.

in south Taiwan to construct a special edamame production zone in an attempt to transform edamame production through mechanized farming. Pingtung County owns the largest share of farmland and hence has become the single largest production site of edamame in Taiwan, boasting 5,186 hectares under cultivation (of 6,660 hectares total) compared to the 80 hectares of the earlier production center in Yunlin (Figure 11).

Patenting Edamame

Taiwan began to erect a legal and regulatory infrastructure for biotechnology transfer, including a series of neoliberal reforms mandating intellectual property protection laws (IPP; Wong 2006). For agriculture, this legal structure was developed in accordance with the WTO's Trade-Related Aspects of Intellectual Property Rights (TRIPS) and the International Convention for the Protection of New Varieties of Plants (UPOV) agreements. Based on these agreements, in 2004, a reform seed and plant law was mandated in Taiwan, authorizing public legal persons to transfer their agricultural innovations to the private sector, and individual researchers and inventors to claim their patents with the institution to which they belong. Agricultural contracts also stipulate and enforce the proportions of profit-sharing stemming from technology transfers. With this new law, scientists who have invented a new species of plant or made seeds available in public databases are able to claim their patents and authorize third parties for contract farming.

During this period of time, edamame became the first patented agricultural product in Taiwan through edamame-related patents that were originally owned by the state and public agrarian research institutions. For instance, the breeder of the new edamame

species in Kaohsiung Agricultural Research and Extension Station has co-claimed patents for nine species bred in the past 10 years. Both the breeder and the research institution have the right to authorize local and foreign farmers and processing plants to use their seeds. In the case of Kao 10, a species bred in 2010–2011, the breeder and his institution received USD 70,000 in profits with each transfer. Since this authorization is not limited to the domestic use of edamame seeds, the new species has been transferred 25–30 times to edamame industries in Taiwan. Transferring the patent of a new species of edamame beans to actors in the edamame industry has helped to form a cluster of edamame production in Pingtung County. Through this process, the breeder shares 20% of the profit, the subordinated institution shares 30%, and the other 50% becomes government revenue.[52]

The breeder and the research institution also have the right to authorize foreigners and corporations from foreign countries to claim patents. Growing competition between China and Taiwan in the Japanese edamame market has forced Taiwan to seek monopoly power. With this aim, from 2010–2015, agronomists in the Kaohsiung Agricultural Research and Extension Station authorized exclusive foreign patents (with secret prices on transfers) of Taiwanese edamame—Kao 6, 7, 8, 9, and 10—to Snow Brand Seed Corporation, one of the biggest seed companies in Japan (see Figure 12 for the technology transfer contract of Kao 9). The objective of this move was to give the Japanese company the right to inspect imported contract edamame from China or Thailand to see whether the products violated the patents of certain species originally from Taiwan. This act, in hindsight, forged an innovative partnership between Taiwan

[52] I was permitted to read the contracts and agreements of the technological transfer of Kao 10 during the process of interviewing the breeder of new edamame species.

and Japan, especially for the Taiwanese producers who were able to control the exclusive foreign patents, thereby solidifying their connection to the Japanese market and enhancing the efficacy of communication with Japanese consumers. In 2012–2013, Taiwan's edamame industry made the decision to increase the production of Kao 9 as the flagship product for edamame export to Japan, based on feedback from consumers overseas (especially from Snow Brand and their subsidiary corporations who own the biggest market share of dairy products in Japan).[53] As one of the main Taiwan edamame producers mentioned:

> Kao 9 is more popular than other kinds of edamame species in Japan, and we [edamame industries] in Taiwan committed to it as well. This is partially because the species is productive and sweeter than other species, but the main reason is that we were informed by Japanese traders with their preference to Kao 9. The Kao 9 patent that we owned is for maintaining the communication between Japan and Taiwan in trading edamame. (Mr. Tsai, O&M)[54]

As this example highlights, patenting the new edamame species has created rent in the edamame production and trade in the geopolitical context of East Asia. The monopoly right of producing and circulating certain species of edamame has "cheapened" the production of Taiwanese edamame beans and thus generated rent. This process has been facilitated by the contractual management of agricultural institutions and agronomists, who used to be public officials, but who now operate more like entrepreneurs. The edamame rent embedded in the East Asian edamame flow has its unique origins in the political economy of East Asia. Agrarian scientists and institutions, and edamame firms are the agents controlling the translocal and scalar flows of the edamame trade,

[53] Author interview with Mr. Kuo-Lung Chou, Chief of Crop Improvement Department, and Hau-Ping Chou, Principle Investigator of the Department of Plant Protection, both in the Kaohsiung Agricultural Research and Extension Station, July 2013.
[54] Author interview with Mr. C. C. Tsai, President of Tai Mei Food Co., Ltd., July 2014.

determining the accessibility of high-value edamame species in the process of re-territorializing the trade network of edamame beans in East Asia.

Summary

This study has sought to address the question of rent appropriation and production in capitalism. I began by arguing that rent relations take shape at the scalar intersections in the social production of cheap nature. Although much of the existing literature on rent from critical human geography has contributed greatly to the conceptualization of rent, there can be more efforts in conceptualizing the way rent is politically appropriated at different scales—especially how states become a part of the movement of capital accumulation through multi-scalar entrepreneurial strategies to cheapen the production processes of nature as the foundation of rent seeking.

Furthermore, edamame rent was appropriated and produced in the intertwined process of hybridizing and patenting of edamame beans. The edamame rent has been realized through processes of scaling up and scaling down, according to a broader scalar strategy (Smith 2007) that aligns with different qualities of edamame beans, and a process of regionalization rooted in the uneven powers of capital among East Asian countries. The reason why Taiwan edamame producers can seek the edamame rent must relate to its successful strategies in appropriating and producing cheap nature of edamame beans.

In the case of the appropriation and production of edamame rent, I have shown that, edamame industries, public agronomists, and agrarian science institutions in Taiwan have appropriated rent through edamame production and trade. Furthermore, stakeholders

from Taiwan have wisely utilized the edamame rent regime, which was established through East Asian subcontracting and the legal innovation of patent laws. In the neoliberal era, public agricultural technicians and scientists are involved in the edamame industry less to contribute to the development of the state and more to engage in their own entrepreneurship in the edamame industry.

Finally, my findings on edamame rents may help to shed light on other agrofood commodities in other parts of the world. The appropriation and production of edamame rents resonate with some scholars' recent efforts to focus on a signal agricultural commodity to inquire how its production and trade underpinned a set of widening imperial connections on a global or regional scale in the neoliberal era (Daviron and Ponte 2005; Beckert 2014; Besky 2014). In line with this scholarship, edamame rents highlight how the food production and trade is embedded within a web of embodied rent relation, in which the cheap nature of edamame commodity enables a polarized edamame market that values 'Taiwan edamame', while devalues 'China edamame'

Table 6. Schematic table of the breeding procedure for edamame beans

Year		2004		2005		2006		2007		2008
Season		S	F	S	F	S	S	F	S	F
Test items		Cross breed	Generation advancement			Single plant sel.	Plant to row trial	Line trials First year	Regional trials	Management trial
Parental breeding lines: A*B		Kao	F1 hybrid	F2 hybrid	F3 hybrid	F4 hybrid	F4 hybrid	Kao?	Kao7	Kao7
Test	Line plant(s)		12	288	634	1266	11	3	1	1

Source: Author's field observation and interview with breeders.

Figure 10. Cross-breeding edamame beans. Photo by author (2012).

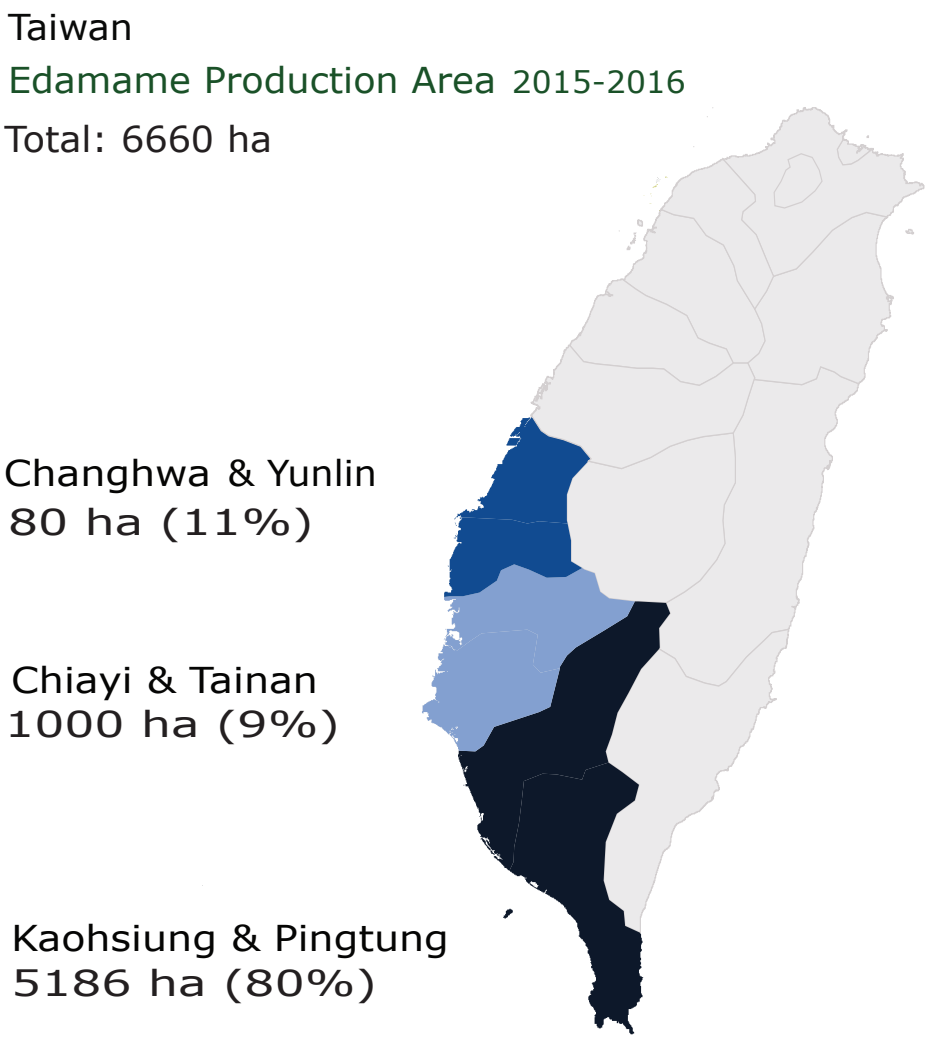

Figure 11. The three edamame production zones in Taiwan (2017)

行政院農業委員會「大豆(毛豆)高雄9號品種」境外專屬授權契約書
高雄區農業改良場

行政院農業委員会
高雄区農業改良場「大豆(枝豆)高雄９号品種」海外独占育成ライセンス許諾契約書

行政院農業委員會高雄區農業改良場（以下簡稱「甲方」）
立契約書人：
授權單位：雪印種苗株式會社（以下簡稱「乙方」）

行政院農業委員会高雄区農業改良場（以下「甲」という）
契約書調印者：
ライセンス許諾団体：雪印種苗株式会社（以下「乙」という）

甲方為有效管理及運用研究發展成果之智慧財產權，依據「行政院農業委員會科學技術研究發展成果歸屬及運用辦法」及「行政院農業委員會農業智慧財產權審議委員會第 61 次委員會議紀錄（農科字第 0970020802 號函）決議」，同意依下列條件授權乙方特定品種，經雙方本於誠信原則同意約定條款如下。

甲は、研究発展成果に関わる知的財産権を有効に管理・運用するため、「行政院農業委員会科学技術研究発展成果帰属・運用規則」および「行政院農業委員会農業知的財産権審議委員会第 61 回委員会議事録（農科学第 0970020802 号文書）決議」に基づき、以下に掲げる条件により乙に対し特定の品種を許諾することに同意し、双方の信義誠実原則に基づく合意を経て、以下に掲げる条項を約定する。

Figure 12. The technology transfer contract of Kao 9. Source: Author's field research.

CHAPTER VI

CONCLUSION – IMAGINING POWER TOPOLOGIES IN A GLOBAL ERA

> Military tactics are like unto water; for water in its natural course runs away from highlands and hastens lowlands. So in war, the principle is to avoid what is strong and to strike at what is weak. Water shapes its course according to the contour of the landscape over which it flows; soldiers achieve their victory in relation to their understanding of the foe whom they are facing. Therefore, just as water retains no constant shape, so in warfare there are no constant conditions.
>
> Sun Tzu, *On The Art of War*.

Power Topologies of the Global Food Trade

In this chapter, I conclude that the primary implication of border assemblages is in tracing how food regimes composed of objects, territorial states, corporations, and regional developments control the global food trade, and how that control has been largely exerted extra-territorially. Contrary to what the free trade doctrine assumes, the entanglement of the global food trade is not assembled in a vacuum. Although homogeneous standards established by regulatory authorities appear to produce uniform order in topographically distant places (Allen 2003, 2016), the global agrofood trade also draws on, and is in turn subject to, the temporality, spatiality, and objects that exist in these inherent (de-/re-) territorialization processes.

While border assemblages are embedded in the global networks they seek to create and operate in order to govern food production and trade, the authority with power actively practices and reaches through the rhythm of territorial-material stickiness (Murphy 2012). As such, the coexistence of regional food regimes and geographies of food production networks dialectically produce border assemblages. The framework of border assemblages emphasizes these dynamics in the emergence and transformation of

the constituent parts that yield global assemblages through the processes of (de-/re-) bordering global food production and trade.

Border assemblages become territorialized and reified through the historical processes that form and stabilize the assemblages, and as a result of the sharpness of the spatial boundaries of a state's territoriality. For instance, the agglomeration of small- and medium-sized edamame processing plants in Taiwan, supported by the government's rural industrialization policy, is an example of territorialization. Accordingly, (de-/re-) territorialization and (de-/re-) bordering refer to the intervention or disruption of the components. This results in the destabilization of assemblages, while the components to territorialize new assemblages are re-articulated. In this context, territorial topology and network topology are agricultural modalities that are assembled in the complexities of the global food system. The specificities of these modalities become resources through which authorities express their power.

It is important to note that the (de-/re-) territorialization of border assemblages has broader implications than implied by present discussions on how global assemblages make rules regarding resource governance. The (de-/re-) territorialization of border assemblages may involve the capture of profit derived from agriculture and/or land-based resources through regulatory authorities in order to define the boundaries of a resource property right. Hence, regional and territorial food regimes operate through geographies of agrofood production that can be synonymous with access regimes for food price determination and food certification.

The goals of this dissertation have been 1) to provide evidence in support of arguments that the power topology of food regimes is not a fixed phenomenon within the

globalization process, but rather is reproduced through an inchoate process of extra-territorialization and regionalization; 2) to document the extra-territorial reach of regional-territorial food regimes, which is crucial to shaping and reshaping the agricultural landscape and used to legitimate socio-political boundaries; and 3) to demonstrate the political and economic consequences of regional-territorial food regimes on regional agrarian development through the geographies of food production.

In the next section of this concluding chapter, I summarize the main arguments of this dissertation by revisiting the key findings of each chapter. The third section situates these findings within the broader literature on food regimes, global production networks, and power topologies of assemblages. Then, in the final section, I highlight the implications of this research, arguing for a re-evaluation of the duality between territorial and network topologies. Instead, the analysis of regional development should depend on the specific questions posed, the scale of analysis, and the specific historical and geographical conjunction.

Border Assemblages in Practice

The Emerging East Asian Food Regimes

The first two substantive chapters—Chapters Two and Three—provide a historical-geographical-material analysis of the modern food regimes emerging in East Asia. Chapter Two considers the historical geography of East Asian agrarian development, focusing on the ways in which the Japanese Empire and the post-WWII U.S. Cold War regime territorialized East Asia through development projects. These projects contributed to the establishment of a regulatory assemblage guiding regional agricultural production

and trade. This chapter also brings to the fore the rarely acknowledged colonial entanglements of knowledge production and exchange in the field of agriculture in East Asia. It begins by showing the importance of agrarian science institutions and agronomists in expanding the Japanese Empire, and then goes on to reveal the colonial logics underpinning the scholarship of two of the founding figures of agrarian science in postwar East Asia: Ding Ying in China and Sun Shou-kung in Taiwan. The chapter compares the complexities of agrarian development in China and Taiwan as they unfolded in disconnected contexts. I pursue transnational/regional lines of argument with regard to the circulation of modern agrarian knowledge in East Asia. I question the view that modern agrarian science institutions and agronomists in different parts of Asia were pursuing similar patterns of agrarian development. Rather, I attribute regional geopolitical and geo-economic variation to the historical geography of colonial knowledge's production and exchange.

Chapter Three establishes the main theoretical arguments in terms of East Asian food regimes and draws on the case of edamame beans to demonstrate how a regional food regime has emerged. The first part of this chapter addresses the role played by agrarian-scientific institutions and agronomists in this transition; specifically, it investigates the spatial topologies, political economy, histories, and socio-cultural contexts of agrarian knowledge production and practices that have conditioned East Asia's transition to a corporate-environmental food regime. The second part offers an analysis of a specific food commodity—edamame beans—to illustrate how East Asian food regimes have changed as they have been incorporated into a corporate-environmental food regime. In investigating the evolution of edamame production and

trade, I analyze how edamame production and trade has been reorganized under East Asian food regimes. The chapter argues that East Asian food regimes have been (de-/re-) territorialized and categorized by the space–time rhythms of the regionalization processes that have been shaped by colonialization, postcolonialism, the Cold War, and post-Cold War dynamics.

When considered together, the first two substantive chapters challenged the duality of territorial states *vs.* global corporation networks that tends to organize human and non-human into either a territorial topology or a network topology of power operated through global trade. The chapters establish a theoretical framework that addresses both the fluidity and fixity of bordering processes. The case study of edamame beans provides empirical evidence demonstrating the emergence of East Asian food regimes in the context of Asian development.

The Reach of East Asian Food Regimes

The second set of three substantive chapters—Chapters Four and Five, and the Appendix—investigate how the extra-territorial reach of the East Asian food regimes has shaped and reshaped the agricultural landscape and legitimate socio-political boundaries in the WTO era, establishing a resource regime for rent production and appropriation. While enthusiasm for the WTO may foster a feeling that the processes of globalization are dissolving boundaries, my analysis of the Asian vegetable trade and edamame production in China, Taiwan, and Japan suggests that the WTO era has instead been characterized by the re-bordering and territorialization of socio-political boundaries. The geopolitical and geo-economic boundary narratives based on food safety and quality

concerns in East Asia in particular have been used to justify bordering practices that include actors in the food production network differently.

The fourth chapter investigates the extra-territorial reach of the WTO food safety regime through an alliance with the Japanese food import complex. This chapter examines how the proliferation of the new Japanese food-safety regime has influenced the edamame industries of China and Taiwan—the two largest producers of edamame beans in the world. The chapter addresses how the interaction between geopolitical realities and the subcontracting of edamame crops has created an access regime governing the vegetable trade in East Asia. By addressing the complexity of the geopolitics related to contract farming, this chapter concludes that, as food and health safety became a primary focus of the emerging food-safety regime in East Asia, the legacy of colonial and post-WWII political economic structures gave Taiwanese agriculture certain advantages.

The fifth chapter shifts the focus to the appropriation and production of edamame rents in the assemblages of East Asian food regimes. Edamame monopoly rent and differential rent were appropriated and produced through the intertwined processes of hybridizing and patenting edamame beans. Edamame rents have been realized through the processes of scaling up and scaling down, according to a broader scalar strategy that aligns with different qualities of edamame beans, and a process of regionalization rooted in the uneven powers of capital among East Asian countries. In the case of the appropriation and production of edamame rents, I show that edamame industries, public agronomists, and agrarian science institutions in Taiwan have appropriated monopoly rent and differential rent via East Asian food regimes. Furthermore, stakeholders from

Taiwan have wisely positioned themselves within the East Asian food regimes, operated through East Asian subcontracting and the legal innovation of patent laws. In the neoliberal era, the involvement of public agricultural technicians and scientists in the edamame industry is less to contribute to the development of the state and more to engage in their own entrepreneurship in the edamame industry.

The Appendix investigates the shifting geography of vegetable trade before and after 2000, when East Asian countries joined the WTO. I find that, since 2000, China has strengthened its role as the leading regional supplier of vegetables in Asia, and Japan has been the most important buyer, while South Korea has emerged as an important importer of Chinese frozen vegetable since 2000. However, Southeast Asian agriculture has been growing rapidly to occupy a position as an important exporter and importer of agro-products. In this region, most fruits and vegetables (the main cash crops) have also expanded territorially, proportionately even more than rice. On a larger scale, the Association of Southeast Asian Nations's (ASEAN) push for regional economic integration has fostered economic liberalization in order to strengthen the competitiveness of the region and promote intra-regional trade. Since 2007, the ASEAN Comprehensive Investment Agreement (ACIA) has established the framework for promoting investment in Southeast Asia, defining minimum standards of protection for cross-border investments. In addition, Southeast Asia's greater integration into the global economy has been accompanied by increasing numbers of preferential trade and investment agreements with East Asian countries. My findings confirm this trend that, among Southeast Asian countries, Malaysia in Archipelagic Southeast Asia and Thailand

in Mainland Southeast Asia are the two countries that have experienced the greatest expansion in terms of cash crop plantations, including high-value vegetables.

Contributions: Food Regimes, Networks, and Border Assemblages

The findings of this dissertation contribute to three main bodies of literature: research into food regimes in rural sociology and agrarian studies; studies of food production networks and agricultural commodity chains, in particular on agriculture and food; and theories that link territoriality to assemblages of power.

Regional-Territorial Food Regimes

To engage with the debates on the multiplicity inherent in food regimes, in this dissertation, I argue that thinking in terms of "regional-territorial food regimes" might better capture the geographies of food production by encouraging us to "raise questions of history, scale and meaning that might be left unexamined if spatial constructs are simply taken for granted" (Murphy 1991, 33). Efforts to develop a regional geography (Murphy 1991; Paasi 1998) suggest that the formation and evolution of regions are important processes in the construction of food regimes and food capitalism. Indeed, food regimes are not merely about modern state formation or the state system, but about a process of (de-/re-) territorialization of political authority in order to control food and resource flows within a regional context.

In effect, elements in the food regime literature justify the conceptualization of food regimes through regional-territorial perspectives. For instance, approaching her concept of the 'corporate-environmental food regime', Friedmann explains how changing class, sectoral, and regional organizations of agricultural capital shape and reshape food, land,

and farming systems (Friedmann 2005, 2009, 2016). Friedmann's conceptual "region" refers to subcontinental regions that are spatially organized by either nation-states or global retailers for territorial-regulatory purposes to become the command centers of global food corporation networks. Focusing on the regional food regime driven by global food corporations, along with Friedmann, McMichael highlights the Japan-centered East Asian food import complex (2000, 2013) as a consequential part of his regional food regime analysis (2013). McMichael argues that Japanese corporations' global food sourcing model has been a "key pillar" of the East Asian food regimes. He illuminates the rise of an alternative organizing principle that has conditioned the multi-centric restructuring of the corporate food regime, particularly with newly industrialized countries (NICs) in Asia joining the crowd of global food sourcing.

However, it is also important to recognize that the power that food regimes operate in and across time and the spaces that forms their habitual geometry of power are not homogeneous; rather, the territorial power of food regimes operates contingently through bounded and relational, fixed and fluxed spatial patterns in a historical-material process of making a region.

Geographies of Food Production

Over the past two decades, the expanded linkages of food commodity/value chains between the global South and the global North have led to increased export of high-value fresh produce and frozen vegetables. This development has stemmed from structural adjustments intended to increase exports from the global South in response to the debt crisis of the 1980s (Watts 1994; Daviron and Ponte 2000; Galt 2010, 328). However, the agricultural trade between the global North and South as depicted by food

commodity/value chains cannot convincingly explain the East Asian food trade. Indeed, the territorialization of food production networks in East Asia cannot be categorically divided along a line between North and South.

Taking vegetable industries as an example, since the early 2000s, the high-value vegetable industry in East Asia has been strongly influenced by food safety standards mandated by both developing and developed countries. In particular, border-crossing procedures for ensuring food quality and safety have been considerably internalized by individual firms (Wang 2018). For instance, after China delineated development zones in coastal areas and opened them to cross-border investments and production networks in the 1980s (Hsing 1998), Taiwanese and Japanese vegetable farmers and processors established new vegetable industrial clusters in south China. However, as I have argued in this dissertation, those clusters were restructured in the 2000s because global vegetable markets started to seek higher quality products in accordance with WTO regulations. Higher production standards exerted greater pressure on profit margins that were already being compressed by steadily increasing labor costs and land rents. Thus, a more flexible way of accumulation was urgently required.

In the case study of edamame beans, the Taiwanese edamame firms that stayed in China decided to integrate into the vegetable industry clusters being formed by state-owned Chinese dragonhead companies, while others reduced their production in China and diversified their products. Meanwhile, many of the Taiwanese firms returned to Taiwan and focused production on the new edamame cluster emerging in southern Taiwan that would be able to produce edamame to the exacting standards of the Japanese market.

In addition, regarding the broader dynamics of production networks, it is worth noting that the rearrangement of trade rules can also reconfigure geo-economic space in terms of the existing geopolitics of contract farming. For example, relationship-specific investments or a socio-economic nexus can secure food safety and quality for specific geopolitical alliances via contractual arrangements. In the meantime, rent creation through limits on competition and access to organization has been central to the formation of a coalition that emerges to structure the state and society (North, Wallis, and Weingast 2009).

In this regard, this research highlights the need to tackle the bounded-contractual relations of regional socio-geographical alliances, wherein geo-economics and geopolitics (de-/re-) territorialize and (de-/re-) border regional agrarian development in significant ways. As Eric Sheppard notes, "Nation states also are territorially and socially differentiated into subnational, and transcended by transnational, regions, which also shape, and are shaped by, national-scale trade" (2012, 60).

It is crucial to be sensitive to questions of the geographic region and scale produced in the reterritorialization of production networks and commodity chains through contract farming. As a result, by approaching contract farming, food production networks assemble the global, regional, national, subnational, local, and so forth as different spaces through which the reach of food regimes is territorialized, regulated, and contested.

Borders Assemblages

In this dissertation, I propose that the territorial-material stickiness of production networks is realized through the plurality of actors and their "mixed motives" that construct border assemblages. The construction of borders delineates relevant

jurisdictions and coordinates political, economic, social, and military interactions (Gopinath and Itskhoki 2008; Carter and Goemans 2011, 2014), culminating in the extra-territorial reach of global food and resource governance. Accordingly, border assemblages incorporate the strategic relations of states and the (re)articulation of transnational space (Jessop 2001; Glassman 2011), in order to govern global food and resource production networks.

Furthermore, the spatial pattern of border assemblages is not merely a zone where the interests of agrofood corporations and nation-states overlap, but a space where resource producers, such as smallholders and peasants, and local politicians continue to mediate and constitute the new border spaces of globalization. Local, regional, national, and global scales of production and resource exchange are interwoven with narratives, memories, and social institutions.

There are three spatial layers of border assemblages— territorialization, de-territorialization, and re-territorialization—each of which facilitates the establishment of "geographies of food production" and "regional-territorial food regimes." Border assemblages become territorialized and bordered through the historical processes that construct the assemblages and the spatial boundaries of a regional food regime. (De-/re-) territorialization and (de-/re-) bordering refer to the intervention, or disruption, of the components. This destabilizes assemblages, while the components are re-articulated into new assemblages, that says the role of sovereign state and its allure of fixed territory and border never melt into the flux of global network. For instance, when new food safety and quality regulations were enforced by the WTO, food suppliers around the world reorganized their agrofood production networks through contract farming in order to

secure food safety and quality. This reorganization aligned with the WTO legal framework and served to establish new geographies of agrofood production.

To develop the research agenda further, first, it is crucial to examine the territorialization and bordering of border assemblages through which the historical trajectories of multi-scaled institutions (Popescu 2012) evolve into border assemblages. In particular, the framework of border assemblages considers the evolution and proliferation of regional and territorial food regimes through agro-trade, and addresses how national agricultural bureaucracies and research institutions "jumped scale" (Smith 1996) by participating in the formation of regional food regimes to govern the global food trade. For instance, the government of Japan implemented neoliberal reforms in the late 1990s, restructuring and downsizing the Ministry of Agriculture, Forestry and Fisheries (MAFF) into a comparatively small organization, and transferring the Ministry's responsibility for rice (trade) inspection to private registered organizations. After 2003, the core administration of MAFF transferred its regulatory functions (mainly regarding rice) to its progeny, the Food Safety and Consumer Affairs Bureau, which acted as the main food safety inspector for Japanese citizen (Mulgan 2005). MAFF regained its power in the context of a BSE outbreak, just as food imports from foreign countries were increasing in the 2000s. In the wake of this crisis, MAFF's functions were actually expanded.

Second, simultaneously, border assemblages have become important symbolic and material spaces in which the new food safety and quality regulations and certifications have de-territorialized the relations among territory, food, people, and corporations with the advent of WTO food regulations. From GATT to the WTO, the trade barrier of

sovereign state for most of trading food crops is no longer exist. Further, in the context of globalization, food and environmental security seems to have been relegated to the domain of environmental degradation or scarcity of natural resources, minimizing the nation-state's ability to effectively address environmental crises (Dalby 1992, 2013). Meanwhile, scholars have highlighted the profound driving force of "food security," particularly in the face of intensified land- and water-grabbing (Friedmann 2005; McMichael 2005). However, the fact remains that some countries proliferate borders for themselves in order to prevent food scarcity, whereas others do so to satisfy the demands of their citizens for higher quality food (Freidberg 2004; Friedmann 2005). There are many overlaps between the political initiatives of food security and food safety. These often conflicting imperatives produce a complex matrix of forces and flows in food production and trade. While border assemblages are territorialized for food security and food safety concerns, the disparate pursuits of heterogeneous state and non-state actors entangled within specific geographies of deterritorialization.

Finally, border assemblages engage processes of commodification and enclosure to re-territorialize food trade and its connection with the natural environment (Vandergeest and Peluso 1995; McMichael 2005; Bridge 2008, 404). Thus, analyzing border assemblages can help us to investigate how border spaces and food and resource networks are coproduced and contingently reconfigured by the circulation of capital and by the rules and situated knowledge of national, bureaucratic, scientific, and specialized actors (Cowen and Smith 2009; Faier 2011; Cowen 2014). Related literature on the global resource trade suggests that the proliferation of borders is intertwined with the materiality of natural resources for trade, which in turn yields profit (Bridge 2008; Faier

2011). In this context, "nature" can, to an extent, be wrested into various forms of profit through trade, thereby conditioning the geographies of agrofood production. Given this dynamic, competition for access to and regulation of natural resources increases rents and thus the profit reaped by property owners capitalizing on the price of nature.

Accordingly, border assemblages provide a lens through which to explore the relationships between humans and non-humans in the geographical political economies of land, agrofood, and natural resources, and to inquire how nature can introduce contingencies into political economic relationships (Goodman and Redclift 1991; Prudham 2004; Sheppard 2016a, 2016b). The capitalist social production of space—producing, for example, market accessibility through institutional arrangements and transportation technologies—and the social production of Cheap Nature—historically producing a different quality of land and other resources relative to the materiality of nature—have coexisted dialectically in the processes of territorializing food production networks. That is to say, the profit extraction mechanism that underlies regional-territorial food regimes is inseparable from the capitalistic mechanism that produces nature, constructs scale, and further extracts profit.

Implications: Bordering Trade in the Global Era

A final important implication that emerges from this research is that it is time to reconsider the duality of territorial states *vs.* global corporation networks, as well as the universal assumption of global trade. On the one hand, the geopolitics of food trade illustrated by the edamame case shed light on how the extra-territorial reach of food regimes is realized through the territorialization of food production networks. In this

context, both territorial states and networked corporations, along with the historical-materiality of food, are constitutive elements in the contractual relationships that shape and reshape global agrarian development. On the other hand, given that the boundaries between territorial states and global corporation networks are contingently constructed across time and space, alternative formulations can be imagined beyond the contemporary hardening of boundaries between the two categories of topologies. Indeed, critical engagement with the multiple topologies of power that lie in assemblages can and should be pursued.

The implications of this dissertation resonate with some scholars' recent efforts to focus on a single agricultural commodity and inquire how its production and trade have underpinned a set of widening imperial connections on a global or regional scale in the neoliberal era (Daviron and Ponte 2005; Beckert 2014; Besky 2014). In line with this scholarship, this dissertation highlights how food production and trade are embedded in a web of embodied power relations in which the valorization of certain food commodities enables a polarized food market that values one food commodity, while devaluing others. The analysis of food globalization depends on the specific questions posed, the scale of the analysis, and the specific historical and geographical conjunction.

Furthermore, this research suggests that geopolitics and geo-economics should consider non-humans as a type of "material politics" that has emerged not around objects in isolation, but entangled in the ever-growing complexities regarding their representation, origin, and impact (Castree 2004; Cowen 2014; Hultgren 2015). In addition to recognizing the complexities of sociopolitical systems coupled with the state, capitalism, and border regimes that are highlighted here, insights from material politics extend this

concern to power geometries of border regimes and enhance evolving perspectives on environmental issues within border studies.

On the one hand, even though the boundaries of sovereign states are not pre-existing "things," physical borders (the "hard" borders) are an inescapable part of the border landscape—as both a symbolic and material space—because both human and non-human actors contribute to the discourses that legitimize sovereign power. On the other hand, this research emphasizes the production of subjectivity, specifically for those forms of labor shaped by bordering processes. As a result, this research indicates that combining border studies with an assemblage/network approach can help to accommodate the extra-territorial reach of border assemblages (e.g., the practices of state regulation, hiring, and labor control strategies of employers, as well as patterns of inclusion and exclusion based on social origins). The application of "border" is no longer constrained by the congeries of territories, people, or modern states, but becomes a comprehensive explanatory framework with its own logic that deepens our understanding of spatial-temporal control over globalized human and non-human resources.

Finally, this research supports a regional-historical treatment of the multiple characteristics behind the shifting flow of capital. Thinking of Asia as a region, the "bits and fragments" that appear to be Western and capitalistic find their historical-cultural roots in the multiplicity of global diaspora, as observed by Kuan-Hsing Chen (2010) in his *Asia as Method* and other scholars such as Sandro Mezzadra and Brett Neilson (2013) in their *Border as Method*. It is important, therefore, to recognize the cultural mechanism that affects heterogeneous practices of economic behavior and organization in order to

explain “differential inclusion” in regional border regimes and their link to the long, variegated, and contested waves of global economic development.

APPENDIX

GEO-NETWORK ANALYSIS

Methods for Geo-Network Analysis

The goal of this research was to combine qualitative and quantitative methods in order to address the territorialization of food production networks. To do so, I developed a geo-network method to contribute to the network approach in geography. The spatial-quantitative revolution in geography was deeply influential for economic geography in the 1950s and 1960s, as the concepts of "network" and "model" became essential components in developing the field (e.g., the location theory embedded in mainstream economics) (Garrison 1960; Garrison and Marble 1965). By contrast, the fields of political, cultural, and historical geography have been relatively less affected by the trend (Cox 2013). Within this context, cultural-political geographers such as John Agnew have advanced geographic knowledge by applying the interdisciplinary "network model," introducing both the concepts "network" and "model" to this subfield. In the concluding chapter of *Geopolitics: Re-visioning World Politics*, for example, Agnew (2003) formulated four network models of power: "ensembles of worlds," "field of forces," "hierarchical network," and "integrated world society," which contribute to the understanding of networked power topologies in geography.

In the context of "new" economic geography, however, the term "network" has other connotations. New economic geography has experienced a fresh wave of "hermeneutic theorizing" marked by an interpretive model of inquiry that is reflexive, open-ended, and comprehensive (Barnes 2001). Accordingly, the "network model," in particular with GPNs, has come to signal the emergence of a variegated and scalar

economic network embedded in (or strategically coupled with) the complex socio-cultural-geographical milieu (Peck 2005). As such, the term "network" shares a similar reference point as it is applied in both cultural-political geography and new economic geography.

The approach of social network analysis (SNA) emerged in parallel to the spatial-quantitative revolution in geography. SNA was originally applied in research using matrix algebra and graph theory to formalize social-psychological concepts in order to objectively discover emergent groups in network data (Borgatti et al. 2009). Beginning in the 1970s, however, as sociology became the primary site of SNA, network analysis was reconfigured to combine both quantitative and qualitative approaches. Representative works include the influential strength of weak ties (SWT) theory developed by Mark Granovetter (1973); twenty years later, this work has developed into a general theory of social capital (see Lin 2002). Padgett and Ansell (1993) analyzed historical data on marriages and financial transactions among networks of the Medici family in fifteenth-century Florence. James Moody (2004) developed social science collaboration network analysis. In all these works, the researchers have not only mixed quantitative and qualitative methods, but also utilized classical sociology theories to facilitate the cultural and relational shift to network analysis in sociology.

A similar trend has also emerged in geography (Jones 2009). Paasi's (2011) recent commentary on John Allen's "topological twist" points out that topological thinking in geography—whether rooted in the epistemology of geometric power or the quantitative revolution—has lasted for decades. However, Paasi's commentary seems to imply that, even after more than thirty years of discussion, topological thinking in geography

requires further elaboration, because "we still have certain sociospatial elements that we cannot write off" (301).

This theoretical background shaped my application of qualitative methods to address the hermeneutic process of edamame trade and production. However, when conducting my research project, I also found that to some degree both the field of new economic geography and the field of political geography have primarily used network research to explore relational sociometrics and failed to acknowledge the potential of networks as a "method." When both fields resist spatial-quantitative work (e.g., mathematics and graph theory in network analysis), it seems that theory has been privileged over the practical application of methods.

As these trajectories indicate, geographers seem disproportionally focused on the epistemology of "network," while somehow ignoring the method itself. For instance, in Agnew's "integrated world society" model, he clearly explains that the nodes of the network represent social groups; however, further explanation is warranted on how the network nodes interact, what sort of ties integrate specific network structures, and how this model should be applied analytically. It seems clear that in order to address the network modalities linked to space, objects, and power, both topological thinking and the method of network research are required. John Allen's topological appreciation of power (2009, 2011, 2016) is in a sense a culmination of new economic geography and political geography's long-lasting effort to reconsider the concept of "network." As Allen highlights, "It is about how they make their leverage and presence felt through certain practices of proximity and reach [in networks]" (290).

In SNA, Padgett and Ansell's (1993) classic research provides a good parallel to

Allen's topological thinking of networked power. Padgett and Ansell characterized the Medici party as "an agglomeration of doubly disarticulated parts" (1285) in which the Medici mobilized new men (new political forces) who were structurally connected to the San Giovanni region through economic relations, such as personal loans. The Medici also secured patricians residing outside San Giovanni through inter-marriage. In their power network, conscious segregation and territorialization were keys to inhibiting both independent ties among followers and multiple ties with the Medici themselves. The result was that the Medici were the only bridge connecting this contradictory agglomeration.

Although Padgett and Ansell's study has been recognized as the foundation of centrality analysis in network studies (Borgatti et al. 2009), centrality analysis is also a geographical method used to measure spatial topologies of power. More importantly, the logic of centrality analysis can be represented mathematically through coding and graphics generated by open-source software, such as R and Pajek. Even though centrality analysis does not cover the full spectrum of power relations in a network, it nevertheless reconsiders Allen's (2009) claim that "powers of (and out of) reach" are unmeasurable. The approach also demonstrates that thinking about space relationally can become actual, thus challenging what Martin Jones highlights: "Despite the multiple potentials of space flagged in relational thinking, factors can constrain and structure space. All things considered potential does not necessarily become an actual…" (2009, 493).

One Project

By early 2012, I had completed an MA thesis on edamame trade between Taiwan and Japan, which was based largely on archival research and intensive fieldwork in

Taiwan. When I was conducting my research, the database of the Food and Agriculture Organization of the United Nations (FAO)—the largest database of food production and trade in the world—had not been updated for almost a decade. As a result, my analysis of edamame trade was constrained, as I was only able to refer to Taiwanese and Japanese trade data. There were few resources available for me to conduct a systematic analysis of the Asian vegetable trade of which the edamame trade is an integral part. Finally, in the summer of 2015, I unexpectedly discovered that the FAO had finally updated its database, launching a whole new version of the database and an interactive website called FAOSTAT. FAOSTAT hosts agriculture data from 1961 to 2013 and agricultural trade data from 1986 to 2013. It also organizes agricultural trade data in the form of a matrix that categorizes regional and global trade data based on the bilateral trade of certain crops.

Facilitated by FAOSTAT, I was able to conduct geo-network analysis on the vegetable trade in Asia. As explained in this dissertation, edamame trade and production shifted in the 1990s when China replaced Taiwan as the largest producer and supplier of edamame to Japan.

In the 2000s, there was another shift when Taiwan regained its supremacy as the largest producer and supplier to Japan's edamame market. While I hope my research project has provided an extensive overview of the political economy context of the edamame trade, I was also curious about the general picture of the Asian vegetable trade: Does the Asian vegetable trade demonstrate the same dynamics as edamame agriculture? If not, how has Asian vegetable trade been organized and shaped by this historical material context, especially after 2000 when Taiwan and China joined the WTO? This is

the time when open source software for computing and graphic analysis, such as R, Python, Pajek, and Gephi, was created to facilitate innovation and data analysis. Adding to that open-source geographical location platforms, such as Open Street Map and Google Map, researchers have more tools at hand for conducting experimental analysis on social networks and their spatial patterns. Accordingly, drawing from historian Patrick Manning, this is the time "for creating and analyzing a global dataset on human societal activities" (2013, 2).

The primary way I reoriented myself to a computational approach was based on the framework provided by Collaborative for Historical Information and Analysis (CHIA) initiative (see Figure 13 and the World History Center at the University of Pittsburgh). In addition, I started to learn how to apply Pajek software and the programming language R. It is not surprising that geographers have contributed greatly to the organization and application of spatial data. In the current climate, however, even more weight is placed on the role of geographer due to advances in information technology, as well as breakthroughs in communication and collaboration among humanities and social scientists in terms of utilizing big data. In particular, geographers play an important role in the process of visualization (see Figure 13), for example, in spatial representation and cartographic design.

Through this process, I found that it was difficult to draw a clear line between qualitative and quantitative approaches, leading me to a position related to exploratory analysis. To determine the topology of the trade network based on ties, edges, or links, I drew on interviews, observation, and other ethnographic approaches in the field. These techniques enabled me to understand the ways in which individuals and local

communities are immersed in the flow of edamame production and trade. This approach treats research design as an ongoing process and emphasizes discovery rather than verification (Gerring 2001).

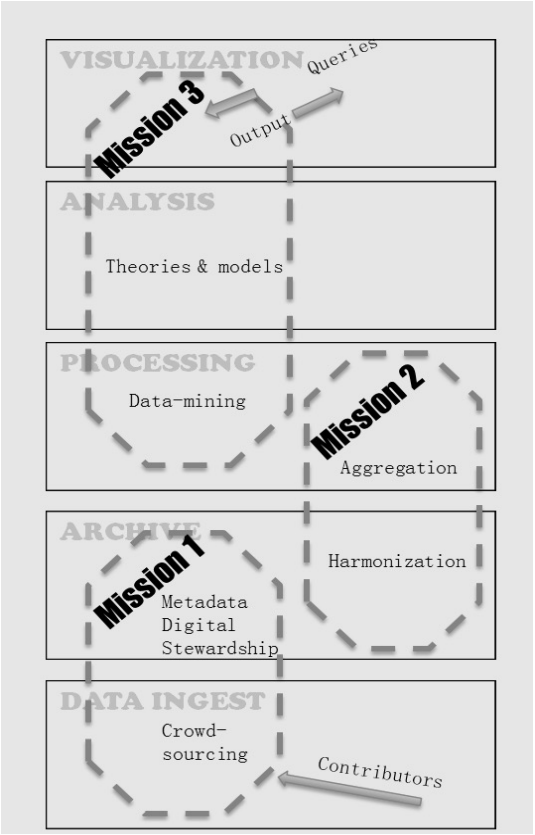

Figure 13. CHIA framework: World-historical data resource, showing functions and activities. Source: Manning (2013, 6).

As part of this project, I conducted centrality analysis of the Asian vegetable trade network from 1986 to 2013 using R software; the objects of analysis were frozen vegetables and fresh vegetables. I divided the timeframe into two periods: 1986–1999 and 2000–2013. My aim was to investigate whether there were changes in the trade networks before and after China and Taiwan joined the WTO around 2000. In centrality analysis, there are three centrality measures of prominence: degree, i.e., the number of

connections a node has to other nodes; closeness, i.e., the length of the paths between actors; and betweenness, i.e., the proportion of intermediary roles an actor plays. These measures rely on the geodesic measure of distance. Closeness, C(*n*i), for example, is the inverse of distance, in that, the shorter the distances between node i and other nodes, the more central node i is. Formally, $C(ni) = [\sum j^{N} d(ni,nj)]^{-1}$, where d(*n*i,*n*j) is the geodesic (shortest path) between entities i and j in the network, and *N* is the network size. Betweenness, B(*n*i), measures the probability that a path from actor j to actor k takes a particular route through agent i, assuming that each one-step tie has equal weight and that interactions will occur through the shortest route. Formally, $B(ni) = \sum j^{N} gjk(ni)/gjk$, where gjk(*n*i) is the total number of geodesics through i and 1/gjk is the probability that a particular geodesic is chosen.

Along with centrality analysis, I also applied the Louvain Method (LM) to detect the modularity of vegetable trade in order to map out the structure of small communities embedded in the trade networks (Blondel et al. 2008). Scholars have recognized that LM outperforms many similar community detection methods in terms of both modularity and time categories (Bichot et al. 2013). For a weighted network, modularity is defined as:

$$Q=\frac{1}{2m}\sum_{ij}[A_{ij}-\frac{kikj}{2m}]\delta(c_i,c_j),$$

where A_{ij} represents the edge weight between nodes i and j; K_i and K_j are the sum of the weights of the edges attached to nodes *i* and *j*, respectively; *m* is the sum of all of the edge weights in the graph; c_i and c_j are the communities of nodes; and δ is a simple delta function. In order to maximize this value efficiently, LM has two phases that are repeated iteratively (Blondel et al. 2008): First, each node in the network is assigned to its own community; then, for each node i, the change in modularity is calculated as i is removed

from its own community and moved into the community of each neighbor *j* of *i*. This value is calculated using:

$$\Delta Q = \sum_{ij} \left[\frac{\sum in + ki,in}{2m} - \left(\frac{\sum tot + ki}{2m}\right)^2 \right] - \left[\frac{\sum in}{2m} - \left(\frac{\sum tot}{2m}\right)^2 - \left(\frac{ki}{2m}\right)^2 \right]$$

where $\sum in$ is the sum of all the weights of the links inside the community that *i* is moving into; $\sum tot$ is the sum of all the weights of the links to nodes in the community; *ki* is the weighted degree of *i*; *ki*,*in* is the sum of the weights of the links between i and other nodes in the community; and m is the sum of the weights of all links in the network. Once this value is calculated for all communities *i* is connected to, *i* is placed into the community that resulted in the greatest increase in modularity. Once this local maximum of modularity has been achieved, the first phase is ended. In the second phase, the algorithm groups all of the nodes in the same community and builds a new network wherein the nodes are the communities from the previous phase. Any links between nodes of the same community are now represented by self-loops on the new community node, and links between multiple nodes in the same community and a node in a different community are represented by weighted edges between communities. Once the new network has been created, the second phase is ended and the first phase can be re-applied to the new network.

As an additional step, I visualized the graph using R software, and finalized and polished the result using Gephi and Adobe Illustrator. The following analysis is based on the visualization of fresh and frozen vegetable trade networks before and after 2000. As I described earlier in this section, the centrality analysis includes three measures to determine the network. I applied the degree measure to calculate which countries had the

most partner countries in the given network (i.e., the greater number of links, the higher degree of centrality).

In my analysis, in-degree refers to export, out-degree refers to import, and all-degree refers to the amount of trade. I applied "betweenness" to identify the countries that often appeared on the shortest trade pathway between two other countries. In other words, high betweenness scores indicate that a country has a central position in mediating the trade flow among countries; it also shows which countries can influence or develop new partner countries. As "closeness" indicates the distance of a country from all other countries, I used this measure to calculate each country's reach within the network. Actors with high closeness scores are well connected in the network.

Asian Frozen Vegetable Trade Networks Before and After 2000

Prior to 2000, the biggest importer of frozen vegetables was Japan, with China and Taiwan as the main exporters. Japanese import quantity was by far the greatest compared to all other countries (1,997,634 tons). Based on the betweenness measure, Singapore and Saudi Arabia were central countries, and the United Arab Emirates was the other major trade hub. Based on the closeness measure, my analysis also identified emerging well-connected countries: the United Arab Emirates, Brunei, India, and Jordan. The most central group was in East and Southeast Asia, comprised of China, Japan, Taiwan, Hong Kong, Singapore, Thailand, Malaysia, Indonesia, Philippines, and Republic of Korea (ROK). Overall, Japan and China occupied the central positions in this network, with the former as the main importer and the latter as the main supplier.

My analysis shows that in 2000–2013, the ROK joined Japan as the biggest importer (ROK: 2,133,826 tons; Japan: 4,000,514 tons), while China remained the biggest

exporter, exporting four times as much (5,624,594 ton) as before 2000. Based on the betweenness measure, Thailand, India, and Pakistan emerged as new hubs. The rise of Thailand as an actor in the vegetable industries reflects the results of edamame studies (Wang 2018) showing that Thailand has become the third largest producer and exporter of edamame beans since 2010. During this period of time, countries in Asia became more connected in terms of the frozen vegetable trade; there were bigger clusters of closely connected countries, and Central Asia became more connected with East Asia.

Fresh Vegetable Trade Networks Before and After 2000

Regarding the fresh vegetable networks in 1983–2000, my analysis shows two significant pairs of trade partners: In one pair, Hong Kong was the top importer (1,451,149 tons) and China was the top exporter (1,562,741 tons); in the other pair, Singapore imported 697,308 tons, while Malaysia exported 646,681 tons. Based on the betweenness measure, Malaysia and Turkey were the key hubs. Overall, China, Hong Kong, and Malaysia played central roles in the Asian fresh vegetable trade in 1983–2000.

In 2000–2013, the scale of fresh vegetable trade increased. My analysis shows that the scale of trade increased among Japan, ROK, Singapore, and Thailand. Malaysia played an important role as the most connected country, as both importer (409,238 tons) and exporter (1,054,286 tons). The United Arab Emirates joined India as the least isolated country. The United Arab Emirates replaced China as the most central trade hub in terms of degree (47), followed by Malaysia (45) and Thailand (43). Malaysia increased its strength as the center of the fresh vegetable trade in terms of betweenness (from 0.45 to 0.49). Although China was the biggest fresh vegetable exporter, the center of the fresh vegetable trade shifted from East Asia to Central and Southeast Asia in 2000–2013.

Summary

To summarize my findings, according to the import and export numbers of the vegetable trade in Asia, China has strengthened its role as the leading regional supplier of vegetables, and Japan has maintained its role as the most important buyer. The ROK has become a significant importer of Chinese frozen vegetables since 2000. However, in terms of betweenness and closeness measures, Thailand and Malaysia in Southeast Asia have grown rapidly to occupy important positions in the vegetable trade networks.

These findings are consistent with De Koninck's (2013) research, which showed that, at the end of the 1990s, all Southeast Asian countries began a program of agricultural intensification, following the implementation of economic reform policies to adopt the WTO free trade regime. These policies were designed to initiate a so-called renewal or Doi Moi—a kind of green revolution benefiting from massive investments in agrarian technologies. As a result, there has been rapid expansion in the agriculture of the region, including rice (the main food crop) and maize. Most fruits and vegetables (the main cash crops) have also expanded for export, proportionately even more than rice.

On a larger scale, the Association of Southeast Asian Nations' (ASEAN) push for regional economic integration has fostered economic liberalization in order to strengthen the competitiveness of the region and promote intra-regional trade in the WTO era. Since 2000, the ASEAN Comprehensive Investment Agreement (ACIA) has established the framework for promoting investment in Southeast Asia, defining minimum standards of protection for cross-border investments. In addition, Southeast Asia's greater integration into the global economy has been accompanied by increasing numbers of preferential

trade and investment agreements with East Asian countries (mainly China, Japan, and ROK, ASEAN Plus Three).

My findings also confirm the trend that, among Southeast Asian countries, Malaysia and Thailand are the two countries that have experienced the most expansion in terms of cash crop plantations, including high-value vegetables (De Koninck 2013). Moreover, my centrality analysis of Asian vegetable trade shows the rise of Malaysia and Thailand in Asian food production and trade networks, highlighting the multiplicity of the new food regime in Asia in the WTO era, as the multi-polarization of the food import complex has led to multiple food production and trade regionalization processes in the region. Furthermore, my analysis indicates that the vegetable trade is not a one-way flow from developing countries to developed countries. Instead, the central positions of Malaysia and Thailand in the Asian vegetable trade networks illustrate that the "ASEAN (Plus Three) flow" of food trade embedded in the WTO free trade regime is a better framework with which to explain the development of food trade networks in Asia. Also, some newly industrial countries such as India, China, and Vietnam, or oil dollar countries such as the United Arab Emirates have imported an enormous volume of vegetables since 2000.

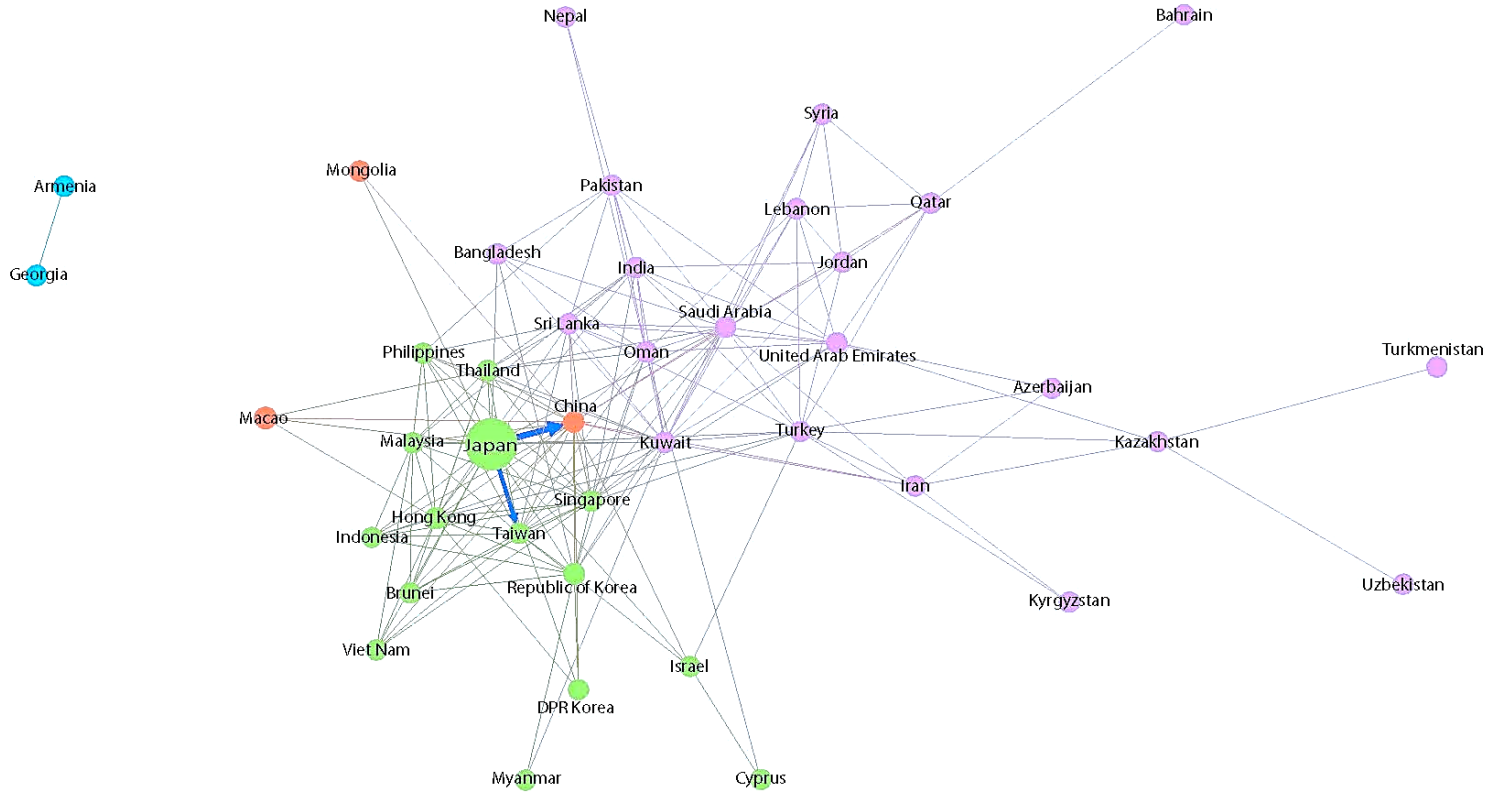

Figure 14. Frozen vegetable trade network in Asia before 2000. The arrows point to the supplier of vegetables.

Table 7. Frozen vegetable trade network analysis before 2000

	Country	In-degree	Out-degree	All degree	Country	Betweenness	Country	Closeness
1	China	19	12	31	Saudi Arabia	0.379	Singapore	0.092
2	Japan	14	16	30	Singapore	0.378	Saudi Arabia	0.09
3	Taiwan	14	10	24	United Arab Emirates	0.253	United Arab Emirates	0.089
4	Hong Kong	11	12	23	Jordan	0.215	Brunei	0.088
5	Kuwait	1	22	23	Oman	0.205	India	0.087
6	Singapore	11	12	23	Brunei	0.197	Jordan	0.086
7	Thailand	14	7	21	Kazakhstan	0.151	Oman	0.084
8	Saudi Arabia	5	15	20	Japan	0.135	Japan	0.084
9	Malaysia	10	9	19	Lebanon	0.135	Republic of Korea	0.084
10	Oman	2	15	17	Republic of Korea	0.132	Sri Lanka	0.083
11	Turkey	13	4	17	Qatar	0.094	Pakistan	0.081
12	Republic of Korea	9	7	16	Turkey	0.087	Thailand	0.08
13	India	10	3	13	Thailand	0.069	Bangladesh	0.08
14	Indonesia	6	7	13	China	0.051	Kazakhstan	0.079
15	Philippines	5	8	13	Kuwait	0.047	Macao	0.078
16	Sri Lanka	3	10	13	Taiwan	0.045	Lebanon	0.076
17	United Arab Emirates	11	0	11	DPR Korea	0.03	Hong Kong	0.076
18	Jordan	5	5	10	Sri Lanka	0.022	DPR Korea	0.074
19	Brunei	2	7	9	Pakistan	0.019	Taiwan	0.073
20	Lebanon	5	4	9	Bangladesh	0.012	Iran	0.073
21	Pakistan	5	3	8	Hong Kong	0.002	Azerbaijan	0.071
22	Iran	7	0	7	Malaysia	0	Kuwait	0.069
23	Qatar	0	7	7	India	0	Uzbekistan	0.069
24	Bangladesh	6	0	6	Indonesia	0	Malaysia	0.067
25	Viet Nam	6	0	6	Philippines	0	China	0.063

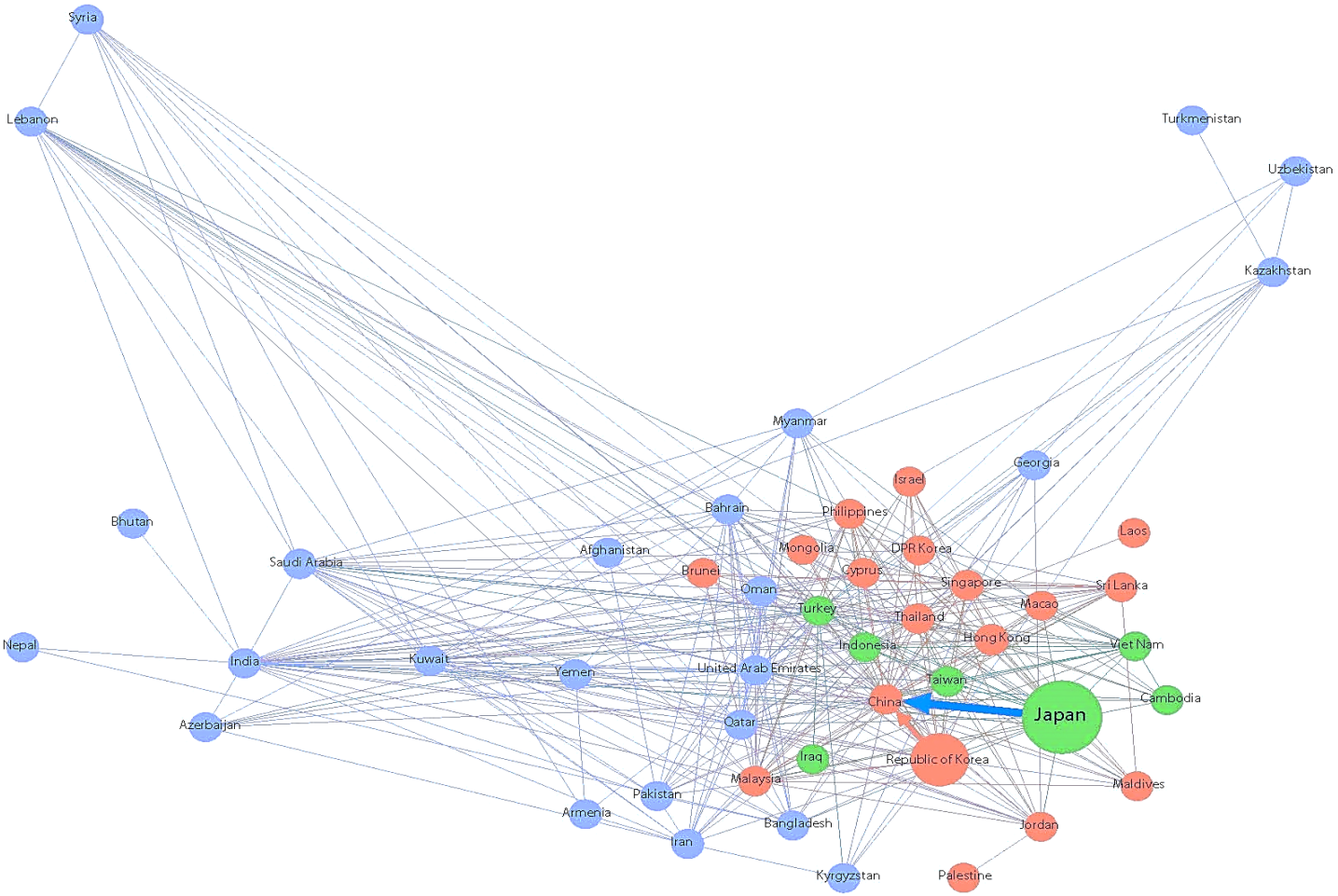

Figure 15. Frozen vegetable trade network in Asia after 2000. The arrow points to the supplier of vegetables.

Table 8. Frozen vegetable trade network analysis after 2000

	Country	In-degree	Out-degree	All degree	Country	Betweenness	Country	Closeness
1	China	34	9	43	Thailand	0.253	Thailand	0.038
2	Thailand	27	15	42	Pakistan	0.227	Pakistan	0.038
3	United Arab Emirates	17	22	39	India	0.201	India	0.038
4	Malaysia	15	21	36	Turkey	0.168	Bahrain	0.038
5	India	27	6	33	Bahrain	0.167	Oman	0.038
6	Republic of Korea	16	15	31	Republic of Korea	0.132	Kuwait	0.038
7	Saudi Arabia	11	20	31	Oman	0.131	Iran	0.038
8	Japan	18	12	30	Kuwait	0.126	Kazakhstan	0.038
9	Singapore	14	16	30	Jordan	0.119	Lebanon	0.038
10	Hong Kong	13	14	27	Iran	0.108	United Arab Emirates	0.038
11	Indonesia	14	12	26	Israel	0.097	Republic of Korea	0.037
12	Turkey	18	8	26	Kazakhstan	0.087	Jordan	0.037
13	Bahrain	1	24	25	Singapore	0.085	Singapore	0.037
14	Kuwait	5	19	24	Syria	0.073	Yemen	0.037
15	Oman	4	20	24	Yemen	0.067	Cambodia	0.037
16	Philippines	11	13	24	Cambodia	0.052	Philippines	0.037
17	Qatar	2	22	24	Philippines	0.049	Saudi Arabia	0.037
18	Taiwan	14	7	21	Saudi Arabia	0.042	Bangladesh	0.037
19	Lebanon	9	12	21	Bangladesh	0.042	Qatar	0.037
20	Pakistan	12	8	20	Azerbaijan	0.042	Malaysia	0.037
21	Jordan	9	10	19	Qatar	0.041	Laos	0.037
22	Iran	14	4	18	Armenia	0.038	Syria	0.036
23	Sri Lanka	8	8	16	Viet Nam	0.035	Hong Kong	0.036
24	Viet Nam	16	0	16	Hong Kong	0.03	Taiwan	0.036
25	Bangladesh	13	1	14	Taiwan	0.029	Cyprus	0.036

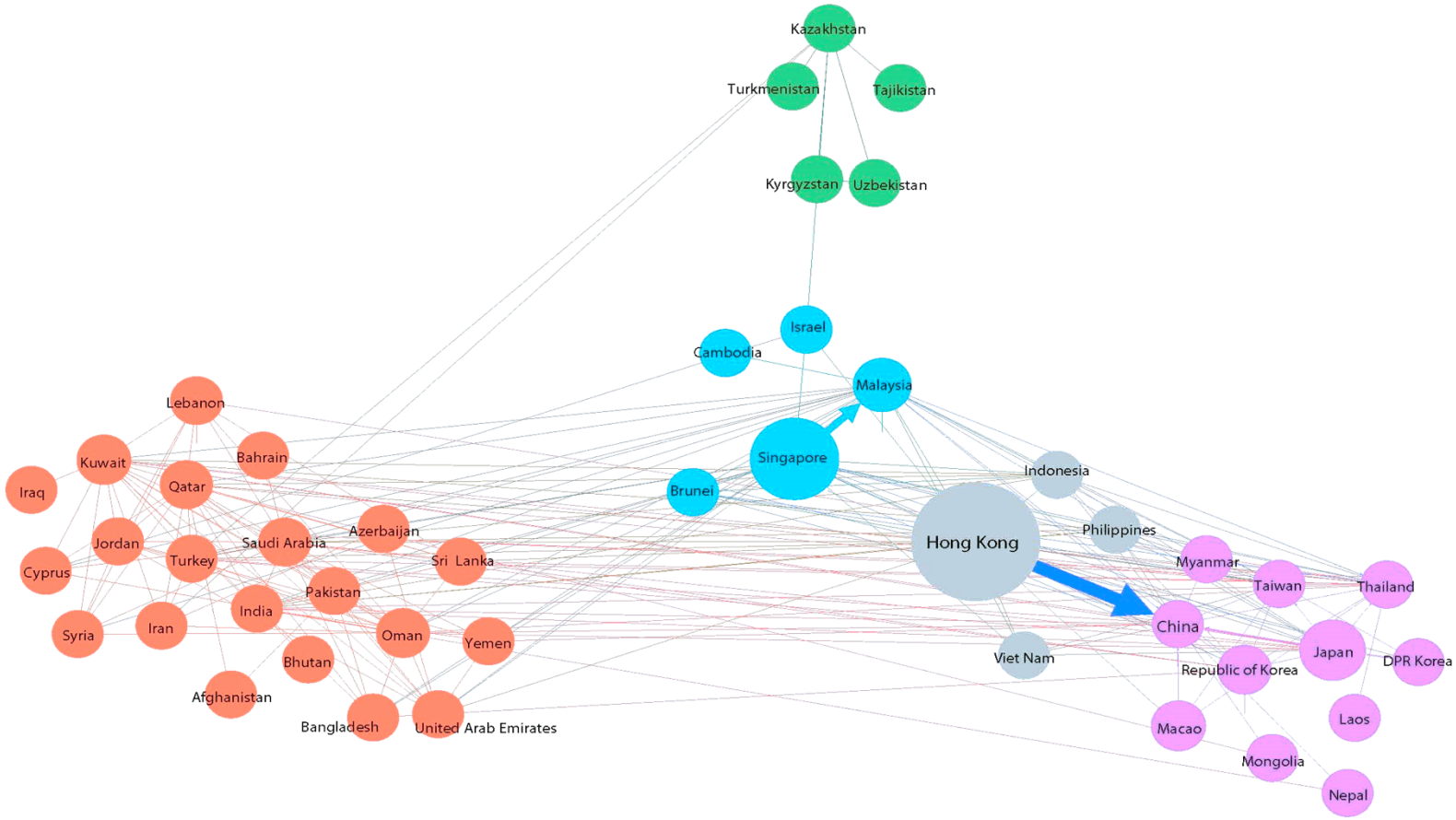

Figure 16. Vegetable trade network in Asia before 2000. The arrow points to the supplier of vegetables.

Table 9. Fresh vegetable trade network analysis before 2000

	Country	In-degree	Out-degree	All degree	Country	Betweenness	Country	Closeness
1	China	16	15	31	Malaysia	0.453	Malaysia	0.07
2	Malaysia	13	18	31	Turkey	0.353	Turkey	0.07
3	Singapore	13	18	31	Japan	0.226	Japan	0.068
4	Hong Kong	13	17	30	Kazakhstan	0.176	Singapore	0.067
5	Saudi Arabia	7	22	29	Cyprus	0.175	Cyprus	0.066
6	Thailand	18	10	28	Saudi Arabia	0.174	Thailand	0.066
7	Japan	13	13	26	Qatar	0.152	Republic of Korea	0.066
8	Taiwan	14	10	24	Israel	0.146	China	0.066
9	Kuwait	2	21	23	Indonesia	0.141	Oman	0.066
10	Oman	3	18	21	Thailand	0.13	Indonesia	0.065
11	India	13	6	19	Hong Kong	0.116	Kuwait	0.065
12	Qatar	0	19	19	Singapore	0.112	Cambodia	0.065
13	Indonesia	10	8	18	United Arab Emirates	0.096	Saudi Arabia	0.064
14	Republic of Korea	11	4	15	India	0.088	India	0.064
15	Philippines	7	7	14	Republic of Korea	0.069	Brunei	0.064
16	Turkey	11	3	14	Azerbaijan	0.064	Qatar	0.063
17	Lebanon	6	5	11	Iran	0.059	Pakistan	0.063
18	Sri Lanka	6	5	11	China	0.044	Sri Lanka	0.063
19	United Arab Emirates	11	0	11	Kuwait	0.044	Hong Kong	0.062
20	Jordan	5	5	10	Kyrgyzstan	0.044	United Arab Emirates	0.062
21	Brunei	1	8	9	Brunei	0.036	Israel	0.061
22	Pakistan	5	4	9	Yemen	0.036	Azerbaijan	0.06
23	Bangladesh	7	1	8	Oman	0.019	Iran	0.059
24	Kazakhstan	1	7	8	Pakistan	0.017	Taiwan	0.059
25	Yemen	2	5	7	Sri Lanka	0.005	DPR Korea	0.059

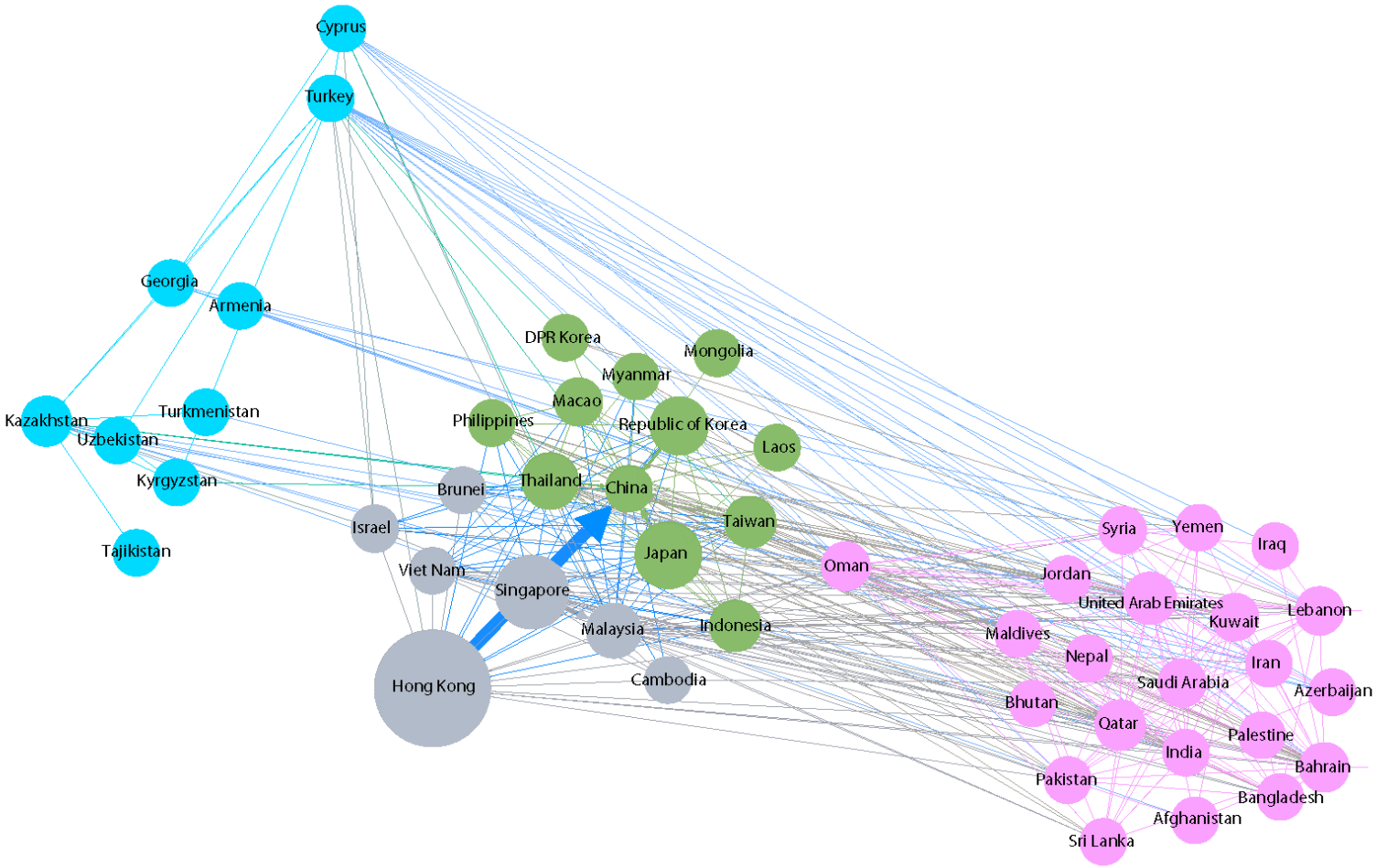

Figure 17. Vegetable trade network in Asia after 2000. The arrow points to the supplier of vegetables.

Table 10. Fresh vegetable trade network analysis after 2000

	Country	In-degree	Out-degree	All degree	Country	Betweenness	Country	Closeness
1	United Arab Emirates	15	32	47	Malaysia	0.49	Malaysia	0.004
2	Malaysia	21	24	45	Lebanon	0.225	Lebanon	0.004
3	Thailand	28	15	43	United Arab Emirates	0.196	United Arab Emirates	0.004
4	China	28	11	39	Pakistan	0.142	Pakistan	0.004
5	Bahrain	5	33	38	Kazakhstan	0.132	Kazakhstan	0.004
6	India	25	13	38	Viet Nam	0.122	Viet Nam	0.004
7	Qatar	4	31	35	Kuwait	0.121	Kuwait	0.004
8	Saudi Arabia	12	23	35	Sri Lanka	0.121	Sri Lanka	0.004
9	Oman	10	24	34	Cyprus	0.115	Cyprus	0.004
10	Hong Kong	17	15	32	Cambodia	0.105	Cambodia	0.004
11	Japan	16	14	30	India	0.101	India	0.004
12	Indonesia	18	11	29	Oman	0.07	Oman	0.004
13	Lebanon	12	17	29	Turkey	0.07	Turkey	0.004
14	Singapore	12	16	28	Qatar	0.062	Qatar	0.004
15	Taiwan	16	10	26	Maldives	0.055	Maldives	0.004
16	Kuwait	6	19	25	Taiwan	0.054	Taiwan	0.004
17	Pakistan	11	13	24	Japan	0.044	Japan	0.004
18	Turkey	16	8	24	Bahrain	0.043	Bahrain	0.004
19	Philippines	11	10	21	China	0.041	China	0.004
20	Republic of Korea	14	7	21	Azerbaijan	0.041	Azerbaijan	0.004
21	Jordan	10	8	18	Thailand	0.04	Thailand	0.004
22	Yemen	8	10	18	Hong Kong	0.037	Hong Kong	0.004
23	Viet Nam	18	0	18	Saudi Arabia	0.035	Saudi Arabia	0.004
24	Kazakhstan	3	14	17	Armenia	0.034	Armenia	0.004
25	Sri Lanka	12	4	16	Singapore	0.026	Singapore	0.004

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