ABSTRACT

SMOLSKI, ANDREW ROBERT. Growing (Un)Sustainable Structures. A Comparative-Historical Analysis of Cuba's Agrarian Social Metabolic Order, 1898-2016. (Under the direction of Dr. Stefano B. Longo).

An important, contemporary focus of environmental sociology is on the necessary conditions to promote a sustainable transition. This debate typically centers institutions within a capitalist world-economy, specifically business, government, and civil society, and their capacity to adapt more environmentally friendly production. In a recent review of the field, Clark et al. (2021) note that this within-capitalism research is often idealist, examining changes in values and planning divorced from material reductions in environmental degradation. A materialist and critical counterargument calls into question the capacity of capitalist social structures to bring about a sustainable transition. Instead, noting that the imperative to accumulate and commodify nature within a capitalist world-economy tends to produce an increasingly environmentally degradative relationship, alternative social structures are proposed as possible necessary conditions for a sustainable transition.

Following this call to interrogate alternatives, the objective of this dissertation is to shift emphasis from change within the capitalist world-economy to a comparison between the capitalist world-economy and anti-systemic social structures in relation to rift potential. I utilize world-system analysis to conceptualize three structural conditions, incorporative, delinked, and exile, along with their characteristics. Incorporative represents the processes underlying reproduction of the capitalist world-economy, while delinked and exile represent processes for producing anti-systemic structures. Additionally, I employ social metabolic analysis to operationalize the link between production and ecology as a social metabolic order interchanging matter and energy leading to an inferred outcome, rift potential. Specifically, I focus on

agricultural production, and the agrarian social metabolic order, as a strategic research site. I argue that a rift-restitutive potential is more likely as anti-systemic structural conditions breakdown incorporative imperatives that evidence tends to show increase the likelihood of rift-making potential.

With this theoretical framework, I conduct a comparative-historical analysis of three periods, 1898-1958, 1959-1991, and 1992-2016, within a single case, Cuba. Each period represents distinct structural conditions, conceptualized as social metabolic pathway, based on trade, (de-)commodification, intra-state administration, inter-state administration, and agrarian structure. Agrarian practice and rift potential are based upon land use change, technology, fertilizer application, and pest management. Secondary data was utilized from varied official sources, like the *Anuario Estadístico de Cuba*. This was supported with secondary historical sources, primarily peer-reviewed articles, and primary sources from an archive.

The results provide evidence for the argument that incorporation into the capitalist world-economy increases the likelihood of rift-making potential within agriculture. However, the inverse was nuanced, in that delinked-incorporation demonstrated a similar rift-making potential, even though the capitalist class had been abolished and means of production were de-commodified by intra-state administration. So, the existence of an anti-systemic structure is not a sufficient condition for rift-restitutive potential, although it can provide important tools unavailable to a fully incorporated structure. In the third period that mixed incorporation, delinked, and exile, there is a trend toward rift-restitutive potential, showing how anti-systemic structures operate complementary to one another and can maintain partial incorporation while reducing environmental degradation in agriculture. Future research should expand the number of cases and periods compared to validate the results.

Growing (Un)Sustainable Structures. A Comparative-Historical Analysis of Cuba's Agrarian Social Metabolic Order, 1898-2016.

by
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DEDICATION

A borrowed epigraph from Paco Ignacio Taibo II's book,

Ernesto Guevara: También Conocido como El Che:

"*Compañeros, tengo un póster de todos ustedes en mi casa.*

Che, (leído al pie de un cartel en Hamburgo, donde Guevara nos sonríe)"

Truly, we are the heroes we have been searching for,

to build multiple betters worlds, together.

For José Luís Pérez Madrigal,

Te extrañamos

BIOGRAPHY

Andrew Robert Smolski was born to a carpenter, James Charles Smolski and a bank teller, Carole Jane Smolski, in a metropolis of highways and humidity. To the surprise of many, at community college he discovered politics. Politics changed a student who barely graduated high school into one graduating Summa Cum Laude from the University of Houston with a Bachelor of Arts in Sociology and Anthropology. Now, he is an environmental sociologist with a specialization in agri-food systems employing critical theories of development. He goes off into the next stage of life wondering where the road less traveled shall take him next. Onward, comrade, to the utopian horizon…

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First, I appreciate the social services and government programs that made this dissertation possible. Without that safety net, I would have had to terminate my studies and find work in a desolate cubicle farm. Instead, a child of the working class got time to think, to learn, to answer questions that the progeny of the shoemaker is often forced to ignore. The social wage won from battles with the capitalist class has a dividend in this dissertation.

Second, I am absolutely indebted to the community of scholars who have supported me. Foremost, I appreciate Stefano for putting up with my starts and stops, the meandering mind of a wanderer. You professionalized me and made me a stronger scholar. For that I am forever grateful. The trip to Cuba set the course, and I have never looked back. Sarah, you got me in the door, and were always open to providing important advice and support. Plus, you gave one of the best seminars during my time at NCSU. Tom, our encounters have been real, a confidence to just speak, and I will always owe you an enViro shirt. Thank you immensely for your cheer and help. Michelle, you built a bridge to another world in agricultural sciences, helped get me connected with CEFS, and have shown me another way of growing food is possible. In connection with those bridges was the Center for Environmental Farming Systems Graduate Fellowship, which provided financial support to dig deep into the theory and data. Ron, thanks for opening up *Latin American Perspectives* to me, exploring new vistas editing, and working across borders. Tied to that is the *Latin American Perspectives* Visiting Fellowship, which opened up UC-Riverside's archives and a profound understanding of the Cuban Revolution from primary documents. And, to Michael, our chats over coffee about sociology and rural development have grounded me in a long academic history on the struggle for another agriculture.

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Overview

In the 21st Century, agricultural production has an increasingly negative environmental impact, from land-system change to disruption of biogeochemical flows and loss of biosphere integrity (SRC 2015). The exacerbation of these harmful conditions tends toward a crisis, whereby there is a likelihood of increasing conflict over resources, increasing drought and pests, and decreasing yields leading to higher food prices (IPCC 2014). The Food and Agriculture Organization of the United Nations (FAO; 2017) argues for sustainable agriculture as an adaptation and mitigation strategy to address these challenges.

While organizations like the Intergovernmental Panel on Climate Change (IPCC) and FAO demonstrate a clear understanding of the agroecosystem crisis and necessity of sustainable agriculture, they often omit the likely political-economic roots of that crisis and the structural obstacles to sustainable agriculture this presents. Social metabolic analysis demonstrates that incorporation into the capitalist world-economy tends to condition the social-ecological relation, or social metabolic order, through a re-organization of social structures for the primary purpose of capital accumulation leading to ecologically harmful agrarian practices (Foster 1999a). These practices tend to degrade ecology, making agriculture more dependent on external, capital-intensive, and synthetic inputs (Foster 1999b).

Building from that premise, this dissertation intervenes in the current debate on the social structural conditions for sustainable transitions (see Antonio and Clark 2015 and Clark et al. 2021 for reviews of competing frameworks within the debate). That debate asks whether there is

a capacity for capitalism to go green, or if a more radical structural reorganization is necessary to bring about sustainable production. In that more radical vein, questions arise about the current agrarian structure, and if polices like redistribution of land to increase the number of smallholder farms and de-commodification may be more capable of bringing about the accepted goal of transitioning to a sustainable agrarian social metabolic order. From the perspective of world-system analysis, those types of alterations represent anti-systemic structures, or alternatively, anarchist, communist, or socialist social structures.

In this dissertation I ask: are anti-systemic structures a necessary condition for sustainable agriculture? If so, what type of anti-systemic structure is capable of conditioning a sustainable agrarian social metabolic order? At the most abstract level, I argue that social-ecological relationships based on anti-systemic structures are more likely to involve niche-specific, restitutive relationships between community and ecology. I suggest that the more there is substantive embedding of relations in autonomous control and production for cooperative and social ends the more likely is a sustainable relationship with ecology. From there, an agroecosystem will be less dependent on external, synthetic, and capital-intensive energy and matter flowing through the exosomatic system. That is, anti-systemic structures could help create conditions that fundamentally alter the current social metabolic order from rift-making to rift-restituting.

Following world-system analysis, I interrogate this claim by historicizing the development of the contemporary agrarian social metabolic order in relation to the capitalist world-economy. Even more, I theorize types of anti-systemic social structures capable of addressing the crisis and comparing the ecological outcomes of these distinct types. I accomplish this task through a comparative-historical analysis of Cuba across three periods from 1898 to

2016, representing differing mixtures of incorporation (within-capitalist world-economy structure), delinking (state-led, in-between, anti-systemic structure), and exile (outside, non-state, anti-systemic structure). In the latter two cases, anti-systemic structures are not created equal in terms of ecological impacts, with differential environmental outcomes based on their relationship with the overall capitalist world-economy and internal dynamics. Therefore, a key purpose for this study is to compare the agrarian social metabolic orders for these two types of anti-systemic structures, delinking and exile, representing distinct strategies for interacting with capital.

Additions to the Literature

Through this dissertation, I add to the literature in three forms. The first is participating in debates on the ecological outcomes of state socialism. Engel-Di Mauro (2021) argues that much of the literature focusing on state socialism and the environment commits an absolutist error concerning state control of economic development. There is an assumption, often explicit, that the state operates without having to account for non-state forces (i.e., a totalitarian state). Scholars, like McIntyre and Thornton (1978) or Díaz-Briquets and Pérez-López (2000), treat state socialism as an all-encompassing system able to act without regard for the dynamics of the capitalist world-economy or the ecological impacts of prior (neo-)colonial development.

I challenge this error by showing in all three periods how Cuba must account for incorporation into the capitalist world-economy because of exports and imports. Even at the height of state control and the United States blockade, the Communist Party of Cuba is aware of and strategizes for relationships with capitalist countries. And policies to economically develop quickly are related to these challenges, even if they come with environmental costs. So, there has never been a socialist state that operates absolutely outside of the capitalist world-economy, even

if it represents the existence of anti-systemic structures. Increasing the production of sugar based on amplifying fertilizer and herbicide applications, more tractors and irrigation, and extensive land use, are agrarian practices with rift-making potential that should be understood relative to that reality.

Furthermore, this ignores the existence of other forms of non-state production, like cooperatives and small farmers, which continued to push for their interests, such as access to land and control over their surplus. In the case of Cuban agriculture, rather than forced collectivization, the Cuban government sought to maintain small farmer support by protecting land tenure, abolishing capitalist ownership of latifundias, and incentivizing cooperativization. The peasantry and rural proletariat formed an important base for the revolution and benefitted from delinked and exilic (about which more below) strategies to increase administration by the direct producers and transition to sustainable agriculture. Thus, there is an important mixture of structural conditions internal to a state that should be accounted for to better approximate the relationship of state socialism to the environment.

Tied to this is the second addition, historicizing the case of Cuba. Much of the literature on Cuba's sustainable agriculture transition beginning in the 1990s provides minimal examination of the 1959-1991 period. Often, this is only to state that it was problematic for following a Green Revolution, while leaving unexamined what structural conditions could motivate the implementation of those agrarian practices (see Machí Sosa et al. 2011). For instance, under conditions imposed by the United States blockades and the terms of agreement with the Soviet Union, Cuba found sugar exports supportive of development and social welfare goals. Similar historical de-contextualization is done in terms of the 1898-1959 period, whereby what agrarian practices were implemented are not examined vis-à-vis their structural conditions

nor ecological outcomes (see Alvarez 2004). As Engels-Di Mauro (2021) states, this is to erase ecological impacts and purposeful underdevelopment that would structure later development decisions.

From the perspective of world-system analysis, longer historical analysis provides a grounding in the unfolding of structural processes that occur over large stretches of time (Wallerstein 1995). Rather than believing anything is possible at any given moment, it posits that prior material conditions promote or prohibit certain trajectories. Social metabolic analysis similarly notes that past ecological conditions impact future possibilities for economic development (Clark and York 2008). Soil cannot be regenerated overnight. Because I marshal data from across periods and compare, I am able to overcome these historical gaps and provide context concerning the link between structural conditions, agrarian practice, and ecological outcomes missing in prior studies on Cuba's sustainable agriculture.

This omission is seen more generally in the scholarship on transitions to agroecology, which have largely eschewed comparative-historical analysis. Often, how to make an agroecological transitions asks, "what can farmers do?", with results based on localized case studies. For instance, van der Ploeg (2021) examines how modes of production can structure whether agroecological agrarian practices are implemented, but utilizes local case evidence to demonstrate his argument and only expands abstractly to a national level. Instead, I move the focus to a more macro-perspective by examining the national level in relation to the global, thereby showing how farmer opportunities are structured by forces external to the farm.

Other studies that focus on the national level, such as on the institutionalization of food sovereignty, do so without a corollary analysis of ecological impacts (Peña 2015). This is part of an ongoing human exemptionalism in the social sciences that often ignores the environmental

benefits and harms that can be caused by changes to policy and production (Dunlap and Catton 1994). By connecting agrarian practices to the agricultural sciences literature on ecological impacts, I aim to address this gap in macro-level social studies of agriculture.

Summary of the Chapters

The dissertation has the following structure: Chapter 2 details the theoretical framework for this study, a synthesis of two Marxist approaches, World-System Analysis and Social Metabolic Analysis, to provide a set of mechanisms for why a social metabolic order incorporated into the capitalist world-economy is potentially rift-making and the possibilities for anti-systemic structures to bring about a social metabolic order conducive to rift-restitution. In Chapter 3, I describe the comparative-historical methodology employed in this study. Additionally, I describe the data and periodization I rely on for my analysis of Cuba, carved into three distinct cases. Chapters 4 through 6, are each an exploration of a specific period to analyze the historical development of Cuba's agrarian social metabolic order. First, I analyze the case of Cuba from 1898 to 1958, and the ecological impacts of sugar's expansion through incorporation into the capitalist world-economy through the US. Then, I examine the case of Cuba from 1959 to 1989, and the ecological impacts of sugar's industrialization through delinked incorporation based on a relationship with the Soviet Union. Last, I investigate the case of Cuba from 1990 to 2016, and the ecological impacts of delinked exile brought on by the collapse of the Soviet sub-system. In Chapter 7, I conclude with a comparison of the cases and discuss the analytical importance of this inquiry.

CHAPTER 2: THE CAPITALIST WORLD-ECONOMY, ANTI-SYSTEMIC STRUCTURES, AND THE AGRARIAN SOCIAL METABOLIC ORDER

Introduction

In this chapter, I present a structural theory of sustainability and the agrarian social metabolic order. The main premise is that the contemporary social metabolic order is constituted by competing world-system structures, the capitalist world-economy and anti-systemic structures. These structures are produced through three processual conditions, incorporation, delinking, and exile (see Table 2.1 for characteristics).

Table 2.1. Characteristics of Structural Conditions.

Structural Condition	Incorporation	Delinked	Exile
Political-Economic Characteristics	• Commodified social relations with the capitalist class and core countries controlling the production process • (Inter)state administration of class relations, market exchange, and trade with the goal of capital accumulation	• Mixture of commodified and decommodified social relations with a strengthened sovereign state that reduces or abolishes capitalist class and core control of the production process • (Inter)state administration of class relations, market exchange, and trade with the goal of national development	• Decommodified social relations based on mutual aid and substantive reproduction • Egalitarian, direct democracy controls the production process, market exchange, and trade

Based on the presence or absence of these processual conditions, I argue for three theoretical claims. The first claim is that the capitalist world-economy manifests through incorporation. Incorporation is a process through which a state's social relations are reorganized by capitalists for commodification in the pursuit of accumulation. This assumption suggests that this is a necessary condition for a rift-making social metabolic order. The second claim is that delinking is a both-and (i.e., at the interstices of incorporation and exile) state-led process of reorganizing the social structure in anti-systemic directions. This involves reduction or abolition of capitalist class power, control over commodification and decommodification, increasing national sovereignty over development, and an expanded role for the state internally, in terms of deciding upon production and ownership, and externally, through administering trade. There are two important sub-claims for delinking: when state emphasis is more on controlling incorporation it is more likely to reproduce a rift-making social metabolic order, and when state emphasis is on supporting exilic formations, it is more likely to support a rift-restituting social metabolic order. The third claim is that exile (a concept I elaborate on further below) as the process of organizing a non-capitalist, non-state social structure based on egalitarian direct democracy, mutual aid, and substantive exchange, is a necessary condition for a rift-restituting social metabolic order. Taken together, these three claims form the theoretical argument of this dissertation.

To substantiate these claims, I begin this chapter by elaborating a world-system explanation of the differential global development of capitalist social relations as more of the world was incorporated into the capitalist world-economy. Afterwards, I describe two types of anti-systemic structure, delinking and exile, in constructing non-capitalist social relations that challenge the capitalist world-economy. Variety is important to a sociological understanding of

social change, because different forms of anti-systemic structure can dialectically resolve with incorporation in ways that maintain ecologically damaging social relations. Therefore, I describe delinking and exile as types of anti-systemic structures, even if they are not absolutely, mutually exclusive. From there, I bring in the general arguments of social metabolic analysis concerning capitalism and the production of metabolic rifts. Then, I apply this general understanding to the world-history of capitalist agriculture and its impacts, as well as to understanding exile as a structural necessary condition for agroecology, especially in terms of agrarian structure and practice. I end with a synthesis of these parts that outlines the theory to be interrogated by my case study.

World-System Analysis

Incorporation

World-system analysis conceptualizes a world-system, an abstract unit denoting an entity more expansive than a locality, region, or nation, conjoining sub-systems together into a larger set of social relations (Wallerstein 1974; Chase-Dunn and Hall 1997). The larger world-system's specific mode of production operates as an axis bringing each sub-system into the fold. Thus, a specific sub-system does not need to share all of the characteristics of the larger world-system's mode of production (Wallerstein 2004). A multitude of world-systems have existed throughout history, and the capitalist world-economy is one type of world-system. In the case of a capitalist world-economy, Wallerstein (1974, 1979) describes incorporation as a world-historical process of geographic expansion commodifying social relations and increasing (inter)state administration.

Commodification is a process through which the dominant mode of valuation becomes exchange-value, when production occurs for sale in a market (Longo, Clausen and Clark 2015; Marx 1976). Once things are commodities, they are alienated from their other values, such as metabolic (i.e., their value to an ecological system) or use (i.e., their value in satisfying a need or function), able to be exploited in the pursuit of a singular goal, capital accumulation (Marx 1976). Worldwide, labor and natural resources became exploitable things (Clausen and Longo 2012a). This is because workers who sell labor-power are dependent upon capitalists who purchase labor-power *and* sell commodities, the worker's exploitation (i.e., not receiving the full value of their contribution to production) a condition of their very survival.

Exploitation confers enormous power on the capitalist class, who is capable of concentrating economic resources and thereby becoming the primary decision-maker concerning what society will or will not produce, distribute, and consume. Capitalists then make decisions concerning production processes based on the imperatives to accumulate within a system of competition. This influences the development of technology that can enable the production of more units for less cost over time, thereby increasing the amount of material flowing through the system (Marx 1976; Schnaiberg 1980). It also means developing technologies that can more efficiently manage labor through standardization and reduce class conflict to the benefit of capitalists (Braverman 1998). *In toto*, technology is largely instrumentalized and put to use by the capitalist class to reduce the cost of production and increase their capacity to exploit, thereby increasing their capacity to accumulate.

As the capitalist world-economy incorporates more of the globe, each sub-system (i.e., regional blocs or groups of nations with direct ties) of the capitalist world-economy can have a differential level of capitalist development, meaning commodified relations of production and

(inter)state administration (i.e., the rules and regulations for labor relations, market exchange, trade, and sovereignty). When incorporated into the capitalist world-economy, each nation is structurally determined to participate in the cycles of capital accumulation based upon their position relative to the overall system. That is, they are either a core, semi-periphery, or periphery country dependent upon their position in a hierarchy of production processes with the majority of surplus value flowing to core countries from periphery countries (Wallerstein 2004). Therefore, when periphery countries liberated themselves from colonial subjugation through the construction of sovereign states, such as many Latin American countries in the 1800s or African countries in the 1900s' post-colonial period, they did not escape from the world-system and its imperatives (Grosfoguel 1996; Boswell and Chase-Dunn 2000). They still competed based upon capital accumulation, still were linked to the Global North through relations of debt, and still were surplus-value extraction points for the core.

This is because the state plays a key role in the incorporation process. In part, this is because the state requires revenues to sustain and expand itself overtime, making it a participant with the capitalist class in a growth coalition (Schnaiberg 1980). Even more, state administrators can share ideological affinities with the capitalist class, and thus are selected into positions of power because they will participate in commodification (Poulantzas 1978; Allen, Longo, and Shriver 2018). As such, the capitalist state is more likely to adopt commodification, with politicians working in conjunction with the capitalist class to privatize property relations by changing laws to make things (more) saleable in the market (Marx and Engels 1978). Therefore, through the state's role in dictating ownership and what is commodified, it has the capacity to alter who is and what is market dependent. The state sets formal rules in modern, hierarchal societies that rationalize market exchange, labor conditions, extent of monopoly, and regulate the

production process to instrumentally administrate the accumulation of capital (Portes 2010; Howard 2016).

The interaction between commodification and (inter)state administration is then the basis of the capitalist world-economy's structure, and it is the process of incorporation which brings it into being. However, incorporation does not occur in a vacuum. It faces resistance, which comes in varied form. I now turn to an elaboration of anti-system structures.

Anti-Systemic Structures: Delinking and Exile

Anti-systemic structure, as defined in the world-system tradition (which is not the only tradition conceptualizing non-capitalist social structures), is the ongoing activity to transform the capitalist world-economy in socialist, communist, and anarchist directions when proposed and implemented by social movements and nation-states (Arrighi, Hopkins, and Wallerstein 1989; Wallerstein 2004). This can entail strengthening labor and environmental regulations, redistributing the surplus more equitably, regulating commodification (even, decommodification), and breaking free from dependency through the construction of sovereignty. Anti-systemic structures can entail leveraging the existing nation-state system and inter-state administration to bring capitalist processes under the control of non-capitalist classes, such as state bureaucrats, the proletariat, or the peasantry. This is part of what is encompassed by the concept, delinking, a within strategy for altering the structural conditions by leveraging state power to counter capitalist control over the economy and the extent of commodification.

In a more radical form, anti-systemic structure involves a flattening of the class structure and de-commodification through the establishment of communist social relations based on egalitarian, direct democracy. This means the end of incorporation through exile (and, in part,

delinking), an outside strategy for a revolutionary restructuring of the world-system based on worker and peasant control of production, abolition of the capitalist class, and the production of community-based political institutions. Because of this variation, anti-systemic structure is best understood as an umbrella concept encompassing structural changes within and outside the capitalist world-economy. That means that what relation with the capitalist world-economy an anti-systemic structure produces is contextual to the case, as is its impact. I start with a discussion of delinking.

\ Amin (1990: 62) put forward the concept of delinking as part of the debates around development that occurred during the 20th Century, whereby there is a "refusal to subject the national development strategy to the imperatives of 'worldwide expansion'." The dominant policies for development locked periphery and semi-periphery countries into a dependent position vis-à-vis the core as points in the commodity chain for extracting surplus value. To break this damaging dynamic, Amin (1990) argued for peripheral and semi-peripheral states to bring the law of value under popular control and develop regional associations based on sovereign development (Rosero and Erten 2010). In its most radical form, the argument was for autocentric development "starting from abolition of the dominant forms of private ownership of land factories, and taking agriculture as its base, that is, not envisaging any forced appropriation from the peasants to 'hasten industrialization' and opting for the most egalitarian possible income distribution (notably between rural earnings and workers' pay)." (Amir 1990: 63).

The quintessential example of delinked states are the 20th Century's socialist states, generally understood as anti-systemic structures (Arrighi, Hopkins and Wallerstein 1989). These movements, at times, resisted imperialist aggression from the Global North (the US, France, Britain, etc.), established sovereignty and national identities and altered the role of the state vis-

à-vis industrial and agriculture policy and the working classes, proletarian and peasant. These are all characteristics of delinking as proposed by Amin. Yet, even while these movements decommodified social relations, reduced exploitation, and reclaimed sovereignty, they often did so by reinforcing the capitalist world-economy. This is especially true of their tendency toward (inter)state administration to manage incorporation, such as the Soviet model's tendency toward bureaucratic control over production. In that, delinking co-occurs with incorporation.

Because of this, and following Chase-Dunn (1980), I argue that socialist states *qua* delinked states were within the capitalist world-economy, with many of them being a part of a Soviet-led subsystem. I do not intend to fully re-create here Wallerstein's (1981) argument that these states are simply capitalist, which requires abandoning important nuance (Goldfrank 1982). Surely, the socialist states maintained certain capitalist social relations because internally the surplus is still being appropriated via an organization that is not made up of the primary producers (i.e., workers), regardless if that appropriation is carried out by a corporation or a state (Resnick and Wolff 2002). Further, socialist states externally operated through capitalist markets, commodifying the goods they produced to bring in foreign exchange to purchase imports for economic development. However, these socialist states represented more radical variation for how a state can administrate itself within a capitalist world-economy, just like the distinction between the Welfare State and the Neoliberal State. Following Maher (2017) and Maher and Aquano (2018), variation exists within capitalism dependent upon how the state institutionalizes markets and (de)commodifies things relative to the current balance of class forces within each polity and between polities (Poulantzas 1978).

Thus, as argued by Bowswell and Chase-Dunn (2000), China, Cuba, and the USSR, amongst the other socialist states of the 20th Century, were not in fact participating in a socialist world-economy. They can be construed as developing an alternative polity, with institutions like the Council for Mutual Economic Assistance (COMECON) providing financing and administrating trade relations between countries in the "Second World." By doing so, they may better their competitive position vis-à-vis core coalitions, such as that centered around the International Monetary Fund (IMF), World Bank (WB) and the Washington Consensus. They can even employ non-commodified forms of trade, such as aid and barter, as a way to maintain satellites with less power. None of this means that they formed an alternative world-system, a social structure capable of regulating the set independently of the capitalist world-economy.

This is because the law of value operated at the (inter)national level for all states, even if highly regulated, with planning focused on a capitalist consideration of economic development as growth (Tsetung 1977a; Tsetung 1977b; Stalin 2005; Guevera 2006a, 2006b), on the continued exploitation of labor to extract surplus value to fuel development (Boswell and Chase-Dunn 2000; Resnick and Wolff 2002), and continuing trade with countries, like the Federal Republic of Germany (i.e, West Germany) and Canada that made up the core. The latter point is especially important, because there was a need to bring in foreign currency, especially dollars, to be able to purchase imports. Even more, these countries were greatly impacted by fluctuations in global market prices of raw materials, both due to impact on export profits and on the capacity for internal production. All of this involves developing techniques for administering the national economy and international relations, which occurred within the ideological coordinates of a statist transition to communism, often mimicking capitalist corporations, a comparison often explicitly stated by party members and state bureaucrats. Whichever party is in power then gets

caught in the same imperatives of the growth coalition, just as occurred with Social Democracy in countries like Sweden, typically held up as exemplars (Boswell and Chase-Dunn 2000).

This should not be taken as a value judgment about their respective projects for national development, sovereignty, and contesting American core hegemony. Many of the 20th Century socialist states are countries brought into their semi-peripheral position through their state-led development. Russia is considered to be a peripheral country until the post-Russian Revolution development drive. China had been coerced into a peripheral position by the colonial atrocities committed during events like the Opium Wars. Post-communist revolution (from 1949 onward), China quickly moved into a semi-peripheral position, and is now a contender for hegemon in the world-system. Even more, the rise of socialist movements and socialist states was part of the reason that the working class globally made advances, such as social security, regulation of labor conditions, and important legislation to protect the right to organize. And it is possible that a delinked, anti-systemic structure offers autonomy and support for even more radical vistas outside of the capitalist world-economy. In that sense, delinking is a transitory state, a both-and, within and outside. However, that motivates the question, what other forms of anti-systemic structures exist that do not pair with incorporation?

Because of how delinking can pair with incorporation, I interrogate anti-systemic structures through an anarchist lens following the work of Grubačić and O'Hearn (2016) on exile as a space outside of the capitalist world-economy. Other formulations of revolutionary, or transformative, anti-systemic structures have looked at non-state spaces as playing a key role in resisting state appropriation and constructing egalitarian, direct democracy. For example, Scott (2009) points to the use of geography, like steppes, to produce friction between state administration and autonomy. Clastres (1987) discusses various "primitive" societies throughout

Central and South America to elaborate on anti-statist practices, such as lacking the institution of chief or having a chief who must constantly give and broker rather than take and compete. Aguirre Beltrán (1967) points to these "regions of refuge" as indigenous territories where a socio-cultural economy continues to operate in contradistinction to modernity's transactional economy. During the 1700s and 1800s, the Maroons of the Great Dismal Swamp in North Carolina and Virginia utilized non-state spaces to resist slavery, proletarianization, and to band together in solidarity (Shirley and Stafford 2015). In each instance, the purpose of ritual and everyday practices is state-breaking and to create a distance, social and geographical, between encroaching administration and their autonomous reproduction of everyday life.

However, Grubačić and O'Hearn (2016) note that these formulations of non-state spaces omit the role of capital accumulation and call for an anarcho-Marxist synthesis to analyze escape from economic exploitation and political domination (O'Hearn and Grubačić 2016). In the case of Scott (2009), he totalizes the extent of (inter)state administration's current reach, making absent existing political and economic projects outside the bounds of the state. Rather than totalizing, Braudel (1979) saw that capitalist social relations relied on the continuing reproduction of material life beyond formal exchange. As such, there is always an outside, a place of exile from which people build anti-systemic structures, where non-capitalist exchange occurs and cooperative relations flourish.

Grubačić (2014) and Grubačić and O'Hearn's (2016) theory of exile is key to understanding this anti-state *and* anti-capitalist, anti-systemic structure. Exile is a strategy for territories to de-commodify, deform states and reclaim autonomy, constructing an alternative to the capitalist world-system's commodification through territorial exit (O'Hearn 2005; O'Hearn 2009; Grubačić 2014; Grubačić and O'Hearn 2016; O'Hearn and Grubačić 2016). Territorial exit

involves autonomous control over a geographic area outside structural imperatives to accumulate, with control over material means of production (Scott 1990; Scott 2009). A further set of characteristics are necessary for exile. The production of exile is based on material and ideological capacity as defined by four characteristics: substantive exchange (social forms of exchange plus ownership over means of production [Federici 2012; Polanyi 1944]), mutual aid (reciprocal, altruistic community-based action; [Kropotkin 2012]), direct democracy (participation of all affected in decision-making process), and egalitarianism (equal power in what decisions get made and how they are executed; [Grubačić and O'Hearn 2016]).

Grubačić and O'Hearn (2016) apply their theory through case studies. They place each case in relation to the ebbs and flows of the capitalist world-economy, with exile being on a continuum altering overtime. This means that there are likely periods and mixtures of incorporation, delinking, and exile, rather than any territory or structure having a strict essence or being absolute either-or. Further, it also means thinking of the dialectic of incorporation and exile occurring from more micro-scales to the largest scale of the capitalist world-economy as a unitary system.

For example, at the (inter)national scales, the beginning of the Russian state formation process co-occurred with the construction of a central bureaucracy, standing army, an alliance with capitalists in Western Europe, and peasant enserfment, tying people to the land and restricting movement (Grubačić and O'Hearn 2016). It was enserfment, to increase agricultural production for the burgeoning capitalist world-economy, especially the embryonic European core countries, which Grubačić and O'Hearn (2016: 54) argue caused the "increasing number of peasants [who] were fleeing to the Cossack territory on the Don", thereby motivating construction of exilic structures. What people were fleeing was the formalization of the

economy, where everything is given a capitalist value for Western Europe's expanding world-economy, and the labor process becomes regimented to increase the rate of accumulation.

In the Don, the subjects in exile developed the krug, a direct democracy institution, a pluri-ethnic and egalitarian system, and were able to reproduce material life through substantive exchanges (i.e., de-commodified) and mutual aid (i.e., based on generalized reciprocity). The krug was a local assembly, and through these decentralized assemblies' politics was carried out (Grubačić and O'Hearn 2016). The raiding economy would loot other territories nearby and then divide up the spoils equally amongst the members, along with treating a Muscovy subsidy as a commons to be shared amongst the people of the Don (Grubačić and O'Hearn 2016). Thus, this became a space outside of the capitalist world-economy, resisting incorporation by the Muscovy power (although, with a certain amount of interaction) and the internal development of a centralized state.

Social Metabolic Analysis

Social metabolic analysis is a theory of social-ecological interaction developed initially by Marx (1976). It has been elaborated on recently by Foster (1999b), and Mészáros (1995), as well as scholars like Fischer-Kowalski (1998) in industrial ecology and urban geographers exploring socio-natural flows in the city (Wachsmuth 2016). Environmental sociologists drawing on this framework emphasize that the social structure interacts with physical, biological, and chemical processes. To analyze the socio-ecological interaction, these scholars study the metabolic regulatory processes occurring ecologically (i.e., ecological cycles), and how social structures interact and alter those processes (Burkett 2014; Clark and York 2008; Foster 1999b).

For Marx (1976), analytical focus was on the transfer of energy and matter through the social system and how this impacted the long-term sustainability of a given mode of production (Foster 1999a, 1999b). Social metabolic scholars begin from the premise that a biological thing must strive to maintain well-being, and that this thing must reproduce itself through consuming energy (Marx and Engels (1978). Additionally, a biological entity is capable of reproducing itself endosomatically (i.e., at the level of individual nutrition) or exosomatically (i.e., through the synthetic use of materials and production of culture) (González de Molina and Toledo 2014). Humans as a species have an incredible exosomatic capacity, transforming entire ecological niches to increase the flow of energy and material through their social systems. Different exosomatic social systems have varied capacity to increase or decrease the flows of energy and matter through them (Fischer-Kowalski 1998; Fischer-Kowalski and Hüttler 1999).

In the case of the capitalist world-economy as an exosomatic social system, structural imperatives push actors to commodify ecology, and thus generate profit from ecosystem services and raw materials (Burkett 1999; Dempsey and Robertson 2012). This social drive toward commodification—a relatively recent development in human history—produces concrete socio-ecological relations, or social metabolism. As a result, social actors with economic means predominantly decide what and how ecology is commodified, how and who produces commodities, what is produced, where the waste byproducts of production go, how the labor process is carried out and all decisions concerning production, distribution and consumption, whether directly (e.g., formal rules, oligopoly) or indirectly (e.g., setting social norms).

Contemporary social metabolic scholars argue the capitalist world-economy based on increasing commodification tends to be unsustainable, a “tragedy of the commodity” (Clausen and Longo 2012b; Longo, Clausen, and Clark 2015). Longo, Clausen and Clark (2015) argue

that private ownership, market competition and an imperative to continuously grow, characteristics of generalized commodity production, are not likely to lead to sustainable management of resources, and in fact, often increase environmental degradation. When ecology is predominantly considered as exploitable for profit, economic cycles can overtake ecological cycles, leading to ruptures whereby ecological cycles no longer regenerate (Foster 1999b; Clark and York 2008). For example, instead of paying for ecological costs by aiding cycle restitution, such as assuring nutrients withdrawn through production are re-inserted into the soil cycle, ecological costs are externalized and shifted spatially or temporally so that capital accumulation can continue (Burkett 1999; Clark and York 2008). This is a key argument of social metabolic analysis; a social system can operate within the boundaries of ecological systems or produces rifts in them (Burkett 2014; Foster and Clark 2016). By producing rifts, the capitalist world-economy can undermine ecological processes and break ecological cycles that not only sustain other forms of life, but also the human social system itself, producing crises (O'Connor 1998).

Social metabolism studies have pointed toward metabolic rifts in various situations. For instance, Longo (2012) and Clausen and Longo (2012b) have shown capitalist world-economy rift-making in marine systems. As salmon and bluefin tuna are increasingly commodified, they tend to be overfished, leading to plummeting populations and incapacity for reproduction at the population level. The reduction in populations disrupts ecosystems, particularly when those degraded are keystone species, thus impacting the ecological web generally. This is because market decisions externalize environmental costs, seeking cost reductions by expropriating freely of nature, or as freely as is possible under (inter)state administration (Burkett 1999; Foster and Clark 2018). Rather than long-term ecological sustainability, the goal is to sell commodities

while demand and prices are high and ignores maintaining the fish stock (Longo 2011; Clark 2017).

Further, (inter)state administration supports this rift-making, even while it does play an important role in regulating social metabolism in the capitalist world-economy. For example, the United States government, across various branches, regulates air pollution while arguing that the environmental health hazards from air pollution have to be weighed against the economic harm regulations could cause (McClellan et al 2009). In a Treadmill of Production analysis, Allen, Longo and Shriver (2018) demonstrate how rules are written by North Carolina's Coastal Resource Commission to spur on development at the expense of ecology and against the scientific evidence on sea-level rise. Nature as a commodity (i.e., coastal land) is more important than nature as a barrier from the impacts of climate change, with elite actors selected due to structural imperatives that push for ideological support of capital accumulation through policies commodifying nature. The state carries out regulation while protecting the capitalist class and its organizations as part of the growth coalition. That is, and as stated in the prior section, the state itself within a capitalist world-economy, also must continue to push for increasing amounts of energy and matter for its economy to produce, gain revenue for economic development, social welfare and environmental regulation, and participate in cycles of capital accumulation (Schnaiberg 1980).

That does not mean that there isn't variation. On the contrary, at the scale of the nation-state and at smaller scales, there is variability in the relationship between economy and environment. This is because incorporation into the capitalist world-economy impacts development trajectories, thereby impacting their energy and material inputs and outputs (Chase-Dunn and Hall 1992; Chase-Dunn and Hall 2006). As such, levels of environmental degradation

are also a result of core-periphery relations, with position in the hierarchy and national production processes playing a role in rift-making and rift-shifting. Core countries have the political-economic capacity to move dirtier or more extractive production processes to semi-periphery and peripheries countries while consuming at higher rates, creating an ecologically unequal exchange (Roberts, Grimes and Manale 2006). Specific levels of certain outputs, like sulfur dioxide and nitrogen oxide, are tied to a country's place in commodity chains (York and Rosa 2006). Further, over the contemporary neoliberal period, countries like Chile, Peru, Ecuador and Mexico, saw exports increase, with a corollary increase in domestic material extraction, as incorporation deepened in each case (Russi et al 2007). Thus, when we speak of variation, we have to account for position in a hierarchy, and therefore the distribution of environmental degradation as a function of the historical conditions of development within the capitalist world-economy (Hornborg 2009).

All of this extraction and degradation hinges on exploitation of labor. From a social metabolic perspective, exploitation of labor involves the expenditure of energy by the working and peasant classes, the amount of energy they can consume from the wage they receive, and, ultimately, the extraction of value. Classical scholars, like Engels (1978) and Marx (1978a), recognized that capitalists needed to maintain only the class of workers, and not each individual worker, at a level of subsistence capable for work. It should come as little surprise that the working class was often undernourished, and often still is, with weights and heights below the median, and died at earlier ages. Even more, studies in environmental justice and environmentalism of the poor continue to demonstrate that the working class, along with racial minorities, are more likely to be found nearer to environmental harms than those higher in the hierarchy, such as white capitalists (Bullard 1994; Martinez-Alier 2004). As such, economic

exploitation is premised on a biological exploitation and a heightened risk of environmental harm. Depending on a workers' place in both the internal class hierarchy and the external world-system hierarchy, they will have a varying degree of metabolic exploitation and contact with environmental degradation.

Therefore, there is a capitalist world-economy and its socio-ecological structure, with its dual way causality between social and ecological relations (Mészáros 1995; Foster 1999b). Social metabolic scholars argue, capitalist world-economy dynamics tend towards rift-making, breaking down metabolic cycles even when there are reflexive attempts at resource and energy conservation and ecological resilience and resistance. While the capitalist world-economy has variability at different scales, no single part within completely breaks free from the general trend toward environmental degradation. Solutions to environmental concerns, for example carbon markets, amongst other ideas from capitalist states, often reinforce commodification, the capitalist class structure, the core-periphery relations of unequal exchange and the role of the state and civil society in promoting economic growth above social and environmental well-being. In each instance, a dialectic between society and nature occurs, whereby society can never fully override ecological cycles, nor can nature ever absolutely resist social domination (Liodakis 1997).

This is not to state that prior world-systems were always sustainable. Chew (2006) argues that in prior world-systems deforestation played a role in producing "Dark Ages," such as a moment of crisis when a regional climb in temperature caused de-urbanization in the Near East System (Chew and Sarabia 2016). Instead, it is a concrete argument about this specific world-system, the capitalist world-economy, and how it tends toward a rift-making social metabolic order. Its structural imperatives drive intensification of production in the service of

accumulation, even at the expense of the biosphere. Compounding this issue at all scales, from the core to the periphery and from capitalist states to socialist states, is that there is a systemic tendency towards increasing levels of dependence on inputs and finances, for example for farmers, and on rural agriculture for urban areas. In the following section, I turn to the production of metabolic rifts through agricultural activity to outline a longue durée history of capitalist world-economy rift-making.

Agricultural Rift-Making and Rift-Restitution

Incorporative Rift-Making

How we produce food, and the way that our (exosomatic) social structure metabolically interacts with ecology for our most basic biological needs, is a strategic research site for social metabolic analysis. From the Neolithic Age, there has been a slowly building capacity to organize the amount of energy flowing through plant and animal systems, thereby increasing the amount of plant and animal biomass available for human metabolic reproduction (Mazoyer and Roudart 2006). Food surpluses and scarcities have played major roles in social change, leading to both rebellions and stability, especially true of the transition from feudalism to capitalism in Europe (Braudel 1979; Moore 2002).

In the case of the capitalist world-economy, as it has expanded and incorporated more parts of the globe, agricultural intensification has been a key, ongoing outcome, repeated globally and reorganizing ecology and social structure alike, often leading to rifts in ecological cycles (Moore 2000). Incorporation reorganized agriculture to bring about a production and consumption system based on exchange value (i.e., commodification), the separation of people from the means of subsistence, and thus an increasing divide between town and country

(Wallerstein 1974; Moore 2000; Clement 2011). The reorganization of agricultural production to fit capitalist imperatives meant overcoming ecological barriers and imposing relations of exploitation and property on the countryside. This project was carried out by different states and capitalists over the longue durée of capitalist world-economy incorporation, a slow and uneven process, with a differential rate of commodification and building the forces of production depending upon sociohistorical circumstances (e.g., relations between exploiters and exploited, relations between landowner and tenant, etc.), as well as the ecological conditions (e.g., quality of the soil, climate, etc.; Mann 2010).

Incorporation into the capitalist world-economy often structurally compels the landowner to expand production, and the class relationships represent this shift. When a landowner begins to rent their land to the sharecropper or tenant farmers, among other market relations, that alters land's purpose from producing for use into production for exchange, just as when the plantation or hacienda produces for export, the motivation behind production alters the labor process, even if they can appropriate labor through extra-economic coercion, like slavery. At the same time, sharecropping and tenant farming is distinct from the development of a rural proletariat because of its continued reliance on a tribute form of exchange. Because the process of capitalist development is uneven, different countries had different mixes of labor appropriation in agriculture (Harris 1978). In the United States (US), slave labor, rural proletarians, yeoman farmers and plantations existed concurrently, with the Southern US operating as an internal periphery producing cotton for a Northern industrial core (Baptist 2014). Thus, more commodified social relations (i.e., capitalist exploitation of wage laborers) existed at the same time as latifundista, and chattel slavery social relations, with the mix dependent upon the actual history of colonization and subjugation in each case. Core countries and elite actors of the

capitalist world-economy benefitted from reductions to the cost of labor that came with these other forms of appropriating labor.

For many colonized countries in the semi-periphery and periphery, as well as enslaved, prior enslaved and colonized people within core countries, these systems persisted. This is the case, even while core countries in the 1800s began to transition to chemical inputs and heavy machinery (Thompson 1968; Foster 1999b: 373). With each change in agrarian practices, like from animal to machine traction or from manure to synthetic fertilizers, there is a tendency to intensify production. In part, this did solve a crucial problem, the recurrent famines that had plagued Europe while shifting them to the (semi-)peripheralized countries in Africa, Asia and the Western Hemisphere (Braudel 1979; Moore 2015). Yield increased, the cost of food to labor decreased, reproducing a cheap food complex that justified modern agriculture (Carolan 2011; Moore 2015). While food became less costly to urban laborers, each revolution also raised costs to peasants and farmers, making agriculture more capital dependent and disconnected from ecosystem benefits and communal labor.

That food system was part of the purposeful displacement of rural populations at the behest of capital. For instance, sheep farming drove land enclosures in England pushing peasants into the cities to become the urban proletariat, which was fed by fewer and fewer agricultural workers supported by increasingly productive technology (Wood 1998). Marx (1976) called this land grab process “primitive accumulation,” whereby non-market forms of coercion enable private property and the concentration of resources for the purpose of capital accumulation. Contemporary scholars, like Harvey (2004), refer to it as accumulation through dispossession, as the process of land grabs continues into the present. For example, politically connected business owners in Paraguay violently forced squatters off their land and land commodification in India

occurred under the diktats of the World Bank (Dangl 2014; Shiva 2014). This has meant the slow destruction of the peasant population. That destruction is often justified by international organizations through the rhetoric of food security and feeding the world premised on the incapacity of peasants to feed themselves, despite ample evidence to the contrary (McMichael 2014).

At the same time, peasant, farmer and farm worker populations have been de-skilled (i.e., the knowledge and technique required to carry out production is simplified), as standardization and science tend to depreciate traditional knowledge and farmer to farmer networks that have historically undergirded agrarian practice (Braverman 1998; Timmermann and Félix 2015). Deskilling and deprecating traditional knowledge is related to the continuous racialization of the farm labor force. There exists a long history of exploiting People of Color, the colonized, and the Other, whether it is Japanese and Filipino workers on Hawaiian plantations, or the exploitation of Chinese immigrant workers for the extraction of guano (Takaki 2008; Clark, Auerbach and Zhang 2018). Even contemporarily this continues with the exploitation of Latinx migrant farmworkers in the United States, part of a 20th Century history of racializing farm work utilizing immigration policy as labor policy (Smolski 2019a). All of this is meant to increase production and the profit margin.

This massive structural change is an unspoken opportunity cost of the short-term reductions in the cost of food and increasing yield (Carolan 2011; Moore 2015). This structural change was implemented by actual agents, such as governments, international organizations and corporations, not just a natural outcome of social evolution. Taken together, these trends reached their apex with the 20th Century model, the Green Revolution, a cogent set of policy prescriptions, military interventions and organizational development coordinated by core

countries, led by the United States, in conjunction with international organizations and transnational corporations, like the World Trade Organization, Rockefeller Foundation and others, spreading throughout the globe (Perkins 1997; Ross 1998; Patel 2013). This involved revamping plant breeding, seed production, and soil amendments, amongst other practical changes (Kloppenburg and Kenney 1984; Perkins 1997; Ross 1998).

Then, science is put in the service of increasing standardization to overcome ecological barriers, reinforcing intensification, reducing the cost and input of labor and increasing yield and profit (Mann 2010). That standardization created technologies to control variations in soil, climate, topography and the life cycle. For example, Gunderson (2011) points to the use of concentrated animal feeding operations (CAFO) as a way to increase animal production through mechanization of the operation and the use of specialized scientific teams to calibrate the process, from genes and breeds to the amount of feed needed per animal. That is also linked to the labor deskilling and traditional knowledge deprecation mentioned prior, and together broaden dependence upon the core.

The intensification of agriculture through technology coincided with modernist inter-state administration to justify certain development trajectories over others that were often anti-peasant agriculture and pro-capitalist accumulation (Friedman and McMichael 1989; McMichael 2009). Through arguments on comparative advantage and specialization, countries' agricultural sectors were reorganized (Carolan 2011). The United States utilized food aid as a way to coax countries into its agricultural model. In both respects, the role of trade agreements was large, like the General Agreement on Trade and Tariffs, especially following the Uruguay Round, which involved the international setting of quotas and tariffs on goods that affected agricultural trade

balances between countries, such as with sugar and the International Sugar Agreement (Marlin-Bennett 1993).

These agreements also impacted the flow of technology and knowledge, as think tanks and philanthropic organizations, like the Rockefeller and Ford Foundations, lobbied for agrarian practices that increased dependence on technologies and inputs external to the farm agroecosystem. That control has been amplified as trade agreements lock in monopoly rights over intellectual property, such as genetically modified seeds, that then provides enormous power to agri-business, like Bayer and BASF (Shiva 1993). At the dawn of the 21st Century, there is a "Fourth Agricultural Revolution" based in biotechnology and an almost complete systemic control in the case of warehouse hydroponic operations or lab grown meat. These co-occurring processes continue intensification and increase capital dependence to restructure the social metabolic order.

Therefore, from a social metabolic perspective, the goal of incorporating agriculture into the capitalist world-economy, especially as expressed by the imperialist core, has been to maximize the energy and material going towards more simplified systemic inter-relations in agriculture. For example, in the case of plant growth, systems can be built that remove competitive pressures on the cultivar to be grown, omitting facilitation between cultivars (Vandermeer 2011). If, for instance, there is a continual market demand for corn that can be processed and used as an input in a variety of products, producers will grow that corn and nothing else. And, because there is a demand for each widget to be similar, this will push for a reduction in the variability of corn, regardless of the loss of genetic diversity, knowledge and the security of redundancy in complex systems.

Overcoming ecological variation is elaborated well by nitrogen fertilizer. Nitrogen (N) is an important macronutrient in the soil for growing crops (along with phosphorous and potassium). In intensive cropping systems, where the land is rarely left fallow or put into cover crop, there is a tendency toward depletion of nitrogen due to continuous crop production (Vandermeer 2011). As such, nitrogen fertilizer becomes an important soil amendment, whereby its application makes continued production possible after soil degradation. It is because of this that reactive nitrogen in biogeochemical flows has doubled since the pre-industrial era and "N applied to fields in synthetic fertilizers (now about 80 Tg N yr -l) is about 4 times as large as is the total amount of the element that humans fix by burning all fossil fuels." (Smil 1999: 647).

To account for this in the capitalist world-economy, there has been shifting sources of nitrogen. Mancus (2007) points out that historically to get reactive Nitrogen (Nr) requires either biological fixation or manures, such as from ruminants or guano. When nitrogen depletion became a worsening obstacle to intensive production in European Agriculture, core countries of the capitalist world-economy relied on Peru as an extraction point for guano (Foster and Clark 2004). With European soil nitrogen depletion and guano, there is a clear representation of how a metabolic rift in one part of the capitalist world-economy is resolved through the production of a rift in another part, shifting the environmental degradation around to continue cycles of capital accumulation. Often, these shifts impact worse those in the semi-periphery and periphery, extraction points for raw materials.

In the 20th Century, the Haber-Bosch process led to the production of synthetic nitrogen through industrial fixation, a process requiring orders of magnitude more energy (Razon 2014) than extraction of manure, cover crops, or even soil heating (Giardina, Sanford Jr. and Døckersmith 2000; Vandermeer 2011). With this process, there was an exponential jump in

nitrogen, from “4,000 tons of nitrogen fixed in 1913-14” to more than “11.8 million tons in 1959-60” of synthetic nitrogen produced (Perkins 1997: 215). Industrial production meant a cheaper source of nitrogen on farms intensifying production, increasing exogenous nitrogen fertilizer dependency, along with amplifying its contradiction with ecology (Mancus 2007).

For example, contract farmers enter into highly competitive “tournaments” placing pressure on them to apply more fertilizer to assure high yields (Schewe and Stuart 2017). That overapplication of nitrogen fertilizer leads to rifts in other systems, such as marine and health. Upstream farming along the Mississippi River with its overuse of nitrogen has led to a growing hypoxic zone in the Gulf of Mexico, leading to reductions in certain fishery stocks, like immobile species, by reducing oxygen levels (Clark and Longo 2018b). Once more, the rift in the nitrogen soil cycle is overcome through a shift to application of synthetic sources of nitrogen (i.e., ammonia nitrate) that under capitalist world-economy conditions of market competition tends to result in the overapplication that accumulates in another part of the biosphere causing another metabolic rift.

Another example of the capitalist world-economy’s agrarian practice’s ecological impact is the ongoing increase in the use of pesticides related to increasing export-oriented production (Longo and York 2008; Jorgenson and Kuykendall 2008; Hedlund, Longo and York 2020). And while certain declines have been registered in the Global North, there has also been a qualitative change in the toxicity of pesticides, requiring less use with an equal or worse impact. The use of chemical pesticides creates a feedback loop resulting in particular ecological outcomes, such as reducing parasitoid populations by producing a rift between them and the hosts they are dependent upon for their reproductive cycle.

Through insecticides and land use change, parasitoid habitats and food sources become fragmented (Fenoglio et al 2013; McIntyre 2000; Raupp, Shrewsbury and Herms 2010; Shrewsbury and Raupp 2006). The effects are reducing parasitoid ecosystem services and increasing crop susceptibility to pest infestation. This then requires increasing insecticides and rural land to overcome reduced ecosystem services. At the same time, the use of pesticides enters into a biological competition, as "pests" become resistant to the chemical controls administered to eradicate them. Overtime, new chemical controls must be invented as applications at the wrong time, survivors, and other conditions result in stronger competitors for the same crops.

This can be favorable from the point of view of capital accumulation, as chemical controls require new chemical controls overtime, a form of obsolescence reliant on ecological processes. It is the solution to the problem it begets. A similar dynamic occurs with pollinators, necessary for the production of many crops, like blueberries, whose population declines due to pesticides, creating another rift in a symbiotic relationship between insect and cultivar.

Together, fertilizers and pesticides mean more money is necessary to pay for inputs, which spurs on the financialization of agricultural production, as debt becomes a main avenue to cover costs until commodities are sold. Thus, how technologies are employed can reinforce power in the imperial core that produces them, thereby increasing the dependence of the semi-periphery and periphery (Girling 1976). The more rifts are created by industrial agriculture, the more dependent upon inputs are producers, the more that the capitalist world-economy is dominant; a quite vicious feedback loop (Bernstein 1977).

Delinking and Rift-Making

The dynamics discussed above are present in delinked, incorporated states. That is because the economic development goals of these states to fulfill social welfare objectives often necessitate technological transfers from the core. In order to bring this about, there is a reliance on exports to bring in foreign exchange to purchase imports that support increases in production. Because of this, I argue that anti-systemic structure as delinking is often framed in human exemptionalist terms, as a race to accumulate, to industrialize, to modernize by taking freely of nature to compete against core, capitalist states. While socialist states relied on land redistribution strategies to break up latifundias that had impeded more equitable and just economic development, these tended to co-occur with reductions in peasant autonomy. This was a form of incorporated delinking, whereby sovereign control over resources and commodification provided states a stronger capacity to develop and redistribute resources in more equitable ways based in a specific form of agriculture that is not ecologically sustainable. Under this framework, agriculture was important for its ability to be transformed similar to the model implemented by Britain in the 1800s or the United States in the 20th and 21st Centuries (Friedmann and McMichael 1989; McMichael 2009; Patel 2013).

Revolutionary groups that took state power and shifted the agrarian structure argued for implementing a "Green Revolution" model of industrial agriculture, even with different class arrangements and normative goals (Moore 2008; Scott 1999). Lenin (2003) concurred with Kautsky (1989) that attempts to guard the peasantry and protect the small farm were "reactionary and harmful," because the peasantry was primarily conceived as a subordinate revolutionary class to the proletariat or as petty bourgeois impediment to social revolution (Harris 1978). As well, Lenin (2004a, 2004b) understood capitalist agriculture to be an advance in terms of the

forces of production, and that dividing up and distributing estates to peasants was “a step back from the standpoint of the capitalist development of the given estate.” In a sense, while proposing different outcomes, both Soviet and US intellectuals argued for modernization (Clarkson 1978) that, intended or not, reproduced the capitalist world-economy. Industrially scaling up agriculture was good, even if it spurred on the town-country divide and led to food dependence.

By adopting the capitalist world-economy’s Green Revolution, with its industrialized agriculture requiring import-substitution policies to bring in chemical fertilizers, pesticides, heavy machinery and the domination of nature, anti-systemic structure in the form of delinked socialist states and national liberation movements in the 20th Century deepened incorporation into the capitalist world-economy as a consequence, intended or not. That’s because the Green Revolution is problematic from the standpoint of socio-ecological relations, requiring large-scale, factory-style farming that reproduces proletarianization and depeasantification through business-led, state-supported private concentration or state-led collectivization. These conditions produce a socio-ecological dependence beneficial to the furtherance of the capitalist world-economy, and not to sustainability or justice for workers, peasants, the semi-periphery and the periphery. In this way, incorporated delinking as anti-systemic structure is in a subversive complicity with the capitalist world-economy, whereby delinking decommodifies certain aspects of the economy while relying on the capitalist world-economy for inputs to develop and grow (Grosfoguel 1996; Svampa 2019).

In countries that pursued radical land distribution policies, like Mexico or in the Soviet sub-system, incorporation meant that the Green Revolution process was carried out, at times at the behest of peasant communities themselves (Scott 1999; Ruvalcaba 2017). For instance, in the

Soviet Union, collectivization brought about larger tracks of land on which standardization of the production process could occur (Scott 1999). This was tied into policies of a development or modernization state that was premised on increasing competitive capacity within the capitalist world-economy. That demonstrates the ideological power of modernity as an understanding of how to develop and the idea of more production as always better (McMichael 2016). It is in relation to this that policies such as import substitution as proposed by dependency theorists, or the Soviet sub-systems attempts at endogenously producing industrial technologies that mimicked technologies produced in the core, deepened incorporation rather than breaking the underdevelopment dynamics.

Contemporarily, certain incorporated, delinked states, especially in Latin America, have institutionalized food sovereignty as a political project in response to popular pressure. In Ecuador, the state enshrined food sovereignty into their constitution relying on the normative framework *sumac kawsay* (translated from Quechua into Spanish as *buen vivir* and into English as living well), which had been employed by peasant and indigenous activists (Peña 2015). While this had led to openings in terms of public policies and expanded peasant autonomy through increased state investment in agriculture and land redistribution, the Ecuadorean state was incapable of fully realizing what had been laid out ideally and struggled for by peasant and indigenous movements. This was due to demobilization of movements and the continued support for large and medium-sized producers over small-scale and peasant producers (Clark 2016; Vergara-Camus and Kay 2017). Additionally, Pink Tide governments (i.e., the Leftist governments in Latin America that came to power from the late 1990s until the 2010s), in general, saw a rise in the use of glyphosate and use of round-up ready soy over this period and they re-focused on primary goods exports in the agriculture sector (Santos and Vasconcelos

2020). So, an important tension exists between the state's capacity to provide openings for experimentation, as well as its structurally imposed need to reproduce the capitalist world-economy impacting agrarian practice, and therefore rift-making potential.

Considering this ongoing failure for an incorporated, delinked anti-systemic structure to produce a sustainable social metabolic order, the crucial question for this dissertation is, what type of anti-systemic structure, or mixture of anti-systemic structures, would be capable of conditioning a sustainable social metabolic order by supporting agroecological agrarian practices? A current gap in theorizations of anti-systemic structures is the role of state deformation processes, whereby control over production is shifted away from the state to the direct producers. This non-state form of anti-systemic structure is largely absent from debates on sustainable transitions within environmental sociology. For example, Pellow's (2007) question, "wither the State?" is answered with a research agenda solely for radical social movements to resuscitate the state to challenge transnational corporations.

That omits anti-systemic projects based on exile from the capitalist world-economy that go beyond bringing capital under control through the state, toward a deformation of the state as a way to amplify autonomous control over production by the direct producers thereby de-commodifying social relations and the relation with ecology (Grubačić and O'Hearn 2016). Such exilic projects themselves can be the result of conflicts over delinking that have come prior and the precursors of conflicts to come. In that, my argument is not that there is an absolute difference between these types of anti-systemic structure, even if they present in the last instance different ecological outcomes. It may be that a delinked anti-systemic structure promotes exile, or vice-versa (about which, more below). Instead, my argument is that an exilic anti-systemic structure must emerge as a part of the debate on transitions to sustainable agriculture, and

sustainable social metabolic orders overall. In the following sub-section, I turn toward the role of exilic anti-systemic structure in conditioning agroecological possibilities and rift restitution.

Exile and Rift-Restituting

This project argues that the construction of an exilic anti-systemic structures, which is the egalitarian, direct democratic control of production by producers reliant on mutual aid and substantive exchange, is a necessary condition for the widespread implementation of agroecology. Following from that claim is that exile will likely be more conducive to rift-restitution and challenge rift-making. Following Foster and Clark (2016), a rift is a breakdown in the "law of restitution," whereby restitution entails endogenous replenishment of ecological cycles. To restore is to re-establish these restitutive cycles (Foster and Burkett 2016). Rather than extracting from nature and turning what would be recycled into waste, the purpose is to maintain and work within cycles developing sustainable conditions within socioecological systems. This alters the social means we can use to bring about desired ends, as well as affecting the time frame in which we can act.

To maintain or restore ecological cycles, critical scholars propose alternative structural arrangements, such as de-commodification based within the commons as a form of sharing use-values (Amin 2009; Sbicca 2014; Longo, Clausen and Clark 2015; Ergas and Clement 2016). Non-capitalist exosomatic types, such as indigenous communities in Central America relying on more extensive agricultural practices like fallow land and slash-and-burn, have shown relatively more sustainable flows of energy and material moving through their agri-food systems (Cordón and Toledo 2008; Ortiz-Avila and Masera Cerutti 2008). Marx noted in his later years the role that common property relations like the Russian *mir*, which were non-state, village communes,

could have in building de-commodified social relations (Anderson 2010). There is also important scholarship on the role of ecology in sustaining maroon communities against the violence of incorporation, as the wild (i.e., uncivilized nature) provided a site of refuge from colonialism, slavery, and capitalism (Malm 2018; Connell 2020; Golden 2021). This relationship to what is labeled as the "wild" by certain scholars is a protection against state and capitalist violence. That in turn led to a radical conservation ideology that exists until the present in communities descendent from maroon insurgency (Favini 2018). That echoes scholarship by Scott (2009) on the role of agriculture in escaping the state and capital in the Southeast Asia Highlands, as certain crops made possible survival and evasion from domination and exploitation.

The village commune and maroon and indigenous communities mimic the characteristics of exile; mutual aid, substantive exchange, direct democracy and egalitarianism. Mutual aid and substantive exchange are premised on a de-commodified form of exchange and reliant on reciprocity and solidarity. Further, direct democracy and egalitarianism are components of decision-making within a commons, a system in which resources are shared. As well, they mimic exilic processes of state deformation by increasing the autonomy of direct producers and exit from the cycles of capital accumulation. How these characteristics and processes of exile and structural change occur will depend on the scale and the socioecological and historical conditions under which they happen.

Agroecological theory provides important insights into the restitution process and empirical studies provide evidence for exile as a necessary condition of this alternative agrarian practice. Agroecology is often described as a science, a practice, and a movement (Wezel et al 2009; Gliesmann 2018). That is, it involves descriptive research on the web of connections between biotic and abiotic organisms that constitute an ecological niche, with validation of the

role of certain interconnections in increasing overall farm output. At the same time, many scholars propose that the implementation of agroecology is premised on active social movements promoting it at all scales (Altieri and Toledo 2011; Sevilla Guzman and Woodgate 2013; Holt-Giménez, Shattuck, and Lammeren 2021). In this conception of science, we find a different idea than that put forward by institutions of the capitalist world-economy. For certain scholars, science in agroecology is no longer a value-neutral endeavor (or, at least presented as such) when conjoined with peasant-based social movements. In these instances, it is an activist-based science that understands the production of knowledge as co-extensive with the social structure in which it is embedded (Lewontin and Levins 2007). This also applies to technology, which forms a part of practice. Developing input substitutes as opposed to capital-intensive technology is a structured choice, rather than a given; and it is a decision that has potential to break dependency through endogenous production when tied to an agroecological social movement (Rosset and Altieri 1997).

This is because dominance of one model or another is dependent upon the capacity for collective action. An activist-inflected scientific process co-occurs with actual implementation by farmers and a movement. For example, La Vía Campesina supports agroecology as a practice capable of transforming the agri-food system to their benefit (Borras Jr. 2008; Wittman 2009). Another example is the Forum for Food Sovereignty in 2007, during which the assembled representatives of farmers, peasants, landless communities, and many more adopted the "Declaration of Nyéléni", with its support for sovereignty over the food system and need to rehabilitate the environment (Nyéléni 2007). Grassroots activism, such as La Via Campesina or the Brazilian Landless Workers Movement (MST for Portuguese acronym), have been pivotal in framing agrarian struggle in terms of agroecology as a way to build autonomy for socialist

transformation (Wittman 2009; Meek 2014). That has also meant reinvigorating the subjective identification of the rural class as a peasantry, and thus as a class with distinct interests. The MST is instructive here. Due to agroecological practice typically being more labor intensive, there has been moves toward collectively organized labor, which the MST organizes at the community level (Wolford 2010; Meek 2014). Rather than the state or businesses (in this case, transnationals and monopolies), community-based political associations and cooperatives leverage culturally relevant knowledge to link the social system sustainably to the ecological system.

In certain regions of Chiapas, a state in Southern Mexico with a rich history of Indigenous resistance that could be considered as representative of anti-systemic structures, scholars demonstrate the ongoing implementation of an exilic sustainable development model as a way to combat dispossession that disrupts the social metabolic order through the implementation of territory-specific cultural practices (Ávila Romero and Ávila Romero 2016). For example, in the Zapatista's autonomous territories based on voluntary territorial exile there has been a push for agroecology with a ban on pesticides and a reduction in the purchase of external inputs that tend to make farmers and peasants dependent upon debt financed production (Manning and Bender 2019). This has involved the development of community education programs with coffee growers that, for example, teach about how herbicides lead to weeds that are harder to combat, as well as the beneficial health effects of reducing the use of toxic chemicals (Manning and Bender 2019). There are additional interventions, like protecting maize production, which has deep biocultural roots in Mexico (Toledo and Barrera-Bassols 2017). That has meant genetic testing, classes on genetics, seed sharing and seed banking, which mixes traditional with scientific knowledge based on the needs of the community (Brandt 2014). That

protection is part of a larger struggle in Mexico over protecting corn, reliant on indigenous organizations, scientists, and even alternative market arrangements, like the *tianguis* (i.e., street markets; Toledo and Barrera-Bassols 2017). Thus, just as in the Southeast Asian Highlands, agriculture has become an important practice for building autonomy and breaking the hold of capitalist markets and the state on Zapatista territory.

There are a variety of reasons these non-state and/or non-capitalist structures can have positive ecological impacts. First, they may have the potential for shifting class structure toward different forms of ownership over the means of agricultural production, and/or increasing democratic planning by actors directly involved (Ergas 2010; Ergas and Clement 2016). Scholarship on rural peasants and urban agriculture demonstrates the challenge privatized land ownership sets for maintaining these alternatives, and how more permanent common property institutions can aid in success and restoration (Wittman 2009; Gunderson 2011; McClintock 2014; Glowa 2017). For example, in Mexico the ejido system of government-led land re-distribution de-commodified tenure, thereby providing an important economic base of autonomy to future struggles and the maintenance of peasant life. On ejidal land, there was less use of external inputs, heavy machinery, and other practices that signify incorporation (Smolski 2019b), even with the government's Green Revolution push (Ruvalcaba 2017). Other studies have also shown the role that secure land tenure plays in implementing more sustainable agriculture practices (see, for example, Nkomoki, Bavorová and Banout 2018 on the role of land tenure in increasing adoption of sustainable agriculture practices and better food security outcomes).

Second, systems of mutual aid and egalitarianism may shift structural imperatives away from increasing profit, to increasing socially and ecologically advantageous production. This occurs through shifting the social-ecological relational structure towards a reciprocal basis,

which theoretically promotes alternative practices, like integrated pest management, which are restorative (Wittman 2009; Gürcan 2014; Ergas and Clement 2016). As such, a rift—like that between parasitoid and host—could more likely be restored through agriculture practices under exilic conditions. We can see a similar benefit with a facilitative understanding of plant competition, demonstrating the inter-dependence of cultivars based upon how they react with biology and chemistry (Vandermeer 2011). This facilitative benefit occurs through intercropping (i.e., the mixing of crops within a given plot of land) and crop rotation (i.e., planting of cover crops and different crops during different seasons) that utilize the different interactions to combat soil erosion and pests (both insect and plant), improve soil health, and improve soil structure, which has been shown in strawberry systems (Garland et al 2011).

Taken together, the argument is that exile is an advantageous condition for implementing agroecology, as well as agroecology being advantageous for the maintenance and growth of exile as an agriculture of escape.

Delinking and Exile: Complements and Conflicts

It is important to note that delinking and exile are not absolutely opposed to one another. Often periods of exile and delinking co-occur in various parts of the world-system, such as during the world-revolution periods of 1968 and 2008 (Wallerstein 2014). It is during exile-in-rupture and world-revolutions that nationalist and socialist states have formed. While, the Soviet sub-system and other nationalist and communist revolutions of the 20th Century did not break free from the capitalist world-economy, they did fundamentally alter their social relations and the social relations of the capitalist world-economy thru their threat of a more absolute exit. This is especially true internally for places like Mexico that implemented land redistribution policies

that expropriated, decommodified and communalized land. Smolski, Castro, and Ross (2018) argue that during revolutionary periods, such as occurred in Mexico from 1910 to 1917 or Russia from 1917 to 1924, that exile played an important role in subsequent state (de)formation, levels of commodification, and the egalitarianism of the subsequent political institutions.

As such, it is necessary to examine how delinking and exile co-occur to shift opportunities to challenge incorporation into the capitalist world-economy, and therefore the rift-making and rift-restituting potential of the social metabolic order. Grubačić (2019) calls for this dialogue, an exilic rethinking of delinking as a series of autonomous and linked communities, similar to Rojava, a revolutionary Kurdish project. Ajl (2018) points toward a much more peasant-centered delinking that also sees a role for a state, although informed by a populist understanding of the sovereign political subject as the "people". Scholars of delinking in the Global South understood the role of the state in supporting peasant movements to develop agroecology by expanding their ownership of land and autonomous control over the production process (Ajl 2018, 2019). This provides an added complexity to the dynamic through which constructing anti-systemic structures challenges incorporation into the capitalist world-economy, and therefore the ecological outcomes for the agrarian social metabolic order.

This is because delinking tends to lead to decommodification of parts of the economy, such as land, which I argue is pivotal for exile. By reducing the control over social decisions by the capitalist class and core countries, delinking empowers alternative practices to occur. Yet, because delinking is about the expanded power of the state, it can also negate exile through centralization of control over the production process. Delinking is then a both/and, a possible structure for expanding exile and incorporation dependent upon the ongoing struggle between the capitalist world-economy and anti-systemic structures. That makes a comparative-historical

analysis useful for understanding the unfolding complements and conflicts between different types of structures relative to the agrarian social metabolic order.

Chapter Conclusion

My argument in this chapter is that incorporation into the capitalist world-economy has predominantly rift-making effects. This is due to the structural imperatives to accumulate that commodify nature and turn it into an essential component for profit. That has been a historical process, playing out in multitudinous facets of the economy from colonialism to the modern era of independent nation-states. It has involved a conflict between social movements, the state and capitalists within the capitalist world-economy.

As incorporation into the capitalist world-economy occurred in agriculture, it simplified agroecosystems through standardization that reduced agricultural labor, dispossessed the peasantry, and in general reduced the capacity for a sustainable agriculture. That system has become more and more totalizing, with mega-farms and international trade propped up by the role of state subsidies and supports, along with think tanks, universities, and more providing the technical altering with the decades, amongst much more. There is a constant state of becoming within somewhat stable confines, as the capitalist world-economy broadly reorganizes time and space to increase the amount of energy and material moving through the exosomatic system.

Importantly, this is not a functionalist relationship, whereby the capitalist world-economy produces the same rifts in all territories across time. Socialist states *qua* delinked states can also bring about rift-making based upon how they incorporate into the capitalist world-economy and how they resist that world-system. As such, social structures and their concrete sociohistorical

construction becomes an important site of analysis for understanding how a social metabolic order produces rift-making and rift-restituting potential.

Furthermore, there is always mutations and crevices in which an alternative is built, because of anti-systemic structures. And those anti-systemic structures, when linked to a type of escape agriculture in the form of agroecology, become even more potent, capable of breaking the bonds of dependency upon the capitalist world-economy and actualizing autonomy and egalitarianism, which I have suggested increase the possibilities for sustainable socioecological development. Following this argument, there is an imperative to understand the possible connection between exile and agroecological practices as being capable of actualizing a sustainable transition away from capitalist world-economy incorporation. In the next chapter, I lay out my method for interrogating this theory based on comparative-historical case study methodology.

CHAPTER 3: A COMPARATIVE-HISTORICAL ANALYSIS OF SOCIAL METABOLIC PATHWAYS

Introduction

In this chapter I describe the comparative-historical methodology I employ to interrogate how structural conditions impact rift-making and rift-restituting potential in the social metabolic order. Importantly, I delineate the unit of analysis, social metabolic pathways, as path-dependent structures demarcating concrete periods. Then I justify Cuba as a case and explain how I periodize Cuba into sub-cases. Following that, I describe my data sources. I conclude with a discussion of study limitations.

Comparative-Historical Analysis

Base Assumptions

Comparative-historical analysis has a long tradition in sociology, and the social sciences generally (see Weber (1930), Skocpol (1979), and DuBois (1992) for examples of comparative-historical scholarship analyzing race and reconstruction, the state and revolutions, and institutions and economic development). Comparative-historical methods often analyze macro- and meso-social units as cases, like countries, organizations, and world-systems, to develop explanations of social change (Ragin 2014). Because these units exist over longer periods of time, they are more susceptible to a structural analysis than an *ad hoc* group of people who meet irregularly and for a short period of time. As well, comparative-historical methods utilize a varied set of units, whereby the explanation can occur at one scale while actions that bring it about can occur at another scale (Ragin 2014).

It is because these units can be classified as either X, Y, or Z from how they condition/are conditioned by patterned, repetitive processes, that it is possible to make claims about them (Bunge 1979). Through detailed analysis of a small number of cases a researcher can interrogate theorized conditions' role in bringing about specified outcomes across space and time (Steinmetz 2004). The conditions are a nominal level of measurement, whereby their existence or not determines the effect (Mahoney 2000a). Analyzing theorized conditions as a nominal level of measurement makes for a determinist research agenda that seeks to establish the non-eliminability of an explanation for why some effect is produced (Mahoney 2000a). That is, does the evidence demonstrate that an explanation is necessary, even if it is not a sufficient cause for an effect. Cases are then chosen to examine the causal impact of theorized conditions, probing their plausibility as causal mechanisms at different levels of abstraction (Mahoney and Rueschemeyer 2003; Rueschemeyer 2003; George and Bennett 2005). Researchers can then compare across cases for the different mixtures of these conditions and examine how they impact the outcome. This is understood as historically conditional theory (Paige 1999).

This logic also applies to ecological phenomena. Ecological phenomena are also historically conditioned and evolving into differentiated units (Fischer-Kowalski and Rotmans 2009). Importantly for this project, the conditioning occurs from an interaction between social and ecological processes and units (Fischer-Kowalski and Rotmans 2009). That is, a socioecological comparative-historical analysis is about bridging an artificial divide between social and ecological systems (Crumley 2006). Humans adapt natural systems to their needs and wants, impacting how they operate and vice-versa. The social metabolic order can deteriorate the soil based upon how it consumes nitrogen through agricultural production and deforestation. And that production will occur based upon the structure bounding agents' interactions with nature.

Unit of Analysis and Observation

The unit of analysis to be delineated is a social metabolic order, which provides a broad classification of historically specific socioecological dynamics of a given era. A social metabolic order embeds the social within the ecological (Carolan 2005), with metabolic regulatory processes conditioned by the social structure (Fischer-Kowalski and Helmut 1993; Fischer-Kowalski 1998; Fischer-Kowalski and Hüttler 1999; Foster 1999a; Clark and York 2008; Burkett 2014; González de Molina and Toledo 2014). However, the social metabolic order is a higher order abstraction "that permeates all aspects of society" (Clark and Foster 2010: 130). Within that overall social metabolic order are variations with differential ecological outcomes dependent upon which structural conditions are present, what I label social metabolic pathways. These social metabolic pathways are the units of observation. Every social metabolic pathway has a distinctive, path-dependent combination of incorporative, delinked, and exilic structural conditions impacting the metabolic regulatory processes. This is because the social structure is an uneven systemic relationship between classes within a given nation-state and the relationship between that nation-state and the capitalist world-economy (Comstock 2012).

The reason that it is possible to discuss social metabolic pathways is because they are generally stable, path dependent entities. Path dependence can be understood as the way structure and institutions operate to reproduce a similar outcome overtime within a system (Mahoney 2000b, 2001). Additionally, initial conditions impact the effects that follow, until a critical juncture occurs that re-organizes the conditions (Mahoney 2000b, 2001). A critical juncture is when conditions for path dependence are contested and set for a new period (Mahoney 2000b, 2001). I delineate between different pathways based upon the occurrence of critical junctures that sets new structural conditions for path dependence. This then acts as a

framework for periodization of cases. That is, combined with a spatial understanding is a temporal understanding. The structure of the unit of analysis is relatively stable over a period of time (Wallerstein 1995). History can be carved up into periods, a span of time that can cover decades, centuries, or even millennia, depending upon the questions asked. In each periodizing schema, the concepts and unit of analysis drive the periodization, with the beginnings and ends based upon the data.

Operationalizing Concepts for Nominal Measurement and Comparison

To measure incorporation, delinking, and exile nominally, I rely on set of components with varied types of measurements (see Table 3.1 for a contrast between incorporative and anti-systemic components). The purpose of analyzing these components is to decide the structural conditions of a social metabolic order, which I do in each empirical chapter. For example, is production for export and thereby dependent upon the capitalist world-economy for economic development? Is this export of a raw material or a value-added product, thereby delineating position in the core-periphery hierarchy? Does the nation-state have a sovereign capacity to dictate production, and thus is it delinked? How is labor involved in production, and how does this impact technology? What non-capitalist and non-state processes are occurring that produce exile? Answers to questions likes these will provide useful specification that can then be used for comparison and explaining the impacts of the social-ecological relationship.

Table 3.1. Components of Nominal Measurement for Structural Condition.

Incorporation	**Anti-Systemic**
Trade and (Inter)state Administration • agricultural exports (e.g., more agricultural exports increased likelihood of incorporation as structural condition) • position in the hierarchy of production processes (e.g., more peripheral position, increased likelihood of incorporation as structural condition)	Trade and (Inter)state Administration • trade agreements (e.g., more control over the terms of trade, more likely delinking as structural condition) • sovereignty (e.g., more sovereign control over national development policy, more likely delinked as structural condition)
Commodification and Capitalist Agrarian Structure • private land tenure (e.g., increasing private ownership of land, increasing likelihood of incorporative structure • Exchange value (e.g., more that agriculture is a commodity for capital accumulation, more likely incorporation is structural condition) • Capitalist exploitation (e.g., more that labor is paid a wage and lacks autonomy over the production process, more likely that the state is incorporated into the capitalist world-economy)	De-Commodification and Anti-Systemic Agrarian Structure • State or cooperative land tenure (e.g., more state-owned farms, increased likelihood of delinking as structural condition) • substantive exchange (e.g., more mutual aid and subsistence reciprocity will increase the likelihood of exile) • direct producer autonomy (i.e., more direct democracy and egalitarian decision-making on the farm, more likely exile as structural condition)

The ecological outcome that I am analyzing is rift-making and rift-restituting potential. For the purposes of this study, rift-making occurs when there is a disruption in an ecological cycle, whereby its potential for restitution—without human intervention—is ruptured. Rift-restituting is an outcome involving recovery in an ecological cycle, such as maintaining or improving soil health, reforesting, amongst other interactions with ecological systems. In making this determination, I focus on the dominant trend nationally, understanding that there is variation

regionally and across different types of farms. I utilize the term potential because this is a nominal analysis. I am not measuring the nitrogen content of soil before and after a sugar monocrop, or the biodiversity before and after deforestation. Rather, it is the agrarian practices of different units that are the explanandum, through which changes in soil, forest, and other ecological phenomena are explained and inferred (Dearing 2006).

I utilize agrarian practice as a proxy for environmental degradation because of the paucity of data on soil erosion, biodiversity, groundwater contamination, and other negative impacts on the environment from agriculture. Certain studies on soil (and other ecological phenomena) do exist, and are included in this study, but not enough to provide ample data. Agrarian practice is a strong proxy, because we have scholarly literature demonstrating the negative impacts of certain practices on the environment. For example, increasing use of chemical controls to combat weeds and herbivorous insects are shown to lead to declines in biodiversity. Also, the overapplication of nitrogen fertilizer is shown to contaminate groundwater. And, the increasing use of heavy machinery leads to increasing use of oil, thereby increasing the output of carbon dioxide, a leading greenhouse gas. Therefore, and similar to structure, to analyze agrarian practice, I focus on a set of practices (see Table 3.2).

Table 3.2. Components of Nominal Measurement for Rift Potential.

Component	Nominal Measurements and Example
Machinery	• Tractors (e.g., increased use of heavy machinery, more likely increased rift-making)
Land Use	• cultivation (e.g., increased land under cultivation, more likely increased rift-making) • cultivars (e.g., increased monocrop, more likely increased rift-making) • forest (e.g., increased deforestation, more likely increased rift-making)
Fertilizer Application	• Fertilizer (e.g., increased use of synthetic fertilizers, more likely increased rift-making)
Pest Management	• Herbicide (e.g., increased use of chemical controls, more likely increased rift-making) • Hand Weeding (e.g., increased use of biological, cultural, and other non-chemical controls, more likely increased rift-restituting)

In the concluding chapter, I compare the results of each chapter in terms of structural condition and agrarian practice relative to the dominant rift tendency for an ecological outcome. In this sense, I formalize the comparative analysis to denote the links between specific mixtures of structural conditions and ecological outcomes in the agrarian social metabolic order.

Cuba as a Case and Periodization

Social metabolic pathway as a periodization is distinct from prior periodizations of Cuba. Prior analysis has often periodized Cuban economic development according to internal periods. For instance, Mesa-Lago (1981) has broken Cuban Revolution economic history into distinct periods based on the level of state control of the economy, reliance on moral and economic incentives, and its relationship to the Soviet economic model. Another example for periodizing

Cuba is based on shifts in how it organized agricultural production through the collectivization process, with shifts in state control, cooperatives, and small peasant agriculture (Deere, Meurs, and Pérez 1992). Lastly, another is to periodize Cuba pre-revolution and post-revolution (Alvarez 2004). I am not arguing whether these are valid ways to periodize, as I think they are valid within their parameters. Rather, these types of periodizing occur within pathways, are often internal-only forms of periodization, and can omit critical junctures between and within periods.

The Cuban case is theoretically interesting because of its historic shifts in social metabolic pathways within the capitalist world-economy and their impact upon Cuban agricultural development. For this dissertation, I delineate three social metabolic pathways, beginning in 1898 and ending in 2016. The first social metabolic pathway (1898-1958) I analyze is marked by incorporation through the United States, which was ascendant as the core of the capitalist world-economy. During this order, Cuba is a peripheral nation-state, lacking autonomy over its economic development and its social-ecological relational structure. The second social metabolic pathway (1959-1991) I analyze occurs from the triumph of the Cuban Revolution in 1959. From that juncture, Cuba gained a certain degree of autonomy over its economic development through anti-systemic delinking and support from the Soviet sub-system. This is an important social metabolic order for understanding how incorporation occurred through a delinked *qua* socialist state, which O'Connor (1989) notes had similar rift-making potential as the capitalist mode of production. The third social metabolic pathway (1991 -2016) represents a partially exilic and delinked anti-systemic pathway, relatively outside of the capitalist world-economy after the collapse of the Soviet sub-system, even while still partially incorporated. During this period, Cuba is known for development policy transforming agriculture models from industrial toward sustainable, even agroecological (Funes 2002). As such, Cuba permits a

comparative-historical analysis of the conditioning effects of three distinct social metabolic pathways on the rift potential of agricultural development. In the following section, I describe the data sources I rely on for developing the analysis.

Data Sources

In this study, I relied on multiple sources of data. When collecting data from primary data sources, I took extensive notes and produced numerous digital copies. I collected data on primary descriptive statistics from various censuses and official statistics published by the Cuban government, such as the *Anuarios Estadísticos de la República de Cuba, Censos Agrícolas,* and *Boletin Estadístico de Cuba,* 1964. These provided descriptive quantitative data on land use, agrarian practices, demographic trends, commercial exchange, and other key data. Sources for statistics were retrieved utilizing interlibrary loan, with more recent statistics accessed directly through the website of Cuba's *Oficina Nacional de Estadística.* With these statistics, I developed tables utilizing Excel. This involved a main database to store statistics across years, as well as sheets for each period: exports and imports, land in cultivation, distribution of land, sugar price and production, number of farm laborers, and fertilizer and herbicide application and imports, amongst other data points. For each type of data collected, a table was developed to organize the data to analyze trends and produce figures when appropriate. The tables then allowed for comparisons between periods by analyzing changes that occurred and how this related to structural conditions and rift potential.

The reason I draw on so many different sources for the statistics is that no digitized database of Cuban statistics exists, and different Anuarios carry different years and statistics. This amounts to a *bricolage* of data, with shifting numbers and data points. Further, this is not an

exhaustive list, as other sources were also utilized, such as reports from the United States government, and international associations. For instance, in the 1898-1958 period, the United States compiled detailed reports. And, in the case of sugar, the International Sugar Organization maintains historical and contemporary data on trends in production, distribution, and pricing. For an exhaustive list of primary sources, refer to the bibliography.

Further, I rely on primary documents, principally *Cuba Socialista* and the magazine *INRA*, which was later titled *Cuba*. These primary documents were accessed at the University of California, Riverside during a visiting fellowship to their archive In the former case, this was a quasi-academic journal whose editorial committee was headed by Fidel Castro and was a key place of debate and discussion concerning the Revolution's economic policies. In the latter case, this was the magazine of the *Instituto Nacional de Reforma Agraria*, the principal institution for agricultural development. These documents provide important data on institutions, demonstrating ideological emphases and planning. Notes were taken on these documents, focusing on institutional changes, such as laws, that impacted agrarian structure, as well as on discussions of agrarian practices and the ideas underpinning the support of different types of agrarian practices. While not always directly cited, they provided invaluable insight into Cuban government planning during the 1959-1991 period. Other sources were utilized, such as documentaries, to provide further contextual data.

Additionally, I collected data from secondary sources. Secondary sources were retrieved from North Carolina State University library holdings, through inter-library loan, and through *RedLAyC*, a repository of academic literature from Latin America and the Caribbean. Certain sources, such as Cuban academic journals, provide important information on structure, institutions, and ecology. As well, these secondary sources provide historical data points on

structural and institutional shifts, data on soil erosion, soil health, deforestation, and other crucial data for inferring rift-making and rift-restitution. Once more, notes were taken on these documents to support the reconstruction of historical changes within periods by studying institutional, ideological, and practical changes, as well as data on structural shifts. Plus, notes were taken to understand contradictions and debates around historical trends.

Limitations

There are a few limitations to this study design. These limitations can be grouped into three categories: missing agency, single country, and missing data. Each of these are limitations of comparative-historical analysis generally. That is, the use of a small number of cases at a macro and meso-scale produces certain problems about claims being made. Limitations exist for any study, and because of these limitations the results and discussion are presented conditionally instead of as absolutes.

For missing agency, the key problem of the study is making claims about farm organizations largely without statements from first-hand accounts of why actors chose certain agrarian practices over others. In some instances, such as state farms, this is less problematic, as the statements of political leaders represents, to an extent, the agency involved in decisions around agrarian practice. However, in the case of small farms, this is more problematic, as there is a lack of data concerning their motivations. Were subsistence farmers in Cuba during the US incorporative pathway against industrialization, or was this a result of the agrarian structure?

While this limitation does exist, there is also a problem of treating an actor's perception of their motivations as their actual motivation. That is, ideology can be divorced from the bounded rationality of actions, just as any person does not automatically know themselves.

Future research should seek data on these micro-level processes to provide further evidence on the macro-micro link, a contemporary concern of comparative-historical research (Ermakoff 2019). Even more, a micro-level analysis is not the focus of this study, and thus this is outside this project's purview.

For single country, the major problem is making general claims from the concrete conditions of one case. Even though this case is examined in three separate instances (i.e., three cases), it does not mean that other cases would prove to operate similarly under the same conditions. Furthermore, the reason I chose Cuba was because of its historical trajectory, a development that did not occur in any other country in the region for most of the 20th Century (Nicaragua in the 80s may be an exception, or Venezuela in the 21st Century). This poses the problem of whether the claims made in this dissertation are due to the special conditions of the case or are more generalizable to other cases.

While this limitation is present, a structural analysis of a single case still reveals important ways that rift is determined by social metabolic pathways. Rueschemeyer (2003) points out that studies of a single case are an important part of comparative-historical research, offering details and insight that can be lost in quantitative studies that reduce countries to a set of variables. Nor was the original argument made without being justified by prior scholarship that also supports the claims being made. Even more, it provides evidence justifying further research in this direction.

For missing data, the main problem is an inability to access archives in Cuba. Due to diplomatic relations and conditions that resulted from long-standing tensions between the United States and Cuba, and more specifically and recently the increased barriers erected by the Trump Administration. Thus, accessing Cuba for research became impracticable without significant

resources and time. Thus, this limitation, as with most limitations, points toward future research and expansion.

CHAPTER 4: THE AGRARIAN SOCIAL METABOLIC ORDER OF EMPIRE'S SUGARCANE PRODUCER, 1898-1958

Introduction

In this chapter, I describe Cuba's social metabolic pathway beginning in 1898 with liberation from Spanish colonialism. In 1898, Cuba gained independence from Spain with support from the United States. This led to a major shift in Cuba's relationship with the capitalist world-economy and internal political-economic development, and arguably domination by neocolonialism. Regarding agriculture, United States protection and domination transformed sugarcane agriculture while maintaining aspects of Cuba's colonial agrarian structure. Generally, United States-led expansion of production would prove detrimental to Cuba's ecology, expanding a social metabolic order based on the degradation of soil, forest, and labor.

I will show three inter-related political-economic conditions for Cuba's agrarian social metabolic pathway during this period. First, Cuban independence led to incorporation into a United States-dominated system of oligopolistic and imperial control over the sugar industry that did not aim simply toward industrializing agriculture, but maintenance of the extraction of surplus value (Huberman and Sweezy 1960; Bray and Harding 1974; Vasconcelos 2016). This meant the coexistence of capitalist structural imperatives to commodify and accumulate capital alongside the latifundia's relations of absentee ownership collecting rent from the land. Second, the impacts of world market sugar price fluctuations on Cuba's economic development cannot be overstated. As a peripheral island nation, it was dependent on exporting sugar to bring in foreign exchange, and therefore price fluctuations had a major role in Cuba's capacity to import and grow economically. Whether sugar prices were low or high, shaped Cuba's decisions to implement policies that reduced or expanded the degree of agricultural extension and

intensification. That was occurring as countries within the capitalist world-economy sought to establish international agreements to stabilize sugar prices to the benefit of core countries. These capitalist world-economy conditions had a crucial role in the level of agri-technological development, and thus its level of mechanization and input-use. Third, at that time there was an extreme exploitation of the rural proletariat and small and medium-sized producers with precarious land tenure arrangements (Nelson 1950; Huberman and Sweezy 1960; Vasconcelos 2016). Land was highly concentrated in the hands of the few who rented it to growers, and labor was underpaid and overworked. At the same time, the reliance on labor for production meant the workers themselves had an incentive to stave off the industrialization of agricultural production (Edquist 1985). This led to contestation of the production process and its level of intensity, as workers would sabotage mechanization, as well as setting fire to the fields in retaliation for poor wages and working conditions.

The social relations of agricultural production shaped by incorporation in the US empire deeply affected the society-nature interactions (i.e., the exchanges of matter and energy). A peripheralized capitalist country with latifundias has structural limits placed on the expansion of its production processes. For instance, the increasing extensification of agriculture converts forested land into cultivated land producing rifts between species and ecological niches, soil erosion, and other ruptures. At the same time, the labor-intensive nature of production can be considered less ecologically damaging than a capital-intensive production that is more likely to produce biodiversity loss, disrupt the nitrogen cycle, and release carbon into the atmosphere. As such, position within the capitalist world-economy and the agrarian structure condition agrarian practice, and therefore the dominance and expansion of a primarily rift-making potential during this incorporated period.

I begin with a section focusing on political economy at the capitalist world-economy and national scales. Due to its importance to the Cuban economy, I specifically focus on sugar, such as exports, trade deals, world market price, and national policy regarding production. I then move on to a section about Cuba's agrarian structure, followed by agrarian practice to infer the likely ecological impacts of Cuba's incorporated agrarian social metabolic pathway from 1898 to 1958.

Sugar and Incorporation

Over the course of this agrarian social metabolic pathway, capitalist world-economy conditions drove sugar prices to rise and fall, making them volatile year-upon-year. Those fluctuations impacted the Cuban economy and agricultural production by increasing or reducing its capacity to purchase imports and how much sugar it could profitably sell on the world market. The fluctuations and the low prices mean capitalist world-economic conditions structured increasing concentration of land by making smaller producers uncompetitive. While American sugar production in Cuba through its large, industrial mills was profitable at 2.25 cents, small and medium-sized Cuban sugarcane producers were not profitable at that level. Data show a low of 1.75 cents in the 1920s for Cuban sugar and a high of 22.5 cents, a difference of 171 percent (James 1931). When discussing millions of tons, these swings represent millions of dollars. As such, world market price volatility provides an important basis for understanding capitalist world-economy impacts on Cuban economic development.

However, the actual price paid for sugar was often different from the world market price, as the price paid was often set through trade agreements (Radell Jr. 1983). This made the world market a residual market for sugar produced beyond what could be sold through the negotiated

prices and quotas. Tied to this negotiated price were attempts to control the sugar price through the establishment of international agreements by sugar producers impacting production. The capitalist world-economy's inter-state administrative apparatus can provide settlements conducive to the accumulation of capital, maintenance of class and core power and stabilize the production process across countries.

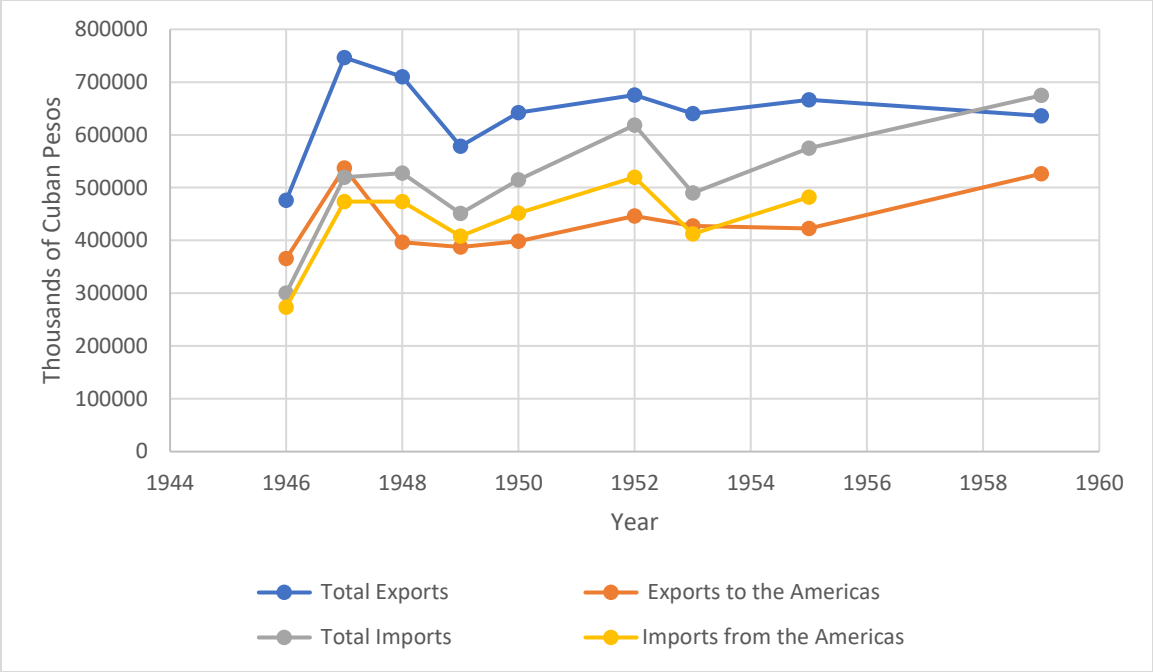
The US was the dominant actor formalizing trade agreements with Cuba. In 1903, the United States and Cuba signed a Reciprocity Agreement, which reduced export and imports tariffs by both parties (Jenks 1928; Huberman and Sweezy 1960). By doing so, Cuba would harvest and mill sugar, then send that sugar to the United States where it would be refined into a differentiated set of products. That arrangement was backed up by the Sugar Trust in the United States, which had lobbied for the agreement (Jenks 1928). It was originally opposed by beet sugar producers in the United States, although the Sugar Trust placated those producers to seal the deal. The agreement provided preferential import tariffs and pricing, which was beneficial when world market prices were low and detrimental when they were high. It was also beneficial because the US represented 20 to 25 percent of global sugar consumption.

The reciprocity treaty would be re-negotiated in 1934, giving Cuba a preferential sugar import tariff half that of other countries and establishing a quota of 1.9 million tons per year (Vasconcelos 2016). The re-negotiation came about after Cuban diplomatic pressure, a reaction to the Hawley-Smoot tariffs passed in 1930. Those tariffs had violated the spirit of the reciprocity treaty, part of a change in United States agriculture policy to protect national sugar producers. It also meant that Cuban sugar would have to reduce its price to continue to sell in the United States, as the tariff was two and a half cents per pound. The 1934 reciprocity treaty, along with the Costigan-Jones amendment, assured that the majority of Cuban exports would continue

to be exported to the United States. However, while the United States was a stable market, these new protectionist measures by the United States saw Cuba lose about half of the US market (Lecuona 2009).

From 1899 to 1914, exports to the United States more than tripled from 36.8 million dollars to 136.9 million, while remaining stable and low with other countries in the Americas, Europe, and other countries globally. Over this 15-year period, exports to the United States were 1.895 million dollars, while exports to everywhere else amounted to 287 million, only 13.2 percent. Over the same 15-year period, imports from the United States more than doubled, amounting to approximately 684.5 million dollars in total for the period. Imports over this period were also increasing from other countries, and at times, doubling. Total imports for the period amounted to 745.8million dollars.

This import-export trend continued and was exacerbated during the period from 1946 to 1959 (see Figure 5.3, showing exports and imports of all goods). As before, exports predominantly went to the Americas, primarily the United States. Even more, imports were increasingly purchased solely from the United States, demonstrating a deepening of Cuba's neocolonial dependency upon the United States. Furthermore, exports always exceed imports, because the United States forbade Cuba from accruing a trade imbalance or debt-financing. This severely curtailed their development strategy, as Cuba was not sovereign over its financial planning. In essence, they were locked into supplying sugar to the United States, while purchasing the majority of finished goods from the US and other core countries, a classic case of dependency or the development of underdevelopment (Frank 1975).



Sources: DGE 1953, 1957, 1958.

Figure 4.1. Cuban Exports and Imports, 1946-1959.

Of the exports, sugar remained dominant over this period. Sugar was the primary good used to bring in foreign exchange to purchase imports, part of the dependency dynamic. For instance, in 1913, out of 165 million pesos in exports, sugarcane and processed sugar was 118 million pesos, 71.3 percent of exports. By 1958, exports were valued at 777 million pesos (the Cuban peso was pegged to the dollar, making it a 1:1 equivalence), with sugar accounting for 591 million pesos, 80.6 percent of total export value. The other major export, tobacco, ranged from 4.6 to 6.8 percent of total export value from 1946 to 1958. As such, Cuba was an export-oriented agricultural producer. Its economic growth and development were largely based on its capacity to produce and sell sugar to the capitalist world-economy, especially the US as a core country.

With these structural pressures from the United States on Cuba's agrarian social metabolic order to produce more sugar, there was an increase in sugar production from 1 million tons in 1903 to 3.5 million tons in 1925. This was produced through infrastructure and mill development, alongside increasing extensive use of land (Dye 1998). The United States government, United States investors, the Cuban government and Cuban national capitalists set about connecting fields to mills to export channels through the construction of a rail system, amounting to some 14,800 miles of rail (Huberman and Sweezy 1960). That rail development was based on the aforementioned Military Order No. 34 that put public land into private use. Additionally, there was investment in the development of modern *centrales*, which are large, technologically advanced mills. This is part of a global convergence in processing technology led by core countries throughout the capitalist world-economy, discussed further below. Through this mill investment and development, there was a tendency toward fewer and larger mills that placed more power over sugarcane production in the hands of agroindustry (Bianchi 1964).

During this period, the "the Cuban-American Sugar Company owned six centrales with [approximately 199,218 hectares] of land; the Cuba Sugar Cane company, twelve centrales with [approximately 145,526.48 hectares]; the General Sugar Company and its dependents, nine centrales with [approximately 120,404.24 hectares]; and the United Fruit Company, two mills with [approximately 115,116.76 hectares]." (Nelson 1950: 95) Just these 4 companies possessed 580,265 hectares of land, and all of them were American owned. Therefore, Cuba's neocolonial relationship with the United States kept Cuba as a peripheral source of a raw material for agroindustry in Cuba and the United States. Taken together, Cuba was not sovereign in that it was lacking political-economic autonomy internally and externally. Therefore, as described previously, it does not represent delinking or exile as conditions, rather being fully incorporated.

There were counter-moves to this reorganization. In 1918 and 1919, a high world market sugar price drove an increase in production due to the before mentioned hegemonic conflict in Europe. After the conflict subsided, there was a crash in the world market sugar price (Vasconcelos 2016). This motivated the Cuban government to increasingly look for ways to control sugar production. Starting in 1926 with the Verdeja Act, quota controls were placed on Cuban sugar production (Pérez-López 1991). That act reduced production by 10 percent. In 1927, the Tarafa Act extended control over production through a prohibition on expanding sugarcane area and fixing the amount harvested (Lecuona 2009). This was followed by the Sugar Stabilization Act in 1930 and the creation of a single export cartel, as the state increasingly intervened in the sugar economy. From 1930 to 1941, sugar production would continuously face restrictions implemented by the state. These restrictions saw production cut from 4 to 5 million tons per year pre-1930, to 2 to 3 million tons per year from 1930 to 1941 (Pérez-López 1991). The only growers exempted from production quotas were those that produced less than 380 tons of sugar. If they produced more than 380 tons in one year, they had a margin above 380 tons that the mills would still process (Lecuona 2009). I argue this is part of the reason for an increase in the number of farms by 1946, reversing the decline by shifting production onto a varied set of sharecroppers, tenant farmers and administrators.

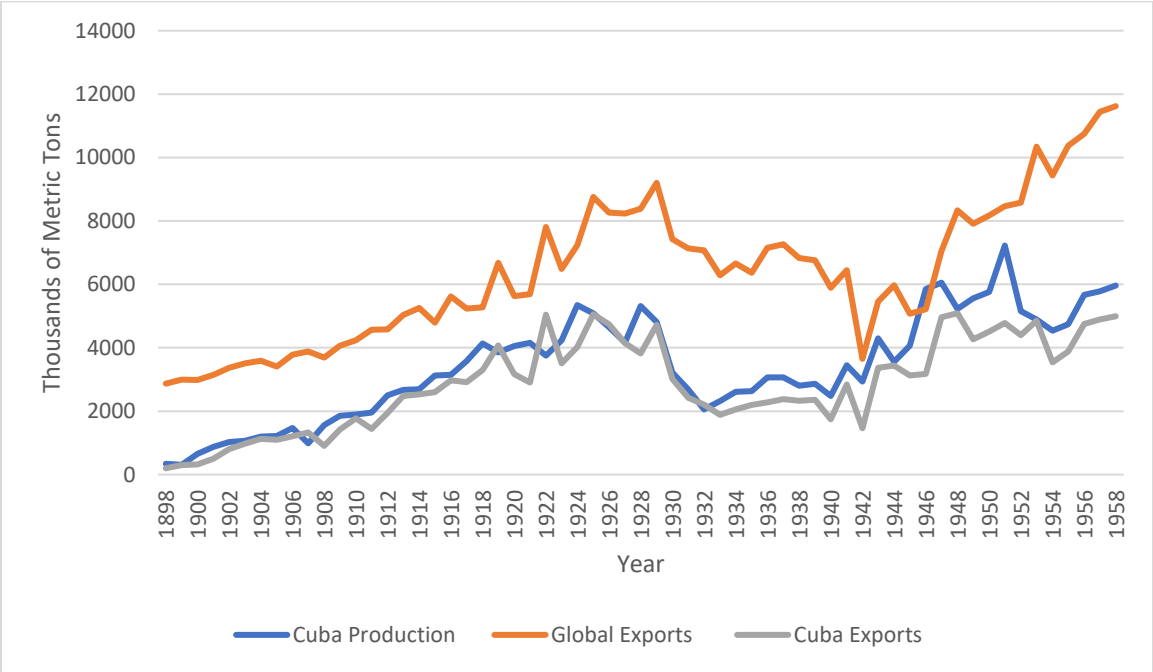
Beyond the United States and internal state controls, there were other instances of inter-state administration, an incorporative mechanism, involving Cuba. An emblematic agreement to control the level of sugar production and price was the Chadbourne Agreement that began in 1930 and was set to last for five years (Fakhri 2014). Rather than an international agreement signed between states, this occurred through informal diplomatic channels and national laws under the informal agreement (James 1931). It was set-up at the behest of American and Cuban

sugar interests to set production quotas on sugar and was entered into by all major sugar producers. The agreement also sought to control prices by fixing them at a given rate, which was also meant to curtail expansion by producers not party to the agreement. The agreed upon price was 2 cents per pound, which would be problematic for small and medium-sized Cuban sugarcane farmers. It had the backing of banks, like Chase National Bank, which would issue bonds for sugar that was segregated from scale to deal with the stored-up sugar that had not been exported from the prior years (James 1931). By restricting production and fixing prices with financial incentives, this agreement sought to stabilize the capacity for capital accumulation by large, multinational sugar producers and processors within a world-economy that had saw major declines in the price of sugar to below a profitable level.

This was followed by the International Sugar Agreement (ISA) in 1937, that set a quota of 940,000 tons per year, which was suspended with the onset of World War II. When the ISA was re-negotiated in 1953 and 1958, it set Cuban production quotas of between 2.2 and 2.5 million tons per year (Pérez-López 1991). This provided Cuba with roughly 50 percent of the global export market, yet it was much lower than the 7.3 million tons produced in 1952. In sum, inter-state administration of production and export had a major role in Cuba's agricultural development and agrarian practice.

In 1900, Cuban sugarcane had come to represent only "3.5 percent of world's sugar supply and 10 percent of the cane supply." (Jenks 1928: 129). By 1913, Cuban sugarcane had returned to prominence, representing "20 percent of the world's sugar and about 30 percent of the world's cane sugar." (Dye 1998: 2). From 1914 until 1929, Cuban sugar production and export would continue to increase alongside global exports, especially during World War I when sugar prices skyrocketed. However, with the onset of the global depression, there is a notable

decline in Cuban production and exports, once again in line with global exports. This trend is not reversed until World War II (see Figure 5.1). The United States' entrance into the Second World War led to it purchasing all of Cuba's sugar at elevated prices (Lecuona 2009).



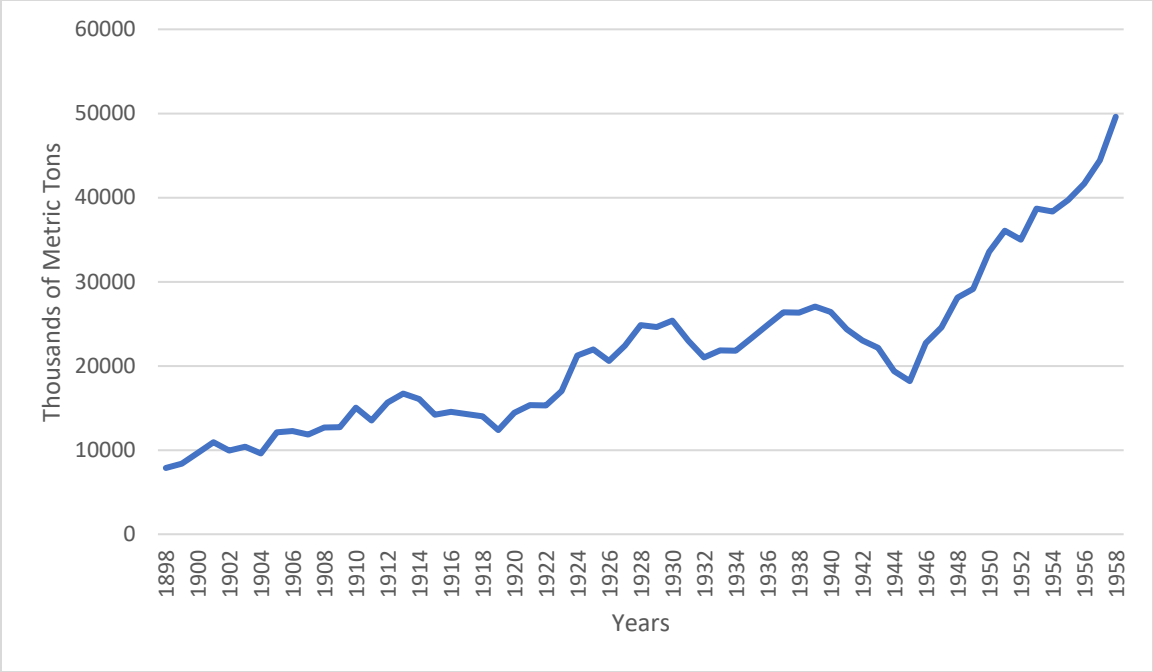
Source: FAO 1959

Figure 4.2. Cuban Production and Export of Sugar and Global Export of Sugar, 1898-1958.

Over a similar period, global production of sugar increased (see Figure 5.2), except for a decline during the inter-war years. Cuba's prominence as a sugar producer is actually prominence as a global sugar exporter, at times supplying more than half of the global export market. Exports were so important that sugar stores were used when production was not sufficient to meet export demand in a given year. That made exports higher than production in some years. Its role was a supplier of a raw material to core countries able through processing to add value and transform sugar into a multitude of other commodities. That is a position distinct

from core sugar producers, who sometimes both produced raw materials and transformed them into commodities with higher exchange value, thus enabling further industrial development.

This is the case, even when Cuba faced increasing beet sugar competition, as well as the increasing production by other sugar producers, such as Dutch-colonized Java (Dye 1998). Beet sugar producers were located largely in Europe and core countries. Beet sugar and sugarcane producers existed in the United States, but the major competitors were in Europe. In agricultural production, certain imperialist and core states had production capacity for fertilizers and were then able to use these in beet sugar production to outcompete colonial states that produced sugarcane (Dixon 2017). This was part of a shift from labor to technology in core agricultural production, and part of a development policy seeking to substitute domestically produced raw materials for imported, colonially produced raw materials (Freidmann and McMichael 1989). Colonial and neo-colonial states that were industrially underdeveloped relied more on the exploitation of labor as a substitute for mechanization and synthetic inputs.



Source: FAO 1959

Figure 4.3. Global Sugar Production, 1898 to 1958.

It is clear then that incorporation into the capitalist world-economy as a periphery played a major role on Cuba's economic development by structurally shaping agriculture production. Despite Cuba's relatively high level of GDP per capita relative to other Latin American countries, its level of economic development was circumscribed by its position in the hierarchy of production processes within the capitalist world-economy. Taken together, these capitalist world-economy conditions structure Cuba's sugar production as a periphery, incorporated without anti-systemic resistance at the level of the nation-state. This had effects on the agrarian structure, which I detail in the following sub-section.

Incorporation and the Agrarian Structure

Dispossession

Sugar agriculture had been devastated during the war for independence by a number of factors: insurgents' regulation of sugar production to force a reduction, fires, abandoned land, and debt. These factors all interacted to place farmers in a precarious position and vulnerable to United States and Cuban speculators and collectors. Cuban independence became an opportunity for United States investors, who as Jenks (1928) relays, were impressed by the fact that "four-fifths of the land was unoccupied, that it was fertile to a degree, that it was absurdly cheap, and that white settlers could live upon it." (141) As mentioned, even before the incorporated social metabolic pathway, Cuba had been selling upwards of 80 percent of its sugar exports to the United States (Bray and Harding 1974). Further, Spain had already begun establishing the legal apparatus that justified the liberalization of Cuban common lands, pointing toward continuity in the dispossession of Cuban small and medium-sized farmers (Balboa 2004).

This core opportunity for capital accumulation was building on an existing trade relationship between the two and an institutionalized liberalization of land tenure. The neocolonial relationship between Cuba and the United States leveraged these characteristics to pursue accumulation by dispossession, whereby resources are privatized to support the capitalist class's profit-making (Harvey 2004). Farmers' land was taken due to inability to service debt and communal land privatized, so that agrarian capital interests could use that land to make profit and proletarianize the labor force. The United States set in motion a series of formal economic institutions that led to their dispossession (Balboa 2004). Initially the United States government did protect the planter class from dispossession through Military Order No. 46, which put a moratorium on debt collections (Pérez Jr. 1985). However, further measures, such as attempts to

set-up agriculture banks for credit or requests for debt relief, were rebuffed by the US Governor General. The Governor General claimed that such actions would be paternalistic and anti-freedom. Instead, he instructed those planters and farmers seeking relief to demonstrate the profitability of their enterprises, specifically for United States-based finance capital (Pérez Jr. 1985).

When Military Order No. 46 eventually expired, it was supplanted by Military Order No. 139, that began the process of debt collection, and thus the dispossession of the planters and farmers to the benefit of national and foreign capital that consolidated and concentrated landholdings (Pérez Jr. 1985; Balboa 2004). Pérez Jr. (1985) reports that a "survey in 1900 revealed that of 40,000 farms assessed, 16,000 were encumbered with mortgages totaling $132 million" (243). With only 60,710 fincas [farms] after the war, this means that between 26 to 40 percent of farms were capable of being repossessed if their debts were not paid. The problems confronting the planter and farmer class were exacerbated further by Military Order No. 34 and Military Order No.62 in 1902. No. 34 was put into effect under the pretext of developing the sugarcane production infrastructure, increasing the amount of public land under private control to build railways to transport sugarcane (Barrios 1998). Even more, No. 34 institutionalized expropriation in the service of capital accumulation (Pérez Jr. 1985). No. 62, colloquially referred to as the "Law of Dispossession," legalized the privatization of common land [*haciendas comuneras*] and the surveying and delimitation of land that had been owned without a title providing a specific perimeter (Balboa 2004). These institutional changes, along with the prior mentioned capitalist world-economy conditions for capital accumulation, meant that by 1929 there were only 38,105 farms in Cuba (Balboa 2004).

There were countermeasures put forward in a series of laws and decrees meant to re-distribute land that were not executed. The Law of January 9th, 1904 and Decree No. 492 from July 1911 called for redistributing state land to independence fighters, mambises, and in general to people who were landless (Barrios 1998). The Law of July 11th, 1906 provided a fund of a million pesos for distributing and preparing land. Their existence points to the demands of the small and medium-sized farmers and planters, which at least rhetorically were actualized by representatives in Cuba's newly minted republican political institutions (Barrios 1998). There was even diplomatic pressure placed on the United States by Cubans to pursue policies supportive of small and medium-sized farmers. However, without actual execution and stiff resistance by the national agrarian landowner class and United States corporate and financial interests, these were little more than words.

Agrarian Structure and Land Tenure

The agrarian structure of Cuba during the United States-social metabolic pathway saw important changes to land tenure and distribution. These changes were directly connected to the dispossession resultant from liberalization of land tenure and the increasing commodification that are part of incorporating agriculture into the capitalist world-economy.

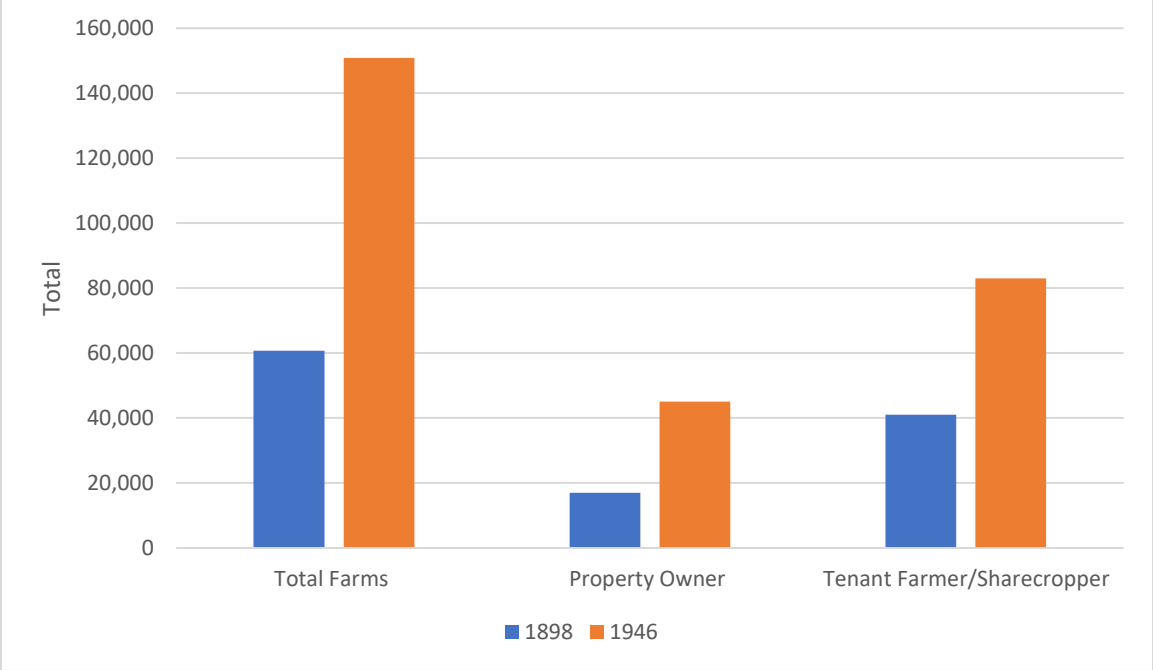
In 1898, of the 60,711 farms (*fincas*), 40,984 were *arrendatarios* (i.e., renter or tenant farmer) and 16,990 were *dueños* (i.e., property owners). There is a residual "*ocupación mixta*" category with 2,737 farms, which is said to "include every other class" of farm (Sanger, Gannett and Willcox 1900; 555). Further, the majority of farms, 63.4 percent, are approximately less than 8 acres in size. Another 19.2 percent are between 8 and 16 acres. Only .5 percent of farms are more than 330 acres. As such, the majority of farms were smaller, tenant farms.

This agrarian structure was supported by the United States. In its *Informe Sobre El Censo de Cuba, 1898* [Report on the Census of Cuba, 1898], a United States government official wrote that, “no case has been given in which a small sugar producer really prospers or gets out of debt…” (542; translation mine). The report goes on to state that this is due to the indebted forced to pay for their loans rather than invest in the farm, along with not receiving the benefits of economy of scale, such as cheaper input prices when bought in volume and increased labor productivity.

The 1898 census is taken when common land tenure carried over from the colonial era continues to exist. For example, the *hacienda comunera* was land tenure held in common granted by the Spanish empire (Ayala 1995). This land system was parceled over the course of the incorporated social metabolic pathway, consumed “in the eastern part of Cuba by “*intereses geofagos*” (“land-eating interests”) in the service of U.S. corporations.” (Ayala 1995: 112). The prior discussed military orders played a key role in this liberalization, forcing the delimitation of land, with those without documents unable to prove ownership and at risk of losing their land (Balboa 2004). There is also a sizable portion of public land utilized to produce wood, amounting to around 495,540 hectares (Portuondo 1899). This land was also privatized, a conversion of the public good into a tool for capital accumulation.

Moving forward, there was a similar agrarian structure in terms of land tenure, although with an increase in the total number of farms. According to the 1946 agrarian census, of the 150,844 farms, only 45,031 were held by *propietarios* (i.e., direct owners). The majority of farms, 103,993, fell within five categories representing tenancies based on utilizing land owned by someone other than the grower: 8,314 in *administrador* (i.e. land administrated for an absentee landowner) 43,758 in arrendatario, 6,756 in *subarrendatario* (i.e., sub-renter or sub-

tenant farmer), 32,429 in *partidario* (i.e., sharecropper), and 12,736 in *precarista* (i.e., squatters without legal title; see Alvarez (2004) for translations of Spanish land tenure terms). Thus, liberalization of land, along with the restrictions placed on production, had led to an increasing use of a varied set of contracted farms. Of these farms, the majority produced little monetarily. 90,957 of farms made less than 1,000 USD in 1945 and only 10,323 of farms made 5,000 or more USD. In addition, 125,491 of farms only had between 1 and 49.9 hectares (approximately 2.5 to 123 acres), overlapping with the majority of farms producing less than 1,000 USD of value per year. The major three types, *arrendatario, sub-arrendatario,* and *partidario* had 54.3 percent of land in cultivation, demonstrating the dominant role of tenant farming and sharecropping in Cuban agriculture well into the 20th Century.



Source: Sanger and Wilcox 1900; Ministerio de Agricultura 1946.

Figure 4.4. Total Farms and Land Tenure, 1898 and 1946

These base statistics demonstrate that the majority of farms were operating on land they did not own, were at the bottom of the economic hierarchy in terms of economic production and contained little of the overall land. Even more, it means that Cuban growers were often renting, or sharecropping land owned by United States companies, with another portion owned by a Cuban landowning class. As discussed prior and in further detail below, United States *centrales* owned large swaths of land in Cuba, such as the United Fruit Co.'s two mills owning more than 100,000 hectares. This follows from the prior discussed history of the political-economic structure, where sugar production was oriented toward the United States market that conditioned a latifundia type of agriculture and made the Cuban landowning class dependent upon US patronage. Thus, the agrarian structure in terms of land tenure remains relatively similar over the course of the US social metabolic pathway (see Figure 5.4). This is the case even when accounting for shifting organizational types, such as the creation of the *precarista* and *administrador*, the increase in the total number of farms after an initial loss, the loss of common and public land, and that the Cuban Constitution of 1940 *de jure* outlawed the latifundia system.

Therefore, Cuba during this period is going through a process of accumulation by dispossession, as common and public land is enclosed during the incorporated social metabolic pathway. This demonstrates how incorporation tends toward reorganization of social relations emphasizing commodification to the benefit of capital accumulation. Because of these structural forces, and as reported earlier, the number of Cuban farms initially declined to 38,105 farms by 1929 (Balboa 2004). Not only did the number of farms decline, but land ownership became concentrated by national and foreign capitalist interests. The national and foreign bourgeoisie was able to utilize this land for the purpose of capital accumulation, both in terms of production

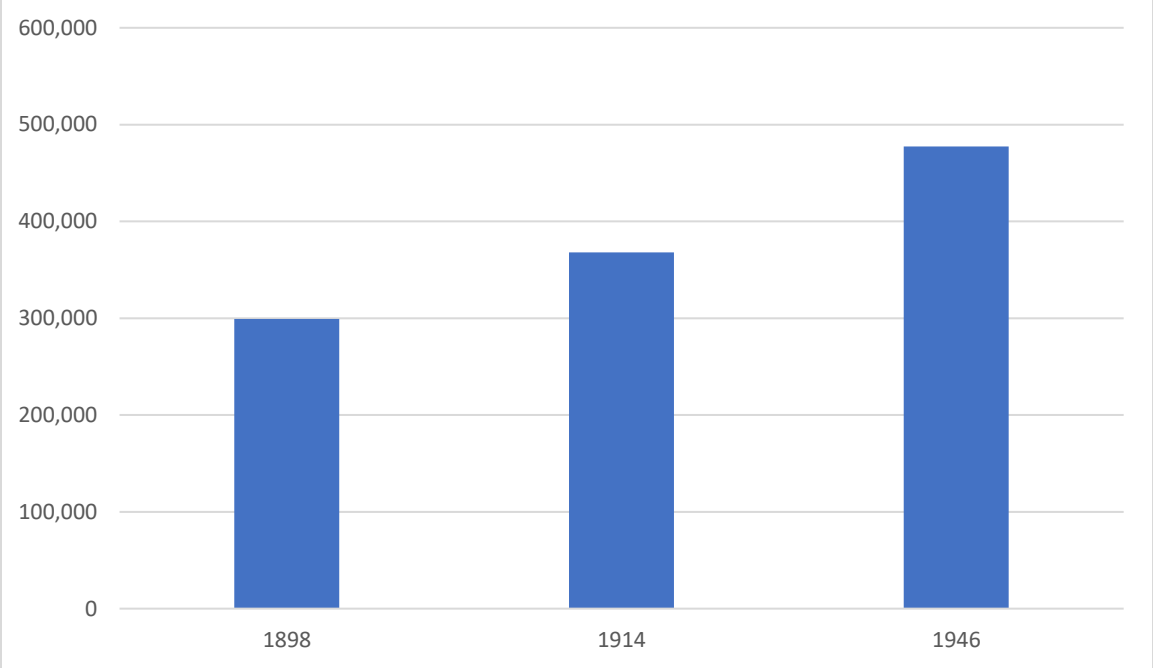
and rent. This allowed those class and core interests to become the foremost decision-makers over how agricultural production would occur and what would be produced.

Agrarian Structure and Labor

The latifundia system of tenancy had an effect on the structure of agrarian labor, proletarianizing and increasing agricultural labor in the periphery at a time when core countries were beginning to use technology to reduce the amount of labor used in agriculture. First, there is a split between wage labor and non-wage labor. In 1946, the only year this number is supplied, non-wage labor accounted for 352,285, of which 331,724 were permanent workers. While not noted, it is likely that this differentiation of salaried and non-salaried is related to whether or not the worker owned the land or was part of a household that owned the land that was being worked. Agricultural labor is often carried out by members of the family, and this labor does not have to be remunerated. Further, Ayala (1995) notes that in 1906, companies in the Eastern part of the country ran into labor shortages because the population had access to land for subsistence farming. As discussed before, with land liberalization and the concentration of land in the hands of fewer owners, evidence suggests that the number of rural non-wage labor has been in decline relative to the increase in wage labor, while producing a semi-peasantry/semi-proletariat with access to small plots of land (Pollitt 1979, 1980). This tracks with Ayala's (1995) point that these companies were seeking to build a rural proletariat, whether nationally or through immigration.

As such, the data show an increase in rural wage labor (see Figure 5.5). According to the 1898 census, a total of 299,197 were employed in the agriculture sector (although, this number also includes fishers and miners). This increased in 1914, when number of agricultural workers employed was 367,931. By 1946, wage labor amounted to 477,383 workers, of which 423,690

were considered temporary (i.e., they did not work the full year). That temporary labor confronted the drudgery of the "*tiempo muerto*" (dead time), when they received no wages unless they were lucky to find employment in the sugar mills (Vasconcelos 2016). Thus, there is a constant increase in the number of agricultural workers. Taken together, the wage and non-wage labor numbers, totaling 829,668, demonstrate that Cuba had a sizable rural (semi)proletariat, along with a sizable peasant class.



Source: Sanger and Wilcox 1900; Ferrara 1915; Ministerio de Agricultura 1946.

Figure 4.5. Total Number of Agricultural Wage Laborers, 1898-1946.

The 1956 and 1957 censuses do not provide numbers on population employed in agriculture, but if the 1946 numbers provide an idea of the percentage of the population employed in agriculture by getting its proportion relative to the 1943 total population provided in the 1956 census. In 1943, the total population was 4,778,583, making an estimate 17.4 percent of

the population employed in agriculture, whether permanently or temporarily. Since I do not have access to the total number of people in the labor force, I cannot provide an exact percentage of agriculture's proportion of the total labor force. Nevertheless, it would be higher than the 17.4 percent of the total population, because the young, elderly, and many women are not included in the labor force. This makes agricultural labor a dominant part of Cuba's labor market, which follows from its reliance on labor-intensive agrarian practices, instead of technology intensive.

Therefore, the agrarian structure reinforced a proletarianizing trend in rural Cuba, even while it maintained a large number of tenant farmers. With land more and more concentrated in the hands of a few capitalists who needed to break the role of subsistence farming, proletarianization became an important part of agricultural development. Doubly important in a low-intensity agrarian system with extensive use of land. At the same time, that proletarianizing trend led to a new form of rural struggle, with the unionization of sugarcane cutters and a different set of demands, from land to wages. That trend reinforced the expansion of wage labor through its attacks on technology, while stabilizing the sale of labor-power through wage concessions. As such, the change in agrarian structure impacted labor with a similar trend over the course of the incorporative social metabolic pathway, demonstrating again how incorporation reorganizes the production process.

Agrarian Practice in the Incorporated Social Metabolic Pathway

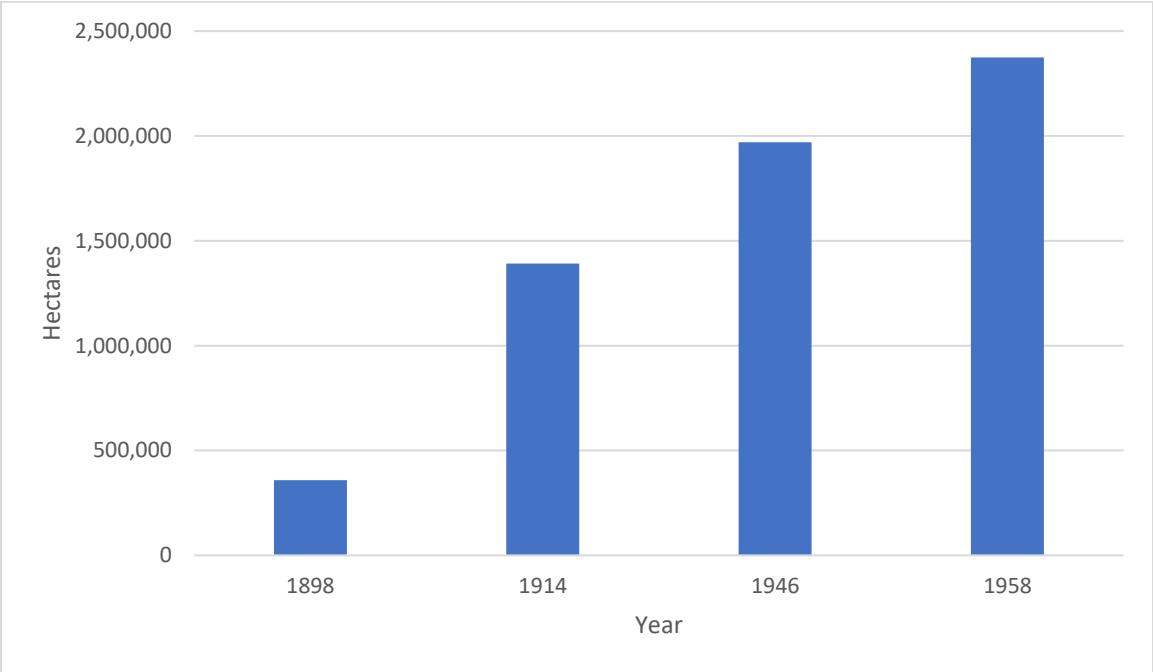
Land Use Change

Land use change for agriculture is a key indicator of rift-making potential, because under certain conditions, like monocrop agriculture, it can disrupt soil cycles and lead to deforestation. That is, it takes the ecological cycles and puts them directly in the service of capital

accumulation. For instance, the soil fertility that is central in reproducing a forest ecosystem is put in the service of cane production, as the amount of land in cultivation increases and the amount of forested land declines. This increase in land cultivation for sugar production is largely destined for the United States and the world market. As such, it is structurally conditioned extensive agriculture for capital accumulation, directed towards the needs of the core nations in world-system. Nutrients, like nitrogen in the soil, and the calories produced were essentially transported to the core.

By 1914, 1,391,278.24 hectares of land were cultivated. That represents an almost tripling of land in cultivation from 1898. At that time, more than fifty percent of cultivated land was in just two commodity crops, sugar and tobacco, neither of which is very nutritionally beneficial for humans. The remaining 621,117.86 hectares was planted in “fruits and lesser cultivars”. By the 1946 agrarian census, there was an approximately 40 percent increase in land in cultivation, with the majority of land in sugar and tobacco cultivation. Chonchol (1963) reports that 1958 statistics show a continued increase in land under cultivation, climbing to 2,374,668 hectares. Of that, 56.1 percent of hectares in cultivation were in just sugar, and “Other cultivars”, which now includes tobacco, was 43.9 percent of hectares. Taken together, these statistics represent an enormous increase in land use for agriculture (see Figure 4.7). From 1914 to 1958 there was a 96.5 percent increase in land under sugarcane cultivation and a 70.7 percent increase in land cultivation generally. Thus, Cuba was dominated by monocrop sugarcane with 56.1 percent of land in cultivation. Even more, despite the introduction of quotas, land in cultivation continued to increase, with other crops being brought into production. This far outpaces Cuban population growth, evidence that, when conjoined with the exploitation of Cuba

by the United States, this cultivated land was put in service of producing a specialty item, largely for the benefit of wealthy nations and national elites.



Source: Sanger and Wilcox 1900; Ferrara 1915; Ministerio de Agricultura 1946; Chonchol 1963.

Figure 4.6. Cultivated Land, 1898-1958.

Importantly from a social metabolic perspective, increased land in cultivation, especially for sugar, has ecological impacts. Planting sugar is shown to have impacts on soil structure and soil quality, which impacts water filtration, fertility, and biogeochemical cycling (Pankhurst et al. 2003; Weil and Magdoff 2004; Cherubin et al. 2017). For instance, sugarcane root growth can lead to soil organic carbon and macrofauna losses, along with soil structural degradation (Cherubin et al. 2017). As well, overtime sugarcane harms soil health leading to an increase in detrimental soil biota, such as fungal root pathogens and nematodes, which then decrease yield (Pankhurst et al. 2003). That means, increased sugarcane cultivation tends to rupture nutrient

cycling, breaking down soil structure, and altering the biological organisms within the soil. This soil damage is compounded by the deforestation required to bring land into cultivation.

Doyon (2013) describes 72 percent of Cuba covered in forest at the time of first contact with the Europeans. By 1959, this had been reduced to 14 percent (Díaz-Briquets and Pérez-López 2000). Nelson (1950) clarifies here that deforestation accelerates with the production of sugar after the Haitian Revolution in 1789. From that time, clear cutting of forests to make way for sugar production was the norm (Nelson 1950). Shaffer (2019) declares that by 1925 "sugar industrialists had cleared forests at annual rates of about 100,000 hectares" (150). This links to the increasing land use change for sugar cultivation directly to a rift-making activity, deforestation, that also disrupts soil cycles. This is one of the main forms of rift-making that occurs through incorporation of Cuba's agrarian social metabolic pathway into the capitalist world-economy via the United States.

It is rift-making because deforestation has a multitude of associated negative ecological impacts. First, deforestation increases soil erosion, which leads to the loss of topsoil, "the breakdown of soil structure and the decline in organic matter and nutrient" (Morgan 2005). Second, deforestation leads to the release of stored carbon, both from the trees and the soil (CBO 2012). Third, deforestation brings about a loss in biodiversity above the soil, in terms of the loss of mammals, birds, and insects, and in the soil, in terms of microbial communities, small arthropods, and nematodes (Giam 2017; Franco et al. 2018). Therefore, deforestation has a significant role in rupturing a multitude of ecological processes.

Extensive Rift-Making

The structural conditions that lead to rift-making in peripheral Cuba, are counterintuitively conditions that dampen the intensity of that rift-making. Or, put another way, the core-periphery dynamics with Cuba subordinated to the United States and latifundia agrarian structure certain rift-making capacities, like deforestation, while not other forms, such as soil compaction from tractor usage.

In 1946, only 144,983.60 hectares of land were fertilized, amounting to seven percent of total land in cultivation. Of land fertilized, only 16.5 percent was non-sugarcane agriculture. This is most likely an underestimate, because it only accounts for crops provided in the 1946 agrarian census: beans, malanga, boniato, café, onion, garlic, squash, yuca, yam, potato, rice, corn, bananas, pineapple, limes, grapefruit, and oranges. At the same time, these are the majority of major non-sugar crops. This means that of land fertilized, a sugarcane was 83.5 percent, the overwhelming majority, demonstrating a possible link between export-oriented production and intensification. However, less than 10 percent of sugarcane land was fertilized. So, while sugarcane land degrades soil health, it appears that during this period other strategies, such as leaving land fallow or bringing more land into cultivation, were chosen to address soil infertility.

Also, only 59,809.40 hectares of land had irrigation, amounting to only three percent of total land in cultivation. Of that, non-sugarcane land only had 17,688.7 of cultivated land with irrigation, amounting to 29.6 percent of all irrigated land in cultivation. This means that of land in non-sugarcane crop production, 4 percent was fertilized and 3.9 percent had irrigation, showing a lower use of mineral inputs and of irrigation in these systems compared to what is the case in the core at that time.

Thus, products oriented toward export, and thus more incorporated into the capitalist world-economy, are more likely to see industrial practices applied. However, the intensity is conditioned by an agrarian structure that seeks to extract the most surplus value from the least capital input. It is cheaper to bring new land under cultivation than it is to prepare depleted soil for cultivation. By not fertilizing and irrigating, this reduces the rift-making that can come from overapplication of nitrogen leeching into the groundwater and groundwater depletion. At the same time, the rift-making that is occurring is preparing Cuban agriculture for a future more dependent on building irrigation systems and applying synthetic inputs, thereby moving in the likely direction of intensification. It is not that peripheralization and latifundia purposefully reduce intensification, but rather that these conditions structurally blunt by blocking agricultural modernization and intensively exploiting labor.

Another statistic that demonstrates the low-level of industrialization is the low number of tractors that were being utilized. Part of the reason for this low use of heavy machinery is the import cost and lack of technological development for sugarcane production. Another reason was that the rural labor movement promoted a direct struggle against technology, with labor against implementing modern technology that could lead to increase levels of unemployment (Edelstein 1983; Lecuona 2009). Technology was seen as competition for jobs by increasing productivity and decreasing the need for labor.

Across Cuba in 1946, there are only 1,880 tractors, meaning 1 tractor per every 1,043.6 hectares or 1 tractor per every 80 farms. For comparison, the United States in 1950 had a tractor for every 2 farms. Tractors require petrol to run, metal to be built, foreign exchange to import and other inputs which increase the flow of material and energy for agricultural production. Further, tractors compact the soil, impacting its ability to drain water and increasing soil erosion.

The low use of tractors is therefore another indicator of lower rift-making in Cuba agriculture, by reducing material inputs into the system and negative externalities from its use. Although, this meant an increased exploitation of labor for cutting cane, pulling weeds, and other agrarian practices that had been supplanted by technology in core countries.

There is no discussion throughout the pre-1959 annual statistics or agrarian census of chemical controls of any kind, such as insecticides, herbicides or fungicides. The 1985 annual statistics does provide a number for pesticide and herbicide imports in 1958. It states that 2,118 thousand of pesos were imported. Because of this, it is not possible to discuss the use of chemical control except through speculating that its omission from the different sources of descriptive statistics as well as its omission in the secondary academic sources would tend toward its low-level of use. The low-level of use would then reduce the rift-making that occurs when pesticides are deployed against both pests and natural controls, damaging food webs and increasing the need for more chemical controls.

What has been recorded are the use of cultural controls and non-intensive methods being used. The two-fifths of farms that were held by small, subsistence farmers did practice more sustainable methods of production, whether due to their beliefs, lack of economic resources or heavy reliance on manual labor. These farmers owned their land, amounting to between .9 to 24.9 hectares (Vasconcelos 2016). For instance, traction and tilling was handled by animal power rather than heavy machinery, shown to be better for soil compaction and to reduce erosion (Bennett and Allison 1928; Nelson 1950). As well, pest management, such as weeds, was carried out by hand, as opposed to utilizing chemical controls (Nelson 1950). Even in sugarcane production, Bennett and Allison (1928) describe the use of planting schedules to have the plants grow leaves to shade the ground and suffocate weed growth. Lecuona (2009) also mentions the

use of biological control to combat the *Diatrea saccharalis* (sugarcane borer), utilizing *Lixophaga*, a fly. These are clear signs of the continuance of activities within an agrarian system that makes rift-making more extensive while dampening the intensity of rift-making.

Chapter Conclusion

In general, the data provide strong evidence that incorporation, in the case of Cuba, increases the rift-making potential of this social metabolic pathway. The incorporative social metabolic pathway is based on a social metabolic order increasing the movement energy and material to produce more and more sugarcane for the capitalist world-economy. Agriculture was heavily commodified with a basis in formal exchange, forest land was converted to agriculture, land was brought into cultivation, and the amount produced largely increased when countervailing structural conditions were not at work. In turn, this leads to rift-making that produces biodiversity loss, soil erosion, soil infertility, and the release of stored carbon. Being a peripheral economy reinforced these dynamics, as the focus of economic development was on a monocrop with little capacity for the extraction of surplus value across the commodity chain. Incorporation as a structural determinant is then a necessary condition for the Cuban agrarian social metabolic order's increased rift-making potential, especially in terms of sugar production.

Yet, certain conditions have to be placed on the link between incorporation and a rift-making social metabolic order, providing a larger role for peripheral position on the level of intensity, due to its impact on sovereignty over political-economic development and industrial capacity. The increasing level of extension was conjoined with a high rate of exploitation of labor and low levels of agricultural industrialization. I argue that this is due to how the social metabolic pathway operated, whereby there was little reason for the neo-colony to intensify

agriculture when it met the extractive demands placed on its agricultural production for industry in the imperial core, the United States, as well as for the national bourgeoisie to access imports and accumulate capital. This allowed for the continuation of latifundia relations between landowners and tenant farmers, who either paid a rent or a tribute to maintain their operations. Without access to capital to industrialize production, this model relied on farmer self-exploitation, the exploitation of the rural proletariat, and an ever-more extensive use of land.

As such, incorporation does play a role in agricultural development, but it is not a linear relationship (i.e., if incorporation therefore increasing intensity of agriculture). The intervening condition is whether there is a structural imperative based upon the agrarian structure and external political economic relations to intensify the production of sugar. When agricultural production is under oligopolistic control aimed at extracting the most surplus value for the least cost, there is not necessarily a structural imperative to industrialize. If, as in Cuba, there is no structural imperative to intensify production, because of access to a resource like existing forested land, that then dampens the rift-making impact of the social metabolic order. United States investment was focused on increasing the capacity of existing land in cultivation to provide the necessary supply of sugarcane for processors in the United States, which is extensive but not intensive. However, as noted above, the practices being carried out would eventually require a more intensive agriculture because of the reductions in yield that follow from soil infertility and increasing amounts of problematic soil biota that sugarcane production creates.

Furthermore, during the 1933 to 1958 era, there were measures to control the amount of sugar produced to affect the price of sugar in the world market. In that instance, the capitalist world-economy itself becomes an impediment to rift-making. That is, incorporation itself will often produce a rift-making social metabolic pathway as a general tendency, but under certain

conditions where capital accumulation is not possible through increasing production, that tendency can be dampened or reversed. Yet, once conditions for capital accumulation reappear, the general tendency returns.

Additionally, the low level of agricultural intensity does not represent either an agroecological form of production or an absence of environmental degradation. The incorporative social metabolic pathway reinforced existing environmental degradation, such as the clearing of forests for sugarcane fields that had occurred during the latter part of the 1800s. While a lack of delinking was an obstacle to higher levels of rift-making during this period, it does not mean that changing conditions in the overall capitalist world-economy or in the relationship with the United States would reproduce this same effect. Instead, it is historically contingent and structured result. This points toward a need to expand the social metabolic pathways under examination. In the following chapter, I examine Cuba's agrarian social metabolic pathway as incorporated and delinked.

CHAPTER 5: THE SOCIAL METABOLIC PATHWAY OF SOVEREIGN, SOCIALIST SUGAR, 1959-1991

Introduction

In this chapter, I analyze Cuba agrarian social metabolic pathway after the revolutionary triumph in 1959 leads to a critical juncture breaking path dependence from the prior incorporated period. By the end of this critical juncture, a delinked and incorporated agrarian social metabolic order has formed led by a socialist-oriented state in the Soviet sub-system of the capitalist world-economy through. In crucial respects, such as the abolition of the agrarian capitalist and latifundia class and de-commodification of land, the Cuban Revolution re-organized its agrarian structure, shifting the development trajectory (Eckstein 2003). However, I argue that this did not push Cuba into exile from the capitalist world-economy, which may not have been possible at this time without severe economic deprivation for the Cuban population.

Instead, Cuba remained incorporated within the capitalist world-economy as a peripheral state linked to the Soviet sub-system. Cuba's Soviet trade relations were contingent on their historical circumstance and ability to survive in a hostile Western Hemisphere, led by the United States' foreign policy (Eckstein 1978). This, in conjunction with its increasing use of capital-intensive technologies and inputs, produced specific social-ecological relations in agriculture as sugar exports remained central. Cuba delinked thus increasing sovereign control over commodification in agriculture and breaking with its neocolonial subjugation by the United States, while still confronting structural imperatives to increase sugar production. As such, Cuba during this period represents an important case for understanding rift-making in a delinked social metabolic pathway incorporated into the capitalist world-economy.

In this chapter, I will describe three inter-related political-economic conditions that impact the rift-making potential of Cuban agrarian practice. First, Cuba's agriculture policy from 1959 to 1989 was principally focused on industrializing agriculture. That was both a cause of and response to the decreasing amount of rural labor. Second, agricultural industrialization was carried out through a dominant state farming system, which opted for larger plots and collectivized administration. That form of agricultural development was meant to leverage Cuba's comparative advantage in sugar to bring in foreign exchange through export and solidify its trade and subsidy relation with the Soviet sub-system. This provided Cuba with capital to finance imports to build an industrial base, both for agriculture and industry writ-large (Eckstein 1978). Third, the peasant class gained de-commodified land that they were able to produce on autonomously, along with access to credit and technology. This was linked to support from institutions, like the National Institute for Agrarian Reform (INRA).

These conditions alter agrarian structure and practice, such as increasing use of fertilizers, pesticides, heavy machinery, and land in cultivation. Thus, while reducing rift-making in certain forms, like reforestation, the overall affect was an increasing flow of energy and material through agricultural production with the inferred ecologically damaging effects. Because of this array of increasing and decreasing rift-making potential, I argue that delinking based on de-commodification and radical reorganization of the class structure while still incorporated does not lead to an agrarian social metabolic pathway with a dominant trend of rift-restituting potential, although it can provide conditions for further changes in that direction in the future.

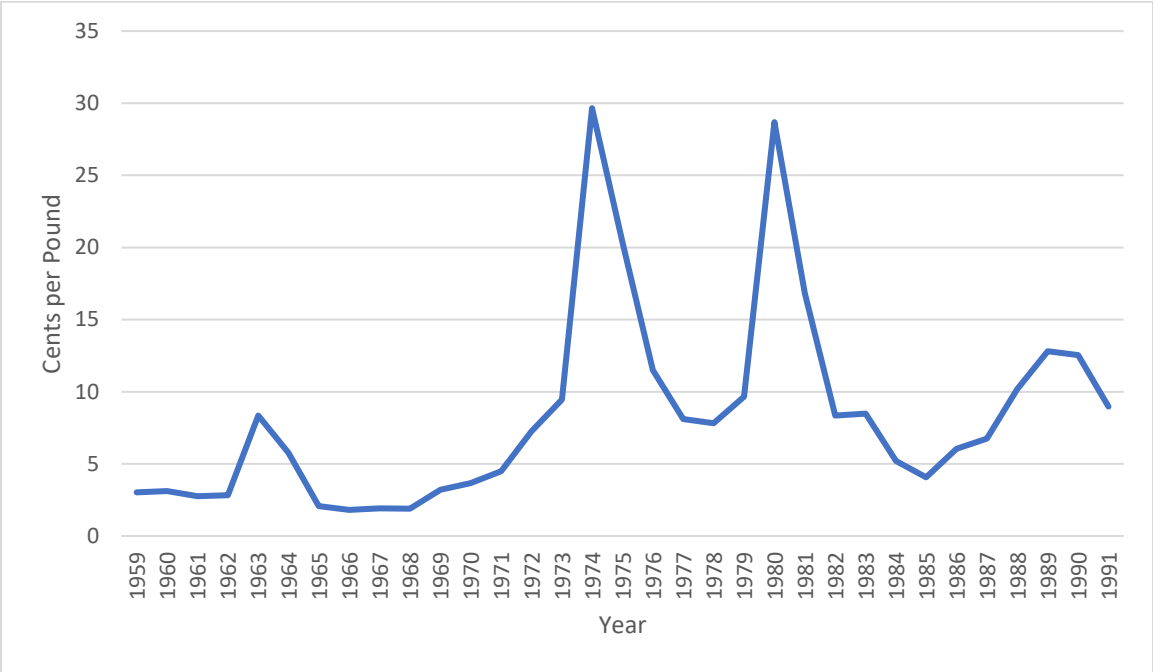
Delinking Sugar and Ongoing Incorporation

Over the course of the delinked, incorporative social metabolic pathway, a new configuration for the capitalist world-economy was in place. Post-World War II conflict between core nations was blunted by inter-state administration, often centering on setting rules for trade and competing for position in the core-periphery hierarchy (Wallerstein 1993). The increasing integration and regulation of production and trade was part of a more general trend in inter-state administration during this period, whereby development policy prescriptions were based around modernization in a stable system for economic growth (McMichael 2016).

In that system, fluctuations in the world market price for sugar from between a low of 1.81 cents per pound a high of 29.66 in 1974 were not as consequential as in the prior social metabolic pathway (see Figure 5.1). As mentioned in the prior chapter, world market price represents the residual market, only 14 percent of world sugar exports (Fry 1985). This is because sugar prices continued to have preferential status set by international agreements. Zimbalist (1988) reports that in 1987 the world market price was six cents, while the Soviet price was 45 cents.

The difference in quota prices and world market prices demonstrate another axis upon which the majority of sugar exports were protected or harmed by fluctuations in the capitalist world-economy. When sugar prices were higher than the quota price, exporters would lose out on the gains from that difference. And, the opposite is also true, that when the world market prices were lower than the preferential prices, exporters would be protected from loses. Yet, this is not the case for Cuba, who was able to leave its sugar obligation to the Soviet Union unfulfilled and sell on the world market when prices were high. Its bilateral agreement,

principally a political agreement, then was a key part of inter-state administration, enabling it to escape the impacts of low prices and benefit from high prices.

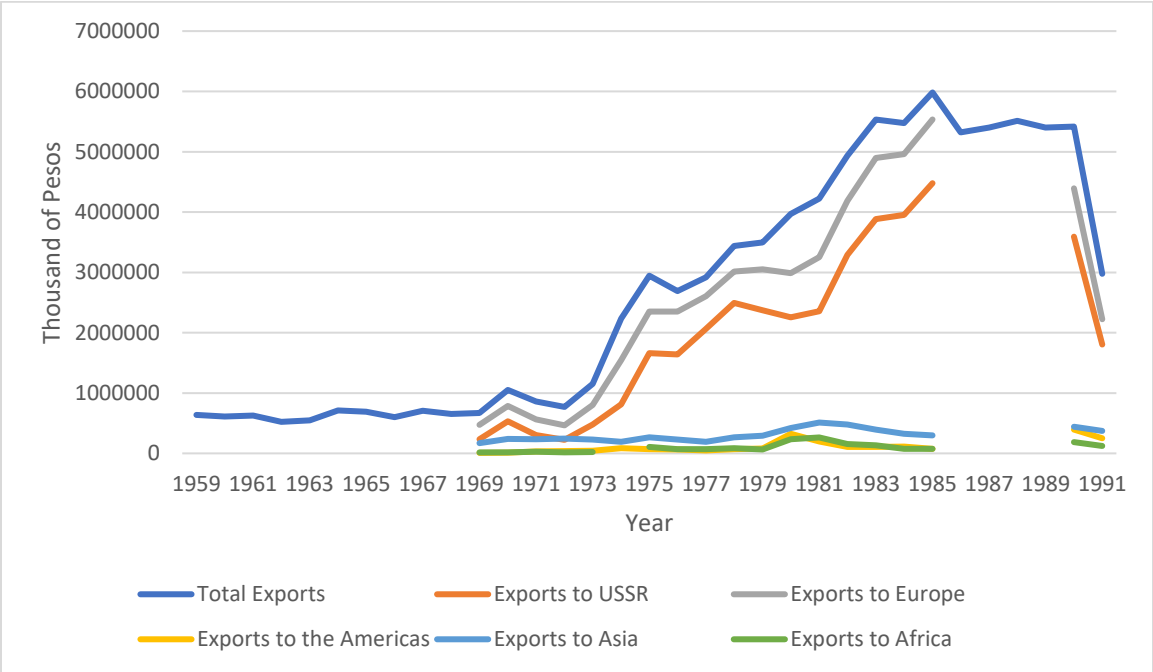


Source: Hannah and Spence 1996.

Figure 5.1. Nominal Price of Sugar, 1959-1991.

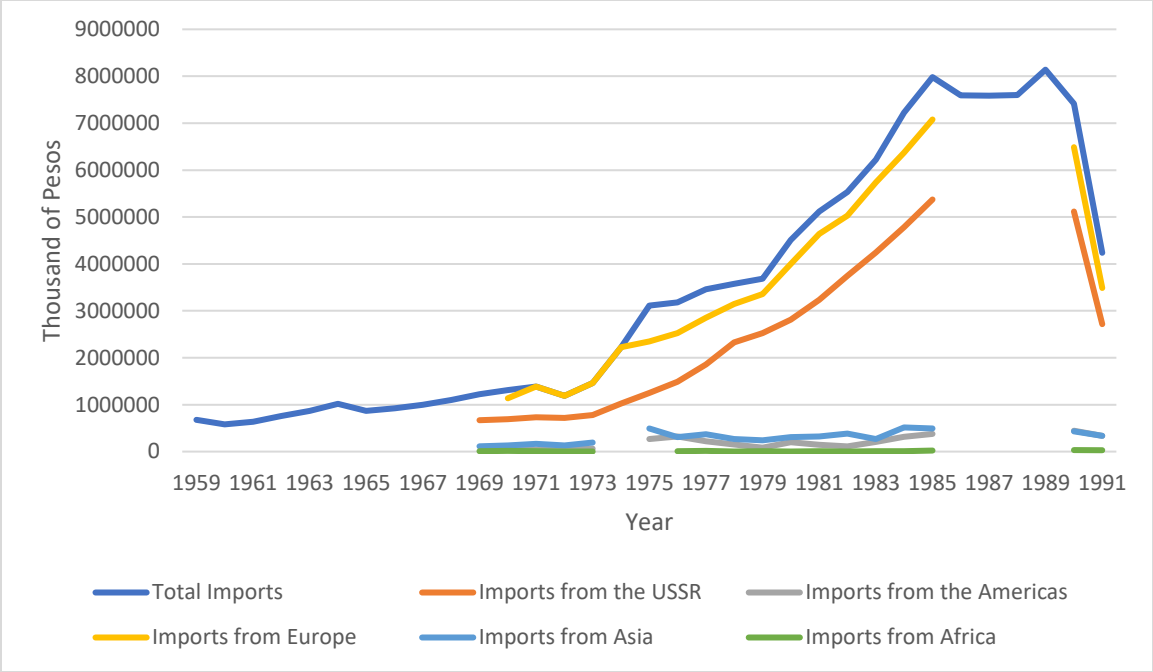
This is why for Cuba, the most important part of inter-state administration during this period was the Soviet sub-system. United States hostility pushed Cuba into agreements with the Soviet Union, as there was a clear economic rationale to shift trade toward a partner that was supportive of the revolution's social justice goals (Mills 1960). When the United States applied sanctions on Cuba, refused to honor its purchases of sugar, and then applied a trade embargo, the Soviet Union stepped in to purchase Cuban sugar exports upon which Cuba was economically dependent, as explained in the prior chapter (Eckstein 2003). This shift can be clearly seen in a comparison of trade data, with the percentage of trade with socialist countries going from 18.7

percent in 1960 to 70 percent in 1961 and 82.8 percent in 1962 (CEC 1965/66; see Figures 5.2 and 5.3).



Source: DCE 1966, 1973; CEE 1980, 1985; ONE 1998.

Figure 5.2. Cuban Exports, 1959 to 1991.



Source: DCE 1966, 1973; CEE 1980, 1985; ONE 1998.

Figure 5.3. Cuban Exports, 1959 to 1991.

Eckstein (1978) notes that during the late 1960s Cuba most relied on the Soviet Union in terms of trade. This was because Cuba was its most isolated at this time in relation to core, capitalist states. And over the entirety of the pathway, Cuba was able to access oil at below world market price, which Cuba could use for energy, as well as for re-sale to bring in foreign exchange (Pérez-López 1979). Even more, Cuba accessed credit, received scientific support for agricultural production, technical assistance in the form of agricultural inputs, and import food (Blasier 1979). These links with the Soviet sub-system solidified further in 1972, when Cuba became a formal member of the Council for Mutual Economic Assistance. From this moment, Cuban exports and imports began to increase rapidly (Bain 2016). The Soviet Union even renegotiated debt payments, deferring payment, to allow for Cuba to continue debt-financing

development (Eckstein 2003). Therefore, Cuba was supported in terms of sovereign development by the Soviet sub-system, thereby demonstrating its delinked structure.

Instead, the Soviet Union had built an alternative sub-system to the one dominated by the United States, tying together countries such as Poland and Czechoslovakia, into its own trading bloc. This was formalized under the Council for Mutual Economic Assistance, which Cuba joined in 1972 (Bain 2016). Under that system, trade agreements were developed in which the Soviet Union would provide investment, technology, and preferential prices, without making ownership claims (Sanchez-Sibony 2014). However, the Soviet Union often did not have the resources nor technology to provide to this bloc, leading them to turn toward capitalist, core countries. The Soviet Union itself would increase its trade with capitalist, core countries from less than a quarter in the 1950s to almost a half by the 1980s (Sanchez-Sibony 2014). Thus, trade and support for socialist states was crucial, it was also insufficient.

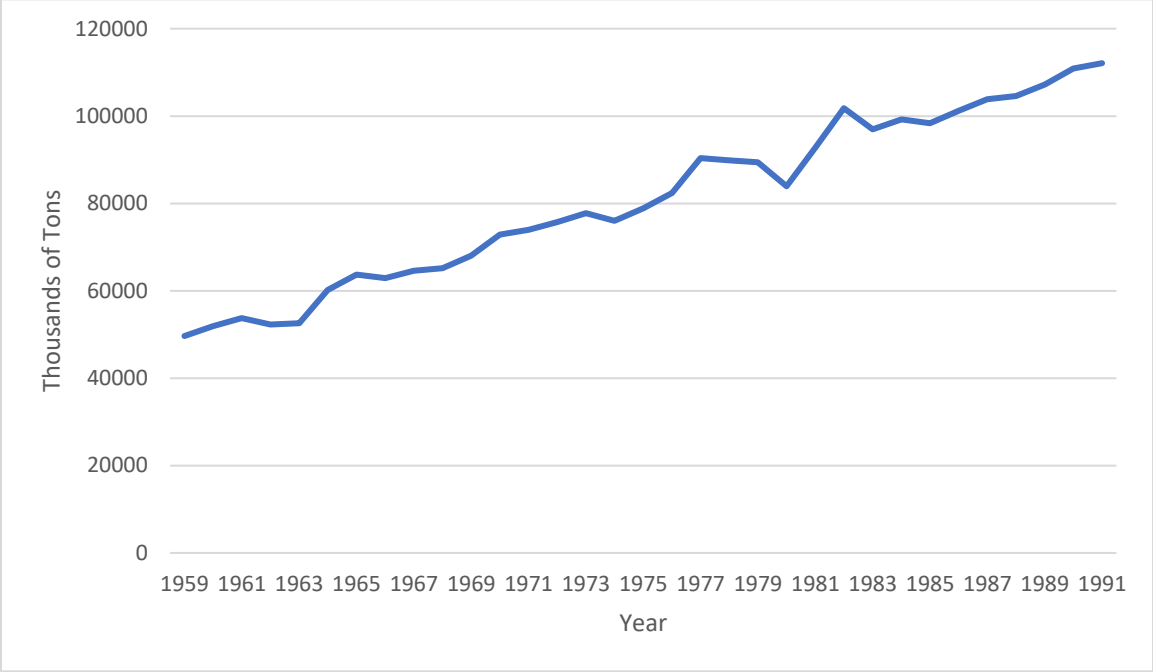
As such, the Soviet sub-system, was a constellation of semi-peripheral and peripheral states, still dependent upon advanced technology from the core for production. To import that technology required export-based trade to bring in foreign exchange. This often meant that within the hierarchy of production processes, these semi-peripheral and peripheral states remained locked into their positions, with lower levels of productivity and less diversified economies. Cuba was no exception, even while the Soviet sub-system aided it in diversifying agriculture and industry. Studies of trading bloc cliques show that the United States was a central core through which trade often passes, with West Germany and Japan also operating as core states (Su and Clawson 1994; Blanton 1999). While providing an alternative trading bloc and form of inter-state administration, the Soviet sub-system was not autonomous from the capitalist

world-economy. Instead, it was a delinked alternative to dependency upon the United States, with socialist countries incorporated on terms conducive to their sovereign, development agenda.

Because of this, Cuba maintained relationships with core, capitalist countries, such as Canada and Spain. For example, in the case of Canada, the relationship proved vital for increasing milk production in Cuba. Cuba was importing Canadian dairy breeds and then crossbreeding them with Cuban breeds for heat tolerance (Funes-Monzote and Palmer 2020). Another key partner was West Germany, which supported Cuba in the manufacture of heavy machinery for agriculture (Edquist 1985). Even more, by the 1980s, Cuba had begun codifying foreign investment, permitting joint ventures with companies from other countries as a part of its development strategy (Eckstein 2003). And Cuba was accessing credit from financial institutions in core, capitalist countries, although this ended when Cuba was no longer able to fulfill their debt obligations (Eckstein 2003).

Additionally, there was the increasing use of multilateral agreements. During this period, two International Sugar Agreements were signed to regulate sugar. Sugar exporters instituted these agreements as part of development strategies to benefit developing countries (Fakhri 2014). The 1968 International Sugar Agreement continued the priorities of previous agreements, utilizing production and exports quotas, along with setting prices, to make the market stable. The International Sugar Agreement in 1977 went a step further in regulating sugar, by also regulating the stores of sugar and providing exemptions for developing countries to maneuver relative to price fluctuations (Fakhri 2014). Specifically, the agreements were aimed at increasing exports and stabilizing prices, thereby bringing in foreign exchange for economic development in the Global South.

Competition continued within the international division of labor, which had a major role in keeping prices low. Competition in the capitalist world-economy's sugar market steadily increased over this period. Across the globe sugar production rose, with many regions registering 37 to 85 percent increases in production between 1972 and 1984 (Brown 1987; see Figure 6.4). Much of this production increase is for internal consumption and processing. For instance, Brazil had an almost tripling of production from 1960 to 1990, going from 3,438,000 metric tons to 9,100,000 metric tons. However, the overwhelming majority of production increase was for domestic consumption, both for consumers and processing into ethanol (Buzzanell 1992).

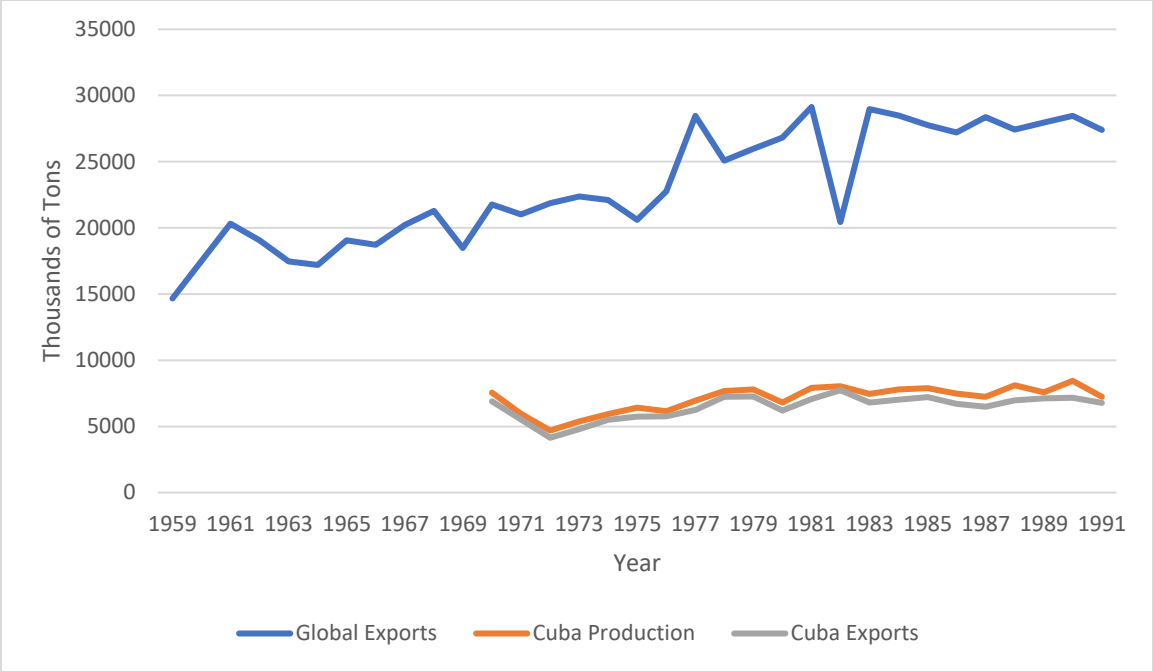


Source: Hannah and Spence 1996.

Figure 5.4. Global Sugar Production, 1959-1991.

In addition, European beet sugar producers were protected to encourage domestic production and discourage imports of cheaper sugar beyond a set quota (Hannah and Spence

1996). That quota provided entry to the European market, but only as a small part of the larger sugar sector. Even more, the European Economic Community would increase its export production from 1974 to 1983 and dump subsidized surpluses when it was convenient (Pollitt 1985a). Then, there was the expansion of high fructose corn syrup in the late 1970s, a major change in the world sugar economy. It was transported in liquid form, cheaper, and uniform, increasing demand from processors (Brown 1987). This meant that sugar cane and beet sugar producers were now competing with corn producers for the same market in sweeteners. So, there is increasing competition for the world export market in sweeteners more generally over this period. Even with this competition, Cuba remained an important sugar exporter, largely due to the Soviet Union and still predominantly through the export of raw sugar lacking value-added processing, maintaining around one-fifth to one-sixth of global exports over the period when measured in tons (see Figure 6.5). Therefore, it maintained its peripheral status within the hierarchy of production processes, even with the preferential economic prices offered by the Soviet sub-system's form of inter-state administration.



Source: Hannah and Spence 1996.

Figure 5.5. Comparing Global and Cuban Sugar Exports with Cuban Sugar Production, 1959-1991.

Therefore, the capitalist world-economy's inter-state administration of sugar impacted Cuban sugar production and exports during this period of a delinked and incorporated agrarian social metabolic pathway. Global trade, competition within the international division of labor, and position within the hierarchy of production processes continue to have important roles, but in altered form. Cuba remains a periphery in terms of technology and monocrop export, but as detailed further below, with a capacity to diversify its economy based on Soviet sub-system support and a planned economy. Due to the increasing incorporation of the globe into the capitalist world-economy with a strengthening inter-state administration, growth itself was no longer as tied to trade as it was in the prior pathway. Cuba's position in the socialist international division of labor played a major role in inter-state administration stabilizing production increases

by assuring a profitable, continuous export market. As such, Cuba is incorporated, however on sovereign terms, delinking which is a major structural change in comparison with the prior agrarian social metabolic pathway.

Delinked State Planning

The Cuban Revolution had a strong rural basis, with a focus on addressing the role of sugar monocrop exports in Cuba's economic development (Rodríguez 1959). Middle-class intellectuals joined by rural proletarians and industrial workers recruited directly from the peasantry in the Sierra Maestra, who then became the majority of the rebel forces (Wolf 1999). This led the head of the *Instituto Nacional de Reforma Agraria*, Carlos Rafael Rodríguez, to characterize the revolution as an *agrarian* revolution in the pages of *Cuba Socialista* (Rodríguez 1959). That agrarian basis would continue to play a pivotal role in Cuba's political-economic order during this period.

Immediately following the Cuban Revolution there was a move toward a re-organization of agriculture, including diversification and redistribution of land. The Agrarian Reform Law of 1959 actualized constitutional provisions that curtailed the owning of large-scale plantations and restricted private property in agriculture (Bianchi 1964; Pérez-López 1991). It did this by restricting ownership to a maximum of 402 hectares, with exceptions for highly productive growers and cattle ranchers (DuMont 1970). The 1959 law's redistribution of land began an important process of providing land to peasants, with up to 32,823 titles granting 382.4 thousand of hectares (Bianchi 1964). Institutionally, this law established the National Institute for Agrarian Reform (INRA for Spanish acronym), which would execute the nationalizations, redistributions, taxes, tariffs, and other agriculture policies (Bianchi 1964). Yet, however radical this first

agrarian reform was, it was still within the parameters of the existing capitalist world-economy by maintaining private property and not socializing nor communalizing agriculture.

In 1963, there was a Second Agrarian Reform Law, which would solidify the effects of the critical juncture and the new path dependence on the delinked, incorporated social metabolic pathway. In part, this second law was meant to counter the reactionary forces in rural areas that had been attacking volunteer brigades and supporters of the revolution, while also abolishing rural capitalists and landowners (Ghai, Kay, and Peek 1988). An even larger portion of land was given over to cooperatives and a state-controlled sector, and the limit on private landholding was set at 67 hectares (Kapcia 2008). With this transfer of land, there was no longer a capitalist or latifundia class in agriculture.

What marks Cuba as delinked was the extent of de-commodification, planning, and the abolition of a capitalist class, which led to an expansive welfare state, socialization of production through the state, and expanded capacity for the Cuban state to develop a sovereign development policy (Eckstein 1982; Figueras 1991). A dominant bureaucratic class, solidified in the Communist Party of Cuba and the state apparatus, maintained power through its capacity to centralize political control over socialized production utilizing planning, quotas and wage controls to administrate the surplus (Hodges 1981). Planning and budgeting occurred through two models; one representing a Soviet model with the Auto-Financing System, utilized by agriculture, in which there was buying and selling between firms, and the other, a Guevarist model, represented by the Budgeting Finance System, in which exchange between firms is handled by the central state (Yaffe 2012). Both were handled through the Central Planning Board (JUCEPLAN for Spanish acronym) and were carried out in different sectors of the economy (Yaffe 2012).

In the case of the Auto-Financing System, it was based on the use of "self-financing" for state enterprises (Ugarte 2006). The argument was that this would provide a motive to produce, as well as imperatives to be cost-effective and profitable to create surpluses that provide revenue to the National Budget and be able to pay workers and for inputs to continue production (Ugarte 2006). At the same time, firms are not able to provide credit between each other, and are only able to access credit through the National Bank, and only look for investments as laid out by the Central Planning Committee (Ugarte 2006). This system was implemented by INRA, a demonstration of the continued use of market mechanisms within the agriculture sector, which externally was the main sector for bringing in foreign exchange.

By 1970, the debate around the use of market mechanisms to coordinate the Cuban economy had shifted even more in favor of a Soviet model. The failure of the 10-million-ton harvest, along with the misallocation of resources to attempt it, had led to a major reassessment. The new model of planning included more market incentives and sought to create more rational budgets (Eckstein 2003). The Cuban government implemented a new planning system, *Sistema de Dirreción y Planificación de la Economía* (System of Economic Management and Planning), which led to increased trade between firms and organizational-level budgeting, even though the state continued to cover losses. This was paired with the implementation of five-year plans beginning in 1975, as the production process overall became more rationalized and bureaucratized (Molina and Rodríguez 1980).

In terms of production, there were important changes under delinked state planning. For industry, this period had industrial diversification, a goal that had been pursued since the beginning of the revolution. There were increases in the production of steel, nonelectrical machinery, nickel, and engineering goods, predominantly machinery for agriculture (Zimbalist

and Brundenius 1989; Figueras 1991). Although, the principal area in which diversification occurred was in agriculture, with even industrial production focused on providing technology to the agriculture sector (Molina and Rodríguez 1980; Zimbalist 1988).

Additionally, to address the black market in agricultural goods, there was the formalization of markets. The first type of marketization that occurred was through state-operated stores that sold goods at higher prices than they would be found in the ration system (Benjamin, Collins, and Scott 1984; Deere and Meurs 1992). The second type were the *mercados libres campesinos* (farmers' markets), at which small landholders could sell their products directly to consumers and set their own prices (Deere and Meurs 1992; Rosenberg 1992). Private farmers still had to sell their production to a*copio*, the state procurement system, at pre-established prices, but anything beyond the quota could then be sold in the *mercados libres campesinos*. Both of these systems were tied into a roll back of the ration system, although caloric intake remained high and with a more diverse set of foodstuffs to purchase (Benjamin, Collins, and Scott 1984).

By the end of the 1980s, there were important reversals to the implementation of capitalist mechanisms, a period known as "Rectify Errors and Negative Tendencies." President Castro criticized bureaucrats and profiteers for reproducing a capitalist ideology (Eckstein 2003). The farmers' markets were closed in 1986, with complaints of high prices (Rosenberg 1992). There were increases in the use of voluntary labor and a rollback of material incentives for labor (Eckstein 2003). Even the SDPE was reformed, as control was re-centralized (Eckstein 2003). while internally there were these rollbacks, externally the government continued to emphasize foreign trade and investment (Eckstein 2003).

Therefore, over this period, despite shifting parameters, delinked state planning continued to provide the Cuban government with tools to dictate development. Specifically, these focused on control over commodification, market competition, and the production process. That is distinct from the prior incorporated social metabolic pathway, in which the Cuban government relied fully on commodification under heavy influence from United States capital, even if it at times utilized policy to provide some level of control. Delinked state planning, mixed with incorporation, had profound impacts on Cuba's agrarian structure.

Delinked and Incorporated Agrarian Structure

Agrarian Structure and Land Tenure

The agrarian structure of land tenure during the delinked, incorporated social metabolic pathway saw important changes. As described before, the change in land tenure types was the result of the agrarian reforms, along with shifting ideas on optimal socialist forms of production and continued support for smallholder farmers. In a major way, these reforms brought about an incredible simplification of the land tenure system from the prior pathway, resulting in three basic types: smallholder, state, and cooperative. These different types of farms were differentiated not only by size and social relations, but also in terms of the crops that they grew and how decisions were made internally.

Of these types, the state farm, or *granjas del pueblo*, was the dominant type, representing a commitment to socialization based on state ownership. It also meant the continuation of large farms, with their predominant focus on sugar production, as well as dairy, egg, and beef production. In 1961, state farms only represented 28.1 percent of farms, with an average size taking land divided by the total number of state farms (300) at approximately 8,500 hectares

(Alvarez 2004). There is not a total number of state farms provided for later years during this period in the *Anuarios*, although they represented 70 to 79 percent of total land, including non-agricultural land, by the 1970s (Pollitt 1982). For the years 1973 to 1976, of total cultivated land, which was from 3,414,800 hectares to 3,544,200 hectares, state land cultivated was approximately 86 to 88 percent of land in production. Therefore, in terms of agriculture, state land tenure was dominant.

Smallholder farms were the next important land tenure type during this pathway. The first agrarian reform led to 150,210 smallholder farms, which by the 1970s had risen to approximately 213,000 smallholders, if measured by ANAP membership (Burgess 1985). These smallholder farms did not have to pay for their land, either by possessing the title or usufruct rights, and were represented by their mass organization ANAP in terms of affecting state policy. While the state did not see smallholders as the optimal type of land tenure, they also did very little toward reducing the number of smallholder farmers. There were certain controls at times on production and the government could rent private land, but these waned when they detrimentally impacted rural support (Eckstein 1982). At the same time, it was more difficult for smallholder farmers to access technology, inputs, and other resources through the state, as preference was given to state and cooperative farms (Alvarez 2004). Many smallholders participated in Credit and Services Cooperatives (CCS for Spanish acronym), where they retained autonomous control over production. The CCS was a way to pool together to access economic resources, from loans to technology, without pooling land (González 2012). What the state did do was to work to persuade smallholder farmers to form and join cooperatives, with some success.

Production cooperatives were originally established in sugar production following the first agrarian reform, with 630 cooperatives operating, and converted into state farms in 1962

(González 2012). The next phase of cooperativization occurred in 1975, with the establishment of Agricultural Production Cooperatives (CPA for Spanish acronym). The CPAs pooled together smallholder farms into a single farm, thereby consolidating fragmented parcels of land (Kay 1987). These CPAs made the use of heavy machinery easier, as it consolidated fragmented land segments, as well as making it easier to provide utilities, such as electricity and schools, as was done in the state land tenure system (Lehmann1985; Pollitt 1992). Land in cooperatives would rise from 383,000 hectares with 1,128 cooperatives in 1980 to 1,008,800 with 1,378 cooperatives in 1985. These were increasingly seen as a more optimal form of socialist production.

Certain types of tenure cannot be readily quantified, as statistics on them either do not exist or are not publicly available (Alvarez 2004). For example, certain land was provided to workers at state farms for independent, subsistence production (Pollitt 1979, 1980; Eckstein 1982). When this was phased out, land owned by the state was utilized for subsistence production by workers. So, while this is technically state farmland, its function was distinct, and its produce was not appropriated by the state. Instead, it was distributed amongst the workers, which was also being done in the cooperative sector (Pollitt 1979, 1980; Lehmann 1985; Ghai, Kay, and Peek 1988). Thus, there is a portion of farming occurring as subsistence that is not counted or overlaps with the prior statistics.

Therefore, during this period land tenure was decidedly marked by delinked relations, in that whether the farm was state or not did not alter the reality that the land had been de-commodified. Even more, a capitalist class did not possess those farms. The state farms were administrated by the bureaucratic class in power, administrated by managers, and operated by rural proletarians. In the case of cooperatives and smallholder farms, they were directly operated by the peasant class. However, the purpose of production was uneven, with part of production

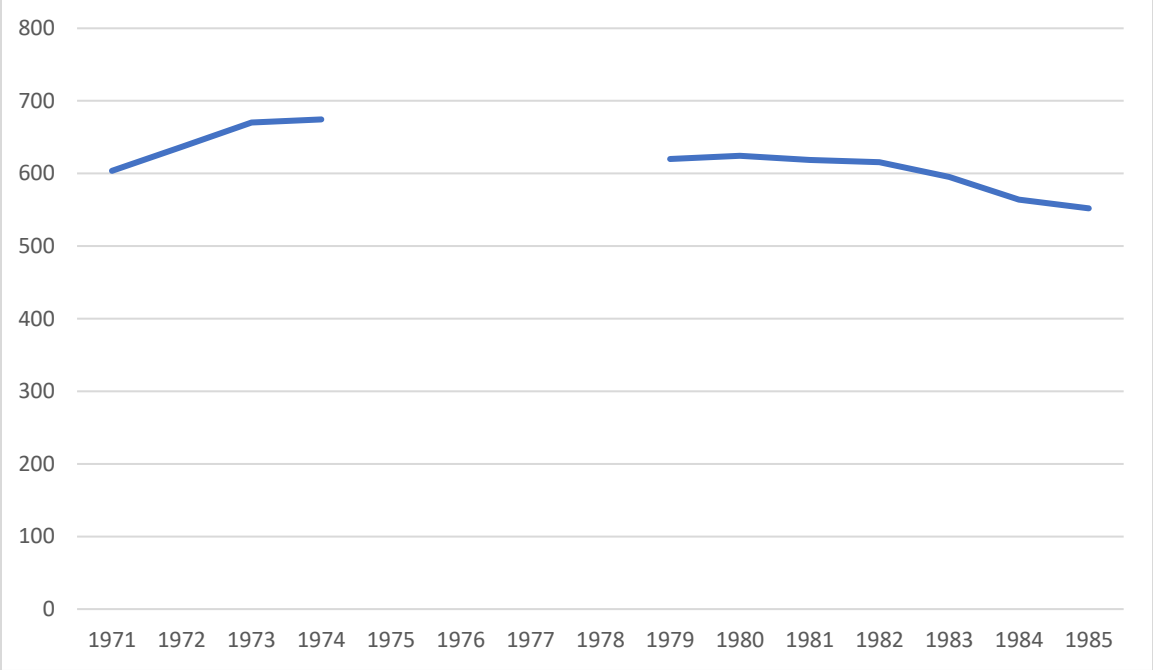
alienated from the direct producers to be sold under the law of value for an exchange value in external and internal markets. Another part was directed toward the state to be distributed in the ration, which while not free, was not meant to produce a surplus value. As such, land tenure is delinked, a major transition from the prior pathway.

Agrarian Structure and Labor

The Cuban Revolution radically altered labor in agriculture. No longer were temporary cane workers living in dread of the *tiempo muerto*. Instead, full employment was guaranteed, along with a pay raise and numerous social benefits (Ghai, Kay, and Peek 1988), there is a substantial increase in the social wage, with "schooling, medical care, medicines, and social security" provided by the state, as well as "water, burial services, sports facilities, even public phones" (Benjamin, Collins and Scott 1984). These benefits were augmented by reducing rent to only 10 percent of income, along with reducing the cost of other utilities, thereby increasing the amount of money the working class had to spend (Benjamin, Collins and Scott 1984). Under these conditions of a high social wage, withdrawal of labor did not incur economic costs. As such, there was a high rate of absenteeism, upwards of twenty percent, which was part of resistance, as well as allowed for time to work on other activities, such as subsistence farming (Pollitt 1979, 1980; Ghai, Kay, and Peek 1988).

There was also quite a bit of out-migration, which led to a loss of important knowledge necessary for diversifying agriculture and industry. This was in part due to the arduous labor necessary for cutting cane sugar, as well as the expanding opportunities in other sectors of the economy. The statistics show that from the 1979 until 1985, the number of laborers in agriculture declined (see Figure 6.7). This is also shown in the percent of the labor force in agriculture,

which went from 30 percent in 1972 to 17.4 percent in 1985. In response to this decline, there was increasing use of material incentives in labor, such as piece rate pay and bonuses for productivity, and rules put in place to control absenteeism, such as an anti-loafing law (Ritter 1974; Eckstein 2003).



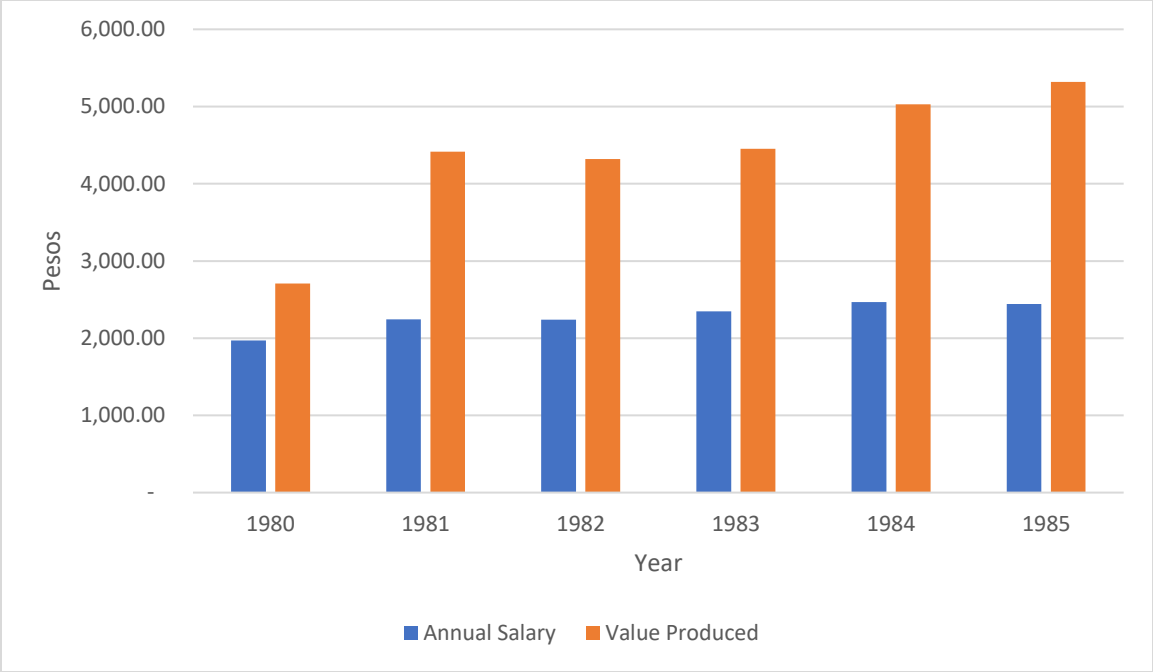
Source: DCE 1973; CEE 1985.

Figure 5.6. Average of Workers in Agriculture, 1971-1985**.**

It is important to note that peasants (i.e., a class with access to land for production, whether for subsistence or sale) and rural proletarians (i.e., a class of agricultural workers paid a wage without access to land for production) are not categories that are mutually exclusive. As Pollitt (1979, 1980) points out, many could be better categorized as semi-peasants, semi-proletarians, due to wanting both land and wages. As discussed, Pollitt (1979) found that workers on state farms maintained subsistence plots on land supplied by the state where they would

deploy their labor. Martinez-Alier (1970) makes a similar argument, that prior to the Revolution, many peasants were in fact proletarians. Once the Revolution began expropriating and re-distributing land, or ruling in favor of squatters, proletarians began to demand their own land (Martinez-Alier 1970). Thus, it is not absolutely clear if laborers can be categorized on state farms as proletarians, at least in the initial part of this period, when Pollitt (1979) argues that they were de-proletarianized to an extent. By the 1970s, it is much clearer that state workers are more proletarianized, as market incentives are increasingly utilized to regulate labor and access to subsistence plot is shifted from household to the state farm (Pollitt 1979; Ghai, Kay, and Peek 1988). Also, as stated prior, at no point were the workers in state farms deciding on the labor process, nor what was produced.

Statistics show that there is a surplus value extracted from agricultural laborers, and that it was increasing during the 1980s (Figure 6.8). The statistic does not differentiate between land tenure types, even though smallholder farms and cooperatives were able to employ labor on their farms. As such, the amount of labor appropriated by smallholder farms or cooperatives cannot be distinguished. Because of this, what I am examining is the general amount of quasi-surplus value that was produced by labor during the period of 1980-1985. In that instance, labor produced roughly double the amount of value than it was paid, which in the case of state sector was value appropriated by the bureaucratic class that controlled the distribution of the surplus for national development policy. However, this must be balanced against a reality of a high social wage. In a sense, by socializing the cost of living in many cases, which enabled the state to offer a lower wage, and thereby appropriate the surplus value of labor for its development program in areas like health and education.



Source: CEE 1985.

Figure 5.7. Salary and Value in Agriculture.

Furthermore, there are other categories of agricultural labor that are neither proletarian nor peasant. Voluntary brigades represent a form of labor based on substantive exchange, as pay was in the form of social prestige and direct provisioning (Eckstein 2003). Although, this also must be understood as a reservoir upon which the state is able to draw and increase the surplus while addressing labor shortages with less productive labor. And there is the rise of technicians and professionals. This is a major part of making intensification possible, by developing the knowledge-base of labor to carry out agronomic tasks, as well as to handle heavy machinery. With the flight of the professional class at the beginning of the period, this required a universal education policy to train this skilled workforce.

Therefore, while there is no capitalist class, the dominant bureaucratic class continues to appropriate agricultural labor for a national development agenda often decided with direct

democratic participation, both to spur on development and diversification and for redistribution through social programs. This is occurring while there is a declining number of agricultural workers, both in total and relative terms. That decline, along with absenteeism and the low productivity of volunteer labor, would motivate the turn to heavy machinery.

Agrarian Practice in the Delinked, Incorporated Social Metabolic Pathway

Agrarian Practice and Land Use Change

During the Soviet social metabolic pathway, there is a long-term trend of intensification (i.e., increasing use of capital-intensive inputs and machinery over labor-intensive) and extensification (i.e., increasing use of land in production). This begins with the critical juncture that involved replacing machinery, clearing sugarcane, and attempting to diversify production, all while confronting a drought, a hurricane, and an empire (Dumont 1970). According to a 1965 planning document, there were two development goals for agriculture: create an agricultural basis for self-sufficient production to sustain the population and to export (Zeuske 2000). In the former case, there is evidence of a 40 percent reduction in food imports from 1959 to 1989. Yet, that is measuring food imports relative to overall imports, and there was an absolute increase in food imports up to 1989 (Zeuske 2000). In the latter case, this drove forward an intensification of agriculture centered around sugar, even while there was a certain amount of diversification in the later years of this pathway through increasing extensive land use (Zimbalist 1988).

In 1964, 2,169,000 hectares were under cultivation, a decline from the 1958 high in the prior pathway. Land in cultivation would see a sharp increase by 1967, with 2,826,600 hectares, continuing to increase into the 70s, before slightly leveling off into the 80s with more than 3,000,000 hectares in cultivation. This represents an approximate 26 percent increase in land in

cultivation. Of cultivated land, a slightly increasing amount was in existing sugarcane, from 1,534,586.4 hectares in 1969 to 1,757,496.7 hectares in 1985. Even in non-state agriculture, while existing land in sugarcane declined, it still remained more than half of cultivated land for the nonstate sector. As well, a large portion of overall land in cultivation was also then planted with sugarcane in any given year. For example, from 1962 to 1985, land planted with sugarcane ranged from 127,282 hectares to 540,009 hectares in any given year. This means that in 1969, 61.2 percent of cultivated land was in sugarcane, a trend that would remain relatively stable over the period. Over this same period, there was an increasing planting of non-sugarcane crops. The majority of non-sugarcane was in rice, citrus, tobacco, and other crops for export and domestic consumption. For instance, from 1970 to 1985, the area planted in non-sugarcane crops went from 513,000 hectares to 798,400 hectares, approximately 38 percent of cultivated land.

Therefore, there is an increasing rift-making potential from land use change, whereby crop diversification is linked to a total increase in agricultural land in cultivation without a corresponding relative decrease in sugarcane land. As well, non-state cultivation appears to show decreases over this period, which follows from the decline of non-state land tenure, solidifying state land tenure dominance. Importantly, more cultivated land means there is more energy and matter being utilized for production, such as expending nitrogen, potassium, and phosphorous in the soil, amongst other ecological impacts. Thus, planning to diversify production comes with an environmental cost, because under delinked incorporation, there is a continued imperative to produce sugar for export to bring in foreign exchange. There is then an underlying tension with the goal of producing for domestic consumption (Eckstein 1982).

A substantial part of the non-agricultural land increase is from reforestation. This was part of a government program to increase the amount of land in forest to combat erosion, leading

to planting eucalyptus trees (Jiménez 1972). From 1975 to 1985, forested land would increase from 1,731,100 hectares to 2,688,500 hectares, representing a 55 percent increase. Increasing forested land with eucalyptus trees has other benefits, such as reducing groundwater salination, increasing the amount of organic matter in the soil, and soil remediation benefits (Madeira, Andreux and Portal 1989; Bari and Schofield 1992; Zancada et al. 2003). There was also discussion of reforesting as recuperating poor soils, showing that it was in part about bringing land out of agriculture specifically, and not just reforesting land that had been converted to grass or was prior not forested (Pardo 1961). As well, more forest supports increasing biodiversity, as it provides an ecosystem to sustain more species than the ecosystem simplification required by modernized agriculture. This demonstrates a clear case of efforts to address rift-making potential, even a possible rift-restitution policy being enacted by the Cuban state, although based in part on producing wood and fruits for national use (Jiménez 1972).

Agrarian Practice and Technological Intensification

During this period, there was a push to modernize agriculture in terms of technology and inputs. In part, this was to address the declining share of agricultural labor of the overall workforce, as well as part of push to increase yields (Pollitt 1992). Additionally, this was linked to the consolidation of land in the state farms, and later in cooperative farms, whereby technology could more easily be applied over larger tracts of lands.

A primary area of modernization was the push to mechanize agriculture, bringing in tractors, crop-dusters, combines and other heavy machinery. There were two processes occurring here. First, with the United States blockade, United States machinery could no longer be reasonably repaired, as there was a lack of access to spare parts. Second, there was an increasing

import of Soviet machinery and internal research and development on producing Cuban machinery. For instance, in terms of cane harvesters, there was the Libertadora model, designed in Cuba and produced in Germany and Cuba, the MF201 produced in Australia, and the KTP-1 designed in Cuba and produced in the Soviet Union (Edquist 1985). From 1971 to 1982, the number of cane harvesters would rise from 172 to approximately 3,000 (Edquist 1985). This entails an increased use of petroleum, increase use of metals and other matter, along with an increasing specialization of labor.

Different types of harvesters relied on different techniques, with some requiring burning and others harvesting green cane, dependent upon the amount of extraneous matter that could be taken up by the machine during harvesting (Edquist 1985; Pollitt 1992: 11). Burning cane leads to decreases in organic matter, which "otherwise acted as mulch, preventing erosion, conserving soil humidity and suppressing weeds" (Pollitt 1992: 11). Furthermore, the increasing use of machinery leads to soil compaction, that then impacts water infiltration and increases soil erosion that leads to phosphorous and nitrogen loss (Magdoff and van Es 2000). That then necessitates an increase in the use of fertilizers, which comes with its own ecological impacts. As such, this represents an important component for increasing the rift-making potential of Cuban agriculture, and largely for producing sugar.

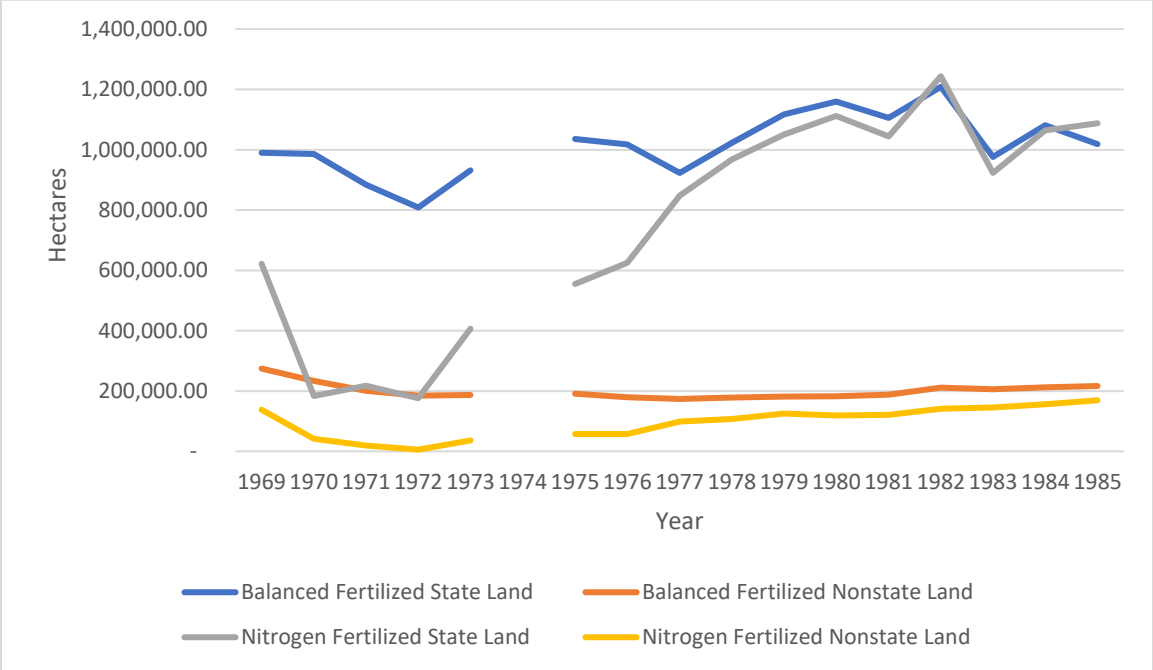
While there is this increase in heavy machinery use, there is also evidence of the continued use of traditional agricultural implements, especially for smallholder farms. For instance, the continued use of plows that are pulled by livestock was still found by Toirac (1989) in Camagüey and Holguín in 1986. Even in sugarcane harvesting, the most mechanized part of agriculture, by 1980 only 45 percent was mechanized, with the rest still harvested by canecutters (Edquist 1985). Thus, while there is an increase in rift-making potential, it is still blunted by both

a lack of technology from Cuba's peripheral position, as well as an incapacity to employ technology with the existing knowledge base of labor. That is, at times a lack of technical know-how to employ certain technologies, like tractors, left them under-utilized in agriculture.

There was also a policy to increase the amount of land that was irrigated. In sugarcane, the amount of land irrigated went from 211,742 hectares in 1970 to 385,909 hectares in 1985. In non-sugarcane crops, planted crops with irrigation remained stable from 1972 to 1985 at around 280,000 hectares. In comparison with the 59,809 hectares in the prior period, this is a substantial increase, representing a ten-fold use of irrigation. That irrigation was made possible through the control of waterways, stopping them from reaching the ocean, and thereby increasing the draw of water from rivers and other sources (Jiménez 1972). Increasing withdrawals can lead to reduced flow and harm aquatic systems (Siebert et al. 2010). And control of waterways also has impacts on ecosystems, because it impedes natural movement leading to "reduced sediment supply and increased subsidence", which in time can lead to increased flooding (Twilley et al. 2016). This is a substantial increase in rift-making potential. Yet, it made agriculture less reliant on rain that during droughts would harm production, as it had done during the critical juncture.

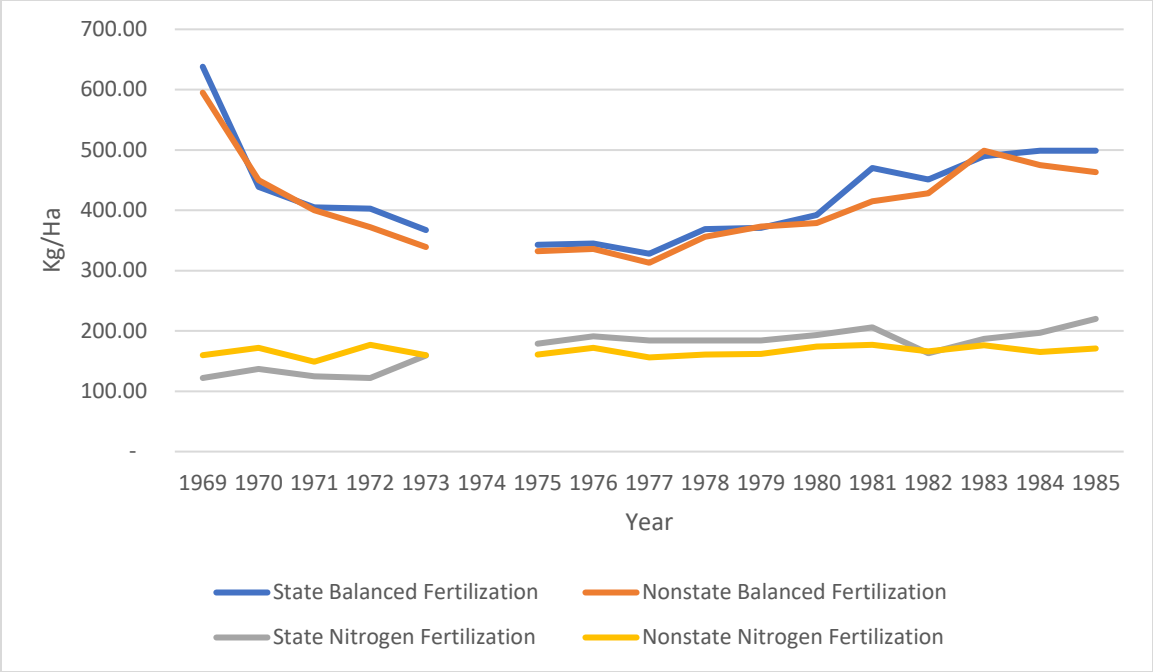
Importantly, there is an increase in the use of chemical control and synthetic fertilizer to intensify agricultural production. In terms of fertilizer, the amount of state land fertilized with nitrogen initially decline from 1969 to 1973, and then increased from 1975 to then become relatively stable starting in 1980 (see Figure 5.9). For balanced fertilization on state land in sugar, there is an increase from 1969 to 1982 and then a decline going toward 1985. In terms of the amount of nitrogen and balanced fertilization in kilograms per hectare, there is a steep decline in balanced fertilization in the state and nonstate sector (see Figure 5.10). To speculate, this decline may represent the end to the push for the 10-million-ton sugar harvest, a time in

which as much labor, machinery, and inputs as possible were put into reaching that goal. That decline recovers in 1975 and begins to increase to a rate of application still lower than the peak in 1969. Nitrogen fertilization remained steady across the pathway, both in total and relative terms. By way of a comparison, this is in line with recommendations for nitrogen fertilization in sugar for other countries, at around 150 to 200 kg/ha (Thorburn et al. 2011). Notice also that the state and the non-state sector had relatively similar rates of fertilization per hectare for sugarcane.



Source: DCE 1973; CEE 1985.

Figure 5.8. Fertilizer Application on State and Nonstate Land in Sugar, 1969-1985.



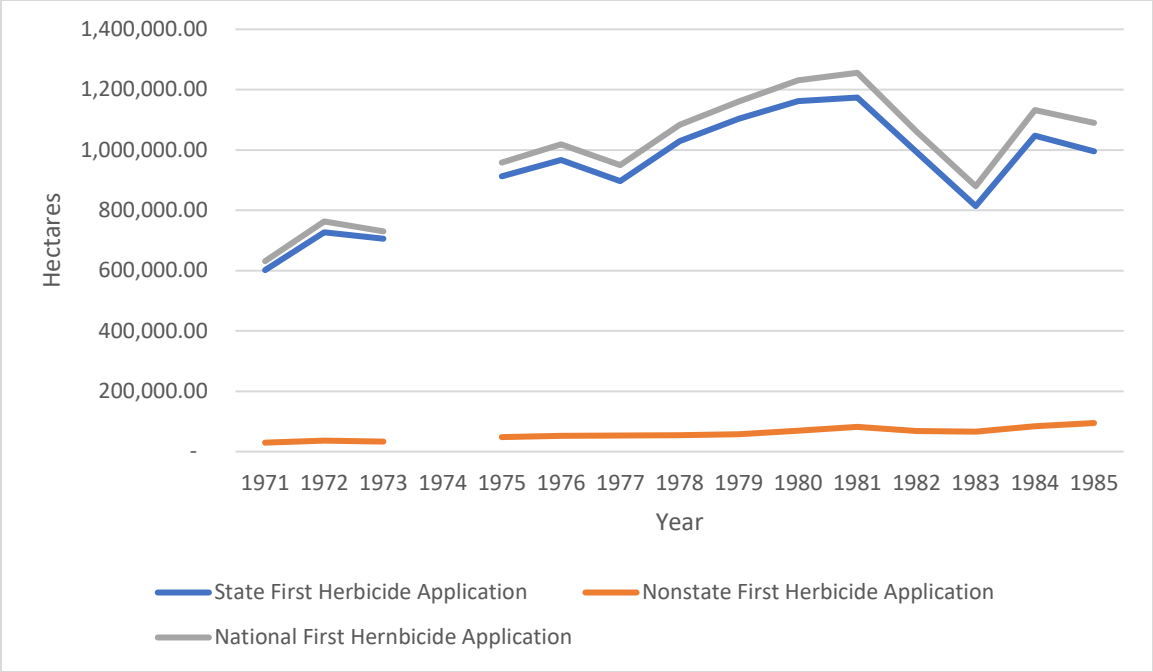
Source: DCE 1973; CEE 1985.

Figure 5.9. Land Fertilization in Kg per Ha, 1969-1985.

There are a few important points here concerning the rift-making potential of fertilizer. First, it is not entirely clear that increasing fertilizer use automatically leads to increasing yields, and therefore may not even present an economic or social benefit from the environmental harm (Mózner, Tabi, and Csutora 2012). Second, the overapplication of fertilizers, especially when soil testing is not conducted to know the exact amount necessary for an increase in yield, can lead to groundwater contamination, run-off that produces algae, and environmental health hazards, such as blue baby syndrome. There was increasing soil testing, as shown by important, and elaborate, studies of soil types in Cuba, but the extent to which this was applied on a farm-by-farm basis is not clear nor likely (Dirreción Nacional de Suelos y Fertilizantes 1975). Third, dependent upon the type of fertilizer used, there is possible harm to the soil microbial community that can lead to the build-up of antibiotic resistant bacteria (Nõlvak et al. 2016). And, while

Purakayastha et al. (2008) show that balanced fertilization can support carbon sequestration in certain cropping systems, they note that the carbon cost for producing the fertilizer reduces the overall benefit to the carbon budget. Therefore, the overall impact of this increasing use of fertilizers is an increasing rift-making potential.

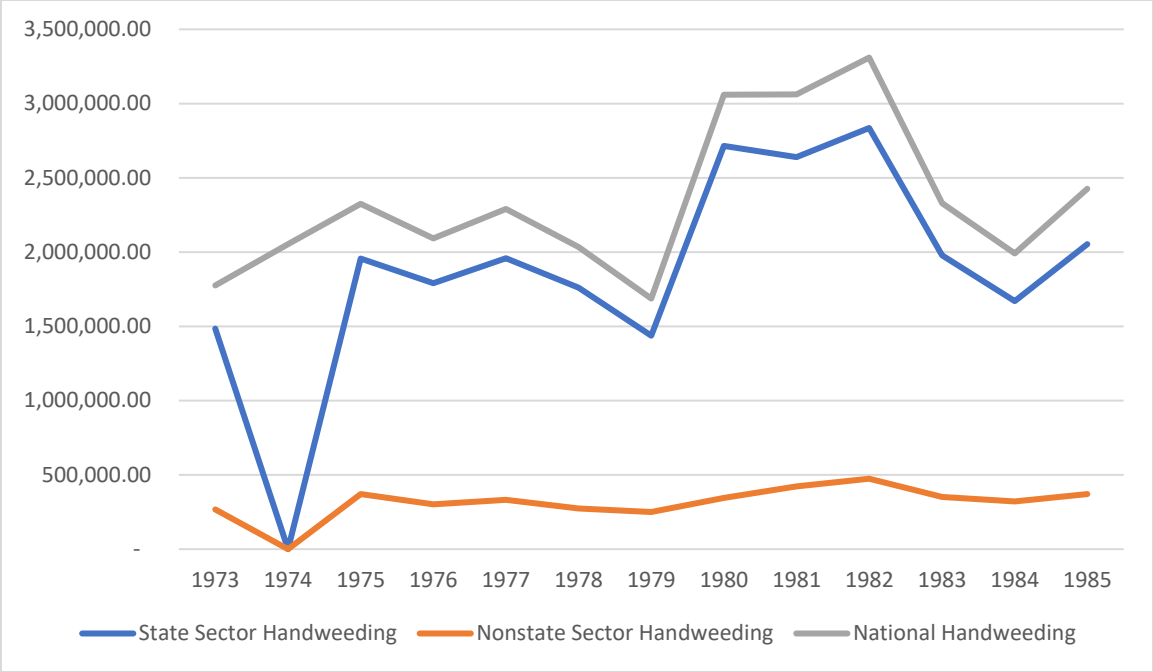
When examining pesticide use, there is also an increase in use for sugarcane cultivation (see Figure 5.11). Herbicide was utilized on the majority of sugarcane in order to control weeds. Their use has a number of rift-making properties. A major problem is their capacity to contaminate groundwater, which can harm aquatic systems and humans (Le Bellec et al. 2015; Relyea 2005). Another problem is the capacity of herbicides to damage soil biodiversity, with major reductions in nematode abundance and in the soil food web (Sánchez-Moreno et al. 2015). Pesticides generally have a negative impact on wild plant life, another harmful impact on biodiversity that then has negative impacts on herbivorous insects and pollinators due to how trophic levels interact (Geiger et al. 2010). Use of insecticides is not provided, and therefore a discussion of that type of pesticide cannot not be had at this time.



Source: DCE 1973; CEE 1985.

Figure 5.10. First Herbicide Application in Sugarcane.

It is important to recognize that there is also the continued use of hand weeding on a large scale. That is, traditional agricultural methods continue to be employed, representing an alternative agrarian practice for pest control with less damaging ecological impacts. Hand weeding can reduce negative impacts on yield, while also eliminating the harmful impacts of herbicides (Stone, Boyhan and Johnson III 2019). Although, this comes with an increasing need for labor in a context of decreasing labor supply, reinforcing the need for herbicides.



Source: DCE 1973; CEE 1985.

Figure 5.11. Hand Weeding on National, State and Non-State Land.

Additionally, Onis (1964) reports in *The New York Times* that there was a difference in planting systems between state farms and non-state farms. On state farms, there was specialization with monocrop systems. On non-state farms, there is evidence of intercropping and integrated farming practices. Onis (1964) reports:

> "On the other side of the road [from a state farm] are lots, ranging from 15 to 75 acres of small private farmers. They are owners or former tenants who now pay no rent. They plant tobacco, corn, beans and tubers, and if they are lucky there is some pasture for a few head of cattle. Pigs, chickens, ducks and guinea hens are under foot in every yard."

This matches with the prior statistics that show major differences in intensification between the state and the nonstate sector. In general, the state sector is more likely to rely

on mechanical methods and external inputs as a percentage of its land, while only in hand weeding is it that the nonstate sector in certain years will employ this method more than the state sector (Alvarez and Puerta 1994; Alvarez 2004).

Agricultural Rift-Making in a Delinked, Incorporated Agrarian Social Metabolic Order

In this chapter, I have shown the role of delinked incorporation in conditioning the rift-making potential of agriculture in Cuba. Those political-economic conditions make up the Soviet social metabolic pathway, a path dependent structure that results from a critical juncture based on an agrarian revolution. The critical juncture abolishes the capitalist class and switches Cuba's incorporation from the US to the Soviet Union. By doing so, this leads to a delinked development agenda socializing the means of production primarily through the state while still employing market mechanisms. This also leads to a Cuba incorporated through the Soviet sub-system that subsidized Cuba's delinked development strategy, meshing with the reigning emphasis of inter-state administration on modernization and import-substitution model. Such a structure of the capitalist world-economy permitted Cuba to continue reliance on sugarcane exports, because it was able to profit from preferential agreements, and even utilize the world-market when it economically benefitted Cuba.

Cuba's agrarian structure reflected this political-economic order. The state land tenure system was dominant, with a smallholder land tenure system that was maintained by its access to de-commodified land. That smallholder sector was also being incentivized to cooperativize, another type of socialized land tenure. All types of agriculture relied on socialized means of production, while also participating in either external or internal markets, such as in selling sugar on the world market or selling in farmers' markets.

Based on the decisions being made concerning the political-economic order and agrarian structure, there was an increasing extensive use of land and intensification, specifically with the increasing use of heavy machinery, irrigation, and synthetic inputs. With increasing industrialization, there was reduced agricultural labor, which drove forward further industrialization. This form of agrarian practice meant an increasing rift-making potential, whether from damage to done to soil structure from heavy machinery and herbicides or from increasing draws on water sources and a reduction in their capacity to flow naturally. While there are certain policies that can be considered rift-restitutive, such as addressing the town-country divide or the reforestation policy, these are outweighed by increasing extensive land use and intensification. These agrarian practices are part of dual goals, diversification of what is produced and exporting sugarcane. Because the former could not come at the expense of the latter, the only possibility was more land in production. Even more, with declining agricultural labor and an ideological focus on industrializing agriculture,

Importantly, smallholder farms, which are the least incorporated, while still the most oriented internally to the market, have the lowest amount of rift-making potential. This is due to less access to technology and inputs that were used in the state land tenure system. As well, it is tied into the continuing use of intercropping and traditional agrarian practices that were criticized by the bureaucratic class. Even within the state system, rift-making potential was structurally constrained by Cuba's peripheral position. As Castro (1985) pointed out:

> "In 1960, 37.3 tons of fertilizer could be bought with a ton of coffee. In 1982, only 15.8 tons could be bought with the same amount of coffee. We, the countries of the Third World, export, generally, coffee, cacao, other similar agricultural products, and import fertilizers from the chemical industry of the developed

> world. To grow corn or other food stuffs we need fertilizers; however, we must deliver more and more coffee to have less and less fertilizers."

This meant less access and resources to implement industrialized agriculture. Even when they had the technology, it wasn't always used for various reasons, such as not having workers trained in how to operate heavy machinery (Marker 1971). Together these conditions produced a continued reliance on traditional implements and hand weeding, as well as a continued need for agricultural labor, which would occur through the use of voluntary brigades when not accessible in terms of waged workers. There is then a very real structural constraint on this type of industrial agriculture for Cuba, and I argue any peripheral country that follows a delinked development route while remaining incorporated. In that sense, do the economic benefits outweigh the ecological costs?

However, there is a corollary question to ask, do the economic benefits outweigh the social costs? In that, delinking's connection with incorporation is not merely, as is often put forward by certain Cubanologists (see Díaz-Briquets and Pérez-López 2000 for an important example), the outgrowth of some innate authoritarian tendency. Instead, Cuba faced real threats from the US in its attempts to harm the population through the blockade, terrorist attacks, and assassination attempts against Fidel Castro (see Bolender 2010 for an in-depth discussion of terrorism against Cuba and Lamrani 2013 for an analysis of the blockade's detrimental and criminal impacts) and had a real need to develop to provide the social services it did. As a matter of survival and transition into sovereignty, delinked incorporation could be claimed the obvious choice for revolutionary leadership. And, in an important sense, it also could be said to provide the structural conditions for the following period, in which Cuba survived as a delinked state with exilic conditions after the collapse of the Soviet Union. As such, the structural constraints of

delinked incorporation have a crucial role in the major changes to Cuba's agrarian structure and agrarian practice in the present social metabolic pathway.

CHAPTER 6: AN AGROECOLOGICAL EXIT BUILDING A SUSTAINABLE AGRARIAN SOCIAL METABOLIC PATHWAY, 1992-2016

Introduction

In this chapter, I argue the Special Period in Time of Peace and after represents a hybrid of all three structural conditions: incorporation, delinking and exile. The collapse of the Soviet Union and the Soviet sub-system represents a critical juncture breaking with the delinked, incorporated agrarian social metabolic pathway. This is because Cuba's main trading partner had transformed into the Russian Federation, reduced the amount of oil it was willing to barter for sugar, and substantially reduced the amount of credit it was willing to provide Cuba (Eckstein 2003). Without the Soviet Union, Cuba's survival as a socialist state required navigating a dangerous terrain with the tools developed through delinking, such as de-commodification of land. This was conjoined with exilic characteristics that enabled an agriculture of escape, as the state re-organized its objectives for agricultural production toward domestic consumption through cooperatives. Those two structural conditions co-occurred along with incorporation through re-commodification of food, exports of sugar, mining, and medicine, and an expanded tourist industry. So, Cuba's social metabolic pathway during this period is in partial exile from the capitalist world-economy, while still partially delinked and incorporated. This shaped a sustainable transition in agrarian practice leading to rift-restitutive potential.

I base this argument on the following set of characteristics. First, partial exile follows from expanded mutual aid and substantive exchange based within farmer-to-farmer networks, as well as a more egalitarian distribution of land based upon usufruct, cooperatives, and private small farms. The Cuban State went through a process of state deformation, as control over agriculture was transferred to cooperatives and small farmers, strengthening an existing type of

land tenure that had been built and maintained in the prior period. And reliance on farmer-to-farmer networks provided the basis for sharing input-substitution and agroecological practices that were supported by the state as a way to handle the reduction in synthetic inputs and technology brought on by forced exile from the capitalist world-economy. Second, due to forced exile from the capitalist world-economy based on the loss of the Soviet Union as a trading partner, the goals of Cuba's agriculture sector moved away from export-oriented production toward production for domestic consumption. This is because without sugar as the dominant export, land in agriculture could be re-purposed for other ends, including sustainability as a goal. That led to a reduction in land use for agriculture, more reforestation, and expanded programs for soil conservation. Third, there was an increasing use internally of market mechanisms in the distribution of food that was supported by an expanded peasantry with direct ownership over the means of production. That was tied into a reduction of the food ration and sale to the tourist sector. This meant that incorporation moved from external commodification to a partial internal commodification of the agricultural sector.

Taken together, this situation provided Cuba a social metabolic pathway with the potential for rift-restitution in agriculture, and thereby to maintain its sovereignty through a more sustainable social relationship with ecology. As tractors were replaced with oxen, synthetic fertilizers with manures, and pesticides with cultural and biological control, agrarian practice represented a difference in kind with the prior pathway's drive to industrialize. Even more, a stronger focus on crop diversification was cemented as the goal for food security, even food sovereignty. Importantly, the array of structural conditions demonstrates that it is not an either/or for anti-systemic structures, or even an absolute absence of incorporation, but rather

understanding how necessary conditions can co-occur to provide a basis for a more sustainable agrarian social metabolic pathway.

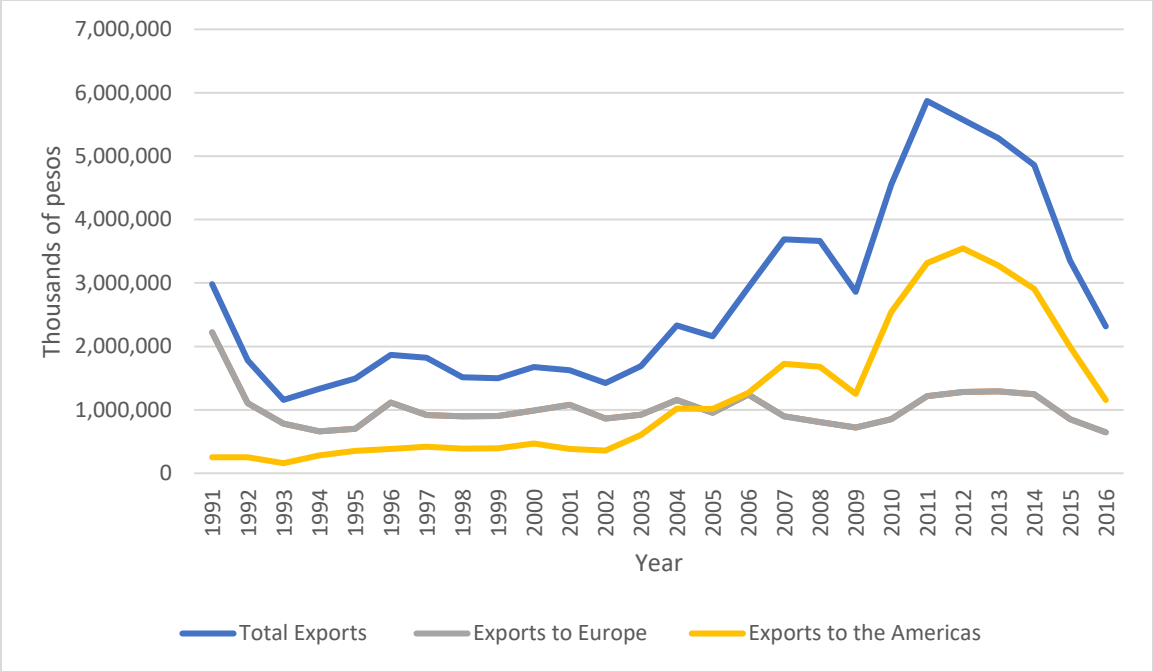
Soviet Disintegration, Land Use Change, and Agriculture's Partial Exit

The period of 1992 to 2016 represented a marked shift in interstate administration and Cuba's capacity to accumulate capital through sugar. The disintegration of the Soviet Union occurred at a moment when the capitalist world-economy had gone through a dramatic shift due to neoliberalization under the Washington Consensus. Corporations and the transnational capitalist class had rolled back the welfare state in nation-states and import-substitution development gave way to export-oriented development motivated by structural adjustment programs (Robison 2014; McMichael 2016). And while post-neoliberal governments in Latin America offered some respite, this was not on similar terms for agriculture, thereby reinforcing its partial exit from the capitalist world-economy. Thus, Cuba's structural relationship with the capitalist world-economy became further hybridized, partially incorporated, delinked, and exiled.

The most important factor was the disintegration of the Soviet Union and the Soviet sub-system. Cuba could no longer depend upon its links to the Soviet sub-system to support trade, causing a major drop in exports and imports that it would not recover from until the 2000s (see Figures 6.1 and Figure 6.2). 1992 saw a more than 50 percent reduction in petroleum, fertilizer, pesticides, and animal feeds, devastating the agriculture sector that had been developed during the prior period (Rosset and Benjamin 1994). Additionally, the US increased pressure on Cuba by strengthening the blockade through the Helms-Burton and Torricelli Acts. These measures constrained international shipping and prohibited US subsidiaries in other countries from trading

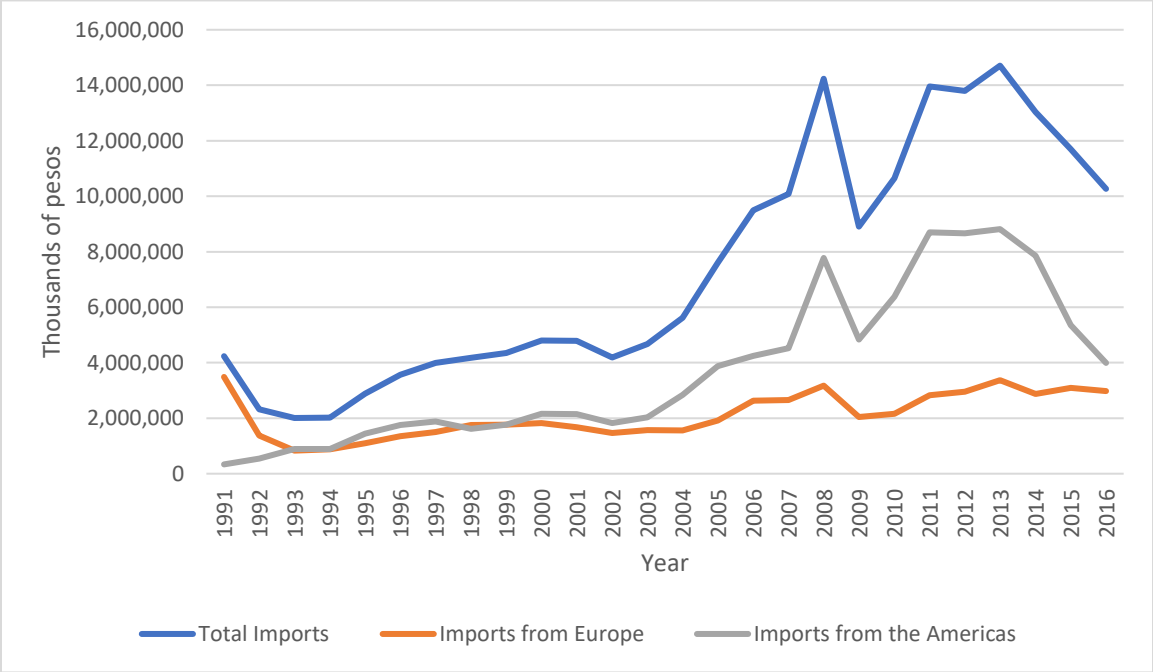
with Cuba (Gordon 2016). That, plus the existing sanctions regime, led to the loss of trade, worsening conditions for trade through harsher terms due to added obstacles, and a reduction of shipping to the island as vessels feared prohibition on their access to ports in the United States (Alvarez and Castellanos 2001).

While this emergency was not entirely unexpected, a similar sub-system or delinked semi-periphery for Cuba to transition into did not exist at that time. There was no Belt and Road Initiative led by China at that time, only a sea of incorporated, neoliberal states and countries, like North Korea, which had been cut-off in many respects from the capitalist world-economy. This left Cuba with less capacity for sovereign, interstate administration of capital accumulation upon which its 1959-1991 social metabolic pathway had been based. Thus, a key relationship for Cuba's incorporated, delinked structural condition was gone, and an alternative structure was needed to replace it and maintain Cuban sovereignty.



Source: ONEI 2018.

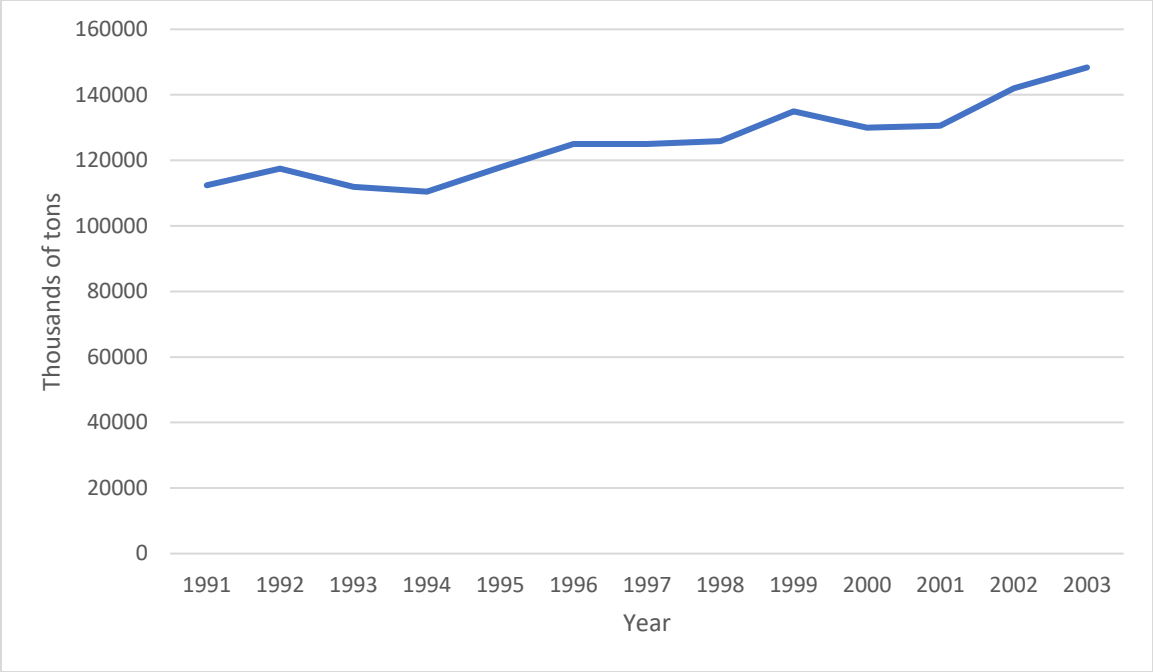
Figure 6.1. Cuban Exports, 1991-2016.



Source: ONEI 2018.

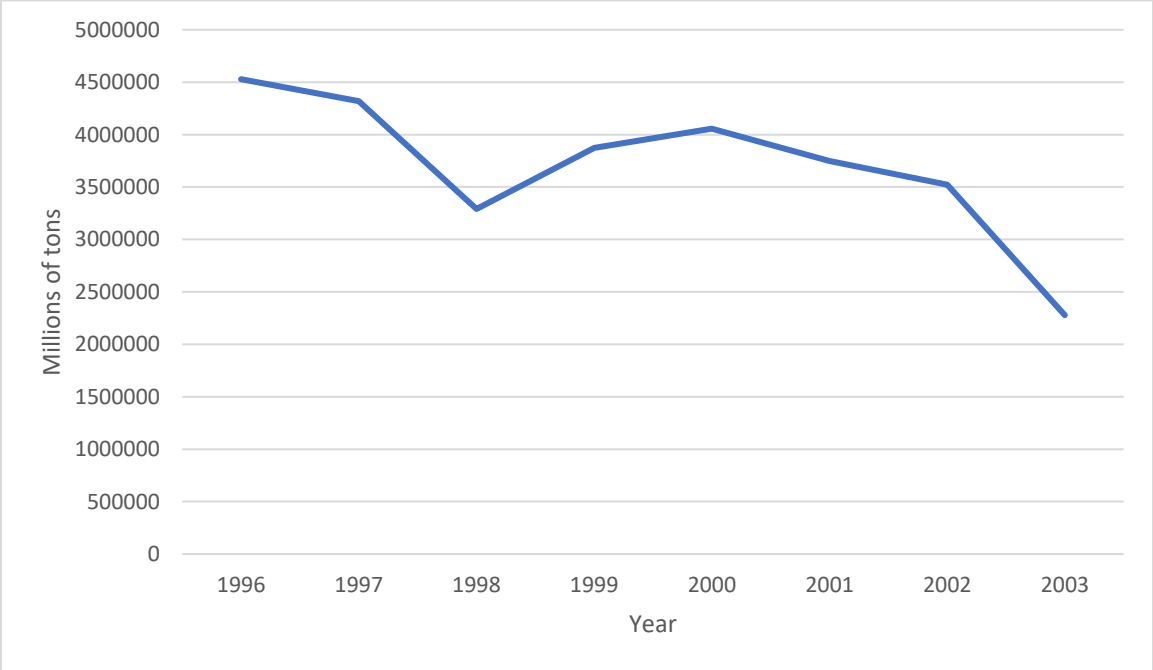
Figure 6.2. Cuban Imports, 1991-2016.

Within this panorama, Cuban agriculture commenced a major exit from the capitalist world-economy, both by force, with the loss of the Soviet Union as a preferential buyer, and voluntarily, with agriculture of escape a principal tactic to survive. The heavy reduction in sugar purchases by Cuba's main preferential buyer left Cuba to sell a higher percentage of a lower total produced on the world market, where the price per pound has historically been lower than Cuba's cost of production (Hagelberg 2005). Russia continued to purchase sugar and swap oil for sugar with Cuba, but not nearly enough to maintain sugar exports at their level in the prior period. As global production continued to climb, Cuban production continued a steady decline, halving from 1996 to 2003 (see Figure 6.3 and Figure 6.4). And this was during a period of relative price stability, although often below the 11 cents per pound price that would make Cuban sugar profitable (see Figure 6.5; Rosset and Benjamin 1994).



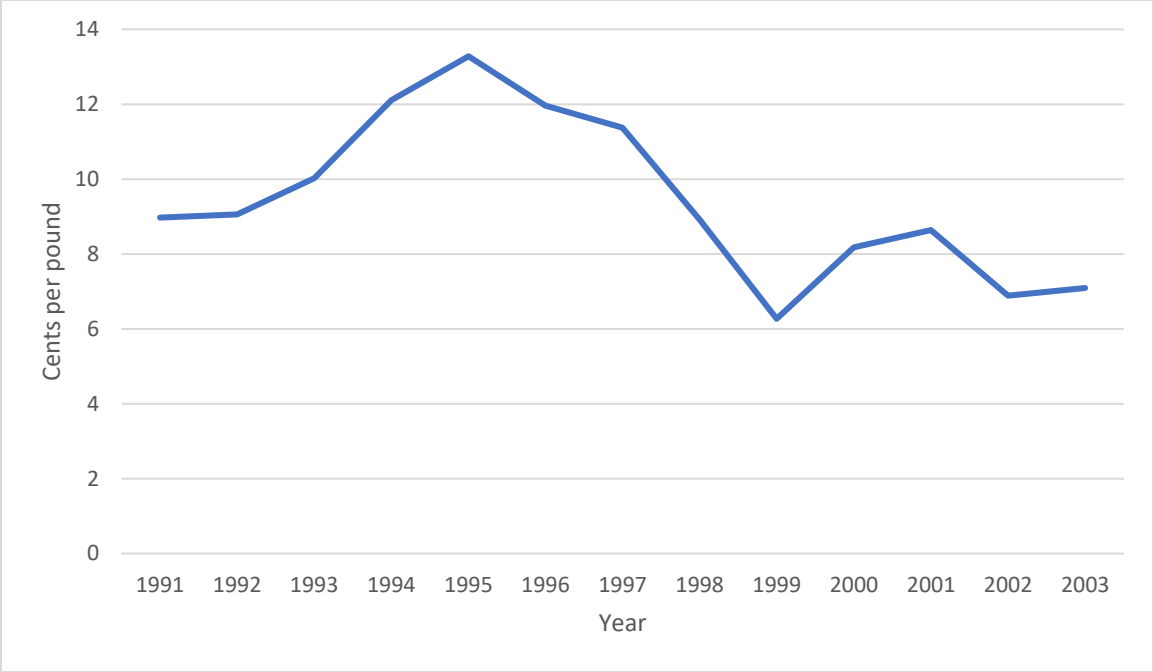
Source: ISO 2003.

Figure 6.3. Global Sugar Production, 1991-2003.



Source: ISO 2003.

Figure 6.4. Cuban Sugar Production, 1996-2003.



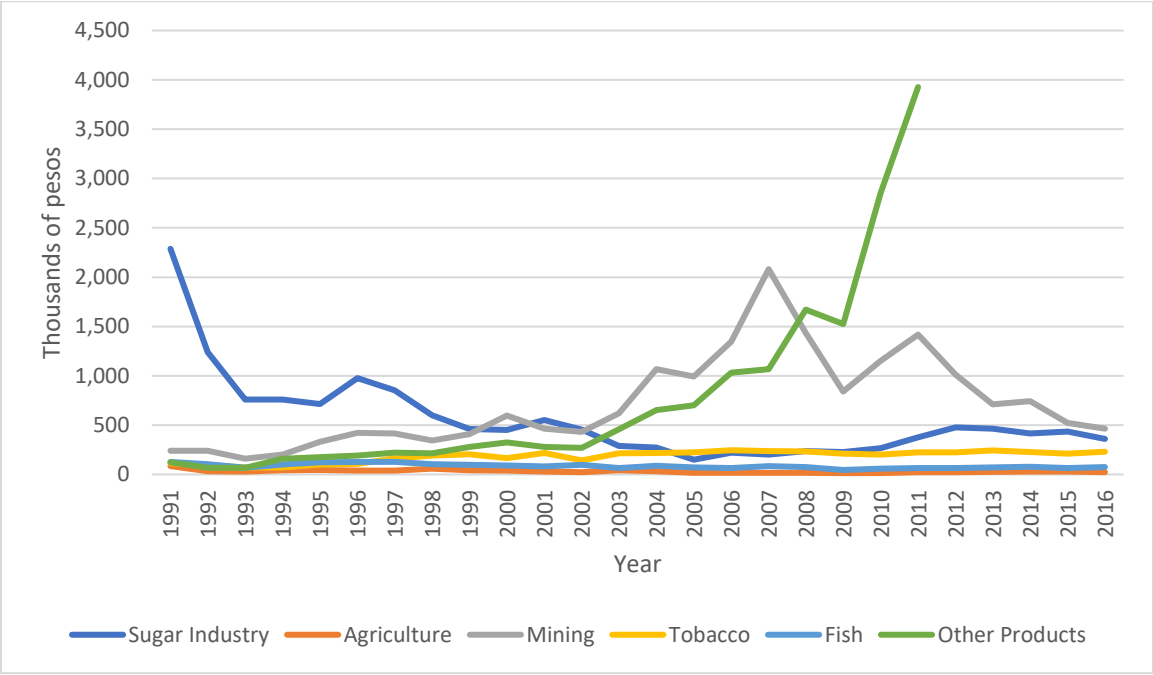
Source: ISO 2003.

Figure 6.5. ISO Sugar Price, 1991-2003**.**

Cuba has increased the export of other agricultural crops, but the overall export of agricultural goods remains low in comparison to other sectors of the Cuban economy (see Figure 6.6). Instead, other export sectors, like pharmaceuticals and mining, ascended in prominence, while tourism became a principal sector for accruing foreign exchange to purchase imports (Eckstein 2003). Part of those imports are food, with Cuba continuing to import more than 50 percent of food, even while a sizable portion of the population is dedicated to agricultural production (Botella-Rodríguez 2019). Those imports are both for domestic consumption and to supply the tourist industry (Enríquez 2010).

So, while Cuba's agriculture was in partial exile during this pathway, other sectors, such as tourism, definitively remained incorporated. Since the 1980s, Cuba has increasingly entered joint ventures with foreign capital, such as Spain's Iberostar hotel company, to bring in foreign

investment to support its tourism development strategy (Eckstein 2003). Therefore, Cuba remains partially incorporated, even in agriculture, because there was still a requirement to purchase imports to supply the country with necessities and promote economic development. Even so, over the entirety of this period sugar never regained its place as the main Cuban export. So, while Cuba has continued to export sugar, it is in a much-reduced quantity (see Figure 6.6).



Source: ONEI 2018.

Figure 6.6. Exports by Sector, 1991-2016.

This partial exile for agriculture had major effects on land use. In this period, there is a reduction in land use for agriculture, reversing a century-long trend. In 1996, 3,766.5 thousand hectares were in cultivation. By 2013, this had reduced to 2,645.8 thousand hectares. In contrast with the prior period where increasing land in cultivation led to diversification, in this period

diversification was maintained as a goal while land in cultivation for sugar was drawn down. This can be seen in terms of the reduction in land in sugar harvested, which went from 1,451.7 thousand hectares in 1992 to 400.3 thousand hectares in 2013. At the same time, total land harvested and in production for other crops went from approximately 900 thousand hectares in 1993 to approximately 1,400 thousand hectares in 2013. Thus, while sugar was reduced to almost a quarter of its former level, land in other crops increased by more than 50 percent. This is a marked transition away from a monocrop agriculture system that brought large amounts of land out of production.

This an important indicator of rift-restitution because it means reducing withdrawals from soil and water, along with reconstituting habitat that can be conducive to biodiversity. Additionally, if the land is fallow, it can provide other benefits when brought back into cultivation, such as biomass for fertilizer, as well as less flooding that could negatively impact nearby communities (Klemick 2011). That is especially the case when land is reforested. During this period, land in forest also saw increases as the reforestation program begun in the prior period continued apace. In 2003, there was 3,014.1 thousand hectares in forest that grew to 3,406.6 in 2014, a more than 10 percent increase. Thus, land taken out of cultivation is being transferred into forest, a key rift-restitution strategy, which also aids to combat soil erosion. And that is part of the expansion of a national program to monitor land in agriculture to combat erosion and improve soil health. This program was applied to around 300 thousand hectares in 2000 and 900 thousand hectares by 2015, a 300 percent increase (ONE 2016).

Furthermore, expanded alternative uses for sugarcane have been developed, one of which is the use of sugarcane byproduct in renewable energy. Bagasse, the residue from the extraction of sugarcane juice, supplied around one-fifth to one-fourth of primary energy for the country

depending upon the year (ONE 2006; Alonso-Pippo et al. 2008). The reduction in greenhouse gases by utilizing sugarcane instead of petroleum is estimated to be "5.4 x 10^6 ton of $C0_2$/year" (Alonso-Pippo et al. 2008: 2178). So, not only is sugarcane export leading to a reduction in cropland, the role of sugar in the economy has also shifted toward supporting sustainable development goals in other key ways.

This land use trend is not reversed when by the end of the 1990s Cuba began a process of re-incorporating into the capitalist world-economy through an emerging intra-Latin America/Caribbean bloc of countries led by Leftists with connections to social movements that came to be known as the Pink Tide (Campos and Prevost 2017). Cuba developed strong ties with Venezuela, Bolivia, Ecuador, and Brazil, amongst other Latin American and Caribbean countries, who supported Cuba through trade. For example, Venezuela became a major conduit for accessing oil through a barter agreement based on Cuba exporting doctors and nurses (Campos and Prevost 2017). As well, the Pink Tide governments supplied diplomatic pressure that led to lifting Cuba's suspension from the Organization of American States, which Cuba subsequently declined to re-join. Even more important was regional integration, like the Bolivarian Alliance for the Peoples of Our America (ALBA). ALBA was expressly set up as a project to regionally delink, by creating an interlocked political-economic sub-system of states (Yaffe 2011). This was a demonstration of changing hemispheric conditions concerning the United States' capacity to isolate Cuba based on a growing movement for sovereignty.

However, the Pink Tide governments were also incorporated, with many of their policies reliant on a commodity boom and exports (Svampa 2019). And connections to the Pink Tide governments of the 2000s and 2010s could not reverse the decline in sugar exports, because Latin American countries, such as Mexico and Brazil, were also major sugar producers

(Buzzanell 1992). Additionally, the Pink Tide began to recede by the end of the 2000s, as military and legislative coups undermined Leftist governments in Honduras, Paraguay, and Brazil (Ellner 2019). This would again put Cuba in a precarious position vis-à-vis the capitalist world-economy and is part of the post-2013 decline in exports and imports, as Venezuela, Cuba's main trading partner, entered its own economic crisis.

Outside of the Western hemisphere, Cuba remained an active participant in supranational bodies, like the United Nations and the International Sugar Association. This was part of continued interstate administration of relations with the capitalist world-economy, and recognition of sugar's continuing role in the Cuban economy, even if diminished. As well, Cuban agriculture has been supported by International NGOs, such as Oxfam, with grants for its sustainable agriculture initiative (Machí Sosa et al. 2011). Therefore, Cuba remained partially incorporated, although with the continued aim of supporting its sovereignty to decide on internal economic relations in a delinked and exilic form.

Taken together, these interactions with the capitalist world-economy heavily reduced Cuba's incorporation into the capitalist world-economy, while producing a partial exile. So, being forcefully exiled still meant a structural relationship with the capitalist world-economy in terms of a delinked state. Cuba's delinked social structured allowed it to navigate this terrain, especially in terms of its renewed relationships within the Western Hemisphere. Most importantly, by moving agriculture into partial exile, Cuba brought land out of production, an important sign of the link between anti-systemic structures and rift-restitution potential. Without the imperative to produce for exports, Cuba was able to re-organize agricultural production. As I will note in the following sub-section, this is tied to a Cuban State that maintained its

sovereignty, but also increasingly relinquished control over the agrarian sector to cooperatives and small farmers.

Delinked State Deformation Toward an Exilic Agrarian Structure

Internally, the Special Period in Time of Peace marks a state deformation period (i.e., a rise in an exilic structural condition) for the agri-food system through increasing control over production by cooperatives and small farms. This includes a certain level of re-commodification in food production and distribution, especially in terms of direct-to-consumer sales. At the same time, by maintaining state, sovereign control over the agriculture sector (i.e., delinking), Cuba was capable of maintaining the decommodification of land, thereby demonstrating an interaction between delinking and exile as anti-systemic structures. This provides the basis for a fundamental alteration in the agrarian structure, one that supports dramatic changes to agrarian practice.

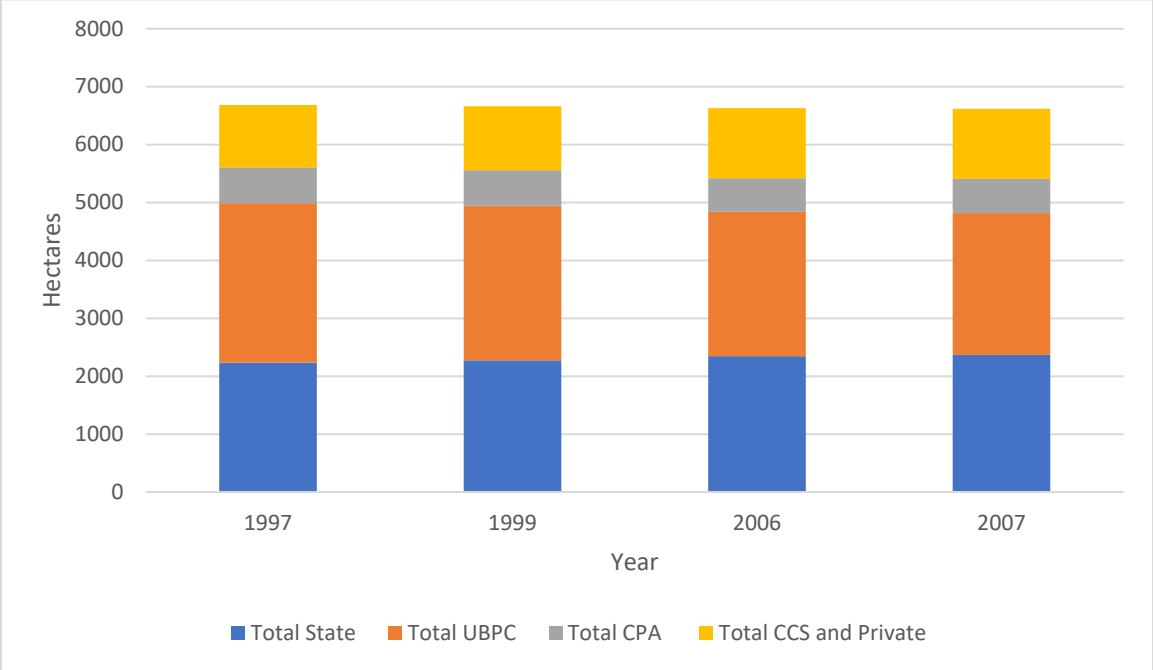
In terms of state deformation, the main component is the reduction of direct state administration of farming. In 1993, “the Cuban Council of State enacted Decree Law No. 142, which transformed the state farms into new units of agricultural production known as the Basic Units of Cooperative Production or UBPCs.” (Gonzalez 2003: 713). This meant a dramatic move away from delinked control of farming, reducing hierarchal control and increasing farmer and farm worker autonomy, characteristics of exile. The UBPCs are based within a system of usufruct rights, whereby the state maintains ownership over land while providing perpetual title to the land to the producers. The state would no longer administrate through a centralized system agricultural production, thereby increasing direct control over production by the producers themselves. Yet, this was dependent upon state de-commodification of the land, thereby

permitting the state to re-distribute land without interference by private owners that could speculate for private benefit and in disregard of the public good.

The same decree also provided usufruct land to smaller producers as parcels. Based on interviews, Enriquez (2003) describes advantages to accessing this land as "economic benefits (from no longer having to purchase the food items they grew and from produce sales), being able to make this contribution to the revolution, and feeling more useful as a person." (211) That is autonomy over production provides for a capacity to participate in subsistence production, a principal of de-commodified food. Once again, this is usufruct land occurring within the coordinates of a delinked structure yet based on increasing egalitarian control over production that leads to a capacity for substantive exchange and mutual aid. This is another demonstration of how one type of anti-systemic structure could be a necessary condition for the existence of the other anti-systemic structure.

Because of these changes, by 1997 state ownership of land was reduced to 33.4 percent and remained around this level over the period (see Figure 6.7). By 2007 of cultivated land the state represented less than a quarter, demonstrating a reduction of approximately 70 percent in state-led cultivation. The UBPCs became the main form of non-state farm type, although based within usufruct land. Of total land and land in cultivation, the UBPCs represented almost forty percent. The other major cooperative farm type was the CPAs, which had existed prior to the Special Period and were discussed in the prior chapter. The CPAs represented less than ten percent of all land and land in cultivation, remaining a more minor farm type. However, the CPAs directly owned the land, like the CCS and Private, another farm type that represented approximately 18 percent of total land and more than a quarter of land in cultivation. As well, private farms were incentivized to operate in cooperatives to access credit and inputs. Together

this amounts to almost three-fourths of land in production under private and cooperative ownership outside of state administration.



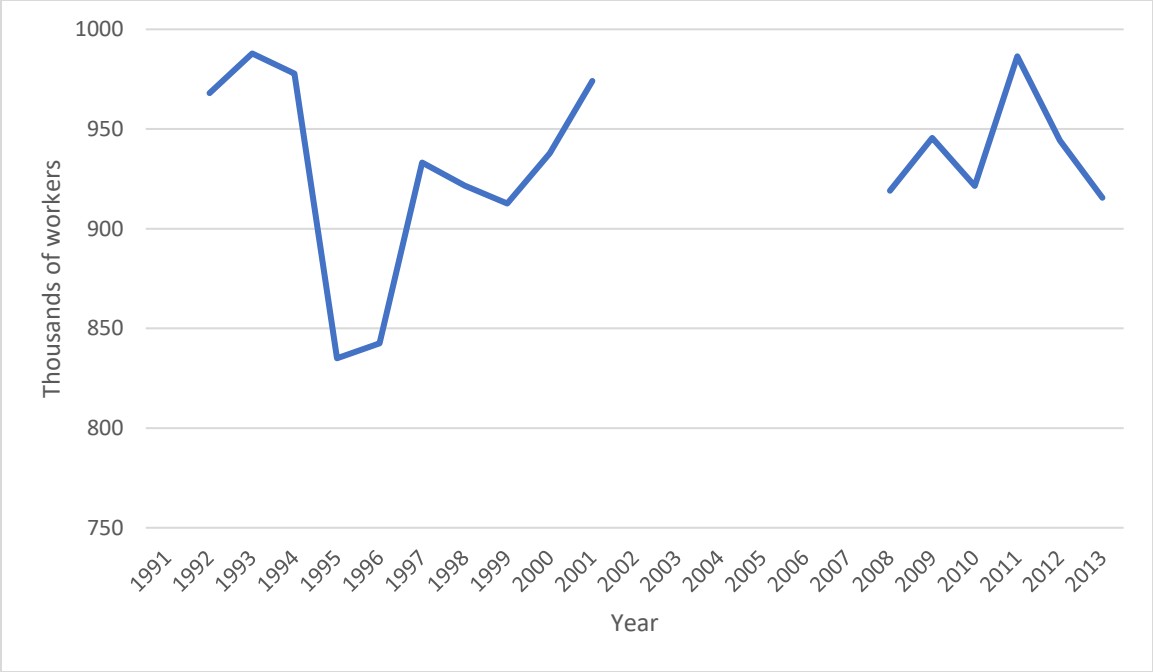
Source: ONE 1999, 2002, 2007.

Figure 6.7. Total Land Owned by Farm Type, 1997-2007.

Further, it should be noted that tenant farming returned, representing another form of re-commodification. Private farmers could now receive income through a new channel, the leasing of their land for production by someone who was not the direct owner. In this way, state deformation has also meant reducing control over the law of value even in land, although not to an extent comparable with its solely incorporated period from 1898 to 1958. In total, 454,919 people possessed land, whether in usufruct, owned, or leased, amounting to almost five percent of the total population.

Thus, the internal changes during this period led a major shift in the agrarian structure, one from delinked, state-dominant, toward exilic, cooperative-dominant. This was in part about utilizing economic incentives to motivate increases in production, but also about an increasing focus on subsistence production as a sovereign strategy and relying on the existing knowledge base to navigate decreasing resources. It also means that discussions of Cuba that solely focus on the Cuba state are ignoring the substantial power held by the cooperative economic sector, especially in agriculture.

The increase in the number of farms outside of the state, was paralleled by stabilization and decline in farm labor, which was predominant on still existing state farms and increasingly contracted directly by cooperative and private farms. Over this period, farm labor remained stable as a total number, fluctuating between 800,000 and 1,000,000 workers (see Figure 6.8). This is important, because it means that agriculture continued to provide a stable form of employment, stemming a flow of workers out of the countryside and into other industries. There is a certain portion of this farm labor that is participating in agricultural production within the cities due to the major expansion of urban agriculture (Koont 2011).



Source: ONE 1999, 2002; ONEI 2014.

Figure 6.8. Farm Labor, 1992-2013.

As a relative portion of the overall labor force, agriculture did see a decline from approximately 25 percent in the 1990s, to below 20 percent in the 2000s. Yet, when compared to the United States' two percent of the labor force in farm work, or Mexico's 13 percent, Cuba's farm labor force remains relatively high (Smolski and Kloppe 2019). And that does not include the ongoing use of voluntary brigades in agricultural production, or food production being carried out within the city for subsistence (Eckstein 2003; Premat 2012). Those forms utilize substantive exchange and mutual aid to connect farms with labor, with voluntary labor subsidized by the state by providing food and shelter. Here again, delinking and exile are working in tandem, rather than in conflict, as anti-systemic structural conditions.

Overall, when farm labor is taken together with people who own land, this represents an upper limit of almost thirty percent of the total population involved in agriculture to some degree

in 2013. Because landowners in the UBPC are theoretically worker-owners after state land tenure was converted and it is not clear from the annual statistics if workers hired by the UBPC and worker-owners are classified distinctly, it may be a lower percentage. Although, this still makes the lower limit more than one-fifth of the Cuban population participating in agricultural production. It is not a stretch then to label Cuba an agrarian society during this period considering its land and labor structure.

State deformation in agriculture was supported by substantive ties in agriculture based within ANAP, ACTAF, and the growing farmer-to-farmer movement. These represent exilic structural conditions based on mutual aid, substantive exchange, and egalitarian, direct democracy in the sharing of practical knowledge to support sustainable agricultural production and political administration of the production process. Beginning in the Special Period, ANAP increased its role for coordinating and representing the interests of small farmers in relation to the state (Machí Sosa et al. 2011). In 1997, and following on examples from Guatemala and Mexico, a farmer-to-farmer movement sprouted in Cuba motivated by ANAP (Holt-Giménez 2006). With support from NGOs, the program extended throughout the country as farmers operated as the teachers and students of a more sustainable form of agriculture (Machí Sosa et al. 2011). Not only was knowledge de-commodified, even more, it meant an egalitarian approach to deciding on production practices throughout much of the country. This reversed the trend of state imposition of best practices based on the Green Revolution model discussed in the prior chapter.

Another component was an ongoing re-commodification of food production and distribution, with the re-introduction of peasant markets, linking local agricultural production to the tourist section, and the rollback of the food ration (Deere 1997; Enriquez 2010a). The peasant markets were an important part of the exile process that increased the role of commodification,

however within an ongoing quota system through *Acopio*, the state food distribution system. This is because only a surplus beyond fulfillment of the quota could be sold in the market. Furthermore, part of local agricultural production was destined for the burgeoning tourist industry, although not at the level necessary to sustain food sales without imports (Enriquez 2010a). That meant turning a portion of agricultural production into an incorporated commodity as part of Cuba's emphasis on the tourist industry as a source of foreign exchange. The increasing use of market mechanisms was conjoined with a gradual rollback of the food rations, as the state was not capable of continuing to support the same subsidy as before (Frank 2015). This was accompanied by the loss of meals supplied at work, and a gradual increase in the overall economy of self-employment and private businesses formalized in changes to the Constitution in 2019.

These changes were part of a general increase in inequality, with the GINI coefficient for Cuba rising "from .24 in 1986 to .38 in 2000" (Frank 2000). Other ideas, like utilizing an organic label, which are about accessing a price premium in the tourist market, can reinforce these trends. That was part of a conversation I was privy to while visiting Cuba in 2016, with a stated goal of being able to charge tourists more for high quality produce. With food prices increasing, along with less access to subsidized food, more of smaller wages had to be spent on meeting daily needs no longer covered by the social wage. That itself is part of a trend beginning in the 1980s (Benjamin, Collins, and Scott 1984).

While inequality has risen, the legal apparatus for land tenure has also meant autonomous rural control over agricultural production in a form that is not present in the majority of countries in the world. The state maintains a property system for land that prohibits its use as a speculative asset and sets controls on concentration. There has not been a dispossession dynamic as there

was in the 1898-1958 social metabolic pathway. Even more, the state administrates the distribution of inputs, which aids in setting constraints on agrarian practices. As Enriquez's (2003) survey data note, credit, land, and other means of production were not a concern for farmers because they had these access channels. Thus, there is a class contradiction in state policy between an agrarian class of producers who benefit and an urban working class who do not.

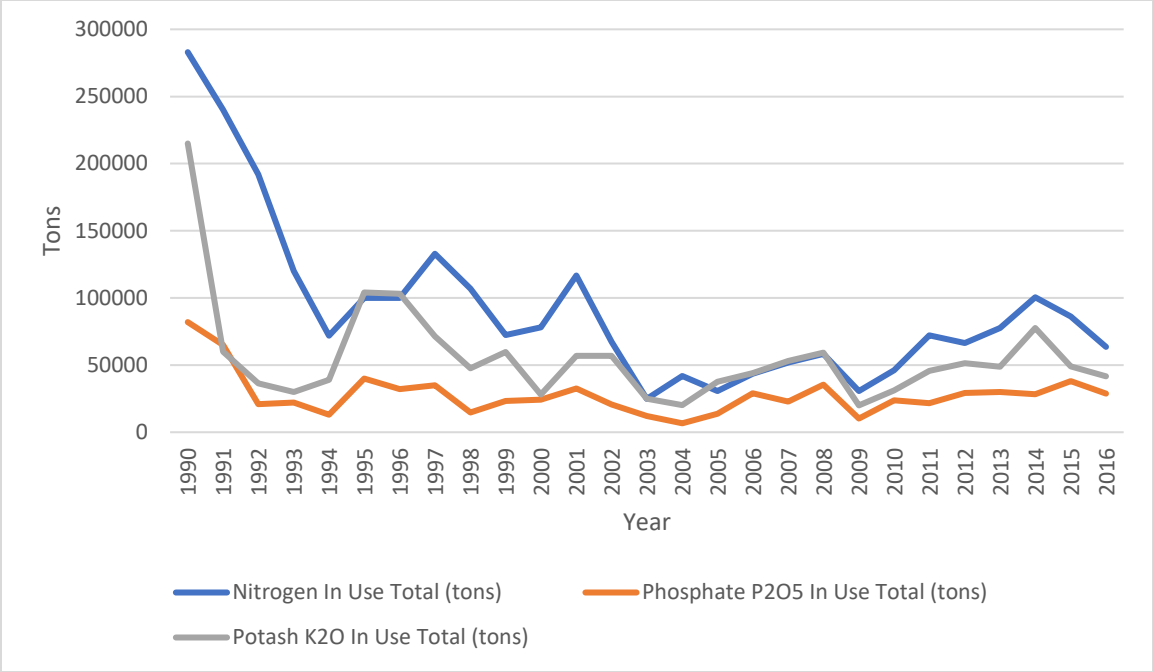
Therefore, the internal structural condition of partial exile was reliant on the maintenance of delinking, with state sovereign control over the law of value, especially in terms of land. While the state did reduce control over the law of value with the re-commodification of food, and part of production was incorporated through its sale at sites of tourism, this was supported through increasing autonomous control by the direct producers. Anti-systemic structures became the dominant structures, reducing the incorporative imperatives on the agricultural sector, which had important impacts on agrarian practice.

The De-Intensification of Agriculture, Input Substitution, and Agroecology

By partially exiling, thereby reducing incorporative pressure on agriculture, Cuba saw dramatic declines in external and synthetic inputs into the system, along with a reduction in the use of heavy machinery and other technology. That points to a reduced use of energy, as well as in the application of chemicals, whether fertilizer or pesticides, which can contaminate waterways, harm human health, and reduce biodiversity. Conjoined with this de-intensification dynamic was the rise of input substitutes and agroecological practices, shared through farmer-to-farmer networks and supported by a set of state institutions.

In terms of machinery, tractor use declined, from 85,000 in 1990 to 73,000 in 1997 (Rios and Ponce 2002). Tractors were replaced by oxen-pulled plow, increasing from 163,000 to 400,000 over the same period, and no-till or minimal till systems (Rios and Ponce 2002; Treto et al. 2002). In a comparison study of animal and mechanical traction, soil quality, crop health, and socioeconomic sustainability were most correlated with systems employing solely animal traction (Mesa et al. 2014). Furthermore, by utilizing less tractors, there is less petroleum used to produce crops, thereby reducing the amount of CO_2 released. Therefore, a reduction in machinery is both beneficial in terms of production, as well as ecologically beneficially for the soil and atmosphere.

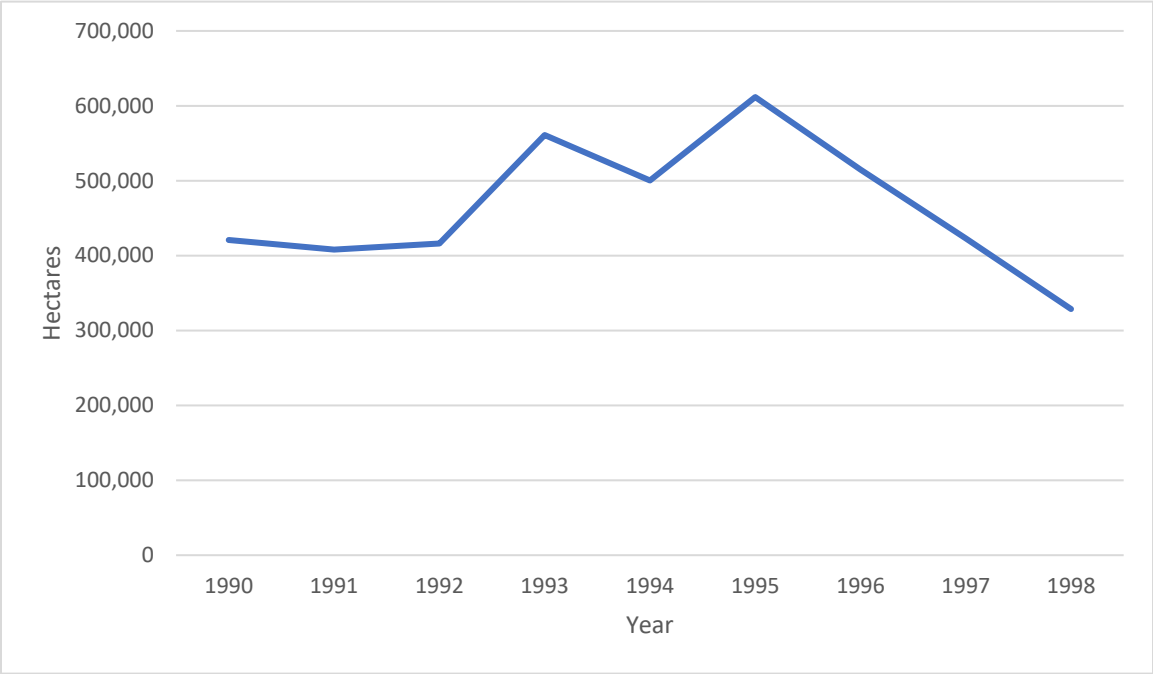
Synthetic fertilizer use saw heavy declines over this period, ranging from approximately one-fifth to one-sixth of use dependent on the fertilizer type in comparison with the prior period (see Figure 6.12). Low-input substitutes were utilized instead, such as manure and vermicompost, which involve recycling nutrients from the production process and waste back into the agroecosystem. A principal form of organic fertilizer is based on sugarcane byproducts, representing a recycling of sugarcane back into the system it withdraws from to be produced. This *cachaza* "has high percentages of phosphorous, calcium, and nitrogen" and "contains more than 50 percent organic matter." (Treto et al. 2002: 167). Manure is another key form of recycling nutrients from agricultural production, this time from livestock. Cattle, sheep, and poultry all produce manure that can be utilized as an organic fertilizer, which recycles nutrients rather than converting them into a waste byproduct. Soil with manure applied "had higher contents of soil organic matter, available [phosphorous], bases, pH, and micronutrients", showing its important, positive impacts on the soil nutrient cycle (Zingore et al. 2008: 280).



Source: FAO 2021.

Figure 6.9. Fertilizer Use, 1990-2016.

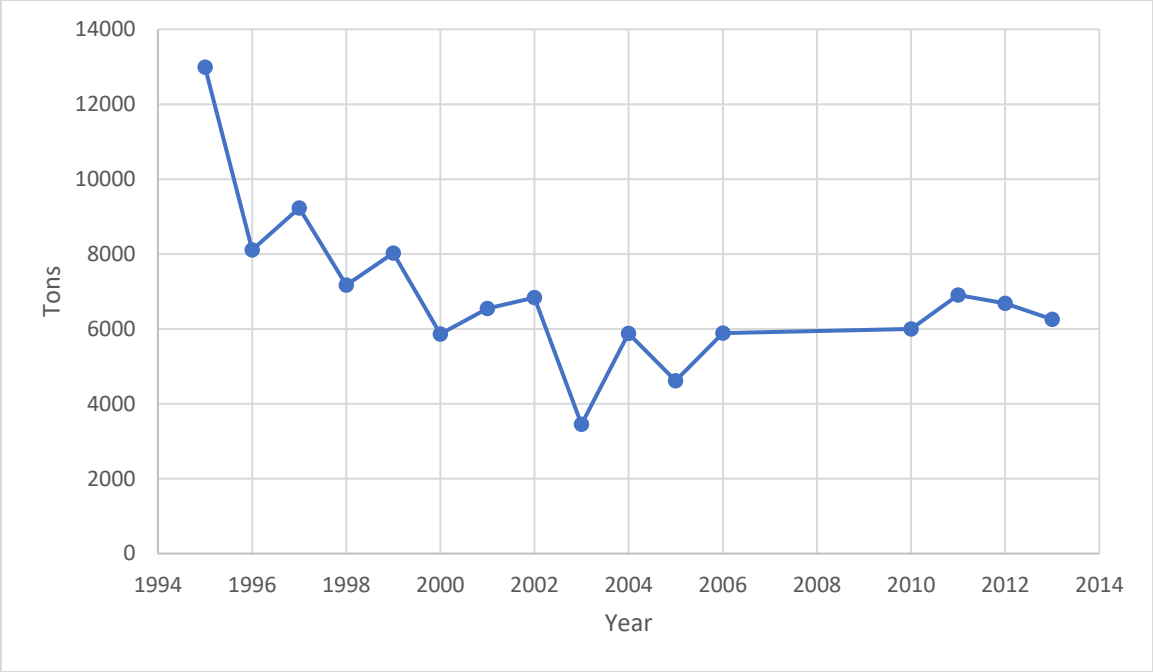
As well, irrigated land in sugar saw an initial increase and then decline over this period (Figure 6.9). This is part of pulling land out of sugar, thereby reducing the need to irrigate for an export crop. That meant less water withdrawals, less energy used to operate pumps to push water through the system, and less materials used to make tubes to carry the water. Additionally, and in relation to reduced synthetic fertilizer, concentrations of nitrogen in rivers are low in comparison to the Mississippi, a sign of "better river water quality" (Bierman et al. 2020).



Source: ONE 1998, 2002.

Figure 6.10. Total Sugar Land with Irrigation, 1990-1998

Additionally, herbicide imports saw major reductions, dropping by half from more than 12,000 tons in 1995 to approximately 6,000 tons in 2013 (see Figure 6.). Pesticide imports overall were reduced by three-fourths in 1998 from a peak in the 1970s. As with fertilizer decline, this was tied into the import drop post-Soviet collapse, that led to a substitution by other methods. However, it was also part of a trend beginning in the 1980s that saw an increasing number of Production Centers for Entomophages and Entomopathogens, going from 82 in 1988 to 227 by 1999 (Pérez and Vázquez 2002). Chemical control of pests and weeds was no longer the major strategy, with other forms of controls coming to be centered, such as biological control.



Source: FAO 2021.

Figure 6.11. Herbicide Imports, 1995-2013.

For example, Vázquez et al. (2010) report that 17 parasitoids were utilized to control 73 pest-cultivar combinations and 6 predators to control 14 pest-cultivar combinations. In the 2000s, *trichogramma* wasps were released as an augmentative biocontrol measure on 685 thousand hectares in a multitude of cultivars, like yuca, corn, sugar cane, and tobacco, with Cuba producing more than six billion per year (Van Lenteren and Bueno 2003; Massó 2007; Vázquez et al 2010). In total, more than 900 thousand hectares had entomophages or biopesticides applied on them in 2003 (Pérez and Vázquez 2002). This amounts to nearly 30 percent of land in that year utilizing a more sustainable form of pest management. Additionally, agroecological practices sought conservation biocontrol as a strategy by building natural reservoirs through polyculture systems and crop rotation (Pérez and Vázquez 2002). This meant increasing biodiversity within the agroecosystem as a check on herbivorous insects that could damage

cultivars. This was linked with cultural and mechanical/physical control practices, such as intercropping and hand weeding, the latter present in prior periods demonstrating a certain level of continuity.

In general, Cuban agrarian practice has seen a fundamental change from a Green Revolution model toward an input-substitution and agroecological model. Across numerous indicators, whether reduced use of irrigation, synthetic fertilizers, or herbicides, or the increased use of methods that recycle nutrients, increase biodiversity, and preserve the soil, Cuban agrarian practice during this social metabolic pathway represents a sustainable transition with rift-restitutive potential.

Structural Hybridity and the Transition to a Sustainable Agrarian Social Metabolic Period

Following this evidence, this social metabolic pathway represents a hybrid set of structural conditions that led to a rift-restitutive potential. Cuba confronted the end of the Soviet Union by utilizing its delinked social structure to support a partial exile of agriculture from the capitalist world-economy. While parts of agriculture remained incorporated through continued exports and insertion into the tourist sector, state deformation into cooperatives and small farmers led to increasing production for subsistence and the development of strong farmer-to-farmer networks. This was possible because delinking provided the Cuban state de-commodified land to distribute in usufruct, as well as maintaining private ownership of small farms and cooperatives.

Additionally, exile provided a de-commodified basis for substantive exchange and mutual aid that aided the proliferation of input-substitution and agroecological practices. With

farmers teaching other farmers, in conjunction with state support, input-substitution and agroecological agrarian practice meant that Cuba had broken with the trap discussed by Castro in the prior chapter, whereby increasing input costs meant that economic returns on exports required increasing amounts of debt. Because the incorporative focus on exports was no longer a motivating factor for agriculture, Cuba could experiment with and expand endogenous, biologically based inputs that recycle nutrients, recuperate soil health, and diversify the production of crops. The benefits of this type of agrarian practice are seen in the increasing rift-restitution potential of Cuban agriculture this social metabolic pathway.

While agricultural production has become more sustainable, it is still not sufficient to feed the population, hence the ongoing necessity of incorporation into the capitalist world-economy. Cuba continues to import more than 50 percent of its food, with some estimates as high as "80 percent of the food consumed" (Pérez Jr. 2019: 181). There is also evidence that Cuba has been able to supply 90 percent of horticulture crops to urban centers through domestic production, pointing toward an uneven production capacity dependent upon type of food consumed. For instance, while Cuba has been successful in producing tubers, vegetables, and other horticultures, it has continued to have problems with supplying the population with bread, meat, and fats/oils. Agroecology does point toward polyculture perennials as one way to address grain production (Crews, Warton, and Olsson 2018). While Cuba has implemented polycultures, there is insufficient data on the extent to which this has involved grains or the yield if this practice has been implemented. Additionally, there is competing evidence on whether production under input-substitution and agroecological agrarian practices has been increasing compared to the prior industrialized period, on the role of declining land in cultivation as problematic in terms of production for domestic consumption, and on whether further structural

changes would be necessary to bring about production sufficient to supply the Cuban population (Álvarez and González 2014; Betancourt 2020). Thus, while Cuban agriculture has an increasingly rift-restitutive potential, this may be at the expense of consumption, an unbearable situation if not addressed through increasing yield or imports.

In that sense, there is a certain level of idealism in proposing absolute exile as a strategy for more than 11 million people who would be expected to confront intolerable material deprivation. Because of this, the Cuban government relies on its tourism and medical sectors to bring in foreign exchange that permit it to purchase food for domestic consumption and sale to tourists. This re-commodifies agricultural production internally in a form that is distinct from either of the prior pathways. Part of that re-commodification focuses on economic incentives for direct producers who have an increasing amount of autonomy over the production process. They navigate that autonomy within a system of scarce synthetic inputs and heavy machinery by relying on one another.

CHAPTER 7: A COMPARATIVE CONCLUSION OF SOCIAL STRUCTURES AND SUSTAINABLE TRANSITIONS IN THE AGRARIAN SOCIAL METABOLIC ORDER

Case Comparisons

The three periods analyzed in this dissertation represent three different mixtures of structural conditions and rift potential outcome: incorporated, delinked-incorporated, delinked-exilic-incorporated. I provide a discussion of how structural characteristics are present in each period, as well as how these conditions operate differentially dependent upon the presence of multiple structural conditions. Afterward, I describe the relationship of agrarian practice to rift potential, focusing on how each period had a differential set of practices and the fundamental break that occurred in the 1992-2016 period. From this comparison, I aim to demonstrate how structural conditions shape agrarian practice and therefore rift potential based on the evidence from the three period.

Structural Conditions and Characteristics

To begin, I compare the components of structural conditions between each case (see Table 7.1). Increasing agricultural exports tend to be connected with incorporation, as this involves a commodified sale and direct interaction with the overall capitalist world-economy. This could be carried out with or without a sovereign state to dictate the terms of trade, which is why increasing export trade could also involve delinked structural conditions, as in the case of the 1959-1991 period. Even when there is a preferential buyer, the imperative of foreign exchange to purchase imports means that fluctuations in world market price impact the sale and production of sugar. When exports are drawn down, then exilic conditions become more likely, as this imperative is removed. Therefore, trade is an important indicator of structural condition

because it is a major conduit to connect a nation with the capitalist world-economy, thereby incorporating it.

Table 7.1. Structural Conditions and Characteristics Across Periods

Cases	1898 - 1958	1959 - 1991	1992-2016
Trade	Sugar export dominance; reliant on food imports	Sugar export dominance; reliant on food imports	Sugar and agriculture are no longer principal exports; reliant on food imports
(De-)Commodification	Land, food, and inputs commodified	Land and food de-commodified; inputs de-commodified in state sector, commodified to an extent in private sector	Land de-commodified; food re-commodified, to an extent; inputs both commodified and de-commodified depending on the type of input
Interstate Administration	International agreements with the United States in terms of sugar exports; Participant in international agreements on the production and sale of sugar	International agreements with the Soviet Union and Soviet sub-system in terms of sugar exports; Participant in international agreements on the production and sale of sugar; Blockaded by the United States	International agreements with the Pink Tide, especially Venezuela, however not linked with sugar; international cooperation with NGOs and international bodies on sustainable agricultural development; participation in international agreements on the production and sale of sugar; Blockaded by the United States
State Administration	Lack of sovereign control over economic development; law of value controls production and distribution	Sovereign control over economic development; law of value impacts external relations with the capitalist world-economy, but is controlled or abolished for internal distribution and production	State deformation through increasing egalitarian and direct control over means of agricultural production; re-introduction of market mechanisms in food distribution; maintenance of state control over input distribution and land tenure
Agrarian Structure	Dominated by international and national capitalists; Tenant and large farms majority	Dominated by state ownership; abolition of the capitalist class	Cooperatives and small farms dominant farm types with usufruct and private ownership; ongoing abolition of capitalist class; ongoing state ownership of approximately one-third of farming sector
Structural Condition(s)	Incorporated	Delinked and Incorporated	Exilic, Delinked, and Incorporated

Commodification is often linked with incorporation, as it is about the conversion of things into exchange values for the accumulation of capital. Countries that interact with the capitalist world-economy in terms of exports are more likely to commodify their production, because the purpose is sale of an exchange value to accumulate capital. From the accrued capital, a country can purchase imports to utilize as part of the economic development strategy. Therefore, during the 1898-1958 period, where Cuba is unable to debt-finance economic development, exports were the only way to purchase imports, necessitating incorporation. As well, the commodification of land during this period leads to dispossession of farms, and an increasing number of tenant farmers who do not control production.

Even during the 1959-1991 period, external trade was commodified, even while internal exchange was de-commodified. This is because de-commodification is often linked with delinking and exile (i.e., anti-systemic structures), because these structural conditions are about placing controls over the law of value or its abolition outright. When land is no longer a speculative asset or able to be concentrated to control agricultural production, as was the case in the 1959-1991 period, then it is de-commodified. Similar could be stated about food. However, as is seen in the 1992-2016 period, de-commodification and commodification can co-exist, even when anti-systemic structures are dominant. It can be argued that the exilic agrarian structure of this period was in part dependent upon partial incorporation by re-commodifying the exchange of food. This is a key point, because it demonstrates how structural conditions exist in varied mixtures that are counterintuitive.

Commodification is linked with internal state administration, especially in terms of how the state is able to make decisions on what is convertible into an exchange value. While absolute incorporation in 1898-1958 meant that the state had little control over commodification, there

were exceptions. For instance, a series of laws meant to control production was about attempting to control price. Yet, this was not the same as delinking, because it did not lead to de-commodification of the means of production, nor was the Cuban state sovereign during this period. Only when the state was able to directly intervene in what was convertible into exchange value can internal state administration be considered to represent a delinked structural condition, as occurred in the 1959-1991 period. During that period, and the 1992-2016 period, the Cuban state was able to decide on how land could be owned and transferred, the price of food, and other important factors of the agri-food system. This provided it an important capacity to dictate agricultural development that was not present without a delinked structural condition. Even more, this provided support for an exilic structural condition, because the Cuban state was able to turn over state land to a reinvigorated cooperative agriculture.

This is also related to interstate administration, because of how incorporation and delinked condition the relationship with the overall capitalist world-economy. In the 1898-1958 period, Cuba had little capacity to dictate its relationship with the capitalist world-economy. The United States, as the principal sugar buyer, set the terms for Cuba's external relationship. And, while Cuba participated in international agreements, it did so with an understanding that United States capital was in control of the sugar industry. When Cuba delinked in the 1959-1991 period, the sovereign state was able to establish agreements with the Soviet Union that were highly beneficial to economic development. This provided Cuba with the capacity to industrialize sugar production and utilize foreign exchange from exports to import technologies that expanded its agro-industrial base. As well, Cuba had an increasing capacity to participate in international agreements that allowed it to structure its relationship with the capitalist world-economy that was more beneficial to its internal economic development.

Even more, when the Soviet Union collapsed, Cuba was able to make a decision to partially exile from the capitalist world-economy, while still maintaining incorporative ties. This was because Cuba's delinked structural condition provided it with a capacity to decide on terms of trade favorable to its internal development strategy, as well as enter into agreements with international NGOs as opposed to supranational government organizations, like the IMF, which could impose structural adjustment. Thus, exile gave space to an alternative to neoliberal development that other countries were dissuaded from pursuing through the penury terms of credit lines.

Agrarian structure is more clearly delineated between the periods, because of how class structure is embedded in the specificity of structural condition. Because of this, capitalist dominance in the 1898-1958 period relates to the sole existence of incorporation as a structural condition as there is not a counter-vailing structural force to impede their control over agricultural production. Therefore, farms are owned by national and international capital with the sole goal of capital accumulation. This meant that agricultural production stagnated in underdevelopment, even while the amount of sugar produced increased.

With the advent of delinking in the 1959-1991 period, the state abolishes the capitalist class and assumes control over the majority of agricultural production in the form of state farms, while still maintaining a portion of land in private and cooperative control. This is because of the prior stated de-commodification of land that state control permitted through delinked structural characteristics that reined in the law of value. That provided Cuba with the capacity to develop agricultural production in modernist directions it had been denied when only incorporated. State farms were then centrally coordinated to increase production. When exile became a structural condition during the 1992-2016 period through state deformation, this maintained the de-

commodification of land while producing an agrarian structure more thoroughly based within cooperative and private farms, while the state ownership continued in reduced form. This shift led to increasing autonomy for direct producers to decide on agrarian practice.

Agrarian Practice and Rift Potential

Now, I compare the components of rift potential between each social metabolic pathway in related with the beforementioned structural conditions (see Table 7.2). Land use change involving the increased land in cultivation for sugar is connected with rift-making potential. This is because it involves the extensive use of agroecosystems for production of a monocrop. The incorporative social metabolic pathway saw a massive expansion of land in cultivation for sugar, along with deforestation. This led to increasing soil erosion, loss of organic matter in the soil, and a breakdown in the soil nutrient cycle. The increasing land in cultivation continued during the incorporated, delinked social metabolic pathway, as Cuba relied upon sugar as an export to bring in foreign exchange to purchase imports for economic development. This meant continued breakdowns in the soil nutrient cycle and soil erosion. However, delinked structural conditions during this social metabolic pathway permitted Cuba to reforest, and thereby counteract the erosion dynamic and re-introduce habitat to increase biodiversity. It is only in the exilic, delinked, and incorporated social metabolic pathway that there is a draw down in land in cultivation, which saw a more rift-restitutive potential occur. This is because land left fallow is more capable of increasing biomass, produce habitats for biodiversity, and to combat soil erosion caused by agricultural production.

Table 7.2. Agrarian Practices and Rift Potential**.**

Cases	1898 - 1958	1959 - 1991	1992-2016
Land Use Change	Increasing extensive use of land for sugar production; deforestation	Increasing extensive use of land for sugar and other crops; reforestation	Decreasing land in cultivation for sugar; increasing land for other crops; overall decrease in land in cultivation; reforestation; soil conservation programs
Technology	Minimal use of heavy machinery and irrigation	Increasing use of heavy machinery and irrigation	Increasing use of animal traction; decreasing use of heavy machinery and irrigation
Fertilizer Application	Low levels of synthetic fertilization; majority of fertilized land in sugarcane	Increased levels of synthetic fertilization; majority of fertilized land in sugarcane	Decreased levels of synthetic fertilization; increasing use of manures, sugarcane byproduct, and other more sustainable fertilizers that recycle nutrients through agroecosystems
Pest Management	Low levels of herbicide use; cultural controls; physical controls	Increasing use of herbicides; increasing mechanization of herbicide application through crop dusting; maintenance of physical controls through hand weeding	Decreasing use of herbicides; increasing use of biological control and biological pesticides; increasing cultural control; increasing physical controls
Rift Potential	Rift-Making	Rift-Making	Rift-Restituting

In terms of the other components of agrarian practice and their links to rift potential, the incorporated social metabolic pathway did not always entail intensification. There was minimal use of heavy machinery, irrigation, fertilizer, and herbicides. Where these were utilized was in the most incorporated part of agricultural production, sugar. This shows that incorporation with

underdevelopment can blunt rift-making potential but does not necessarily lead to rift-restituting potential. Instead, during that period labor was the point of extraction for energy, and small farms that produced for subsistence were less likely to utilized intensive agrarian practices. Thus, this reinforces the key argument that incorporation tends to lead to rift-making, even if it does have industrial forces of production.

Intensive agricultural production expanded during the incorporated, delinked social metabolic pathway, when Cuba was able to access heavy machinery, irrigation, fertilizers, and herbicides. These were utilized to overcome rifts and increase production, while also compensating for a reduction in agricultural labor. The state was able to coordinate the use of these inputs and technologies in concentrated land that was de-commodified. The use of these inputs has the capacity to reduce biodiversity, degrade soil, and increase withdrawals from inputs like water. By doing so, they disrupt ecological systems, even while supporting socially beneficial goals like education and healthcare. Small private farms and cooperatives continued to exhibit lower rates of use, a foreshadowing of their role in rift-restituting potential in the exilic, delinked, and incorporated social metabolic pathway.

In the final pathway, input-substitution and agroecological practices came to predominate that demonstrate a rift-restitutive potential. The application of biomass and manure to soils increases organic matter, recycles nutrients, and tends to lead to better soil health. The use of biological control repairs relationships between species within an ecological niche, while reducing chemical control can increase biodiversity. Additionally, the increased use of animal traction is shown to be beneficial for soil and plant health. In total, this pathway provides a key case for the possibilities of a sustainable transition based within a cooperative and small farm dominant agrarian structure.

Summary of Comparison

With this information, a relationship between structural conditions, agrarian practice, and rift potential is more easily distilled. Specifically, the existence of incorporation in terms of connection through exports to the capitalist world-economy tends to lead to agrarian practices that have a rift-making potential. This is even the case when delinked. as incorporation reduces there is not an automatic shift toward a rift-restituting potential. That is, reducing incorporation is not a sufficient condition for addressing rifts in agriculture. This is because delinked-incorporation is in part premised on maintaining harmful dynamics through the continued reliance on exports derived from an industrialized agrarian practice.

Only when exile was present as an anti-systemic structural condition does rift potential shift toward restitution. By reducing imperatives to produce for exports and shifting control to the direct producers, a novel form of agrarian practice increasingly became the norm. That also continued to support socially beneficial goals, such as feeding the population, through reliance on subsistence production. As well, it led to better economic outcomes for farmers who were able to sell post-fulfillment of the quota at parity prices for their labor. Thus, it is not that exile is a sufficient condition, nor that delinking and incorporation must be absent. Rather, it is a necessary condition that alters the impacts of the other structural conditions bringing about a rift-restitutive potential in the agrarian social metabolic order.

Findings

There are five findings on the relationship between structural conditions and rift potential. The first major finding, and highest level of abstraction, is that structural condition

tends to impact rift potential. This provides supporting evidence for prior work in critical environmental political economy that argues institutional changes without a corollary change in the social structure tend to not produce reductions in environmentally degradative practices (York and Rosa 2003; Clark et al. 2021). This is because structural conditions appear to impose imperatives upon production that changes in values or regulations are typically not capable of overcoming by themselves. Because of this, environmental sociology should emphasize the role of structure in sustainable transitions, especially in terms of material outcomes.

That connects to the second finding supports existing research on the role of capitalist structural imperatives in producing metabolic rifts (Foster 1999b). The commodification of nature alters the social relationship with ecology in ways that are more likely to produce environmentally problematic outcomes. While it remains a theoretical possibility for an incorporated social structure to bring about a sustainable social metabolic order on its own, the evidence from these case comparisons does not support this contention. Incorporation on its own, without the existence of anti-systemic structures, tends to lead to rift-making potential in terms of agrarian practice. This has important implications for policies to bring about sustainable transitions, because it may require a more radical adjustment to the existing agrarian social metabolic order than is currently proposed, even by policies like the Green New Deal (Ajl 2021).

The third finding is how structural conditions mix dependent upon their historical development. Rather than the capitalist world-economy's incorporative structural condition being absolute, dependent upon the social conditions of the social metabolic pathway numerous hybrids can impact the rift potential of agriculture. These hybrids also point to how specific mechanisms, like (de-)commodification, have differential impact based upon the concrete set of structural conditions. Rather than a functional relation if-then relationship, whereby if

commodification then unsustainability, the relationship is conditional. This is seen most clearly in the re-commodification of food during the 1992-2016 period, which was linked to increasing rift-restitutive potential because of how this was conditioned by access to usufruct and private land, substantive exchange, and other delinked and exilic anti-systemic conditions.

This is connected to the fourth finding of this study on the interaction between delinking and exile. As anti-systemic structures, this provides supporting evidence to Smolski, Castro, and Ross (2018) who argue that delinking and exile interacted in producing the outcomes of both the Russian and Mexican revolutions of the early 20th Century. Rather than either being a sufficient condition or in absolute opposition, it is their interplay that open up possibilities in a world dominated by incorporation into the capitalist world-economy. Even more, delinking is a strategy to confront structural constraints imposed upon a state by the capitalist world-economy and prior periods of underdevelopment. It may not always be possible to build exilic structural conditions without harsh deprivation being hoisted upon a population.

The importance of this finding is shown by how the delinked, incorporated social metabolic pathway provided conditions for the partial exilic-incorporated and delinked period. The Cuban government invested heavily in education that trained scientists and technicians and de-commodified land enabling access to it by people who wanted to produce. Even more, the transition to sustainable agriculture had already begun in the delinked period, as a group of agricultural scientists and ecologists promoted the idea as a way to address environmental degradation brought about by industrialized agricultural production (Oppenheim 2001). Even more, there was an increasing awareness of the perils of dependence upon the Soviet Union, leading to the development of alternative agricultural inputs in the 1980s (Stricker 2007). Therefore, state sovereignty and socialist central planning provided important conditions to make

viable the acceleration of sustainable agriculture when a crisis occurred. This means that delinking should also be considered a necessary, but not sufficient, condition for supporting a sustainable transition.

The fifth finding of this study is on the interaction between exile and agroecological practices. It is not that decentralization or local are *a priori* more sustainable, but instead how social relations involving autonomous control and substantive exchange can support a different type of agrarian practice. As direct producers navigate reduction in intensive inputs, they share knowledge that they are able to apply to the conditions of their specific agroecosystem. This is an egalitarian and direct democratic way to establish technologies and inputs that can be beneficial for ecology. If this is the case, as evidence from this dissertation tends to show, then land redistribution and cooperative ownership may be a sensible policy for promoting a sustainable transition in the agrarian social metabolic order.

Yet, this is only a necessary condition, and not a sufficient condition on its own for a sustainable transition. One reason is that agroecology at the farm level may be resilient, but only insofar as the system at higher levels is also resilient (Holt-Giménez, Shattuck, and Lammeren 2021). While agroecology and input substitution reduce costs to the farmer, this does not automatically entail a capacity to supply farmers with the necessary implements to carry out these agrarian practices. For example, while the Cuban government is able to invest in surveilling fields for weeds and pests, it does not necessarily have the capacity to supply the input substitutes to all farmers to address these problems, as seen in statistics on cultivated areas applied with the differentiated set of biological input substitutes (Febles-González et a. 2011). This can be a reason that farmers often note a problem with accessing inputs, and that farmer support for agroecology is more often pragmatic than idealistic in Cuba (Nelson et al 2009;

Enríquez 2010b). In this sense, exile may need to be a generalized condition, in which case it would no longer be exile, but an alternative world-system. The problem of 'socialism in one country' continues as a quintessential problem, regardless of its status as a necessary condition for a more sustainable social metabolic order.

Conclusion and Future Research

Concluding Remarks

The objective of this dissertation was to provide support for shifting the debate away from whether institutional changes within-capitalism support a sustainable transition toward a focus on structural changes. In a crucial sense, it brings to the fore a classical Marxist argument on causal direction, whereby structural change precedes value changes that have material outcomes. The theory and evidence presented here support the idea that structural change is a necessary condition for a sustainable transition. That would mean that theories like ecological modernization which call for a reflexive change in values will be insufficient to address the compounding ecological crises in agriculture.

This dissertation does not offer a definitive answer on what structural conditions will permit a sustainable transition, although the evidence points in crucial directions concerning delinking and exile as necessary conditions. If de-commodified land and increased autonomous control over production by cooperatives and small farmers are the structural basis of sustainable agrarian practice, supported by a robust state that is able to control the law of value and diminish capitalist power, then the world is currently on a trajectory toward continued unsustainability regardless of green rhetoric. Yet, it is an open question, one that is not answered by sociologists but social movements and states, whether land redistribution is once again brought to the fore as

it was in many countries during the 20th Century. And it remains to be seen if existing resources will be shifted away from increasing synthetic inputs and technology toward input-substitution and agroecology. Current trends do not make me optimistic, such as lab meat, precision agriculture based on drones, and other capital-intensive inputs into the agroecosystem that will most likely reinforce an incorporative social structure to the detriment of delinking and exile.

If agroecology is truly to be a force in the future, then the theory and practice it proposes will need to be invested in internationally. And while agroecological scientists and practitioners promote ideas like circular and solidarity economies, there must be recognition that such strategies do not exist in a vacuum. Power is real, and dictates the resilience of agroecosystems in the long-term, economically, socially, and environmentally. Therefore, to bring about the 13 agroecological principles of recycling, input reduction, soil health, animal health, biodiversity, synergy, economic diversification, co-creation of knowledge, social values and diet, fairness, connectivity, land and natural resource governance, and participation, more radical vistas should become part of the debate (Wezel et al. 2020). This echoes organizations, like La Via Campesina, which understand agroecology as a social movement tied to science and practice. Otherwise, agroecology could become another strategy for capital to reproduce itself through its instrumental application as way to continue intensification and maintain incorporation of agriculture.

Future Research

This research should be developed with an increase in the number of cases analyzed. For instance, what structural conditions does North Korea represent and what is the rift potential of

its social metabolic pathway? What about in Mexico, with ejidal land that represents delinked and exilic anti-systemic structures? Or, what about a country like Denmark? Through an increase in the number of cases, more evidence can be gathered to refine this analysis, provide nuance, and validate findings. As well, more cases would support a more quantitative type of methodology, like Qualitative Comparative Analysis that utilizes Boolean algebra, that could be applied to formally demonstrate links between conditions and outcomes. While only a single case, this is an important first foray into this discussion, one that should support a strong, future research program.

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