

REVIEW

New opportunities, new challenges: Harnessing Cuba's advances in agroecology and sustainable agriculture in the context of changing relations with the United States

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Cuba's transition to agroecology is perhaps as widely known as it is misunderstood. In response to the economic crisis of the early 1990s, the Cuban agricultural sector largely departed from the industrial model of food production that it had previously pursued. The subsequent transition towards an agroecological model has been a dynamic and uneven process, elevating Cuba on the world stage as a global leader in sustainable agriculture while at the same time producing unique challenges for Cuban farmers, policy makers, researchers and academics. This article synthesizes and updates contemporary literature on the Cuban agricultural system, paying attention to both successes and shortcomings of agroecology in Cuba to date. In particular, it situates these literatures alongside contributions from academics and practitioners alike, bringing a number of data sets, experiences, and perspectives into conversation in the context of changing realities within Cuba and the nation's evolving geopolitical relationship with the United States. By analyzing both the historical and contemporary processes through which agroecology has taken root in Cuba, we demonstrate that, despite its uneven and incomplete implementation, such a sustainable agroecological transition holds great, untapped potential. Agroecology in Cuba currently faces pressure from normalizing Cuba-US relations, with potentially profound implications for agriculture in both countries. But increasing opportunities are also emerging for investment, collaboration, knowledge exchange, and solidarity. In this paper, we provide an overview of the evolution of the Cuban agroecology movement; analyze the state of food security and challenges to food sovereignty on the island today; outline US-Cuba policy changes occurring since December 2014 that may affect the agrifood sector; and conclude with recommendations for supporting agroecology – for food security, food sovereignty, and sustainability – under this new and evolving relationship. *Please refer to Supplementary Materials*, DOI: <https://doi.org/10.1525/elementa.337.s1>, for a full text Spanish version of this article.

Keywords: Cuba; Agroecology; Food sovereignty; Food security; Resilience; Sustainable agriculture; Cuba-US relations; Agricultural trade

La transición agroecológica cubana es quizás tan ampliamente conocida como malentendida. Como respuesta a la crisis económica a principio de los 90, el sector agropecuario cubano se apartó en gran medida del modelo industrial de producción alimentaria que anteriormente había perseguido. La transición posterior hacia un modelo agroecológico ha sido un proceso dinámico y heterogéneo, que 1) ha convertido a Cuba en líder en el desarrollo de una agricultura sostenible a escala global y que, al mismo tiempo, 2) ha producido

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una variedad de desafíos inéditos para agricultores, decisores políticos, investigadores y académicos cubanos. Este artículo busca sintetizar y actualizar la literatura contemporánea sobre el sistema agrícola cubano, prestando atención tanto a los éxitos como a las debilidades de la agroecología en Cuba hasta la fecha. En particular, sitúa esta literatura a la par de los aportes de académicos, técnicos y agricultores, aportando una diversidad de datos, experiencias y perspectivas a la discusión, en un contexto cambiante tanto dentro de Cuba, como en las relaciones geopolíticas con los Estados Unidos. Partiendo del análisis de los procesos, tanto históricos como actuales, a través de los cuales la agroecología se ha enraizado en Cuba, este artículo muestra que, a pesar de su implementación desigual y aún no completa, la transición agroecológica sostenible en Cuba tiene un gran potencial por explotar. Si bien actualmente la agroecología cubana enfrenta la presión de la normalización de las relaciones Cuba-Estados Unidos, con implicaciones potencialmente profundas para la agricultura en ambos países, también puede beneficiarse de oportunidades cada vez más emergentes para la inversión, la colaboración y la solidaridad. En este artículo, proporcionamos una visión general de la evolución del movimiento agroecológico cubano; analizamos el estado de la seguridad alimentaria y los retos de la soberanía alimentaria en la isla hoy; resumimos los cambios en la política Estados Unidos-Cuba desde diciembre del 2014 que pueden afectar al sector agroalimentario; y concluimos con recomendaciones para apoyar la agroecología (para la seguridad y soberanía alimentaria y la sustentabilidad) bajo esta nueva y cambiante relación. *La versión en español de este artículo se puede encontrar en Materiales Suplementarias*, DOI: <https://doi.org/10.1525/elementa.337.s1>.

Palabras clave: Agroecología; Soberanía alimentaria; Seguridad alimentaria; Resiliencia; Agricultura sostenible; Relaciones Cuba-EEUU; Comercio agrícola

1. Introduction

One of the greatest challenges we face as a global community is to sustainably feed a growing population while conserving the finite natural resources our society and economy depend on. Despite massive increases in global agricultural output achieved in the past century, around 2 billion people go hungry worldwide (Hickel, 2016). Global agriculture currently produces enough food to feed 1.5 times our population of 7.5 billion people (FAO et al., 2017), but debates about whether the dominant industrial agricultural model or alternatives like organic agriculture or agroecology are the best approach to feeding the world too often focus on the question of production. While production can be a barrier to achieving food security, hunger is a multi-faceted issue that requires addressing structural problems of distribution, food waste, poverty, power and inequality (Sen, 1984; Lappé et al., 1998; Pimbert et al., 2001; Maxwell, 1996). Ample evidence shows that the industrial agrifood model has failed to adequately and nutritiously feed us while perpetuating a system that is ecologically destructive, socio-economically unjust, yet politically powerful (Pimbert et al., 2001; Chappell and LaValle, 2011; Holt-Giménez and Altieri, 2013; McMichael, 2009). Furthermore, 70% of the food consumed on the planet is produced by small farmers using 20% of the resources, highlighting the need to invest in and support this sector (ETC, 2009).

The concept of agroecology has gained momentum, in recent years, within international governance bodies as an agrifood systems paradigm that more effectively addresses the problems of hunger, poverty and inequality while curbing biodiversity loss and providing more resilience to climate change (FAO, 2015; IAASTD, 2009; De Schutter, 2010). This uptake comes both from increasing evidence that the current model must change and from decades of persistent implementation, defense and advocacy for this approach from farmers, scientists and NGOs

globally. In simple terms, agroecology is the “application of ecological principles to the design and management of agroecosystems through the integration of traditional and scientific knowledge” (Altieri, 1995).

However, agroecology is not just a science and on-farm practice, but also a social and political movement that seeks to transform the dominant corporate food model by researching, implementing and advocating for socially just, economically fair and ecologically resilient models (Wezel et al., 2009; Francis et al., 2003; Méndez et al., 2015). A deliberately expansive term, agroecology encompasses ancient sets of agrarian practices, knowledges, and cultures such as agroforestry, seed saving, and contour terracing. It also refers to a burgeoning, integrative, robust science devoted to exploring, explaining and expanding this world of agricultural knowledges. More than simply a set of techniques, agroecology is firmly in the realm of grassroots social movements promoting and defending such practices, their biocultural heritage, and their emancipatory political potential. Agroecology establishes principles for identifying, selecting and cultivating the designs and management that support sustainability throughout agrifood systems.

The multifaceted benefits of agroecology are gaining ground—and attention, despite being marginalized and dismissed by mainstream agricultural sciences and policy for decades. This is evident even at the FAO, where practitioner-experts, scientists, and civil society have gathered regularly since 2014 to advance this work (FAO, 2015; FAO, 2017). Meanwhile, as various international bodies and reports have acknowledged and advocated the multifaceted benefits—and urgency—of agroecology (IAASTD, 2009; UNCTAD, 2013; De Schutter, 2010; IPES, 2015; IPES, 2016), goals of mainstreaming bring up questions of co-optation, a particular concern when the concept is stripped of its social and political elements and reduced to its technical science. Agroecologists warn of “agroecology-lite”

(Holt-Giménez and Altieri, 2016) and risks of dilution and reductionism upon institutionalization (Giraldo and Rosset, 2017). Efforts at mainstreaming agroecology should not ignore the research and experiences on scaling-up and scaling-out of agroecology, including the Cuban experience (Machin Sosa et al., 2010; Rosset and Altieri, 2017; Wijeratna, 2018; Mier y Teran Gimenez Cacho, 2018; McCune et al., 2017; Varghese and Hansen-Kuhn, 2013; Parmentier, 2014; Altieri and Nicholls, 2012). Food sovereignty activists, farmers and academics by in large recognize the 2007 and 2015 Nyéléni Declarations as the vision for grassroots-led agroecology (Nyéléni, 2007, 2015).

“Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations.”

– Declaration of Nyéléni, the first global forum on food sovereignty, Mali, 2007

These publications and the regional FAO meetings all recognize the need for more research on where and how agroecological production systems are already happening, and how they are faring. Our paper contributes to this global, growing conversation on agroecology by focusing on a particularly renowned—and often misunderstood—model: Cuban agriculture. Cuba actualizes many of the central principles of agroecology, from low-external-input production to diversified farming systems, horizontal methodologies, and social justice orientation. The social movement dimension of agroecology is particularly strong throughout Latin American contexts, from Nicaragua to Brazil, Guatemala to Colombia. Toledo and Barrera-Bassols (2017) chronicle an array of grassroots organizations and movements in southern Mexico that are calling for, and implementing, political agroecology. Across the hemisphere, the Cuban case stands large as an extraordinary instance of revolutionary agrarian reform against improbable odds.

Cuba has promoted and implemented agroecology for over 20 years as part of its struggle to sustain national food security and domestic sovereignty. These experiences offer important lessons to other farmers, research institutes, non-governmental organizations (NGOs), and governments who are also working toward food security, food sovereignty, sustainability, and economic stability. The story of Cuban agroecology is ongoing and multifaceted; and this review paper gathers existing data and analysis on the complexity of Cuba's agroecological transitions to contextualize the changes and to examine their impacts and challenges. This review is of use to agroecologists, policy makers, civil society, and Cuba studies scholars.

This review is also relevant to agrarian change scholarship. For over a century, scholars around the world have asked ‘the agrarian question’: how capitalism captures—and yet fails to capture—‘peasant’ agriculture (Moyo et al. 2013). Capitalism targets small-scale farming, seeking to

penetrate agrarian landscapes and economies for accumulation, but the agrarian realm keeps eluding corporate capture—even by means of self-exploitation. Cuba, particularly in relation to the US, epitomized the 20th century agrarian question (Graddy-Lovelace 2016), with the Revolution improbably flouting the political dominance of US-based agro-capitalist fruit, sugar, rum, and chocolate companies on the island-nation. Generations later, Cuba-US agricultural relations ask different agrarian questions, as this paper demonstrates. In fact, the rise and challenges of Cuban agroecology characterize the evolution of the agrarian question, itself. At the start of the 21st century, Cuba shows how agroecology serves as an agrarian answer—as a field of answers—to the questions of how to feed ourselves in the face of ecological and economic pressures. In this way, agroecology, as practiced, explored, and adapted by Cubans, serves as a mode of surviving the crises wrought by industrial agriculture—in both its capitalist and communist forms. Thus, studying Cuban agroecology, contextualized within US-Cuba agricultural relations, contributes to the long and important line of inquiry regarding agrarian crisis, change, and resilience.

Since December 2014, Cuba and the US have begun normalizing relations, and new possibilities for trade and engagement are emerging, although tempered now under the Trump administration's more hardline approach on Cuba (Piccone, 2018). This brings both opportunities for expanding and challenges to sustaining the agroecological advances made on the island. In this paper, we provide an overview of the evolution of the Cuban agroecology movement; analyze the state of food security and challenges to food sovereignty on the island today; outline US-Cuba policy changes occurring since December 2014 that may affect the agrifood sector; and conclude with recommendations for supporting agroecology – for food security, food sovereignty, and sustainability – under this new and evolving relationship.

2. Evolution of Cuba's agroecology movement

Cuba's agroecology or sustainable agriculture movement is often framed as being born out of necessity after the fall of the Socialist Bloc caused food, fuel, and material shortages (referred to as the “Special Period”). While this is certainly true, it is important to recognize that the movement was built upon the knowledge of traditional farmers and researchers who were practicing, researching, and advocating for more sustainable approaches to agriculture for decades. What the Special Period did was open the political and economic space that allowed this type of agriculture to take root across the island.

When the Soviet Union collapsed in the early 1990s, the island nation experienced what many consider a simulated peak oil situation; food, fuel, machinery, and other imports were drastically reduced, as were export markets for the island's sugarcane. The food and economic scarcity experienced by Cuban citizens, and the challenges agricultural producers faced in maintaining output, were made even more dire by passage of the U.S. government's laws, the Toricelli and Helms-Burton Acts, which tightened the US blockade against Cuba. Twenty-five years later, Cuba still struggles with material and economic scarcity, but

stands strong as a global leader in sustainable agriculture and eradication of extreme hunger. This is due in large part to strategic alliances made between farmers, scientists, and the government to disseminate alternative production techniques, reduce chemical usage, and increase domestic fruit, vegetable, and grain production (Altieri and Funes-Monzote, 2012).

However, Cuba's agrifood system is by no means dominated by sustainable agroecology systems. Instead, it is a mixture of large- and small-scale farms with varying degrees of fertilizer, pesticide, and other input use, and representing differing stages of transition to integrated agroecological systems. A dichotomy persists as well in the policy realm. Cuban researchers, professors, agronomists, and farmers alike are split in their views on the agrifood systems with the most promise: some fall in the conventional agriculture camp, while many others advocate for the government to fully support a transition to sustainable agroecology systems (Vázquez et al., 2017). In this section, we summarize the changes Cuba has enacted in land tenure and management, food distribution and marketing, farmer innovation, and research and extension in order to develop agroecological farming systems. We also address gains that agroecology has made in policies as well as the role of international cooperation in this transition.

2.1 Decentralizing land tenure

For any model of agriculture, land is a primary asset. In an agroecological or sustainable model, access and rights over land are key to both farmer empowerment and the sustainability of the system. As with many revolutions throughout Latin America, nationalization of land through agrarian reform was decisive to regaining autonomy for the Cuban state, as well as for many rural people (Rodríguez, 1987). One of the first acts of the Cuban revolution was to outlaw the *latifundio* (large, private estate landholdings), and through the First and Second Agrarian Reform Act (1959 and 1963), the government set a maximum of 5 *caballerías* (67.10 ha) per private owner, redistributed small tracts of land to landless farmers, and moved the rest into state control (Rodríguez, 1987).

The First Agrarian Reform Act promoted cooperativism among those small farmers who retained or were granted private land, and by 1963, 3,526 cooperatives were created (Figueroa-Albelo, 2005).¹ However, the government's priority was to promote a strong state sector (Deere, et al., 1992; Figueroa-Albelo, 2005), and by 1989, more than three-quarters of total arable land was managed by large state-owned enterprises (see **Table 1**), which received proportionally more resources than the cooperative and private enterprises (Deere et al., 1992).

These state enterprises practiced agriculture on an industrial scale and prioritized commodity crops, especially sugarcane. The model was reasonably successful while the state had access to imported inputs and a secure market; but, when the Soviet Bloc fell, the Cuban supply of agricultural chemicals bottomed out, and productivity on state farms dropped sharply² (Funes-Monzote, 2008; Wright, 2009).

Table 1: Changes in percentage of total arable land managed by State and Non-State sector 1988–2016. DOI: <https://doi.org/10.1525/elementa.337.t1>

Type of Management	1988	2007	2016
State	82	36	31
Non-State	18	64	69
CCS* and private farmers	10	18	36
UBPC**	0	37	24
CPA***	8	9	9
Total	100	100	100 (6.2 million ha)

Source: ONEI 2017a.

* Credit and Service Cooperative.

** Units of Basic Cooperative Production.

*** Agricultural Production Cooperative.

In a context of a severe food crisis, Cuba once again restructured land management in 1993, this time with the goal of decentralizing and stimulating production and innovation (Decree-Law 142). State farms were broken into smaller parcels and transferred into management by a new form of cooperative – Basic Units of Cooperative Production (UBPC) – run by former state-workers and other new farmers. The land was granted to these farmer/workers freely and indefinitely, under usufruct rights, which allow grantees to use and occupy land, even though they are not formal owners of it. In return, UBPCs sell a large percentage of their production to the state. Additionally, the state granted small plots (up to 0.5 hectare) to people who could not become full-time farmers, so that they could cultivate basic items for family consumption (Decree-Law 142). The UBPCs have had mixed results, and the percentage of land area under UBPC management has decreased over the years (**Table 1**).

Table 1 shows the progressive shift from majority state run farms in 1988 to majority non-state managed farms in 2016. Most of this shift has been through the creation of UBPCs and an increase in land managed as Credit and Service Cooperatives (CCS) and private farms, through Law Decrees 259 and 300, as discussed below. This table represents percentages based on Cuba's total arable land, 6.2 million hectares (ONEI, 2017b). The Ministry of Agriculture breaks this category into cultivated (2.7 million hectares) and uncultivated land (3.5 million hectares) (ONEI, 2017b). Furthermore, the uncultivated land consists of 2.6 million hectares in natural pasture, presumably under some type of management for livestock, and 910,000 hectares in idle land (ONEI, 2017a).

In 2008 and 2012, respectively, Raul Castro's government passed two laws that constitute one of the most progressive contemporary agrarian reforms aimed at recruiting more Cubans into farming to boost food production and reduce the country's dependence on food importation. Law Decrees 259 and 300 (2008 and 2012) allow landless citizens to gain usufruct rights to up to 13.42 hectares (1 *caballería*) of land and allow existing

farmers to gain usufruct rights that extend their farm sizes up to 67.1 hectares. This policy has facilitated the distribution of more than 1.7 million hectares of mostly idle agricultural lands to more than 200,000 farmers, many of whom are new to farming (Nova-González and Figueroa-Alfonso, 2018). There has not been a comprehensive analysis of the impact of this land policy on food production and food security. Anecdotally, we know that results are mixed, as new farmers face limitations including farming knowledge, access to credit and loans, access to basic inputs (hand tools, seeds, water, etc.), difficulty clearing land of aggressive invasive species such as *marabu* and acacia trees, and inefficiencies in distribution systems, among other challenges.

At the end of 2016, 883,900 hectares of agricultural land remained unused (ONEI, 2017a), most of which was in the hands of the state, prompting the state to update Decrees 259 and 300 in the summer of 2017. In an attempt to move more land into cultivation and give farmers greater security and confidence in taking out credit, the new guidelines doubled the amount of land that new growers can request to 26.84 ha, and now allow usufruct rights to be granted in 20-year periods to individuals, and indefinite periods to legal entities (Hidalgo de los Santos and Doimeadiós Reyes, 2016; Cubadebate, 2017). The new guidelines also allow for homes to be built, further incentivizing the “repeasantization” of the rural sector.

The shift from large state farms to smaller cooperative farms offers optimal conditions for the continued development of sustainable agriculture based on agroecology. The small-scale private and cooperative farmers have made the most advances in low-input, diversified production, and have demonstrated the greatest increases in production since the Special Period, as we outline below (Machin et al., 2010; Nova-González, 2016; Altieri and Funes-Monzote, 2012). However, these transformations in *land management* have not altered the existing structure of *land ownership*; as of 2016, the state still held 78.7% of all agricultural land (ONEI, 2017a).

2.2 Restructuring food distribution

Just as the Special Period highlighted the inefficiencies of large-scale farms and prompted redistribution of land, it also pointed to a need for new food distribution models (Deere, 1997; Enriquez, 2010; Wright, 2012). Since the 1960s, there have been distinct forms of food distribution, but in general this has been through a centralized system. The *libreta*, or ration, system is a hallmark of the Revolution. The diversity and abundance of *libreta* food products has diminished since the Special Period (and, at the time of writing this paper, there was discussion of phasing it out); but *libreta* still provides an important safety net for families and contributes to a minimal level of food security. With the onset of the Special Period, the state began to slightly liberalize food distribution by establishing different types of farmers markets, middlemen, and direct sales, often on experimental bases (García-Álvarez y González-Águila, 2016). This section briefly describes some of these changes and the general functioning of the food distribution system; but, due to the complexity

and continual changes in rules, we do not provide a deep analysis of pricing, changing regulations, pros and cons of distinct forms of distribution, or challenges of the system. Instead, we provide a snapshot of Cuba's food distribution model.

Most farms, both in state and non-state sectors, continue to have contracts with the state to sell a certain percentage of their harvest to Acopio, the state distribution enterprise, which then distributes foodstuffs to the population, along with imported items, through the *libreta* (ration book) and state-run markets. This is despite some changes done to liberalize distribution and markets in order to increase availability and access to food in non-state-run channels. Over the years, Acopio has faced challenges in managing distribution, especially as farm production became more and more decentralized with management transfer from the state to the non-state sector. The agency began shifting to a local and regional model of procurement in the 1990s, and instituted common pick-up spots, in an attempt to streamline its processes. However, with limited fuel and transportation, it was difficult for multiple farms and Acopio workers to coordinate timing (Wright, 2009), and a significant volume was still not picked up or distributed in time.

In response, the state created new, subsidized farmers markets, and, beginning in 1994, also allowed for the reopening of “*mercados libres campesinos*” (Decree-Law 191), free markets, where farmers can sell extra product directly to consumers, at higher prices, after meeting their quotas with Acopio (Alvarez & Messina, 1996). During this time, the urban agriculture movement was also burgeoning and provided a new outlet for food purchases. Changes enacted after the VI Communist Party Congress in 2011 opened up new opportunities for food sales, including direct marketing to hotels and restaurants, as well as small food cart vendors, called *carretilleros*.

These changes have helped put more domestically-produced food into circulation, but many challenges remain. Escalating prices at the *mercados libres* are inaccessible for many Cubans, and problems of storage and distribution means that significant food is wasted. Alvarez (2004) estimated that 10–15 percent of available food had been wasted since the 1980s. In 2017, a report financed by the Spanish International Cooperative Development Agency reported that as much as 57% of food produced in Cuba is lost before it reaches consumers; 30% in harvest and post-harvest phases, and 27% during distribution to local and regional populations. Researchers attribute the loss to obsolete equipment, poor transportation and storage systems, and insufficient processing during the initial harvest phases (OnCuba, 2017). These numbers are not far off from global averages of food loss, which is identified as a key issue to be addressed in order to improve food security. However, in industrialized countries the causes of food loss have more to do with capitalist overproduction and the supermarket retail model where shelves are overstocked (Holt-Giménez, 2017).

This problem is difficult to address without increased capital and materials, but the state has begun to prioritize “minindustrias” – the small-scale production of processed

food (such as tomato puree, fruit-based products such as juices and jams, yogurt, garlic paste, dried yucca, etc.) directly on farms. While it is unclear what effect this will have on a national level as such projects continue to scale out and up across the food sector, early examples anecdotally indicate improved income for producers, improved access to healthy options for local customers, and decreased food loss.

2.3 Farmer innovation, research and the decentralization of technical assistance

While material scarcity and limited access to inputs helped spark the agroecology movement, a group of researchers and farmers had been slowly advocating for change in the 1980s.³ They were already seeing the negative impacts of the highly industrial system on productivity, environment and health and were exploring the viability of integrated, agroecological systems, even before the Special Period. When the collapse of the Soviet Union created a political and economic opening for their work, they found opportunities to build partnerships between research institutes, state ministries, and international organizations, and to generate strong infrastructure and systematic linkages between alternative agriculture projects. A core principle underlying many of these efforts was the importance of supporting farmers to share their traditional knowledge, carry out projects, and generate innovation.

The strong institutional and human capital that Cuba had cultivated for decades was essential to the spread of agroecology, a knowledge-intensive science and practice. In the early years of the Revolution, the Cuban state recognized the key role that research and technical support could play in advancing the agricultural sector. In the 1960s and 1970s, dozens of agricultural research institutions were created throughout the country. The body of research compiled by these institutions over the years indicates clear, and mounting, evidence of the unsustainable, and inefficient nature of conventional agriculture even before the Special Period, and so some attention was given to alternative agriculture (Vázquez et al., 2017). One of the earliest agroecological related research projects was initiated by researchers in the Institute for Sugarcane Research and the Institute of Plant Health, who in the 1970s began to investigate biological controls. The results of this research were the scientific basis for the creation of the Centers for the Reproduction of Entomophages and Entomopathogens (CREEs) in the 1980s, which are local-level state supported laboratories that investigate and produce biological control agents to manage pests and improve production. In the 1990s, as the demand for these products increased, their work intensified. Additionally, Labiofam, the state pharmaceutical and chemical production company, began to develop biological products on a larger scale for pest control and nutrient management in agroecological systems. As these facilities provided agroecological products to farmers, other state institutions also developed agroecologically-compatible techniques and tools. For example, state led rural innovation programs pioneered the use of animal traction (instead of tractors) for tilling. Many research

institutions and associations like the Institute for Tropical Agriculture (INIFAT), the Fundación Antonio Nunez Jimenez (FANJ), the Indio Hatuey Institute for Pasture and Forage Management, the Agrarian University of Havana, the Institute for Agricultural Science (INCA), the National Research Institute for Tropical Roots and Tubers, and others focused attention on different forms of low-input, sustainable agriculture. Furthermore, the decentralized nature of research institutes and state agricultural service offices played an important role in the broad development of agroecology given that a principle of agroecology is the importance of local, context specific solutions to production problems.

Not only was there a shift in some institutions in the research focus and technologies promoted, there was also a shift in how research, education and extension was carried out. While the tendency today is still the traditional top-down approach of transfer of knowledge from research institute to farmer, the growth of agroecology was coupled with a growth in more bottom-up, participatory, interdisciplinary approaches to rural development (Vazquez et al., 2017). Much of this was inspired by popular education methodologies promoted by the Cuban Association Center for Martin Luther King, and others. Research stations like Indio Hatuey, began to form partnerships with campesinos.

Perhaps the best example of the peer-to-peer and co-learning model engendered by agroecological principles is the National Association of Small Farmers (ANAP) farmer-to-farmer movement. The *Movimiento Agroecológico de Campesino a Campesino* (MACAC), was started by ANAP, inspired by experiences from Mesoamerica, on a trial basis in 1996, and by 2003, it was active in all provinces. MACAC brings farmers together to share traditional farming techniques as well as application of newer agroecological techniques. Instead of conceptualizing technological and practice innovation as a top-down process, it is a “horizontal” model of participatory knowledge construction and exchange, carried in partnership with research organizations and technical and professional organizations (ANAP, 2015; ANAP, 2016). MACAC played an enormous role in disseminating sustainable practices across the country, and it also influenced the incorporation of horizontal agroecological transfer in other parts of the world through partnerships with the global peasants’ movement La Via Campesina. By 2011, researchers report that MACAC had reached 110,000 out of 350,000 campesino families (Rosset et al., 2011). As of 2017, each provincial branch of ANAP has a MACAC facilitator promoting agroecology and participating cooperatives have promoters. Some campesinos report that CAC exchanges are no longer as active as they once were, which is likely a result of limited funding for transportation and organization (Williams, 2017).

2.4 Urban, suburban, and family agriculture program

The urban agriculture movement was key to tempering the food crisis of the 1990s and is today one of the most important spaces, alongside MACAC, in the promotion of agroecology. Food production in city limits in Cuba began as a popular movement on a small scale, in backyards,

patios and roof tops, as a response to the food crisis. Given that close to 80% of the Cuban population lives in urban settings, the government saw enormous potential for confronting the food crisis through urban agriculture (Funes and Vazquez, 2016). Soon a diversity of forms and scales of production sprouted around cities across the island with support from the Ministry and Agriculture, research institutes, associations, and local governments. Today, urban agriculture is regulated, managed, and supported by the Urban, Suburban and Family Agriculture Program (PIAUS by acronym in Spanish), and is housed under the National Institute of Tropical Agriculture (INIFAT), one of MINAG's research institutes (Companiononi et al., 2016). This program ensures that "urban farms" (whether in densely populated neighborhoods of Havana, mid-sized cities, small towns, or other residential areas) are dispersed throughout all municipalities in Cuba, and that they have infrastructure to support them. Urban and suburban agriculture in Cuba encompasses 12,588 km² of the island, which represents 14% of the total agricultural land of the country. It includes all of the province of Havana, the 10 km radius from the rest of the provincial capitals, the 5 km radius from municipal capitals, and the 1–2 km radius from towns with more than 1,000 inhabitants (Companiononi et al., 2016). The fact that there were large areas of unused land in these geographies helped instigate the movement. The benefits of urban agriculture have been significant for food security, employment, environmental services, education, and health, as well as for localized forms of food sovereignty. PIAUS and the various farms and projects it has helped to support have been influential in promoting local capacity and control over food production, as well as increased autonomy from centralized markets (Rodríguez-Nodals et al., 2006; Companiononi et al., 2016; INIFAT, 2016).

National policy has played an important role in the acceptance and scaling up of urban agriculture. As early as 1987, before the crisis, Raul Castro, in his position as head of the Armed Forces, initiated the production of food for the institution's dining halls through intensive production in raised beds called *organopónicos*. When the food crisis hit, the *organopónicos* were a popular form of production that spread throughout cities in Cuba. All Ministries, institutions and schools were encouraged to tear up their lawns and produce food for self-provisioning. In the 2011 and 2016 *Guidelines for the Social and Economic Policy of the Party and the Revolution*, a key government policy document published every five years, there are two guidelines specific to developing and implementing urban agriculture and reducing inputs (see next section for more information).

The urban agriculture movement has generated more than 300,000 jobs and trained tens of thousands of farmers, technicians, and government officials in agroecological techniques through numerous formal and informal trainings and exchanges including in collaboration with the ANAP's Farmer to Farmer Movement (Companiononi et al., 2016). Urban farms run educational programs with elementary schools and supply highly subsidized foods to schools, hospitals, retirement homes, and other social institutions.

Cuba's urban agricultural sector produces around 50% of fresh produce for the country, surpassing one million tons of production in 2014. In terms of production area, in 2014, there were 2,855 *organopónico* units covering 1,366 hectares and 6,875 intensive gardens covering 6,787 hectares. Urban agricultural sales topped 4.7 billion pesos (\$188 million USD) annually (Companiononi et al., 2016).

Another key contribution of the urban agriculture movement has been the increased availability and access for the Cuban population to a diverse selection of fresh fruits, vegetables, and medicinal plants. This has served to increase the dietary diversity in the population and to improve nutrition in a diet that is otherwise heavily comprised of meat, rice, beans, and root crops. The majority of these staple crops are still produced in rural areas or imported.

2.5 Resilience and agroecology in Cuba

The question of resilience in agricultural systems is always important, but in the context of climate change, which is already increasing climatic extremes globally (IPCC, 2014), it is even more pressing. The concept of resilience spans many disciplines and in recent decades has become a popular concept for climate change, development, and agricultural research, practice and policy (Caswell et al., 2016; Bene et al., 2012; Folke et al., 2002; Frankenberger et al., 2014; Altieri et al., 2015). The links between resilience and agroecology are strong and there is much literature that documents this (Holt-Giménez, 2002; Altieri and Nicholls, 2012; Koohafkan et al., 2012; Kerr et al., 2016; Altieri and Toledo, 2011; Caswell et al., 2016; Greenpeace, 2015). Of course, in Cuba, the lived experience of resilience runs deep, as a society that has withstood the many stresses and shocks of colonialism, the US blockade, the Special Period, and more recently the effects of climate change. Cuba's advances in agroecology go hand in hand with their ethos of resiliency. The combination of strong social networks, and government support for disaster preparedness and response, with agroecological farms in Cuba has resulted in greater resilience for those farms and communities in the face of increasing effects of droughts, floods and hurricanes, as well as socio-economic shocks and stressors, as documented by several Cuban researchers (Machin Sosa et al., 2010; Vazquez et al., 2016). This is yet another area where we can learn from Cuba.

In a study conducted just after Hurricane Ike hit Cuba in 2008, Machin Sosa et al. (2010) found that agroecological farms had 50% crop loss versus 90–100% crop loss on conventional monoculture farms. The study also found that vegetative recovery rates 40 days post-event were much higher on agroecological farms than conventional monocultures. There are several physical (crop diversity, multistrata vegetation, windbreaks, soil conservation practices), biological (genetic diversity with resistant varieties) and human/social (strong social support networks in cooperative or in community/family, strong sense of ownership and commitment to farms) practices applied in agroecological systems that build resiliency. The concept of diversity in all aspects, as a tool to spread risk and increase resiliency, is essential to Cuban agroecological

farms. In a recent study of drought and resilience in eastern Cuba, Vazquez et al. (2016) found that farms that integrated crops with fruit trees, were farmed by traditional farmers, and were managed by women, scored higher on a resilience to drought index than conventional farms that were larger, had a mix of traditional and conventional farmers, and were managed by men. Vazquez et al.'s (2016) study emphasized not only the importance of ecological farm management, but also the importance of a network of articulated actors based on a set of values guided by social, human, economic, ecological and physical capital. This network values those farmers who have demonstrated resilience through innovative practices and are integrated into a local network of actors. The authors emphasize the need to establish strong relationships with external actors who play an important role in post-event recovery efforts, as well as the constant transformation of the broader agricultural system along more sustainable, agroecological lines. In September of 2017, Hurricane Irma made landfall in Cuba in the midst of a several-year long drought, devastating the national sugar industry and impacting over 300,000 hectares of sugarcane according to official reports (Granma, 2017). A more complete evaluation of the impacts of Irma on different types of agricultural production systems remains to be seen. But Casimiro (2017) recounts the experience of one agroecological farm in the Province of Sancti Spiritus, Finca del Medio, discussing the resilient practices they implement. Cuba's experiences with researching and implementing resilient farms through agroecological principles warrant closer attention for lessons learned, in particular for Puerto Rico and other Caribbean islands.

2.6 Agroecology in Cuba's policies and guidelines

The different programs, projects and initiatives that have been implemented over the past two decades have helped to elevate agroecological ideas, techniques and policies to the forefront of debate in Cuba (Vázquez et al., 2017). Initially, these initiatives had very practical aims to address the food shortages and economic crises presented by the Special Period. In the intervening decades, however, they have grown to constitute the basis for a broader commitment on the part of the Cuban state at implementing agroecology within the Cuban food system, which is being increasingly translated into law and strategic development planning. The majority of agricultural public policy in Cuba relates to a transition to economically and politically sustainable systems, mostly in response to the negative impacts of external socioeconomic factors, like the blockade and the fall of the Socialist Bloc (Vázquez et al., 2017).

One of the most important documents that sets up the framework for laws and decrees to be put into place in Cuba is the document that is released after Cuba's Communist Party Congress (Partido Comunista de Cuba or PCC), which takes place every five years, and outlines the economic and social strategies for the country's development. The most recent version, released in 2017, specifically addresses agricultural policy in 30 line items (lines 150 to 179) (PCC, 2017). Overall, the guidelines imply and

allow support for a "combined" model that embraces both agroecology and conventional agriculture, depending on the context and the current interpretation as to what is most feasible for the centrally-planned economy.

While the term agroecology is not explicitly used in the national party congress guidelines, there are several sections that outline principles associated with agroecology. Guideline 159 asserts that, in order to develop a sustainable agriculture, it is necessary to recognize the diverse productive scales within the food system. Guideline 160 points out the need to prioritize the conservation, protection and betterment of natural resources, not only amongst themselves, but also among the soil, water and genetic resources of plants and animals. These guidelines highlight the proposition that Cuba should cease to be an importer of food and work towards the substitution of imports (150, 163, 165 and 169). They emphasize this by calling for the development of self-provisioning municipal food as supported through the National Program of Urban, Suburban, and Family Agriculture (173 and 174) (PCC, 2017). In the guidelines from 2011, guideline 185 discusses the importance of import substitution by prioritizing a territorial view of agriculture, incentivizing local production for local consumption through the urban and suburban program. Guideline 187 discusses the importance of using agroecology practices to increase yields through diversification, crop rotation and polycultures and to "develop a sustainable agriculture in harmony with the environment, that provides the efficient use of phyto and zoo genetic material, including seeds, technology, and the use of organic fertilizers, biofertilizers and biopesticides" (PCC, 2011, pg. 27).

The implementation of these policies has materialized in the formulation of laws, decrees, programs, plans and projects in diverse sectors, in particular those which can be seen in the recent law number 124 of 2017 *De Aguas Terrestres* and decree number 337 regulating this law. In the approval on April 25th of 2017 of the *Tarea Vida: Confronting climate change in the Republic of Cuba*, six of the 11 tasks of this state plan are related to the production of food, food security, human, animal, and plant health and the conservation of natural resources (CITMA, 2017).

Another important policy that supports agroecology is the MINAG's Policy for the Municipal Food Self-Provisioning Program from 2015. This policy document states that food sovereignty is a top priority of the state and the Cuban government and that the key strategy for achieving this is by decentralizing the agricultural sector by increasing community and municipalities' capacity to feed themselves. The policy states that a municipality's capacity to guarantee food for the population should include the "participation of all actors in the territory (individual producers, cooperative members, state enterprises, municipal agriculture delegations) in order to succeed in developing a solid economy at the municipal level, based on agroecological principles, following local climatic and demographic contexts, integrating all facets of municipal livelihoods, including traditional agrarian culture and food of the population" (MINAG, 2015).

Much of the realization of agroecology at the policy level in Cuba has come through the institutionalization of agroecological principles and agroecological thinking in various organizations and at many scales within the Cuban food and agricultural system. Initiatives, such as the *campesino-to-campesino* movements, which took root during the Special Period, have focused on both vertical and horizontal integration within the food system, facilitating exchanges between farmers, research institutions, extension services, and the Cuban state. Such a holistic approach that connects local experiences and successes to national production efforts is necessary for creating a fertile context in which agroecology can be implemented in a meaningful way (Vázquez et al., 2017).

2.7 The role of international cooperation, collaboration and solidarity

While the evolution of the practice, science and movement of agroecology in Cuba was highly endogenous with participation from a diversity of actors on the island, international organizations also played an important role. Some key organizations include Oxfam, Welt Hunger Hilfe, Bread for the World, Food First, HIVOS, Spanish Society for Ecological Agriculture, Mundubat, OIKOS, CARE, COSUDE, UNDP in addition to many more.

Some of these projects have brought significant funding to Cuban agroecology (**Table 2** provides a summary of recent international financial cooperation projects that have promoted sustainable agriculture), others have contributed research collaboration, and some have brought intellectual and political motivation. For example, the international peasant group Via Campesina invited ANAP to join their coalition in the early 1990s, and the groups have collaborated not only on agroecological practices and knowledge dissemination, but also in the elaboration of a theoretical base for agroecology and food sovereignty.

Table 2 shows a sampling of key projects revealing the extensive support of and collaboration between mostly European governments and organizations and Cuba. Notably, the US is missing from this table because formal international cooperation projects⁴ (with a defined financial component) between the US and Cuba have been restricted by US sanctions against Cuba. One of Obama's changes, in March 2016, opened a space to allow funds to be transferred to Cuban institutions through grants. No formal grant to date has been executed in the agricultural sector, but attempts are in progress to support agroecology in Cuba through this avenue by supportive networks in the US.

Table 2: List of Key International Cooperation Projects in Sustainable Agriculture and/or Agroecology. DOI: <https://doi.org/10.1525/elementa.337.t2>

Title of Project	Description	Cuban Partners	International Partners
<i>Bases Ambientales para la Sostenibilidad Alimentaria Local (BASAL) [2012–2017]</i>	Facilitate knowledge exchange, promote adaptive strategies to address threats from climate change.	CITMA MINAG	UNDP COSUDE EU
<i>Proyecto de Apoyo a una Agricultura Sostenible en Cuba (PAAS) [2013–present]</i>	Training and capacity building to improve production of and access to organically grown foods and developing a participatory certification system.	ACTAF	COSUDE Hivos
<i>Biodiversidad Agrícola en Ecosistemas Protegidos Cubanos (COBARB) [2013–present]</i>	Addresses food security and conservation issues by integrating agroecological systems in Cuban protected areas.	INIFAT MINAG MINREX CITMA	UNESCO FAO Bioversity International
<i>Articulación Agroecología [2011–2015]</i>	Demonstrate scalability and functional sustainability of agroecological model to achieve local nutrition and food security.	ACTAF MINAG	EU Hivos COSUDE
<i>Programa Innovación Agrícola Local (PIAL) [2012–2017]</i>	Improving farmer and cooperative innovation and exchange at the local level, focused on seeds.	INCA	COSUDE
<i>Co-Innovación [2011–present]</i>	Horizontal integration between actors/institutions to support innovation, exchange and technology in food production.	Indio Hatuey CIAP IBP	EU CARE France
<i>La biomasa como fuente renovable de energía para el medio rural (BIOMAS) [2009–2017]</i>	Integrating local biogas/biodiesel production with food production for food and energy security.	Indio Hatuey MINAG MINEM	COSUDE

Source: Elaborated by authors.

Acronyms—*Cuban Partners*: Ministry of Science Technology and Environment (CITMA), Ministry of Agriculture (MINAG), Ministry of Foreign Relations (MINREX), Ministry of Energy and Mines (MINEM), Tropical Agriculture Research Institute (INIFAT), Cuban Association of Agricultural and Forestry Technicians (ACTAF), National Institute of Agricultural Sciences (INCA), Center of Agricultural Research (CIAP), Institute of Plant Biotechnology (IBP); *International Partners*: United Nations Development Program (UNDP), Swiss Agency for Development and Cooperation (COSUDE), European Union (EU), United Nations Educational, Scientific and Cultural Organization (UNESCO), Food and Agriculture Organization (FAO), CARE International France (CARE France).

However, there have been other effective ways that the agroecology, sustainable agriculture and cooperative movements in both countries have interacted. Although official relations between the Cuban and US governments ceased in the 1960s, citizens have found ways to engage, in particular, through academic and civil society relationships. Most notable are the solidarity groups such as Pastors for Peace, the Venceremos Brigade, Witness for Peace and other grassroots groups. Also over the past three decades, there have been hundreds of exchanges focused on agriculture, between Cuban and US farmers, alternative agriculture advocates, policy makers, and academics engaging in a variety of participatory workshops and meetings regarding agroecology, food sovereignty, food security, climate change, etc. Often convened by US non-governmental organizations (NGOs) or academic institutions who have petitioned for permission to engage in “person-to-person” or educational travel, these exchanges have been a significant part of relationship building between US and Cuban citizens, and they have also contributed to the development of alternative agriculture movements and sectors in both countries. The first delegation from the US to Cuba that looked specifically at agriculture and food was led by Peter Rosset from Food First and Medea Benjamin from Global Exchange in the early 1990s. Miguel Altieri from the University of California, Berkeley was also involved during this time and has since been a key collaborator in the agroecology movement in Cuba. This led to ongoing exchanges organized by both Food First and Global Exchange. There are now countless other universities and organizations that have organized learning exchanges and that conduct research in collaboration with leading institutes in Cuba. These include the University of Florida, which has had a relationship with the University of Havana since 1993 (as noted in Alvarez, 2004), as well as American University, the University of Vermont, Federation of Southern Cooperatives, EcoCuba Network, Vermont Caribbean Institute, Cuba-US Agroecology Network (CUSAN), Research Initiative for the Sustainable Development of Cuba (RISDoC), the National Cooperative Business Alliance’s US-Cuba Working Group, and others.

3. Food import dependency, agricultural production and food security

Given the successes of the people and government of Cuba to promote, scale up, and scale out agroecology across the island, many wonder why a variety of foods aren’t more available, and why Cuba still imports so much. In this section we provide different analyses of the dependence on imported food, provide data on changes in national production statistics for different foods in the state and non-state sectors, analyze food security data, and discuss the role of agroecology and food sovereignty in these contexts.

Debate abounds on the extent to which Cuba produces its own versus imports its food, and the role agroecological efforts play in food production and food security on the island (Altieri and Funes-Monzote, 2012; Avery, 2009; Alvarez, 2004; Alvarez and Messina, 1996; Machin et al.,

2010; USDA FAS, 2015; Spoor and Thiemann, 2016), with a range of opinions stemming from reliance on different data, anecdotes, and interpretations. Attempts at delineating an accurate picture of the Cuban food system require navigating complex and sometimes contradictory sets of data, as well as the contentious political narratives that frame discussions about agricultural development, and Cuba, in general (Mesa-Lago, 1998; Álvarez, 2004; Wright, 2009). Here, we rely on official statistics from the Cuban National Office of Statistics and Information (ONEI), as well as secondary international data from FAOSTAT. Although the latter is based on ONEI datasets, oftentimes the numbers are inconsistent (see Spoor and Thiemann, 2016 for more detail).

One key limitation to assigning any causality or correlation between changes in production, imports, or food security and the increase in low-input and agroecological approaches on the island is that the national agricultural data do not distinguish between different types of production methods. However, we can make the following assumptions based on state programs and priorities:

- The Urban and Suburban Agriculture Program (PAUS) is based on principles of agroecology and so we can assume all farms in the program use agroecological practices, to differing degrees (Companioni et al., 2016).
- The Farmer to Farmer Agroecology Movement (MACaC) promoted by ANAP is also firmly based on principles of agroecology, with more than 100,000 farming families participating (Rosset et al., 2011).
- The *Poligonos de Suelos* led by the Institute for Soils promotes agroecological practices for soil conservation within large landscapes (Aguilar et al., 2015).
- The Ministry of Agriculture’s National Program of Biological Products integrates a network of more than 200 Centers for the Reproduction of Entomophages and Entomopathogens (CREEs) and 4 Biopesticide Production Plants. The products produced are used on more than 1.5 million hectares annually.
- Agroecology has been promoted much more in the non-state sector (i.e. private farms and cooperatives) than in the state-sector.
- Dozens of international cooperation programs promote agroecology to differing degrees (see section 3.6).
- Most of the crops deemed high priority by the state are produced on large-scale monoculture farm systems that receive “technical packages” including synthetic fertilizers, pesticides, seeds and other equipment for conventional agriculture. Crops include rice, citrus, sugar, beans, potatoes, and tobacco among others, and tend to be produced on state run farm enterprises. Much of these are part of the *Programa de Polos Productivos* or “productive poles program”.
- The non-state sector serves as a proxy for low-input, organic and agroecological systems to differing degrees, hence, we can assume that data about this sector represents data for low-input, organic and agroecological systems.

- Fertilizer, pesticide and tractor usage has not regained pre-Special Period levels. Most agriculture in Cuba is a mix of low-input and integrated agroecological practices to differing degrees, with some state farms implementing higher-input systems, but still not at pre-Special Period levels.

3.1 Food imports

In 2009, Dennis Avery, from the Center for Global Food Issues at the Hudson Institute, sparked a contentious debate with claims that “84 percent of Cuba’s current food consumption is imported.” If Cuba is still reliant on food imports, he reasoned, then “the organic success was all a lie” (Avery, 2009). In a 2012 paper, agroecologists Miguel Altieri and Fernando Funes-Monzote (2012) tackle this claim head on, arguing that the figure is an uncorroborated misinterpretation of a 2007 press release. The press release, published by Granma Newspaper, quotes the then Vice Minister of Economy and Planning, Magalys Calvo, as stating that 84% of items in the basic food basket (i.e. the state ration system) are imported (Granma, 2007). While the state ration system once provided a large portion of a household’s food needs, its provisioning capacity since the Special Period has decreased significantly. Various researchers, the FAO, and ONEI all provide data showing that food import dependence has decreased steadily between the 1980’s and late 1990’s, as demonstrated in **Figure 1** (Álvarez, 2004; Altieri and Funes-Monzote, 2012; Shultz, 2012; FAO, 2016; ONEI, 2017b). The most recent data from the FAO and ONEI, from 2013, suggest that dependence on imported food now fluctuates around 40 percent, a number which is much lower than Avery’s claims, or the level recorded during the 1980’s before agroecology was systematically introduced to the island, or the 80% number which is commonly used today.

Just as with other island nations, Cuba has imported a large portion of its food in large part due to its long history as an agricultural economy based on a limited number of monoculture export items (Figueroa-Albelo, 2003; Schultz, 2012; García Álvarez and Nova González, 2014).

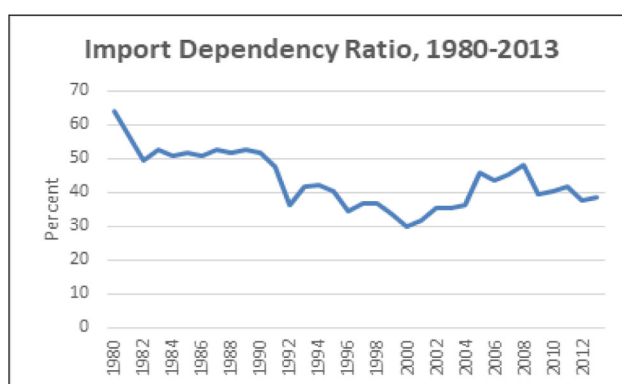


Figure 1: Evolution of the Import Dependency Ratio (1980–2013). This graph illustrates the Import Dependency Ratio from 1980–2013. Elaborated by authors with data from: FAOSTAT Food Balance Sheets, FAOSTAT Trade, Crops and Livestock 13.09.2017. DOI: <https://doi.org/10.1525/elementa.337.f1>

Although the Cuban government officially promotes food import substitution⁵ and has implemented some such policies, the nation needs more comprehensive reforms on price, taxation, monetary and exchange rate policies, and investments to foster agricultural production for the domestic market (García Álvarez and Nova González, 2014; Spoor and Thiemann, 2016). Drops in import dependency that occurred in the 1990s are a closer reflection of the state’s economic position and foreign purchase capacity rather than of gains in domestic, agroecological production.

A closer look at the composition of Cuba’s food imports shows a predominance of food items provided via the ration system (rice, poultry, wheat derived products such as bread, milk and cooking oil), further supporting the estimate that imported foods comprise 84% of food for the ration system (**Figure 2**). Certain imported food items represent crops that aren’t efficiently produced domestically due to climatic limitations. For example, imports for wheat and other cereal crops will likely remain high and largely unaffected by agroecological or agricultural efforts in general. However, import substitution for rice, cooking oil, and poultry are being addressed through pilot programs supported by the state such as the “popular rice” program (Socorro and Sanchez, 2016).

3.2 National production and yields

Production and yields for key crops and livestock were in decline before the 1990s, when the fall of the Socialist Block devastated Cuba’s agricultural sector. Even with intense investments, high use of nutrients and abundant tractors, production declines and loss of efficiencies were reported since the mid-1980s (Nova González, 1994; Alvarez and Messina, 1996). Some Cuban agronomists were aware of this trend and the eventual negative impact on productivity, health and environmental externalities of the high-input conventional system. They began to explore and promote more integrated and biologically diverse agricultural approaches. The conditions of the Special Period opened the political and economic space

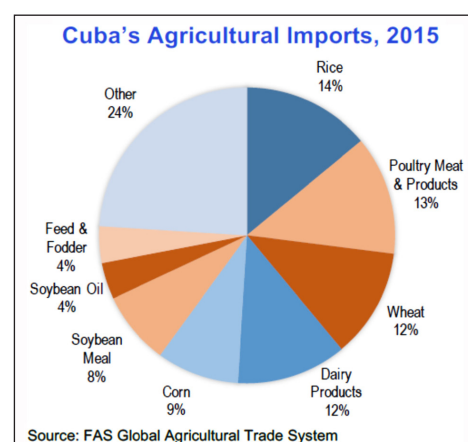


Figure 2: Cuba’s Agricultural Imports, 2015. This pie chart shows the distribution of types of agricultural imports by percentage. DOI: <https://doi.org/10.1525/elementa.337.f2>

to allow for alternative forms of agriculture to take root. As data in **Figure 3** show, significant gains have been made in production levels for root vegetables, vegetables and beans. Machin et al. (2010) show similar results with production increases for root vegetables, vegetables, and beans despite a decrease in fertilizer and pesticide use, suggesting that low-input agroecological practices have contributed to increased production.

Beef and poultry production dropped slightly in early years of the Special Period and has increased minimally, overall remaining stagnant. The significant amount of poultry imports leaves little incentive to invest in increasing domestic poultry production. Milk production dropped more significantly and has not recovered. The trauma to the livestock sector cannot be overstated. Thousands of head of beef and dairy cattle died in the early-mid 1990s, and replacement of herds is a slow process. However, many locally successful examples exist of implementing agrosilvopastoral systems and breeding more resilient breeds (Funes-Monzote, 2008). Leaders in this research include the Agricultural Experimental Research Station Indio Hatuey and the Institute for Animal Science. Pork production has seen an increase in recent years, an important and preferred source of protein for the Cuban population.

The non-state sector has been at the forefront of championing agroecology in Cuba since the Special Period. Small-scale peasant family farms have come to produce more than 65% of the nation's food production on 35% of the total arable land (Casimiro et al., 2017; Rosset et al., 2011; Shultz, 2012; Grogg, 2007). Alvarez and Messina (1996) and García Alvarez and Nova González (2014) also point to data indicating relatively high levels of productivity among cooperatives and the non-state sector in general. The non-state sector has produced an increasingly greater percentage of the nation's food supply since the Special Period (**Figure 4**). For key food items such as vegetables, root vegetables, rice, beans, and milk the numbers are above 80%, with eggs just under 80%. Beef, pork, and poultry are still dominated by the state sector, but there has been a significant uptick in non-state sector beef production since 2009.

It stands to reason that the non-state sector's contribution to national production has increased over the years in line with the progressive redistribution of land from state to non-state management. Looking at both the increases in national production for certain crops and the increased percentage of this production coming from cooperatives, and to lesser extent private farmers, we can assume that low input, agroecological, small-scale farming has positively contributed to the recovery of Cuba's food

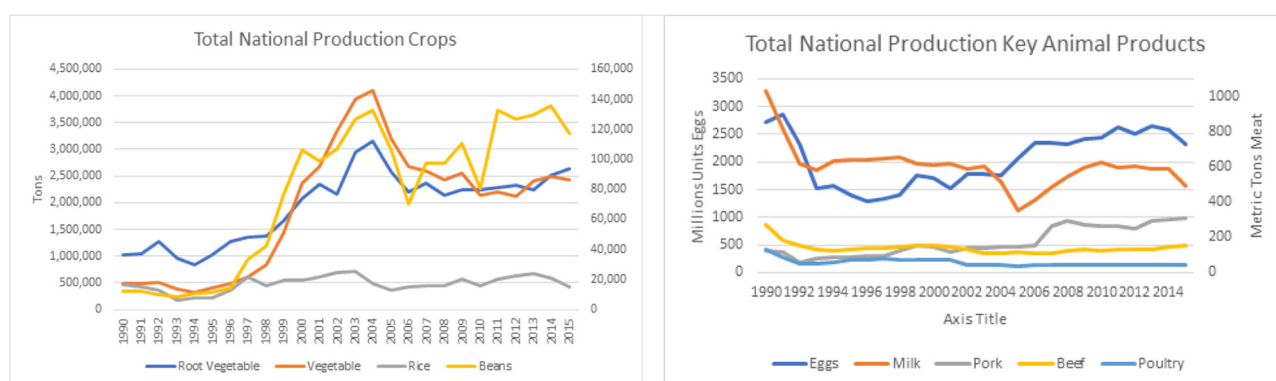


Figure 3: Total National Production for Key Crops, Meat and Dairy. These graphs show the changes in production levels for key crops, meats and dairy products between 1990 and 2014. Elaborated by authors with data from ONEI 2011. DOI: <https://doi.org/10.1525/elementa.337.f3>



Figure 4: Non-State Sector, Percent of National Production for Key Crops, Meat and Dairy. These graphs show the percentage of national production for key crops, meats and dairy that comes from the non-state sector (cooperatives and private farmers). Elaborated by authors with data from ONEI 2011. DOI: <https://doi.org/10.1525/elementa.337.f4>

production. It also stands to reason that national production for many crops has increased, since the area of land under cultivation has increased. Hence, it is important to look not just at production but at yields.

Figure 5 shows the change in yield between 1985, a time when some of the highest yields pre-special period were recorded, and 2016, for key crops. All crops show a yield increase since 1985, with vegetables, sweet potatoes, maize, and beans showing significant gains in yields.

While data presented in **Figures 3, 4 and 5** consist of official data, it's important to highlight the significant role of unrecorded food production to food security. This comes in two forms – production for household consumption and food sales in the unregulated market. Production for household food consumption in urban and rural areas occur in homegardens, or *solares*, patios and roof tops. Production in these spaces is often unrecorded but contributes significantly to many Cubans' daily diets (Buchmann, 2009). Additionally, significant volumes of domestically grown food are unrecorded and sold on the black market, sometimes as a result of Acopio's failures to pick up harvests, and sometimes as a result of farmers' interest in gaining the higher profits often found on the unregulated market.

3.3 Food security

Food import and production data only show us the availability of food. It says nothing about the three other key aspects of food security – access, utilization and stability – which are often the greater barriers to overcome because they relate to deeper systemic issues of poverty, inequality, and structural economic issues. Despite some recovery in production levels for key staple foods, the average Cuban household still struggles daily to put food on the table. This has less to do with issues of productivity than it does with low purchasing power, high food waste, inefficient distribution and marketing systems, the dual currency, and a taxation system that incentivizes an import-based distribution model rather than a domestic distribution model (Spoor and Thieman, 2016). Despite challenges in procuring food, Cuba's commitment to the ration system, *la libreta*, even as its provisions have significantly decreased

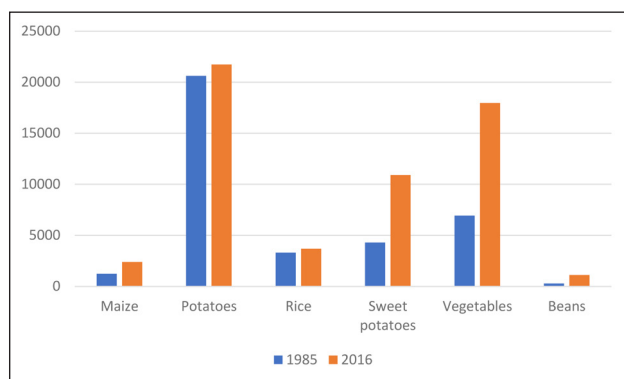


Figure 5: Yield change (kg/ha) from 1985 to 2016 for key crops. This figure shows average yield for each crop as aggregated for state and non-state sectors. Data compiled from ONEI. DOI: <https://doi.org/10.1525/elementa.337.f5>

over the years, provides an important safety net for much of the population and has been essential to preventing levels of extreme hunger and malnutrition seen in other parts of the Americas. As shown in **Figure 6**, data from the FAO shows dietary energy to be much above adequate, fluctuating around 130%. Despite a recovery in average kilocalorie intake since the early 90s, this indicator does not adequately represent nutritional security. Protein supply, while not quite meeting needs has increased since the late 1990s almost reaching the 100% of the FAO recommended daily protein intake for food security.

3.4 Food sovereignty

The concept of food sovereignty is linked to growing and dynamic grassroots movements and scholarly activism that carries a degree of complexity and nuance beyond the scope of analysis for this paper. However, we find it important to include a short section on this issue because of Cuba's prominent role, practical and scholarly, in building food sovereignty, and because of agroecology's essential role in food sovereignties. Food sovereignty, at its core, aims to push a more progressive agenda for food and agriculture globally. This vision is a direct response to the limitations of the food security concept—simply put, food security does not account for how food is produced, who is producing it, where it comes from or if it aligns with an individual's, community's, or nation's choice about the who, what, where and how of food production, distribution and consumption. Food sovereignty was born out of farmers' movements protesting the economic, social, and environmental impacts of the neoliberal free trade system; and is fundamentally a political concept linking local progressive actions to a larger political agenda in order to make structural changes to local and global agrifood systems (Schiavoni, 2016). The concept of food sovereignty was coined at a Via Campesina meeting in the mid-90s, although the term also has roots in Mexican movements (Edelman, 2014); and its definition is evolving through an iterative process reflective of the movement's dynamism. The first global forum on food sovereignty held in

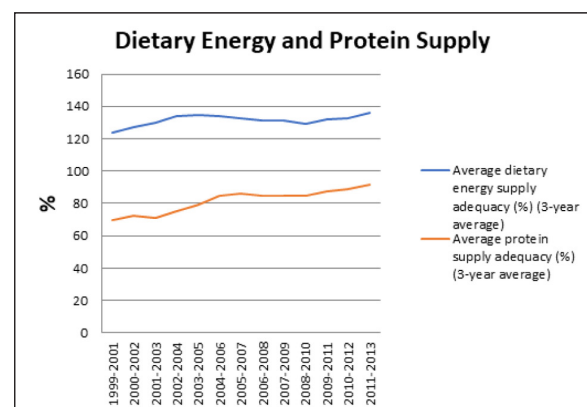


Figure 6: Dietary Energy and Protein Supply. This graph shows the average dietary energy supply adequacy and the average protein supply adequacy from 1999 to 2013, based on the FAO recommended daily intake for food security. Source: FAO 2016. DOI: <https://doi.org/10.1525/elementa.337.f6>

Nyeleni, Mali, in 2007, issued the following definition of food sovereignty: “The right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts those who produce, distribute, and consume food at the heart of food systems and policies rather than the demands of markets and corporations”. Some key points supported by members of the food sovereignty movement include: the right to food for all, the re-localization of food systems, the right to productive resources, gender equality, protection against ‘dumping’ practices, protection against land grabbing, and the promotion of agroecology as fundamental to achieving food sovereignty. The principles of agroecology complement the goals of food sovereignty because agroecology breaks the dependence on outside inputs by taking advantage of diverse agroecosystem services for pest control, soil health, land productivity, nutritional diversity, and an array of other goals. Furthermore, agroecology uses transdisciplinary, action oriented, and participatory approaches to building sustainable agrifood systems—all principles aligned with food sovereignty.

A growing range of actors are paying attention to the agroecology for food sovereignty paradigm as we are faced with multiple crisis caused in part by the current global agri-food system—the food crisis, climate change, biodiversity loss, continued poverty, and hunger. The food crisis of 2008 sparked the interest of some governments, in particular of the Global South, to the food sovereignty concept as they see rebalancing their agricultural commodity and food imports and exports as a necessary strategy to reduce their vulnerability to the volatility of markets and to global environmental change. The FAO has recognized the important role of food sovereignty by partnering in 2013 with Via Campesina in the promotion of small farmers as key agents in the eradication of world hunger (FAO, 2013). Non-governmental organizations are increasingly promoting food sovereignty over food security because of its emphasis on farmer’s and nature’s rights and structural change. Academics have also taken to studying food sovereignty movements and using it as an analytical frame to understand agrifood systems (Pimbert, 2008; Patel, 2009; Wittman, 2011). Strategic alliances between different actors in different regions of the world can contribute to the scaling up and out of food sovereignty.

Leading Cuban agroecologists, who have been at the forefront of promoting an alternative model to conventional agriculture since the origins of the organic movement and urban agriculture, acknowledge that agroecology is the basis for food sovereignty (Funes-Aguilar, 2001; Monzote et al., 2001; Machin-Sosa et al., 2013; Funes-Aguilar, 2016; Caballero-Grande et al., 2016; Caballero-Grande et al., 2000; Vazquez et al., 2017; Simon-Reardon et al., 2010; Casimiro-Rodriguez, 2016). An explicit statement is made by the Cuban institutional member of La Via Campesina, ANAP with its 380,000-producer’s membership, through its adoption in its vision and strategic direction of the agroecological perspective, emphasizing the agroecological model as a step towards food sovereignty (ANAP, 2015; ANAP, 2016; Machín-Sosa et al., 2010; Simon-Reardon

et al., 2010). In a similar fashion the national Urban, Suburban and Family Agriculture Program, present in all 168 municipalities across the country, engenders the food sovereignty concept (Rodriguez-Nodals et al., 2006; Companioni et al., 2016; INIFAT, 2016).

From a dialectical and historical perspective, working towards food sovereignty is not free of contradictions and struggles, internal and external, and targets keep moving and transforming (Edelman et al., 2014; Schiavoni, 2016). Cuba could take one of three potential paths: one path is to redouble the commitment to an alternative mode of productive-relations based on agroecology and food sovereignty; a second path would straddle and combine two competing models (conventional and agroecological); and a third path would deepen and expand the conventional industrialized mode of production typical in capitalist economies. The current agroindustry model enshrined in the government’s PCC guidelines implicitly encourages the development of a combined model (PCC, 2011; PCC, 2017). Moreover, given the presence of GMOs on the international market and Cuba’s domestic biotech industry, debates are ongoing regarding production and dispersal of genetic modified organisms, and what it means for any advance on agroecology and food sovereignty (Funes-Monzote, 2009; Altieri and Funes-Monzote, 2012).

Advancing towards food sovereignty based on an agroecological vision in Cuba, as in any other nation, entails a shift in political, social, economic and ecological relations. This shift is not isolated from external influences. Cuba’s endeavors to attain enabling conditions for food sovereignty are, on one hand, directly hampered by the US economic and financial blockade (Davalos-Fernandez, 2012) but, on the other hand, aided by the blockade’s effect of protecting Cuba from encroachment of capitalist agriculture and the corporate food regime. And, equally important, a shift towards food sovereignty is directly affected by economic and political decisions and the will of Cuban leaders to invest, promote and implement an alternative development model that builds on the research, knowledge and experience gained since the Special Period.

Developing food sovereignty based on an agroecological paradigm also calls for reorganizing trade at local, national and international levels. This would require promoting and protecting the local and national economy, just as developed economies have done in the past (Moyo et al., 2013; Amin, 1976). As Cuba continues to ‘update’ its social and economic model, with a focus on food import substitution, the nation has an opportunity to develop new types of trade models that respect principles of food sovereignty.

4. Changing agrifood trade relations and policy

Before the Revolution, Cuba’s food and agricultural system was highly determined by its relationships with the United States; US investors owned large tracts of agricultural land, where they primarily produced sugar, and about half of Cuban’s daily diet came from imported foods, 75% of which were imported directly from the

United States (Nova González, 2012). When the Revolutionary government seized land from US owners and launched a campaign to diversify both ownership and agricultural production, the US retaliated by cutting off Cuba's sugar quota. From that point on, US policy toward Cuba has been characterized by isolation and aggression, in attempts to dismantle the Castro government and the Cuban Revolution. Because of the US's efforts to limit other nations' trade with Cuba, its geographic proximity, and the close family connections between many Cuban and US citizens, the US plays an outsized role in affecting not only Cuban agricultural systems, but the economy and society, in general.

US-Cuban trade post-Revolution was non-existent until October 28, 2000, when President Bill Clinton signed the Trade Sanctions Reform and Export Enhancement ACT (TSRA). For the first time in decades, TSRA allowed US companies to sell food and agricultural products to Cuba. The Cuban government hesitated to engage until Hurricane Michelle struck in October 2001, devastating the island's agricultural production. In December 2001, Cuba made its first purchase of agricultural products from the United States in order to fill the gap (Alvarez, 2004). Purchasing from the US steadily rose thereafter. Between 2003 and 2012 the US was either the number one or number two supplier of agricultural products to Cuba, before falling to fifth after the EU, Brazil, Argentina, and Vietnam which have been able to offer better financing despite their greater geographic distance (EngageCuba, 2016).

Since 2000, US agribusiness, lobbyists, and representatives from agricultural states have intermittently engaged in efforts to ease trade restrictions with Cuba. In addition to encouraging an end to the economic embargo, they have lobbied to change TSRA, which does not allow any purchase with credit and effectively requires exchanges on a cash basis, therefore prompting Cuba to purchase from other countries. In December 2014, President Castro and President Obama's announcement regarding the normalization of relations created a fertile political environment in which to advocate for change in the arena of agricultural relations; an end to the blockade even appeared possible. In this section, we profile the policy changes that have taken place since the end of 2014, before analyzing their repercussions for the Cuban agroecology movement in the following section.

4.1 Changes under the Obama administration

After the December 2014 announcement, several key policy changes occurred that affect the Cuban food system and US-Cuban agricultural engagements in the areas of trade, tourism, remittances, and cooperation. In February 2015, the US State Department released a list of allowable Cuban goods and services that could be imported into the United States. It stipulated that these must come from "independent Cuban entrepreneurs," rather than the Cuban state. In the following year, the list was amended to include Cuban coffee grown by small farmers.

In March 2016, the Cuban Ministry of Agriculture (MINAG) and the United States Department of Agriculture (USDA) signed a Memorandum of Understanding (MOU)

for bilateral cooperation on areas including plant and animal sanitation, organic production, climate-smart agriculture, soil and forest conservation, and agricultural irrigation (USDA and MINAG, 2016). This was followed in 2017 with a more detailed MOU on animal and plant health, which lays the groundwork for cooperation on research and standards, and for protecting both countries' agricultural systems in the case of trade transactions (USDA and MINAG, 2017). Although then-Secretary of Agriculture Tom Vilsack emphasized that expanding US markets in Cuba was a major goal of the agreement, the MOUs also open room for increased academic engagement (Vilsack 2016).

Under the Obama administration, the State Department also relaxed restrictions on remittances and travel, which has infused both capital and demand into Cuba's small business sector. It is estimated that these remittances have provided 70 to 80 percent of the capital investments that have been made in Cuba's growing "*cuentapropista*," or small business sector (Henken, 2017). Much of this sector is comprised of bed and breakfasts and restaurants, both of which are inextricably linked to the Cuban agri-food system, because of their needs for food-purchasing. Additionally, Obama's easing on travel restrictions brought an influx of tourists to Cuba in 2015 and 2016 – both US citizens and visitors from other countries rushing to see Cuba "before Americans ruin it" – bringing the total number of tourists in Cuba up to a record-breaking 4 million in 2016 and placing additional demands on these small businesses and the food supply (Felipe Gonzalez, 2016; Ahmed, 2016).

US agribusiness quickly pushed for opportunities to take advantage of the changing executive policies and growing Cuban market. In January 2015, only a month after the President's announcement, an executive from Cargill founded the US Agriculture Coalition for Cuba (USACC), an association of agribusinesses and commodity associations working "to lift the embargo in order to liberalize trade and investment and reestablish Cuba as a market for US products" (USACC, 2016). USACC has supported a bi-partisan coalition of politicians who have introduced legislation that would give US agricultural firms greater access to Cuban markets.

Thus far, proposed legislation has taken two tracks: adjustments to TSRA and an end to the embargo. In January 2017, Representative Crawford introduced H.R. 525, the "Cuba Agricultural Exports Act," which would amend TSRA to allow producers to extend credit to Cuba for agricultural purchase. This follows one that Crawford introduced (but never came to a vote) in 2015. In February 2017, Senators Heitkamp and Boozman introduced a companion bill, S. 275, the Agricultural Export Expansion Act into the Senate. At the time of writing this paper, both Bills had gained strong bi-partisan support, but neither had come to vote.

The Cuban Trade Act is significantly more ambitious than the proposed changes to TSRA. H.R. 442, introduced in January 2017 by Representatives Emmer and Castor, and S. 472, introduced in February 2017 by Senator Moran, would effectively end the embargo by repealing large

sections of the Cuban Democracy Act of 1992, the Cuban Liberty and Democratic Solidarity (LIBERTAD) Act of 1996 and the Trade Sanctions Reform and Export Enhancement Act of 2000, while also rescinding the embargo as enacted through the Foreign Assistance Act of 1961. At the time of writing this paper, the House bill had gained seven additional co-sponsors, but the Senate Bill had none.

While USACC and congressional allies have largely focused on market opportunities as the center of engagement, another coalition (involving co-authors of this paper) was also founded in 2015 to encourage mutual engagement around agricultural knowledge and movement building. The mission of the Cuba-US Agroecology Network (CUSAN) is to “connect people, institutions and movements in Cuba and the US who are dedicated to building more ecologically resilient, socially just and economically fair farming and food systems.”

4.2 Changes within Cuba

The Cuba-US relationship is not only guided by changes in US policy, but also by the parallel actions of the Cuban state. In 2015, the Cuban Ministry of Foreign Commerce (MINCEX) published an annual Portfolio of Opportunities for Foreign Investment, which lays out very specific guidelines for economic partnership and demonstrates the Cuban state's intent to carefully control engagements. These guidelines grant new tax incentives to joint enterprises between foreign entities and Cuban cooperatives, but they do not allow for any transfer of land ownership to foreign properties. As stated by MINCEX “The new law for foreign investment is not looking to sell the country or give away national patrimony and land. It intends to strengthen national, economic growth, with respect to the socialist principles and our projections about the process for updating our economy” (MINCEX, 2016). This position is important for maintaining a context in which agroecology could expand and the goals of food sovereignty could be advanced. Even though industrial agriculture continues to have a strong presence in Cuba under the socialist model, the inability of foreign markets to commodify Cuban land is key to the possible holding back of capitalist agriculture.

While the Portfolio represents an arena of strong centralized control, expanding small businesses indicate a degree of de-centralization in the Cuban economy. The expansion in tourism and increase in remittances have dove-tailed with domestic policy changes in Cuba that have authorized an increasing number of private bed-and-breakfasts (*casas particulares*) and “paladares,” or restaurants since 2011,⁶ which, as mentioned above, has a significant impact on the Cuban agrifood system. We further discuss these impacts in section 5 below.

4.3 Changes under the Trump administration

Even before taking office, President Trump declared that he would be seeking a “better deal” with Cuba than the previous administration, and he has aligned with anti-Castro hardliners. Nonetheless, many of the openings made under the Obama administration continue. Legisla-

tion that was introduced, trade and investment deals that began to be discussed, and plans for bilateral exchange that were made before Trump took office are still being considered, negotiated, and implemented. The Trump administration, like Obama's, also seeks expanded opportunities for US businesses.

However, in June 2017, President Trump announced that he would make changes to Obama's policies, and in November of that year these changes went into effect. The Trump administration policies allow major business or travel engagements planned before the changes to continue but prohibit new US engagement with entities connected to the Cuban military, including certain hotel chains. These policies also cancel individual “people-to-people educational” travel, which Obama had added as a legal reason for US citizens to visit Cuba.

Perhaps most significantly, in October 2017, after press reports of leaked information on mysterious “sonic incidents” and ailments experienced by US diplomatic personnel in Cuba, the US Department of State announced that it would downsize operations at the US embassy and would not be able to issue visas for Cubans wishing to visit the U.S. This abruptly halted many Cuban academic, NGO, and farmer visits to the U.S. Cuban foreign minister Bruno Rodríguez stated that there is “no evidence a sonic attack has taken place,” yet the state department also issued a non-legally binding travel advisory against visiting Cuba. While individuals and organizations can still choose to ignore the warning and travel to Cuba, the advisory limits some public universities and scientific agencies with risk-averse policies from sending students, researchers, or other representatives to the island, and thus undermines the progression of bilateral academic and research collaborations.

4.4 Initial trade engagements 2015–2017

US exports to Cuba have continued, including a 2016 gift of 20 metric tons of rice from Missouri company Martin Rice (Ward 2016), because agribusiness lobbyists and associations continue to push for expanded opportunities in Cuba. Additionally, two Cuban products have made initial entrances into the US market, and US agricultural machinery companies are competing to get a foothold in the Cuban market.

In 2016, Nestlé imported 16 tons of Cuban coffee, which were routed through a London affiliate and then sold in the US under the Nespresso brand. Nestlé, a Swiss company, which has sold ice cream and soft drinks in Cuba since the late 1990s, has announced plans to invest over \$60 million in Cuba's Mariel Special Development Zone, where it will focus on coffee, cookies, and cooking products (Morales, 2017). Then, in January 2017, a shipment of Cuban-produced charcoal arrived in a Florida port. The charcoal is a product made from marabú (*Dichrostachys cinerea*), an invasive plant that Cuban farmers must clear from their land and can convert into a clean burning fuel source useful for barbeques and pizza ovens (Vinik, 2017). This was the first imported product to arrive directly from Cuba in the last half century.

The Nespresso deal, and the corresponding addition of coffee to the State Department list of Cuban products that could be sold in the United States, sparked a minor diplomatic controversy, with the Cuban Small Farmers' Association (ANAP) critiquing the State Department for announcing that only coffee purchased directly from small farmers, rather than the state, could be sold to the US. In Cuba, a state-owned coffee company controls distribution and exports, and thus, it would be illegal under Cuban law for a farmer to export directly to a foreign state, not to mention that it would be logistically impossible. ANAP's response included, "As Cuban small farmers we are not afraid of change, as long as it is initiated by ourselves. The permanent pretension of the US government to dismantle the unity of the Cuban people cannot be permitted, because it will destroy our revolutionary process that has given us participatory democracy, liberty, sovereignty and independence" (Granma, 2016). The statement highlights the difficulty of moving forward with engagement as long as the official line of the US is to support small businesses, as opposed to the state, in conflict with Cuba's internal policy.

In 2017, new deals with more clear impact for large-scale or state farmers, rather than small farmers, were announced. US agricultural machinery giants Caterpillar and John Deere both announced plans to sell equipment to Cuba during Cuba's International Trade Fair. John Deere plans to deliver tractors and associated implements to Cuba over a four-year period and Caterpillar received authorization to establish a dealership in the Mariel Special Development Zone (Miller, 2017). These announcements came a year after Cleber, LLC, which produces a tractor called the Oggún, suitable for small-scale production, was rejected from the Zone, mostly likely because it was not seen as technologically advanced and large enough to be suitable for the development project (Whitefield, 2016). Ironically, while Trump's new policy aims to restrict transactions with Cuban state and military entities, the types of tractors that will be available via John Deere and Caterpillar, if those deals go forward, are for large, conventional farms, which are typically run by Cuban state enterprises with connections to the military.

Although current US policies as of July 2018 do not prohibit ongoing business engagement with Cuba, the actions of the Trump administration have caused the Cuban state – through which all business deals must be organized – to exhibit caution in dealing with US entities. Moreover, the Cuban state's lack of capital and financing mechanisms (problems provoked by the US sanctions) make it difficult to engage in international deals. Nevertheless, members of Congress from both parties continue to advocate for expanded agricultural trade with Cuba. As governors from grain states keep visiting Havana, bipartisan Representatives from Kansas (wheat), Minnesota (corn, soy), and Arkansas (rice) lobby for HR525 Cuba Agricultural Exports Act, among others. The economic mathematics of capitalism's search for new markets (Marx & Engels 1978) could trump the ideological vestiges of capitalism's antagonism with communist governments.

5. Opportunities and challenges for Cuba's agroecology movement

Today, Cuba's agroecology movement possesses strong potential to continue building social and environmental sustainability across the island. Based on data from Finca del Medio, a farm located in Sancti Spiritus province, Casimiro et al. (2017) state that replication of small, agroecological farms across Cuba's arable land, could produce the food energy and protein needs for 8 million people, more than 70% of the population. While this suggests the strong potential of agroecological techniques that have been developed in Cuba, ongoing barriers and macroeconomic conditions pose challenges to meeting this goal.

Expanding the agroecological model in Cuba would require the country to re-address the agrarian question and clarify its commitment to food sovereignty and the role of rural communities and small farms in its future. As described above, Cuba has remarkable usufruct policies that serve to avoid the accumulation of private property, curb industrialization of agricultural practices, and render land significantly more accessible to young people and new farmers than it is in either the US or most other countries. However, if the rural-urban migration cannot be reversed, even with progressive land reform policies, the resulting rural labor shortages could stimulate industrialization of the agricultural sector.

As scholars have noted, Cuba, particularly when analyzed in relation to the US, epitomized the 20th century agrarian question: how does capitalism both "capture" the means and production of small scale "peasant" agriculture yet fail to fully capture its meaning and practices, or eliminate it entirely (Graddy-Lovelace 2016). Cuba in the early 21st century shows the evolution of the agrarian question itself: the question has transformed from an inquiry into how and why small-scale farming survives even under capitalist models of industrial agriculture development, into an inquiry into how agrarian practices of agroecology are themselves responses to the ecological and economic challenges of modern agro-industrialization. Cuba demonstrates how what scholars once framed as "the agrarian question" is now an agrarian answer—wherein diverse, resourceful agrarian adaptations and regenerations unfold in mixed farming systems, orchards, seed fairs, patio gardens, and urban farms across the country.

Nonetheless, official estimates reveal that less than half of the arable farmland is being cultivated, while 883,900 hectares remain entirely unclaimed/unused and 2 million hectares are characterized as uncultivated pasture land (ONEI, 2017a). The Cuban population remains concentrated in urban areas and there is an ongoing exodus of youth from both the countryside and the country. With a steadily aging population and low birth rates, it is difficult to find new farmers willing to work the land. Some researchers term the imbalance between rural and urban areas a "metabolic rift" and argue that it creates cultural and economic barriers to re-peasantization (Clausen et al., 2015).

This rural-urban rift is exacerbated by Cuba's ongoing struggle to resolve its dual currency system and

relationship to international markets. At present, Cuban state workers and those operating in the domestic economy earn Cuban pesos (CUP), worth only 1/25th of Cuban convertible pesos (CUC), the latter of which are pegged to the US dollar, generated in the tourism sector, and used to purchase foreign-produced goods. Although many farmers can generate higher incomes than a typical state employee, they earn significantly less money than those working in positions with linkages to tourism and foreign markets. Many youth – as well as some older citizens – aspire to jobs that give them access to CUC because such jobs are increasingly important for achieving material security, and necessary for any potential travel or even temporary residence overseas.

While it is important to emphasize that US engagement is far from the only external factor that affects Cuba's agrifoods system, US relations do have significant potential positive and negative ramifications for Cuba and Cuban agroecology. As the histories of US trade agreements with Mexico, Central America, and other countries notoriously reveal, US agricultural exports can devastate local food economies, and force consolidation and environmentally destructive intensification in these areas as producers attempt to compete (Wise, 2009a; Wise, 2009b; Daviron and Ponte, 2005; Bouët et al., 2005; Einarsson, 2000; Gonzalez, 2006). In this section we identify how the changing policies and relationships (outlined in section 4) regarding travel, trade, foreign direct investment, and research and people-to-people collaboration could affect Cuba's agroecology movement. We argue that, while a policy of mutual exchanges could benefit agrifoods systems on both sides of the Florida straits, a policy revolving strictly around conventional production and commodity trade could hurt the advancement of agroecology, and hence Cuba's environment and livelihoods.

5.1 Travel

Feeding and entertaining foreign visitors has placed an increased burden on the Cuban food system. Food imports have increased and small farmers have also found new markets for their production. Some commentators celebrate the economic influx or speculate that organic-food seeking tourists could support agroecological farmers while others worry that tourism will derail food from domestic to tourist markets, necessitate conventional production, and lead to growing inequity in access. As it stands today, much of the food procurement for hotels and some restaurants is via markets that do not compete with the Cuban population (both food imports and from domestic production), and that pay in the same national currency that farmers who produce for domestic markets earn. Many *paladares* do shop at farmers' markets and supermarkets where Cubans shop and this sliver of the tourism sector may have an impact on availability of food to domestic populations over time. A much smaller subsection of *paladares* purchase directly from farmers but, because these farmers are still obligated to supply to national markets and local social institutions, this very new practice currently does more to support agroecologi-

cal livelihoods than it does to distort income or divert food away from domestic markets.

5.2 Commercial trade

Agroecologists Altieri and Funes-Monzote (2012) have written that, historically, Cuban policy-makers cyclically move between agroecological and conventional paradigms. They support agroecology during times of material scarcity and once again support conventional production during times when it is economically possible to import food or chemical inputs. This perspective suggests that increased trade with the US – or trade with other countries – could cause the Cuban government to de-prioritize agroecological production and agroecological farmers. In this scenario, US companies could benefit from increased sales to Cuba, but Cuban citizens, farmers, and the environment could eventually suffer over the long term, if the country gradually shifted back to a model that prioritized production of industrial crops for export and cheap food goods for import. It is unlikely this would happen if the government continues to prioritize food import substitution and is committed to a sustainable, prosperous, social and economic model. But certain sectors, such as domestic poultry production, have already declined due to low competitiveness with US imports that began in 2001 (García Álvarez and Nova González 2014).

Nonetheless, Cuba would have clear economic benefits from increased trade with the US. Open trade is likely to result in Cuba shifting their source of food imports from the EU, Brazil, Vietnam and China to the US. This does not mean an increase in imports, but a substitution of source, which would likely result in purchasing similar goods for a lower price because of considerably lower cost of shipping. This could also lead to less overall expenditure in food imports, allowing for more funds to be invested in domestic production. Additionally, an end to the blockade or expanded US-Cuba trade could increase the availability of basic farming implements that even small-scale growers need, such as irrigation equipment, shovels, wheelbarrows, and netting to protect crops, and of implements for small-scale food preservation companies, such as jars and canning equipment. Improved food conservation technology and material resources to support infrastructure for local storage and distribution could also significantly improve Cuban food security, considering the high volume lost in harvest and post-harvest stages (Mundubot, 2017).

Moreover, lower cost trade in areas outside of food and agriculture (either with the US or with other countries that are currently affected by US sanctions) could increase Cuba's overall economic security. This could theoretically enable more budget spending to go to local, provincial, and national programs and institutions that support and provide much needed resources to farmers, or to go toward improving local infrastructure for distribution and marketing of agroecologically-produced foods.

Cuba also has an emerging opportunity to export agricultural products to the US, especially those marketed as agroecological or organic. Shortly after the first MOU was signed between US and Cuban agricultural departments,

Representative Chellie Pingree of Maine organized a trip of US organic food producers and advocates (including executives from Stonyfield Farms, Honest Tea, and Global Organics), with the mission to explore opportunities for US industry to support Cuba's low-input and organic sector, purchase from it, and encourage it to become organically certified.

Although these efforts have been stalled by the reticence of the Cuban government to pursue such steps at this time, and fear from US based companies, this possibility is worth analyzing as it could re-emerge, and present both an opportunity to Cuban farmers and a potential concern for the Cuban domestic market. If the state were to decide to divert a larger portion of the Cuban agricultural market toward certification for export,⁷ or to allow individual farmers greater autonomy in making this decision individually, this could weaken domestic availability and affordability of food and incentivize producers to grow for foreign markets. Valuable resources like freshwater may be routed to irrigate export crops, which would pose problems for the island because droughts are projected to be a key impact of climate change here (Gonzalez, 2018). Additionally, certification of Cuban farms by foreign certification boards could water down principles and practices that are already being implemented in Cuba, thus leading to less biological diversity. However, as Altieri et al. (2011) argue, "There is nothing wrong with small [Cuban] farmers capturing a share of the export markets, as long as it does not mean neglecting their roles as local food producers." The risk of a neo-colonial organic export market is low considering the Government's commitment to prioritize food import substitution as well as its commitment to social safeguards that guarantee minimum levels of food security for the population. If the Cuban government continues to buy local food products from campesinos in order to subsidize food for schools, hospitals and other institutions, then there are possibilities to preserve local availability of fresh food and fair compensation for small-scale producers whose production model is not suitable for export crops.

The combination of a strong agroecology sector in Cuba and a growing interest in organics and diversified agriculture in the US could represent a unique opportunity for establishing a new kind of trade relationship. Instead of one that centers around commodity production, low-wages, marginalized labor, and damage to domestic food systems in both countries, there is an opportunity to pursue relations centered on principles of agroecology, cooperativism, and food sovereignty. For instance, Cuban cooperatives and US cooperatives could exchange products that they either cannot reproduce in their respective environments, or that are out-of-season. Tropical fruits and sweeteners could be sent to the US, and cold weather crops (grains and apples, broccoli, beets, carrots) sent to Cuba without undermining existing industries in either country. Some Cuban growers have also identified "*mercados solidarios*" (markets based on solidarity) (Leslie, 2017) as a means to support agroecological efforts both in Cuba and the US by directly connecting communities with similar social and ecological principles. For example, the

Federation of Southern Cooperatives from the US has had a longstanding relationship with Cuba's ANAP since 1999 and have been exploring opportunities in establishing fair trade agreements with their cooperatives and farmers. Can like-minded US and Cuban counterparts forge and develop new models of trade under new economic rules? If there ever was an opportunity for innovative rules of capital and trade relations to be developed, it is today as Cuba and US relations roller coaster their way to normalized relations, as capitalist agriculture is in crisis globally, as climate change pushes us to adapt and will require ever more deep transitions towards resilience.

5.3 Foreign direct investment

The Cuban state has developed legislation on direct investment, and since 2015, has published a Portfolio of Opportunities for Foreign Investment. While this offers new opportunities for economic development in Cuba and maintains the Cuban state's determination over how development will occur, it also could promote models perceived as "modern" and "technologically advanced" at the expense of the Cuban environment and small-scale producers. An example, mentioned in section 4 above, was allowing sales of tractors from large companies like Caterpillar over the small Oggún tractor in the Mariel Special Economic Development Zone. If Cuba's environmental policies are enforced, this may not be a risk. The Cuban National Assembly approved in April 2017 a long-term strategy for climate change, called Tarea Vida, or Life's Task, that has several commitments to agriculture and food security.

Cuban law presently prohibits foreign companies from owning more than half of a business or owning the land upon which it sits. This could protect against the financialization and commodification of farmland which, in the US and other countries, has contributed to accumulation of farmland in the hands of a few, and reduced incentives for diversified, sustainable production. It will be important for usufruct and other laws to continue to make land available to small-scale producers, in order to protect the agroecology movement, and decentralize the accumulation of newly generated wealth.

Opportunities for direct foreign investment are also leading to an expanding tourism sector, with new joint-owned hotel and entertainment ventures. As these businesses offer an influx of much needed cash into the Cuban economy, it will also be important to balance them with environmental concerns and local land use needs, when making decisions about size and location.

5.4 Research and collaboration

Despite recent setbacks to engagement between the US and Cuba, avenues remain open for legal professional, research, and educational collaborations. Some of the US based authors of this article have found the opportunity to disseminate the social and ecological values of the moral economy embedded in agroecological forms of production to be particularly powerful and inspiring in Cuba. Implications of such values on building a more sustainable and equitable food system are already evident in the

progress the Cuban food system has made over the past several decades. The potential for full realization of such benefits, in part through solidarity networks and knowledge exchange between US and Cuban producers could be substantial. The longstanding relationship between Cuba's Small Farmers' Association (ANAP) and the Federation of Southern Cooperatives (facilitated logistically by University of Florida faculty) exemplifies how engagement can benefit both Cuban farmers looking for collaborators on new farming techniques and seed varieties and US farmers working to face economic marginalization in a financialized, neoliberal economy. Other groups, such as Food First since the 1990s and the Cuba-US Agroecology Network (CUSAN) since 2015, have played a key role in facilitating dozens of exchanges between leaders in movements in both countries to share knowledge, establish mutually beneficial relationships around trainings, research and education and to amplify the voice of Cuban agroecologists outside of Cuba.

The MOUs signed between the Cuban Ministry of Agriculture and US Department of Agriculture are a positive step toward increased collaborations. Although Secretary Vilsack's stated motivation was to expand US market opportunities, the agreements open doors to greater direct collaboration between researchers, institutions, and farmers themselves. Similarly, new pathways are opening up for universities and other research institutes to work together, as US-based NGOs and universities sign MOUs with Cuban counterparts. These partnerships were previously limited by US law preventing grant sharing with Cuban state institutions (including public universities), but changes made to OFAC regulations under Obama in March 2016 make this possible for scientific collaboration and agricultural development. Such partnerships remain possible even as travel warnings made during Trump's presidency make some universities confused about the safety of sending students and researchers to Cuba for collaborative purposes, and the shutting down of consular services at the US embassy in Havana makes it difficult for Cuban professionals to attend meetings in the US.

Working with Cuban researchers and farmers provides their US counterparts opportunities to learn more about the many Cuban advances in biological pest management, pasture and forage crops, use of beneficial microorganisms, and many other social and ecological innovations (see contributions in this Special Feature). Cuba also has rich experience in social methodologies for sharing agroecological knowledge. Notably, Cuba's *campesino a campesino* methods have created farmer-to-farmer networks of solidarity and co-learning, which can serve as potential models for farming groups in the United States, including the Federation of Southern Cooperatives, the National Family Farm Coalition, Rural Coalition, the Southeastern African American Farmers' Organic Network, and others. Additional Cuban forms of *cooperativismo* (cooperatives) serve as interesting case studies for US farmers who are increasingly looking for ways to enter into economic and knowledge-sharing cooperation as the US agrifoods

system makes it increasingly difficult for family farmers to survive. These experiences, as well as those in developing infrastructure for urban farmers, are of great interest to US extension offices' agricultural institutes, non-profit organizations, and farmer associations.

The US, on the other hand, has extensive experience developing and accessing methods for distributing locally and agroecologically grown food products. Experiences with food hubs and Community Supported Agriculture (CSA) could contribute to Cuba's growing interest in "marketing" as farmers encounter increased opportunities to sell to the private market. The US can also collaborate with Cuba on developing infrastructure for processing, transport, and cold storage. Furthermore, both countries are facing the challenges of resiliency to climatic change and mutual collaboration would be of benefit to both countries.

6. Conclusions

Although the future direction of the process of Cuba-US normalization of relations remains unclear under the Trump administration, the changes initiated under the Obama administration have created momentum and possibility that actors in both countries will continually re-examine and develop for years to come. A shift in Cuba-US relations will produce both opportunity and risk for the Cuban agrifood system and food sovereignty and for agroecology movements on both sides of the Straits, a balance that will have to be navigated by many actors and interests in the US, Cuba and elsewhere. Cuba's agrifood system is far from perfect, but the fact that agroecology in Cuba has gotten so far with so little is a testament to its people and to its unleashed potential. Some of the key ingredients necessary for agroecology to expand to a national scale exist in Cuba: access to land (albeit with its unique limitations); a pedagogical system in line with agroecological values; academic programs for agroecology; a horizontal process of learning and knowledge creation; successful examples of innovative diversified agroecological farms; an unparalleled urban agriculture system; a strong cooperative sector for social organization; and policies that begin to value agroecology. The limited ability of agroecological farms to feed Cuba's population has less to do with levels of productivity of this type of agriculture and more to do with barriers in the economics of the food system that include: a lack of access to credits and investment for small infrastructural improvements such as green houses, netting, tools, solar panels, digging equipment, biodigestors; the lack of markets to purchase basic inputs; the lack of diverse markets to sell food produced; the high rate of food waste due to inefficient distribution systems and lack of adequate storage and processing facilities; a taxation system that favors an import food model; a complicated licensing system for production and marketing; a generally precarious economy; and a dual currency model that distorts the national economy. Cuba's agrifood system also faces serious environmental challenges including erosion, salinization, invasive species and climate change impacts including the severe drought and increasingly

severe tropical storms and hurricanes. And the island faces demographic obstacles like those faced by the US: an aging farmer (and general) population amidst broader trends of urbanization.

Ultimately, Cuba's leaders and people will determine the trajectory of changes in their agrifood system, as Cuba confronts pressing questions regarding its level of commitment to agroecology and food sovereignty, the role of the rural sector in its society, and its relationships to the outside world. In this paper, we have argued that continuing evolution of the engagement between Cuba and the US offers an important opportunity to support a continued expansion of sustainable agriculture. This opportunity involves an agroecology that is ecologically resilient, economically fair and socially just. The achievement of such a model in Cuba will have far-reaching ramifications within the country and also for the broader international community.

Notes

- ¹ In the 1960s, the state created Credit and Service Cooperatives (CCS's) as a structure in which farmers own or lease their land, but come together as a cooperative to share credit, infrastructure, and markets. In the 1970s, Agricultural Production Cooperatives (CPA's) were formed as an option for farmers to share and work the same piece of land.
- ² In 1989, Cuba had significantly higher rate of use of fertilizers, tractors and irrigation per hectare than the United States and Latin America (Funes-Monzote, 2008).
- ³ Researchers from different institutes had been advocating for change and some came together and formed the Cuban Association of Organic Agriculture known as ACAO. ACAO, under leadership of Fernando Funes-Aguilar, received the Right Livelihoods Award in 1999.
- ⁴ International cooperation projects in Cuba have a specific definition which involve transfer of funds, are guided by Resolution 2015, and usually require a Terms of Reference to be signed with the Ministry of Foreign Commerce (MINCEX).
- ⁵ See PCC, 2011. *Lineamientos de la política económica y Social del Partido y la Revolución*, Partido Comunista de Cuba, La Habana. and PCC, 2016. *Actualización de los Lineamientos de la política económica y social del Partido y la Revolución para el periodo 2016–2021*, Partido Comunista de Cuba, La Habana.
- ⁶ In September 2017 Cuba put a halt on new licenses for these businesses. It is unclear when licensing will resume.
- ⁷ According to Kilcher (2009) in 2008, 2954 farms covering 14,314 hectares, producing sugar, citrus, coffee, coconut, mango or honey, were certified organic by foreign certification agencies.

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The authors have no competing interests to declare.

Author contributions

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- Contributed to analysis and interpretation of data: MF, JW, GF, MM, LV, NP, GGL, GR, LC
- Drafted and/or revised the article: MF, JW, GF, MM, LV, NP, GGL, LC, FFA
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