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Food Security in the 21st Century: Lessons from Cuban Agriculture for Materializing Realities

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To the Graduate Council:

I am submitting herewith a thesis written by Evan L. Weissman entitled "Food Security in the 21st Century: Lessons from Cuban Agriculture for Materializing Realities." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Sociology.

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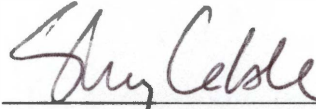
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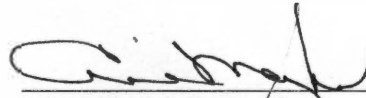


John Gulick



Lois Presser

Accepted for the Council:



Vice Chancellor and
Dean of Graduate Studies

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**Food Security in the 21st Century:
Lessons from Cuban Agriculture for Materializing Realities**

**A Thesis
Presented for the
Master of Arts
Degree
The University of Tennessee, Knoxville**

**Evan L. Weissman
August 2005**

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To all who struggle for a better world.



Acknowledgements

For my thesis, I have relied greatly on the work of others. This project is an attempt to synthesize diverse areas of research in the hopes of uncovering new knowledge useful for moving humanity forward into the 21st century. I am fully indebted to the work from which I borrow.

The faculty who guided my thesis project worked closely with me from the very beginning of my career as a sociologist, beyond the standard requirements of any committee or educator. The time, effort, and guidance offered to me over the past two years greatly influenced my intellectual development. I am deeply indebted to my committee. Sherry Cable was instrumental in bringing me to sociology in the first place and subsequently introduced me to environmental sociology. Her commitment to the discipline and to her students is extraordinary and my work is possible because of her efforts. John Gulick worked directly with me over the past two years in the endeavor to strengthen my analysis. It was as a student in his class that this project first emerged and subsequent individual study under his guidance that my ideas continued to develop. Lois Presser facilitated the development of my ideas through conversation, dialogue, and through example. Bridging the gap between academic thought and social action proves more difficult than imagined and Lo has consistently guided me in this process. Additionally, I must acknowledge the assistance of my close friend and colleague Kristen, with whom I struggled through my master's degree and my thesis. Our conversations over the past two years are fully evident in this project.

My family and friends have served as a constant source of support and inspiration. I can honestly say that no one is as lucky as I am to be surrounded by such wonderful people. I was taught early that dedication to social justice is a life commitment. I am forever grateful to my brother Casey and my parents Marsha and Jim. My partner Erin provides support that cannot be measured and I am truly grateful just to share her company. I am constantly challenged by her intellect and she has fully influenced the path of my work. The beauty she brings to this world serves as a constant source of inspiration.

Any and all mistakes remain my own.

Abstract

Worldwide, hunger continues to pose great problems for humanity. Despite popular belief, hunger is a problem of inequality, not agricultural production. The fast-approaching global peak in oil production, the point at which half of all existing oil has been used, means that hunger, now a problem of inequality, will soon become a problem of production unless contemporary agricultural production is transformed. This project examines the promise of urban agriculture in providing food security following the collapse of petroagriculture.

The case of Cuba, albeit fostered by political economic conditions and not emerging geophysical limitations, provides a model of agricultural development for the rest of the world. The collapse of the Soviet trade bloc in 1989 undermined Cuba's agriculture sector, as former inputs (particularly petroleum) were no longer available. To feed its population, Cuba initiated the largest organic agriculture effort in history. In doing so, Cuba successfully thwarted potentially devastating hunger and possible famine.

Degradation of the planet is inextricably linked to the degrading conditions of life for the majority of the world's population. A systematic examination of the Cuban case exemplifies the importance and feasibility of urban agriculture for simultaneously addressing the roots of both.

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I. Introduction

The popular image of hunger is a person of color, wide-eyed, with bloated belly, surrounded by swarming flies. This image implies the innocence of such victims, whose misfortune is being born on a continent, usually Africa, Asia, or South America, where people are not educated enough to produce food for themselves, where population growth surpasses ecological limits, and where environmental disasters tax the available food supply. The dominant view is that hunger and food security are problems of agricultural production and overpopulation.

This image of hunger as an unfortunate but inevitable aspect of contemporary life is misleading. As many analysts have demonstrated (Altieri, Rosset, & Thrupp 1998; Cook 2004; Davis 2001; Dawkins 2003; Lappé, Collins, & Rosset 1998; Magdoff 2004; Magdoff, Foster, & Buttel 2000; Manning 2004a; Poppendieck 1986), food security today is a problem of food access and distribution, not agricultural production or overpopulation. As a result of technologies implemented following the Second World War, contemporary agricultural processes produce enough food globally to meet the expanding demands of a growing world population. People go hungry because of inequality, not ecological limits to food production.

And yet, the popular image of hunger as a problem of agricultural production appears to have been darkly prophetic. Assuming that problems of inequality are resolved, massive hunger in the future is likely because the contemporary mode of agricultural production will inevitably end due to its dependence on finite, non-renewable

petroleum¹ resources (Goodstein 2004; Heinberg 2003; 2004; Roberts 2004; Shah 2004). Every stage of agricultural production – from farm to plate – uses vast quantities of oil. The fast-approaching global peak in oil production, that point at which exactly half of all existing oil has been used, means that hunger, now a problem of inequality, will become a problem of production unless contemporary agricultural production is transformed.

The specific form of any transition to post-petroleum agricultural production is not a certainty, but depends on the social responses to peak oil. The certain end of petroagriculture (that is, contemporary agriculture dependent on oil) means that production patterns will necessarily change – with or without planning. But the abilities of individual nations to address the problem differ significantly. If insufficient action is taken, the inequalities in national capacities for adapting to the changing conditions will foster even greater levels of food insecurity and may lead to more widespread global conflict over the now-scarce resources. Adverse consequences of the sudden end of petroagriculture suggest the need to search for alternatives to petroagriculture *prior* to the global peak in oil production.

Urban agriculture in Cuba arising within the last fifteen years provides insights into possible alternatives to contemporary agricultural production. Cuba experienced an abrupt end to their oil supply, essentially experiencing peak oil fostered by political and economic conditions rather than geophysical realities. To ensure food security, Cuba worked quickly to transform agricultural production. The collapse of the Soviet trade bloc in 1989 undermined Cuba's agriculture sector, as inputs necessary for agricultural

¹ Petroleum and oil are used interchangeably.

production, most notably petroleum, became less available. Cuba subsequently initiated the largest alternative agriculture effort in history and successfully thwarted famine.

Using secondary data sources, I provide a descriptive account of urban agriculture in Cuba after the elimination of petroleum imports. My purpose in undertaking this examination is to illuminate how Cuba accomplished this transformation in the mode of agricultural production. I identify some of the conditions that sparked the shift in production techniques, describe the transition process, and analyze the potential of urban agriculture as an alternative to contemporary agricultural production that depends entirely on oil. The goal of this project is not to generalize the experiences of urban agriculture in Cuba, but to identify and analyze the case to understand how Cuba may provide lessons for urban agriculture elsewhere.

II. Problem Defined: Food Security in the 21st Century

I employ a literature review to elaborate and substantiate the description of my research problem. I first draw on the literature to examine food security and the role contemporary agricultural production plays in generating food security and/or insecurity. I then examine the techniques of agricultural production to illustrate agriculture's reliance on oil. After a brief discussion of peak oil production, I scrutinize the adverse consequences of an unplanned response to the inevitable transformation of agriculture. Finally, I identify some ways for avoiding those negative consequences.

A Political Ecology of Famine: Food Security and the Social Foundation of Hunger

The Food and Agriculture Organization of the United Nations (2004a) estimates that 852 million people were undernourished in 2000-2002, but this statistic underestimates the problem: hunger is a much greater problem when viewed within the framework of food insecurity, the overall lack of reliable access to adequate food. Expanding the concept of food security beyond those who are immediately undernourished drastically increases the number of people threatened by food security. Fred Magdoff (2004) states that as many as 3 billion people are actually living under food insecurity globally.

Several theoretical perspectives explain hunger. Central to the differing theoretical perspectives are views on the relative weights of two factors in creating hunger: food production and population growth.

		Assumptions Regarding the Role of Population Growth	
		Non-Malthusian	Neo-Malthusian
Assumptions Regarding the Role of Food Production	Productionist Increased food production is central to alleviating hunger	Conservative	Productionist – Neo-Malthusian
	Nonproductionist Nonproduction factors are central in alleviating hunger	Radical	Ecological Malthusian

Figure 1. Theoretical Perspectives on Hunger

(Source: Humphrey, Lewis, & Buttel 2002)

Craig Humphrey, Tammy Lewis, and Frederick Buttel (2002) analyze the nature of theoretical perspectives on hunger through a typology reflecting different positions on those two factors – population and production (see Figure 1). Neo-Malthusian² perspectives view hunger as a problem of population pressures, while adherents to non-Malthusian views argue that population pressures are not causal factors of food insecurity. Productionist viewpoints situate production increases as necessary to the reduction of hunger and nonproductionists argue that social factors such as inequality in food access and distribution are instrumental in creating food insecurity (Humphrey, Lewis, & Buttel 2002).

² Thomas Malthus theorized in the early 19th century that population growth and ecological limits in combination produced hunger; Malthusian theory blames environmental degradation on the working class and provides a ready cover for capitalist exploitation.

There are four general typologies regarding hunger. *Conservative non-Malthusians* argue that free-market expansion will increase agricultural production and reduce hunger; *productionist neo-Malthusians* view population control coupled with production increases as the solution to hunger; *radical non-Malthusian political economists* understand the problem of hunger as rooted in social systems and do not view population pressures and agricultural production levels as causal factors of food insecurity; finally, *ecological Malthusians* link population growth with ecological degradation generally as the cause of food insecurity (Humphrey, Lewis, & Buttel 2002).

Historical records support the radical view of hunger. Evidence suggests that hunters and gatherers were not hungry. This finding counters the traditional account that depicts hunger as the motivation for hunters and gatherers to invent horticulture and sedentary agriculture, or the cultivation of crops and livestock by humans for consumption. Indeed, research reveals a persistence of famine in agricultural societies and provides evidence that hunger originated with the advent of sedentary agriculture. The construction of social status, facilitated by food storage, created the problem of food scarcity for segments of the population (Davis 2001; Diamond 1999; Manning 2004a). As such, food insecurity is actually a *product* of agriculture. Sedentary agriculture created notions of social status based on the storage of foodstuffs; food could be hoarded by some individuals and denied to others. Prior to storage, there was no reason to store (or hoard) food. Food items (plants and animals) would simply rot, hence community sharing and collective attainment of food was commonplace (Manning 2004a).

The historical record, then, indicates that hunger and famine are not results of food supply shortages. Through historical research on hunger and famine in Asia and

Africa throughout the late 19th and early 20th century, Mike Davis (2001) notes, “Although crop failures and water shortages were of epic proportion – often the worst in centuries – there were almost always grain surpluses elsewhere . . . that could have potentially rescued drought victims. Absolute scarcity . . . was never the issue” (p. 11). Indeed, we know that hunger today is not a problem of production, because ample supplies of food exist (Altieri, Rosset, & Thrupp 1998; Cook 2004; Davis 2001; Dawkins 2003; Lappé, Collins, & Rosset 1998; Magdoff 2004; Magdoff, Foster, & Buttel 2000; Manning 2004a; Poppendieck 1986).

To grasp adequately the fundamental causes of hunger, I adopt a radical perspective, or the ‘political ecology of famine’ from Davis (2001), which incorporates “the viewpoint both of environmental history and Marxist political economy” (p. 15). A political ecology of famine, Davis (2001) explains, situates any ecological limits of food production not through deterministic natural relations, but “by ‘negotiated settlement’ since each society has institutional, social, and technical means for coping with risk . . . Famines [thus] are social crises that represent the failures of particular economic and political systems” (p. 288). Hunger is not a result of population growth or a problem of production (as many argue), but is a problem first and foremost of social institutions – particularly, the institution of capitalist agriculture.

Hunger is the logical result of capitalist agriculture, because it is not directed to serve human needs. In capitalist society, agriculture does not produce food; rather, it produces commodities, or goods for the market. “As we have seen, industrial agriculture grows commodities, not food. The fact that commodities do not meet our bodies’ needs is irrelevant” (Manning 2004a:163). More precisely, capitalist agriculture produces food

(a use-value in political economic terms), for the purposes of producing a commodity that yields a market price, covering the cost of production plus a profit (exchange-value). As a commodity, the products of agriculture must be kept in high demand to be profitable; food must be scarce if it is to be used as a tool for capital accumulation. Controlled scarcity of anything, including food, increases prices and profits. So hunger is as necessary to capital accumulation as is unemployment. Magdoff (2004) explains, “Under capitalism, food is just another commodity – like a pair of shoes, a television, or an automobile. People have no more legal right to food than they have to any other commodity” (p. 4). With agriculture a captive of capitalism, profit maximization is more important than food security.

Growth, as the driving logic of capitalism, destroys food security when applied to agriculture. Surplus and overaccumulation are outcomes of, and possible threats to, capitalism. In respect to agriculture, the inherent tendency of capitalism to expand creates an oversupply of food, but as commodities this oversupply hurts prices. Extra-economic means, such as advertising and branding, are then used to make agriculture profitable. Periodic overproduction of foodstuff commodities leads to price crashes that wipe out less competitive (or less politically protected) small producers (Cook 2004; Magdoff, Foster, & Buttel 2000).

Market competition punctuated by overproduction crises drive the concentration and centralization of agricultural capital into the hands of a few large agribusinesses that squeeze and/or eliminate less competitive (or less politically protected) small producers. Under capitalism, small-scale producers of agricultural commodities face a downward pressure on prices and/or upward pressure on inputs (Cook 2004). This pressure in turn

forces the adoption of new technologies and continual increases in the scale of production, creating a never-ending cycle: production increases are necessary just to retain revenue levels. “The treadmill that this creates is indicated by an old New England saying: ‘we grow more corn, to feed more cows, to make more milk, to buy more land, to grow more corn’” (Magdoff, Foster, & Buttel 2000:12). As with other forms of production under capitalism, agricultural production tends to concentrate and centralize within large business. This trend toward increasing economies of scale produces hunger as a predictable by-product of the displacement of small-scale subsistence farmers who lose self-sufficiency.

The problematic nature of capitalist agriculture has long been recognized. As Karl Marx (1981) noted in *Capital, volume 3*:

the capitalist system runs counter to a rational agriculture, or that a rational agriculture is incompatible with the capitalist system (even if the latter promotes technical development in agriculture) and needs either small farmers working for themselves or the control of the associated producers (p. 216).

The problem of food insecurity has accelerated in recent decades as Northern³ capitalism uses agriculture as a tool to incorporate all corners of the world into the global capitalist system. Agriculture became a global project through what is commonly referred to as ‘development,’ by the neoliberal world order (Biel 2000).

Today, development implies the capitalist model of economic growth. “[T]his notion is universalized in contemporary neoliberalism as *the* proven solution to the social and economic problems of *all* countries” (Peet 1999:13). Neoliberal development is a

³ The term ‘global North’ or ‘North’ is used to denote countries called “core,” “developed,” or “first world,” in most of the existing literature; unless otherwise noted, the author’s original language is preserved to denote said geographies.

one-size-fits-all approach that systematically undermines the socio-ecological stability of the global South⁴. The South provides either primary commodities or, increasingly, wage-labor-produced consumer goods to the North. Development serves to create wealth in the North, while systematically impeding economic development and self-sufficiency in the South (Biel 2000).

Agriculture is part of the neoliberal model of development. The agricultural bases of the South are destroyed by World Trade Organization⁵ (WTO) programs such as the Agreement on Trade Related Intellectual Property Rights (TRIPs), which privatized agricultural inputs and products, and the Agreement on Agriculture (AOA), which expanded Northern agricultural production at the expense of the South through surplus dumping, the government-subsidized foreign sale of commodities under market price. WTO programs *require* nations of the South to import food, regardless of domestic availability, and force governments to cut social programs that support food production in the name of market liberalization (Bello 2001; Dawkins 2003).

Within neo-liberal development models, agriculture is designed for export. The North supplies cheap, abundant food to the South through unrealistic price reductions and binding agreements imposed by global financial institutions. Food from the North destroys local bases of staple crop production; the South thus remains bound to monocrop cultivation for export and relies on the success of a few agricultural commodities.

⁴ The term 'global South' or 'South' is used to denote countries called "developing," "periphery," "poor," "third world," or "underdeveloped," in most of the existing literature; unless otherwise noted, the author's original language is preserved to denote said geographies.

⁵ The WTO was created in 1994 as part of the Uruguay Round negotiations of the General Agreement on Tariffs and Trade (GATT). GATT was established in 1948 to stimulate economic development after World War II. TRIPs and AOA originate from the Uruguay Round (Dawkins 2003).

Consequently, agriculture is subject to the volatility of international markets. Countries are encouraged to produce cash crops and use earned revenue to buy staple food items produced more cheaply elsewhere. A cycle of debt ensues, and countries continually look to increase income – usually by producing more cash crops in the search for hard currencies (Magdoff 2004). Today, Robert Biel (2000) notes, “large-scale agriculture, the global food system, the development of scientific methods, and so on – are all manipulated by the global accumulation system in the interest of Northern capital” (p. 145).

Agriculture is now industrialized, facilitating mechanization and driving migration from rural to urban areas as machines are needed for production more than farmers. Historically, agricultural advances increased production, thus freeing up labor. People would not need to grow food, but now could – indeed had to – migrate to cities in search of work to earn money to *buy* food. This pattern of urbanization occurred as capitalism developed. With less need for farm labor, agriculture *pushed* people from rural areas, and job opportunities *pulled* workers into urban centers. Moreover, colonial and imperial expansion provided foodstuffs for the homeland, facilitated agricultural expansion through incorporating new lands into production, and served as an outlet for overproduction by creating new markets (Magdoff, Foster, & Buttel 2000).

Contemporary urbanization in the South is fostered by different conditions than past urbanization in the North. Migration to urban areas in the South is driven not by expansion in domestic food production, but by global capital, displacing farmers under both internal and external pressures originating from the contemporary economic order (Magdoff, Foster, & Buttel 2000). “The result” Magdoff (2004) notes, “has been the

explosive growth of slums in the third world, accompanied by misery and hungry people without access to land to grow their own food” (p. 2).

Unable to grow food and lacking self-sufficiency, urban populations are disproportionately victimized by food insecurity (Magdoff 2004). Recent findings by the United Nations Population Division (2004b) that chart global population trends document that in 2007, for the first time in history, the global urban population will be greater than the global rural population (see Figure 2). This trend of global urbanization is likely to continue as the effects of capitalism reach ever more remote corners of the globe. With more people living in cities, modern agriculture is pressed to feed more people. Fewer people are direct producers of food or other agriculture products. Magdoff (2004) argues:

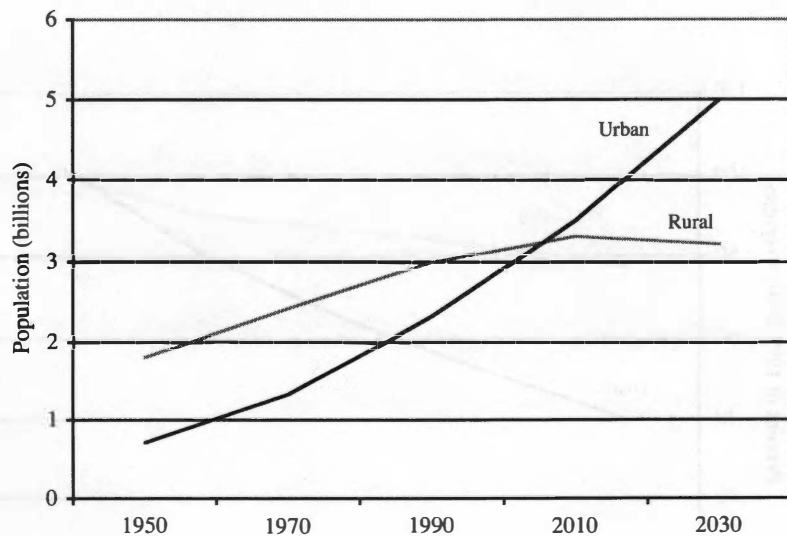


Figure 2. Global Population Trends 1950-2030

(Source: United Nations 2004b)

The situation is far from static. A continuing mass migration of people from rural regions into the cities of the third world is underway. Some 20 to 30 million people leave their villages each year, swelling the ranks of urban populations. People move to the cities in response to difficult conditions in rural areas (thinking that there are better prospects in the cities) or because they are pushed off their farms when an expanding capitalist farming sector takes over land or mechanizes production (pp. 1-2).

Although hunger has been commonplace since the advent of agriculture, it now persists in the context of greater quantities, of both absolute and per capita food production, than at any other point in human history (see Figure 3) (Lappé, Collins, & Rosset 1998; Humphrey, Lewis, & Buttel 2002). Under the social and economic order created by capitalism, the paradox of want amid plenty, or what historian Janet Poppendieck (1986) eloquently describes as “bread lines knee-deep in wheat,” is much more pronounced and systemic.

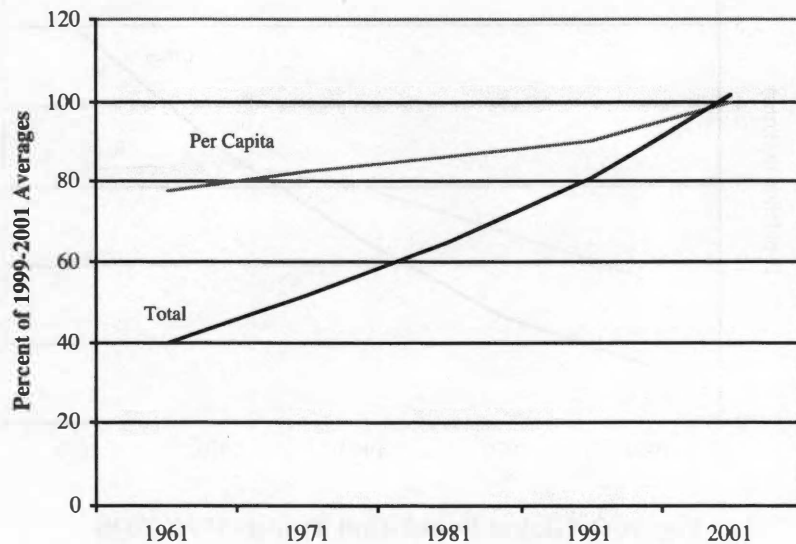


Figure 3. Global Food Production Trends 1961-2001

(Source: FAOSTAT 2005)

Unequal access to food and the necessary requisites for capitalist agriculture foster food insecurity. As record levels of agricultural production have been achieved, food security is now a problem of inequality in social institutions. Problematic for the near future, these vast levels of production are entirely dependent on petroleum.

Producing Food 'Rich' in Oil: Petroagriculture and Hubbert's Peak

Historically, expansion in agricultural production has occurred by bringing more land under production. In the early 1960s, agricultural expansion reached its limits, as hardly any land suitable for agriculture remained uncultivated. From that point on, increases in agricultural production have been gained through increases in yield per acre. Although there are examples of increasing yields per acreage achieved in pre-capitalist agriculture, the new increases in yield are qualitatively distinct from previous agricultural developments (Manning 2004a).

The new bases for the expansion of contemporary agriculture are technological developments. Inappropriately dubbed the "Green Revolution," the transformation of agriculture post-1960 was rooted in hybridization, the crossbreeding of different plant strains. The remarkable gains in agriculture were dependent on high-yielding hybrid varieties of plants along with implementation of resource-dependent technologies including synthetic fertilizers, pesticides, herbicides, and machinery. Agriculture became heavily reliant on 'off-farm inputs' and capital investment (Altieri, Rosset, & Thrupp 1998; Cook 2004; Humphrey, Lewis, & Buttel 2002; Lappé, Collins, & Rosset 1998; Manning 2004a). Richard Manning (2004a) notes:

This subtle change signaled the integration of farming into a host of industrial processes. Fuel for plowing was no longer farm-grown hay fed to farm-bred horses, but store-bought fuel fed to factory-built tractors. Fertilizers came from chemical plants, not the floors of stables and corrals, now emptied of horses. Before, farming had been uniquely autonomous of industry, because machines couldn't make food, only nature could. All of a sudden machines were integral to the process (p. 91).

The new conditions of agriculture brought on by the Green Revolution were based on drastic changes, not only in the production of food, but in all aspects of agriculture – from farm to plate. Beyond growing food or producing commodities, agriculture now involves the vertical integration of everything from growing crops to transportation, processing, packaging, marketing, and distribution systems (Cook 2004; Dawkins 2003; Humphrey, Lewis, & Buttel 2002; Lappé, Collins, & Rosset 1998; Magdoff, Foster, & Buttel 2000; Manning 2004a).

Contemporary agricultural production is extremely energy intensive.⁶ The key factor shaping contemporary agriculture and facilitating yield increases is the availability of cheap, abundant oil. Richard Heinberg (2003) notes, “virtually all of this increase [in yields per acre] was directly or indirectly attributed to energy inputs” (p. 175). The new hybrid varieties of the Green Revolution are specifically designed to rely on a “whole technical package” (Foster 1999:118).

We could reasonably assert that agriculture is soaked in oil. Diesel and fuel-run tractors and other farm machinery are used for plowing, sowing, and harvesting; in the field, crops are sprayed with oil-derived fertilizers, herbicides, and pesticides, as the monocrop hybrid varieties require large doses of petrochemicals to thrive, or even

⁶ Input energy for food is estimated to be around 10 times the food energy produced (Heinberg 2003; Manning 2004b)

survive; seeds, chemicals, and crops are transported great distances on oil-burning trucks and planes; as commodities, agricultural products are packaged in oil-derived plastics; the product must then travel again to reach the store, where consumers drive to shop (Heinberg 2003; Shah 2004).

Petroleum is the main factor shaping contemporary forms of agricultural production. A cycle of petroleum dependence ensues: the mechanization made possible by oil favors large-scale agricultural production that drives further mechanization and monopolization of production; oil facilitates transportation whereby food can travel farther, making cash crops from the South available to the North in the first place; the use of petrochemicals destroys the natural ability of plants resist pests, leading to further reliance on said chemicals; and since hybrids do not breed true (meaning offspring are the same phenotype) by design, farmers are forced to purchase new seed stock annually along with their accompanying petrol-inputs (Foster 1999; Heinberg 2003). Manning (2004b) notes, "Ever since we ran out of arable land, food is oil. Every single calorie we eat is backed by at least a calorie of oil, more like ten" (p. 42). And oil is finite.

A Saudi saying describes the brief history of oil: "My father rode a camel. I drive a car. My son flies a jet airplane. His son will ride a camel." Simply stated, the age of oil will be a mere speck in the landscape of human history. But the problems generated by the foreseeable end of oil will surface long before the oil actually runs out.

Predictions of the end of oil are centered on peak oil production, rather than the absolute end of recoverable oil, because peak production marks a drastic turn in socio-ecological history. From that point on, the global economy will be on a continual downward slide. Global oil production will peak when roughly half of all available

sources have been used. At that point, the continually increasing demand for oil will meet a rapidly decreasing supply, since it will be impossible to extract as much petroleum each subsequent year (Heinberg 2004). Based on the work of geophysicist M. King Hubbert⁷, analysts currently estimate that global oil production will likely peak between 2006 and 2016, although conservative estimates predict the global peak will come around 2030, which is not much later. All estimates concur that the exact peak in global oil production will only be recognizable in hindsight (Goodstein 2004; Heinberg 2003, 2004; Roberts 2004; Shah 2004).

Peak oil production will bring potentially disastrous problems. When peak oil production is reached, the “crisis” of the 1970s will pale in comparison.⁸ Agricultural production will be immediately and dramatically affected. As petroleum has been the main input in agriculture following the green revolution, contemporary modes of production will be increasingly more expensive and eventually altogether impossible. Following the global peak in oil production, petroagriculture could function for some time thereafter, but would require an aggressive reallocation of inputs.

Heinberg (2003) offers this prediction:

It is not difficult to imagine the likely agricultural consequences of dramatic price hikes for gasoline or diesel fuel used to run farm machinery or to transport food long distances, or for nitrogen fertilizers, pesticides, and herbicides made from oil and natural gas. The agricultural miracle of the 20th century may become the agricultural apocalypse of the 21st (p. 177).

⁷ Hubbert developed a widely accepted method to predict peak oil production during the 1950s.

⁸ That “crisis” was a small, temporary decline of only 7 percent in oil flow. Seemingly small, it was enough to create great panic within capitalism in the global North (Shah 2004).

An unplanned transformation of agriculture will exacerbate the current trends of food insecurity. The most vulnerable populations – urban areas, particularly in the South – will be disproportionately impacted. In those places where people still have some access to arable land, a basic living can be achieved by engaging in subsistence agriculture, but such a solution is not possible for the urban poor.

Greater levels of food insecurity will likely fuel more widespread global conflict. Extensive research, most notably the work of Thomas Homer-Dixon (1999) and Nancy Peluso and Michael Watts (2001), documents the linkages between the environment and conflict. The probable conflict that will accompany an unplanned end to petroagriculture cannot be envisioned through simplistic, deterministic linkages between environmental scarcity and increased violence. In fact, much research has examined the potential of cooperation in the face of environmental scarcity, standing in direct opposition to deterministic violence (Peluso & Watts 2001). As hunger is a problem rooted in social systems, it is critical to understand violence, as Peluso and Watts (2001) argue, “as a site-specific phenomenon rooted in local histories and social relations yet connected to larger processes of material transformations and power relations” (p. 5). It is essential to view any conflict likely to accompany an unplanned end of petroagriculture in terms of “the political economy of access to and control over resources” (Peluso & Watts 2001:5). This standpoint situates violence within the context of the underlying problems of food insecurity today, namely inequality based in the capitalist order.

Beyond Organics: Analytical Stance for the Case Study

This research examines the coming crisis of agricultural production because the possibility exists that the crisis can be averted. Humanity has the capacity to divest agricultural production from its reliance on petroleum. Sonia Shah (2004) exclaims, “The end of oil’s story is still being written, but it is clear that the conclusion nears” (p. 173). Whenever the point of peak oil production is reached, agricultural production will inevitably change. Many people do not see this as a potential crisis because they believe solutions can be easily found.

Some analysts (and much of the public) turn to *new* technology as the solution for the crisis in agricultural production (Humphrey, Lewis, & Buttel 2002). Technological developments got us into the problem of extensive oil consumption, the argument goes, and we can surely invent our way out. These new technological solutions focus on finding alternative sources of energy, the use of new technology to limit the dangers of petroagriculture, and the creation of new genetically modified organisms to further boost yields. Others view the solution to the crisis in agricultural production as organic agriculture. Organic agriculture, supporters argue, reduces use of petroleum in agricultural production. And some believe that the capitalist market and political systems will recognize the problem and work towards prioritizing agricultural production or that the capitalist market, if left alone, is best suited to managing the end of petroagriculture (Cook 2004; Heinberg 2003; Magdoff, Foster, & Buttel 2000).

I argue that these answers are insufficient responses to the problem of food insecurity. New technology will not systematically address the *social* problems of contemporary agriculture; organic agriculture does not go far enough in changing

petroagriculture; and the capitalist market and political systems benefit from the contemporary structure of global petroagriculture.

The focus on new technology is misplaced, as it does not directly deal with the future problems of food security after petroagriculture. Agriculture existed for thousands of years before reliance on petroleum. Even if they cannot support the current global population alone, farming techniques implemented during that pre-petroleum period remain useful today. Moreover, evidence suggests that new technology alternatives aimed at reduction in petroleum use do not provide the intended service of actually reducing energy consumption. In fact, as Shah (2004) notes, the opposite effect is the norm: energy use *increases* with wide use of energy efficient technology. Fuel-efficient tractors, for example, lead to increases in tractor use that results in a net increase of fuel use. Most important, any alternative source of energy currently available is insufficient to replace petroleum, which is transportable, energy-dense, easily refined into many fuel types, and suitable for many purposes, including petrochemicals for agriculture. Hypothetically, oil could be rationed for non-substitutable uses, but any alternative source of energy will still be insufficient to maintain current levels of energy use based on expanding petroleum consumption (Heinberg 2003).

The problematic relationship of agriculture to oil goes beyond the changes offered by organics. Organic agriculture certainly uses less petroleum used to manufacture pesticides and herbicides, but uses vast amounts of petroleum elsewhere, from tractors used on farms to transportation and distribution systems. Journalist Bill McKibben (2005) explains the pattern, “when organic produce started to take off, for instance, industrial growers soon took over much of the business, planting endless rows of organic

lettuce that in every respect, save the lack of pesticides, mirrored all the flaws of conventional agriculture” (p. 68). Thus, the reliance on petroleum could be abated by organics to some degree, but inequalities in access and distribution will remain. Organics do not address the form of food insecurity today. For the most part, organic agriculture facilitates the continuation of the problematic nature of agriculture by *not* addressing the problems of commodified agriculture; organics do not facilitate the realization of food security for all (Cook 2004).

The capitalist market and political systems are also unable to provide an alternative to contemporary agricultural production as both benefit greatly from the current structure of agricultural production. The relationship between contemporary petroagriculture and capitalism is problematic. The two are inseparable. Contemporary food insecurity is tied directly to capitalist agriculture that produces commodities. This same form of agricultural production uses any available resource in the search for expanding profits; petroleum is integral to the vast yields per acre that bring about the profitability of agriculture. And, the political system is directly tied to the economic structure. Additionally, Manning (2004a) notes:

The political system cannot be counted on to reform agriculture because any political system is a creation of agriculture, a coevolved entity. The major forces that shaped and shape our world – disease, imperialism, colonialism, slavery, trade, wealth – all are a part of the culture agriculture evolved (p. 187).

If the answers to the problem of petroleum dependence for agriculture do not lie with technology, organics, or the political and economic system, we must look elsewhere. Capitalist agriculture cannot be tinkered into providing food security now, let alone after the global peak in oil production. The problems of agriculture must be addressed

holistically. Any alternative to petroagriculture must target the driving logic of the system. Christopher Cook (2004) explains:

Any approach that focuses on one part of the system – such as helping farmers, consumers, or the environment – will indeed produce some benefits but will fail to deal with deeper fundamental problems underlying the entire food system. Today's food fight is . . . about power and control over food: how it is produced, by whom, and for whom (p. 10).

A great deal of discussion surrounding issues of food security focus on food security as a basic human right (Humphrey, Lewis, & Buttel 2002; United Nations 2004a). Food security is commonly viewed as the adequate attainment of food for a population by the state. Under Green Revolution proscriptions, food security is gained by states through the export of cash crops and the import of foodstuffs for national consumption. I argue that the coming end of petroagriculture requires us to understand food security as self-sufficiency in staple crop production. Local production for local consumption is a necessary aspect of food security under materializing global realities.

The end of abundant and cheap oil necessitates that food be produced geographically closer to where it is consumed and vice-versa. The end of petroagriculture compels a radical change in town-country relations. To the extent that large metropolises will remain a part of the geographical landscape following the global peak production of oil, urban agriculture plays a vital role in facilitating food security after petroagriculture.

Under urban agriculture, production of food occurs where it is most needed, in cities. Problems of transportation and storage are thus eliminated. Small-scale production, characteristic of urban agriculture, is labor-intensive and uses less heavy machinery and subsequently less petroleum. As urban gardens are located in areas of

high population density, urban agriculture works best when local resources – animals, plants, soil, and water – are properly managed. Hence, using these best management practices reduces the use of toxic petrochemicals and conserves water. Additionally, the small-scale and non-specialized character of this urban agriculture facilitates nutrient recycling. Small-scale agriculture is typically diverse in what it produces, providing natural protection against disease and pests. Urban agriculture under these conditions also facilitates self-sufficiency, as the problem of food availability is addressed directly by people themselves (Rosset & Benjamin 1994).

I suggest that the most viable long-range alternative to petroagriculture brought on by the eventual arrival of peak oil must be a) organic (in the broadest sense), b) local (in terms of proximity between production and consumption), and c) non-capitalist (production of food for direct consumption and not profit). Urban agriculture meets these conditions. Cuba has recently adopted urban agriculture as a solution to a crisis in food availability brought on by a drastic cut in access to petroleum. Despite its imperfections, urban agriculture in Cuba meets all three criteria of an alternative to petroagriculture: organic, local, and non-capitalist.

My research is a descriptive study of urban agriculture in Cuba. I examine the factors that pushed the transformation and the process by which the transformation occurred. I undertake a critical assessment of contemporary food production and agriculture in Cuba, focusing on the existing conditions that facilitated the drastic switch in farming practices, the possibility and likelihood that the Cuban model might be adopted elsewhere, and the feasibility of urban agriculture to address the problem of food security in the 21st century.

III. Research Strategy

For this research I employed a historical case study. I used archival data from multiple sources to reconstruct the development of urban agriculture in Cuba with a particular focus on the factors contributing to it.

The Case Study

The case study is a research design focusing on one specific case. In regard to urban agriculture, the case study makes good sense. Cuba provides the rare opportunity to conduct research on urban agriculture as practiced on a large scale – that is, city- and nation-wide as opposed to neighborhood-wide. As the political and economic factors that facilitated the shift in Cuba away from the Green Revolution are already known and easily identified (Altieri, et al. 1999; McKibben 2005; Nieto & Delgado 2001; Rosset 2000), the case study is used here as a method of research for investigative purposes to identify the factors contributing to the *success* of the urban agriculture movement in Cuba. The Cuban transition away from petroagriculture, though motivated not by geophysical realities but rather by political and economic forces, serves as a global model because similar forces to abandon global petroagriculture were the same as for Cuba – the escalating costs and unavailability of petroleum.

The case study facilitates understanding of social phenomenon in terms of *what* occurred and the specifics of *why* something happened (Naumes & Naumes 1999). Using the case study method, urban agriculture in Cuba is examined with the end goal of a comprehensive understanding of the nuances of the specific case. Robert Stake (1995)

argues, “A case study is expected to catch the complexity of a single case . . . Case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances” (p. xi).

Two principal advantages of the case study are close reading of data and the contextual “situating” afforded. The case study provides an opportunity to paint a full picture of the phenomena under investigation. Moreover, the case study situates the research within the broader scope of global history and geography through contextualization (Orum, Feagin, & Sjoberg 1991).

Case study, like any research method, has some limits. Its main disadvantage is the “difficulty in generalizing from the results of these studies, in extrapolating the results of single case research into a larger context” (Naumes & Naumes 1999:59). Thus, while the conclusions reached may indeed be relevant to other experiences with urban agriculture, further research is needed to confirm this. However, this limitation of the case study is less problematic in light of this specific research project.

The goal of this research is not to generalize the precise experiences of urban agriculture in Cuba, but to understand how the case may provide lessons for urban agriculture elsewhere; the purpose is not to generalize, but to learn. This case study may generate potential lessons for other nations.

Data Sources

Cuban agriculture is studied in historical context using archival data. Within this context, urban agriculture in Cuba is examined from 1989 through 2004. The starting date, 1989, was chosen specifically for the purposes of identifying the particulars of the

development of urban agriculture in Cuba following the collapse of the Soviet trade bloc and subsequent loss of agricultural inputs, including petroleum, to Cuba.

Data sources for the research project include literature (i.e. books, journal articles, news reports, and conference proceedings) that document the transition to urban agriculture in Cuba. Official reports from both national and international governing bodies and nongovernmental organizations (NGOs) provide data on global geophysical trends and the Cuban case as it relates to these conditions.

In order to ensure accuracy of secondary data sources, this case study is conducted using a triangulation of sources. Stake (1995) explains, “To describe the case, we try to present a substantial body of uncontested description. We want to tell quite a bit about the case that almost anyone, who had our opportunity to observe it, would have noticed and recorded, much as we did” (p. 110). Triangulation of sources provides for the examination and utilization of multiple sources and data of multiple origins, thus enhancing the validity of conclusions (Orum, Feagin, & Sjoberg 1991; Stake 1995).

The case of Cuba is examined through in-depth analysis of secondary data sources that present the story of urban agriculture in Cuba as completely as possible, specifically seeking to understand its complexity. To be sure, urban agriculture in Cuba could be examined using quantitative methods of social science research. But the literary-narrative approach – a method for revealing findings through qualitative analysis – adopted here facilitates analysis that strikes at the root of the problems of contemporary agricultural production and draws attention to possible alternatives.

The literary-narrative approach can be precise and disciplined – and at the same time graphic, readable, and imaginative. As with the novel, the narrative form permits the sociological researcher to tell a story, a story

with actors, action, and a background, even one that may possess a compelling plot. Vivid description is not the less scientific because it is descriptive (Orum, Feagin, & Sjoberg 1991:20).

The story of Cuban agriculture provides insights for the future of global food production. Telling this story through historical analysis provides a glimpse of food security in a post-peak oil world.

IV. The Cuban Experience: Food Security Before and After Petroagriculture

Beginning with the origins of the Cuban Revolution almost fifty years ago, food security has remained a high priority for the nation of Cuba. However, the Cuban approach to food security has been altered throughout history in response to differing material conditions. A full grasp of agriculture in Cuba today, including the achievement of food security under changing conditions of production, depends on a basic understanding of the history of agriculture in Cuba. Cuban agronomist Fernando Funes (2002) explains, “In order to understand the organic farming movement and sustainable agriculture in Cuba, one must begin with the history of Cuban agriculture” (p. 3). This history provides the context for the problems Cuba faced in pursuing food security at various points in time. Additionally, the selected history clarifies my use of Cuba as a case study with the potential to generate insights about food security in a post-petroagriculture world.

The history of Cuban agriculture is a microcosm of global agricultural history. Cuba’s agricultural sector once exemplified the prescriptions of the Green Revolution in many respects; contemporary urban agriculture in Cuba foreshadows future global agriculture by operating without petroleum inputs and, thus, exemplifies an alternative to petroagriculture.

After a brief history of Cuban agriculture prior to the 1959 Revolution, I offer a selective history of Cuban agriculture that examines agriculture and food security in Revolutionary Cuba before and during the Special Period in Peacetime. The Special

Period as a historical division exemplifies both global contemporary petroagriculture and a transformation in agriculture following a global peak in oil production.

Agriculture in Cuba Prior to the Revolution

Once Cuba was established as a colony for Spanish plunder with the ‘discovery’ of the Americas in the 15th century, sugar production was developed to serve colonial interests. Sugar retained its importance through Cuba’s different socio-historical identities – colonial subject of Spain, client of the United States, and dependent of the Soviet Union (Pérez 1988).

The role sugar played in shaping the character of Cuba cannot be understated.⁹ It is even said that the history of Cuba is the history of sugar. Historian Louis Pérez (1988) posits, “The influence of sugar . . . was pervasive and total . . . In the end, sugar shaped the national character” (p. ix).

Cuba was formally colonized during the early 16th century. The native Indian societies were immediately destroyed through conquest and most survivors of the original conquest died soon after colonization. Food insecurity was commonplace, creating conditions ripe for infection and illness. Most notable was the introduction of export-oriented agriculture. Pérez (1988) notes, “Spain introduced a new economic purpose to the island, and nowhere did this change of purpose stand in sharper relief than the new function of land. European agriculture displaced Indian farming” (p. 28). Coffee, sugar,

⁹ A sustained discussion of sugar’s role throughout Cuban history is much too complex for the scope of this project. For a more comprehensive analysis see Pérez 1988, 2001.

and tobacco were cultivated for export. As a Spanish colony, agriculture in Cuba was developed to serve colonial interests (Pérez 1988).

Cuban agriculture was relatively diverse and balanced until the middle of the 19th century, when the “scale slowly tilted against diversified agriculture and in favor of sugar” (Pérez 2001:92). From that point on, Pérez (2001) observes, “the die was cast” (p. 108). The Cuban agricultural economy was essentially based on one crop, sugar, and would grow to 90 percent of Cuba’s total exports by value over the next century. The growing importance of sugar for the Cuban economy, Pérez (1988) notes, “came at the expense of everything else” (p. 77). Sugar systematically undermined Cuban development.

During approximately the same period, Cuba struggled. On February 24, 1895 the Cuban war for independence began under the leadership of José Martí. Recognizing the immanent defeat of the Spanish by the Cubans, the U.S. intervened in the Cuban struggle for sovereignty, driven by the opportunity to gain control over the island. Pérez (1988) comments:

The intervention changed everything, as it was meant to. A Cuban war of liberation was transformed into a U.S. war of conquest . . . So it was that the Cuban war for national liberation was transfigured into the ‘Spanish – American War,’ nomenclature that denied Cuban participation and presaged the next series of development” (p. 178).

After almost four centuries of colonization, Cuba finally won independence from Spain, only to become an official possession of the U.S. on January 1, 1899. Cuba went from colony to U.S. client state in short order (Pérez 1988).

The war for independence ravaged Cuba’s agricultural sector, and thus left the island in economic ruins. Throughout the first half of the 20th century, Cuban agriculture

was developed similar to colonized Cuba – generally, sugar production served external interests. U.S. control over sugar expanded and by 1905 it was estimated that 75 percent of all land in Cuba was owned by foreign interests. Pérez (1988) explains, “Cubans had achieved self-government without self-determination and independence without sovereignty” (p. 192).

Cuban opposition to U.S. control was strong from the outset. Cubans organized and rebelled against the U.S. throughout the first half of the 20th century. In the 1950s, the struggle against the U.S. and its supporters developed into full-blown revolutionary warfare. The origins of Cuban discontent lay to a large extent in its agricultural monoculture causing socio-economic dissatisfaction accompanied by growing political grievance. Pérez (1988) explains:

Throughout the 1950s, Cuba was experiencing economic dislocation. Cubans continued to suffer from the vagaries of an export economy, and relief was nowhere in sight. Vulnerability to the effects of price fluctuations in the international sugar market and the boom-bust cycles continued to play havoc with all sectors of the Cuban economy. By the 1950s sugar had ceased to be a source of economic growth and could not sustain continued economic development (p. 295).

In both rural and urban areas, Cuban resistance against the U.S.-propped government grew. The economy was unable to support the Cuban population. The overall impoverished conditions under which many Cubans lived, particularly those in rural areas, facilitated the expansion of armed struggle. The guerrilla movement grew quickly and enjoyed widespread support. “Social undercurrents ran deep during the late 1950s and contributed to transforming the struggle . . . from a political contest between elite power contenders into a more ambiguous movement for socio-economic change” (Pérez 1988:303).

Agriculture and Food Security During the Cuban Revolution

Revolution was successful in Cuba in 1959 under the leadership of Fidel Castro. Cubans were finally able to free themselves from the U.S. control that gripped the nation following the successful struggle against Spanish rule (Pérez 1988). The Revolution is still alive today, and Cuba remains a sovereign state under the self-rule won in 1959.

From the beginning of the Revolution, Cuba has consistently remained dedicated to food security (Rosset 2000). Marcos Nieto and Ricardo Delgado (2002) posit, “If one were to look at the first four decades of the Cuban Revolution, what stands out are the positive steps taken by the Cuban government to assure food availability” (p. 40).

Strategies to achieve food security, however, changed over time.

An initial goal of the Revolution was to reverse the underdevelopment of Cuba resulting from sugar dependence. The plan was to reduce the role of sugar in the Cuban economy through programs aimed at industrialization and the diversification of agricultural production (Crawford 2003; Enríquez 2000; Pérez 1988). Pérez (1988) explains:

Agricultural diversification promised to reduce agricultural imports, increase national production, and promote new exports. The idea was quite simple. Too much emphasis had been given to sugar. Foreign exchange was being spent on goods that could be produced in Cuba (p. 337).

This strategy was not a total abandonment of sugar production, but a basic reduction of production to lower, stable levels and a divestment of wholesale economic reliance on one good. Additionally, Pérez (1988) explains, “Cuban planners also hoped to achieve

self-sufficiency in food production” (p. 338). The initial plan of the Revolution was to achieve food security through self-reliance.

These developmental strategies were sound in theory but they were not fully implemented because of externally imposed constraints. In 1960, less than a year after the success of the Revolution, the United States instituted an embargo against Cuba in response to the nationalization of U.S. holdings. The embargo undermined the Cuban economy as the U.S. cancelled its sugar order, creating dire conditions for many parts of the country. Although agricultural diversification was an initial goal of the Revolution, extensive failures in the agricultural sector forced the abandonment of such efforts. In fact, dependence on foreign imports of foodstuffs increased, as did Cuban reliance on sugar exports. Cuban efforts to industrialize and achieve self-sufficiency in food production were unsuccessful (Enríquez 2000; Pérez 1988).

With few options, Cuba turned to the Soviet bloc for economic assistance. The Soviet bloc offered Cuba favorable trade conditions for sugar. The Soviets were engaged in the Cold War, a power struggle against the U.S., from the 1950s through the 1980s. Thus, they had their own vested geopolitical interest in Cuba. The geographical location of Cuba was enticing to the Soviet bloc and Cuba served on the front line of the Cold War (Pérez 1988).

Armando Nova (2002) explains that historical success in sugar production and trade with the Soviet bloc created “a secure market [for sugar], with long-term, stable, and preferential prices. This led to a decision to reconsider the reduction of area devoted to sugarcane, thus prolonging [Cuban] dependence on a one-product farming system” (p. 29). Already possessing the labor, knowledge, ecological characteristics, and experience

for sugar production, Cuba became wholly committed, and sugar production became a national priority. As Pérez (1988) declares, “This was not simply an objective – it became an obsession” (p. 339). Cubans became transfixed by the goal of collective advancement promised by sugar production.

Cuba was pushed toward state planning to compensate for the loss of U.S. management over Cuban production, resources, and distribution. As Pérez (1988) explains, “The crisis with the United States, moreover, climaxing in the trade embargo, increased the importance of state planning to reorganize Cuban industry around Soviet exports and facilitate the integration of Cuban trade with the socialist bloc” (p. 328).

The Soviet bloc relationship meant that Cuba’s agricultural sector developed in a manner similar to that of other third world countries. The methods of national development entailed an increase in agricultural production for export to generate capital for agricultural investment (in the form of inputs) to increase production of agricultural commodities (Enríquez 2000; Nova 2002; Pérez 1988; Rosset 2000).

Cuban agricultural production, then, was characterized by heavy dependence on imported agrichemicals, hybrid seeds, machinery, and petroleum. Peter Rosset and Medea Benjamin (1994) explain, “Cuban agriculture was based on large-scale, capital-intensive monoculture, more similar in many ways to the Central Valley of California than to the typical Latin American *minifundio*” (p. 3). The agricultural sector in general, and sugar in particular, was industrialized at the onset of the Soviet relationship (Enríquez 2000). Funes (2002) depicts the degree to which Cuban agriculture was industrialized:

On the average, 1,300,000 tons of chemical fertilizers and 600,000 tons of feed concentrates for livestock production were used every year, together with \$80 million worth of pesticides. The number of tractors employed in Cuban agriculture grew to 90,000, as the number of oxen teams shrank to less than 100,000. In the first three decades of this period, the favorable terms of trade Cuba received from socialist countries, especially the Soviet Union, made such heavy investment in this agricultural model possible (p. 5).

Cuba's economy quickly became more industrialized than did any other Latin American country (Rosset 2000).

Food security in Cuba was made possible by the long-standing commitment of the Revolution to social equity and the trade enjoyed with the Soviet bloc. Cuban sugar was exported to earn revenue to purchase adequate supplies of food, which was available to Cubans through equitable distribution patterns. Cubans had access to food through a variety of avenues: a rationing system established by the Cuban state that guaranteed basic foodstuffs to all households; sufficient wages and low unemployment supported the ability of Cubans to buy food at state-reduced prices; meals provided at work and schools supplied at least one meal per day to many Cubans; and both the "grey market" (the trade of food rations, i.e. unneeded milk for needed eggs) and the black market supplemented rationing and food markets (Pérez 1988; Rosset 2000). For the most part, food security was achieved through the import of food, coupled with an equitable food access and distribution system. Pérez (1988) notes, "In this fashion, the revolution achieved one of its most dramatic achievements: the elimination of malnutrition" (p. 361).

Cuban nutritional needs were all but fully met by the 1970s – not, to be sure, with any great quantity or with great variety, but with certainty, regularity, and sufficiency. Malnutrition was all but eliminated. By the early 1980s, the United Nations Food and Agriculture Organization estimated the Cuban daily per capita calorie intake at 2,705, considerably

above most Latin American countries and above the generally recognized minimum daily requirement of 2,500 calories (Pérez 1988:362).

During the Revolution, Cuba imported approximately two thirds of its food and almost all of its agricultural inputs, including fuel. Farming in Cuba was fully industrialized with many inputs and was entirely dependent on petroleum: large, centrally-controlled farms, an agricultural sector based on mono-crop export, with great reliance on technology and inputs in the form of petrochemicals, herbicides, pesticides, and inorganic fertilizers. Cuba's population was fed, but production was unmistakably industrial, and thus dependent on petroleum inputs and global trade (Altieri, et al. 1999; Funes 2002; Nieto & Delgado 2002).

Food security was achieved during the Revolution by essentially following the guidelines of the Green Revolution: produce cash crops for export using industrialized modes of production and import foodstuffs for national consumption. Throughout the Revolution, Cuba became increasingly dependent on its relationship to the Soviet bloc, as Nova (2002) explains:

This [decrease in food production] came about in an intensive development model, based on high levels of external inputs and a high external dependence (mainly machinery, fuel, and agrochemicals); similar to the situation faced by other countries applying the same productionist model (p. 38).

Throughout the 1970s and 1980s, Cuba remained aware of the need to try agricultural diversification again as a long-term strategy for food security. As a new developmental strategy forged during this time, Cuba worked to provide more local political power or *poder popular* (people's power). This democratization project, coupled with planning improvements, helped to reduce sugar dependence.

Diversification reduced sugar dependency and the sugar declined as part of the total value of Cuba exports. Cuba maintained its commitment to food security and began the path toward increased self-sufficiency in food production (Pérez 1988).

Revolutionary Cuba also put great emphasis on education. Pérez (1988) explains, “Indeed, nowhere was the quest for an egalitarian society more fully attained than in the area of education” (p. 358). Education was used to develop and strengthen political support for the Revolution, boost economic activity, and facilitate Cuban development. During the Revolution, the illiteracy rate fell from approximately 25 percent to become virtually nonexistent. Extensive gains were made in other areas of education, particularly in advanced training (Pérez 1988). McKibben (2005) notes the undeniable success: “Fidel Castro, as even his fiercest opponents would admit, has almost from the day he took power spent lavishly on the country’s educational system. Cuba’s ratio of teachers to students is akin to Sweden’s; people who want to go to college go to college” (p. 64).

Into the 1980s, Cuba faced tough material realities, but the Revolution remained alive and well. “The combination of sustained economic growth and political stability, backed by Soviet economic support and credit subsidies, allowed Cuba to fulfill many of the most ambitious programs of the revolution” (Pérez 1988:356).

Despite great progress in pursuing a development path toward self-sufficiency, Cuba remained more or less dependent upon the production of one crop until the Soviet trade bloc crisis that fully materialized in 1989. To be sure, food security was achieved through adequate access and distribution programs, but their food security was dependent on a model of agricultural production that defies any notion of security, stability, or sustainability.

Food Security During the Special Period in Peacetime

In 1989 economic stagnation provoked the collapse of the Soviet bloc. The Soviet influence declined globally as the neoliberal agenda conquered ever-farther lands. Instantaneously, socialist alternatives disappeared around the world and the capitalist mode of production proliferated globally. The situation quickly became dire for Cuba, which no longer had a supplier for the extensive inputs on which the country had become dependent. Nor did Cuba have markets for its exports. The Soviet bloc supported 85 percent of Cuba's trade. After its collapse, Cuban imports dropped 75 percent and exports were reduced 79 percent; the deficit reached 33 percent of gross domestic product (GDP). A reduction in oil imports by more than 50 percent diminished the availability of fuel needed to run the Cuban economy, and also destroyed the base of Cuba's foreign exchange through the re-export of oil, a major source of revenue for the cash-strapped country (Altieri, et al. 1999; Enríquez 2000; McKibben 2005; Murphy 1999; Nieto & Delgado 2001; Rosset 2000).

The ensuing economic crisis completely undermined Cuban food security. Availability of fertilizers and pesticides plunged by more than 80 percent, and fuel and other petroleum products dropped by more than 50 percent. Food production became Cuba's most immediate need as the imports that formerly provided 50 percent of the caloric intake of the population disappeared virtually overnight. It is estimated that during the early 1990s, caloric and protein intake by Cubans dropped as much as 30 percent below levels in the 1980s – from almost 3,000 calories a day to 1,900. Urban areas in particular were devastated, causing widespread problems in a country where

approximately 75 percent of the population lives in cities. The lack of fuel for shipping meant that the food still available from Cuba's rural areas and sources from abroad were no longer able reach the urban population (Altieri, et al. 1999; Enríquez 2000; McKibben 2005; Murphy 1999; Nieto & Delgado 2001; Rosset 2000; United Nations 2004b).

Cuba's dedication to food equity was seriously challenged. After 1989, Cuba, no longer able to access the imports that the entire economy had become accustomed to, needed new ways to feed the population and to maintain social equity. The situation was exacerbated as the twice-strengthened U.S. embargo isolated the nation from the rest of the world. The U.S. saw the Soviet collapse as a chance to finally destroy the tiny nation (Nieto & Delgado 2001; Pérez 2002; Rosset 2000). McKibben (2005) explains:

The United States, Cuba's closet neighbor, enforced a strict trade embargo and Cuba had next to no foreign exchange with anyone else – certainly the new Russia no longer wanted to pay a premium on Cuban sugar for the simple glory of supporting a tropical version of its Leninist past . . . In other words, Cuba became an island. Not just a real island, surrounded by water, but something much rarer: an island outside the international economic system, a moon base whose supply ships had suddenly stopped coming (pp. 61-2).

Despite the dire conditions now faced by Cuba, Nieto and Delgado (2002) explain, “a fundamental decision was made to maintain the principles of social equity established by the revolutionary government” (p. 47). U.S. policy, intended to overthrow the Revolution, actually had the opposite effect and solidified Cuban resolve; the more the U.S. pushed, the more Cuba resisted. Cuba remained dedicated to survival and the Cuban government in 1991 declared the “Special Period in Peacetime” in response to the crisis, effectively placing the country on an austerity program similar to periods of war, and quickly began to devise solutions for the new problems. The entire country was

reorganized to contribute to the continued existence of the Revolution by adapting to changing conditions (Altieri, et al. 1999; Crawford 2003; Murphy 1999; Rosset 2000).

Human resources were mobilized to meet the needs of the country. Cuba was, in fact, prepared to handle the grave conditions that arose after the Soviet collapse. Since the Revolution, Cuba emphasized the advancement and education of its citizens.

Emphasis on the development of national capabilities between 1959 and 1989 equipped the nation with the flexibility to respond to the crisis. Although Cuba has only 2 percent of the population of Latin America, it has almost 11 percent of its scientists. Moreover, Cuban scientists were already conducting research on agricultural alternatives prior to 1989. During the Special Period, their research was intensified and findings were systematically implemented (Rosset 2000; Rosset & Benjamin 1994).

To feed its population, Cuba initiated the largest effort in history to convert industrialized agriculture to organic farming. "In doing so" McKibben (2005) posits:

they have created what may be the world's largest working model of a semi-sustainable agriculture, one that doesn't rely nearly as heavily as the rest of the world does on oil, on chemicals [derived from petroleum], on shipping vast quantities of food back and forth [also heavily dependent on oil] (p. 62).

Alternatives for the now unavailable inputs were needed across the entire agricultural sector. Chemical inputs were replaced by biological substitutes: biopesticides, natural enemies, resistant plant varieties, crop rotations, and cover cropping to suppress weeds. Biofertilizers substituted for synthetic ones: earthworms, compost, other organic fertilizers, manures, and integration of grazing animals with crops (creating manure, and providing aeration). Animals were used instead of tractors, reducing the need for fuel, tires, and spare parts. Organic farming also requires the one input abundant in Cuba (and

much of the world): labor (Altieri, et al. 1999; Crawford 2003; Koont 2004; Murphy 1999; Rosset 2000).

Food has remained adequately available to all Cuban citizens since the Revolution and particularly through the difficult extremes of the recent Special Period by employing a variety of tools. First, food has remained within physical and economic reach of the entire population (including schools and hospitals) through regulated food entitlements and the continuation of rationing programs that were first implemented by the Cuban revolution. Secondly, food is often distributed from producers voluntarily, out of a sense of Cuban solidarity (Koont 2004; Nieto & Delgado 2002). There are also state-based competitors that offer alternatives to farmers' markets through *placitas topadas* (limited price) markets. The most important provision securing food distribution is that land, the primary means of food production, is available to all Cubans for free. As Koont (2004) points out:

This principle has enabled work collectives, from state farms and industrial enterprises to schools and hospitals, to put nearby idle land to good use by raising crops and animals for the consumption of the workers in workplace cafeterias. It has also enabled individuals who are not officially integrated into the agricultural workforce on state farms, such as retirees, to ask for small parcels of land to produce their own food (p. 19).

The development of Cuban agriculture during the Special Period systematically reversed the underdevelopment of the nation based on sugar production. The diversification of agriculture, long a goal of the Revolution, was realized. "It is the reverse, that is, of the Green Revolution that spread across the globe in the 1960s, an industrialization of the food system that relied on irrigation, oil, and the massive application of chemicals to counter every problem" (McKibben 2005:65).

Urban Agriculture During the Special Period

An important element of the alternative agricultural plan in Cuba is organic urban food production. “Urban agriculture reemerged recently in this new context for several reasons: the economic difficulties of the 1990s; the low quality of vegetables on the market; shortages of traditional spices and seasonings; and the under-exploited production potential of cities” (Companioni, et al. 2002:221).

‘Urban’ agriculture has no widely agreed upon definition. Additionally, ‘organic’ is used in a wide variety of ways to denote any number of cultivation techniques. In Cuba, urban organic agriculture is generally defined as food production within a city’s regulatory limits, or officially recognized periphery, that uses no synthetic fertilizers, pesticides, or herbicides (Crawford 2003). It “refers to the cultivation and production of agricultural products, including edible, medicinal, and decorative plants, grown without the assistance of chemical agents, and within the outside limits of the official peripheral borders of Cuban municipalities” (Crawford 2003:743).

Small-scale *organopónicos* (the Cuban term for all urban gardens) are necessarily diverse in production and participatory. Diversity in production is used as a tool to maximize yield in urban agriculture, similar to any other type of small-scale agricultural production. In this case, diversity serves as a natural protection against pests and makes possible a cycle of harvests throughout the year. The small-scale characteristic of urban agriculture increases labor needs, as animal power and mechanization are not a possibility; urban agriculture thus encourages widespread participation (McKibben 2005).

Three broad notions guide urban production in Cuba: organic cultivation, use of resources in accordance with local needs, and direct distribution of goods to consumers. Organic methods protect the local environment and the health of consumers. Local conditions guide the use of local resources to facilitate sustainability and reduce the agricultural sector's interference with other urban activities. Consumers are provided direct access to foodstuffs in the pursuit of realizing food security for all citizens (Companiononi, et al. 2001).

Urban gardens began to emerge all over Havana in the early 1990s to counter the food crisis. Many analysts agree that this trend of urban agriculture began as a *popular* response in the truest sense: food was needed, so the population grew it (Altieri 2002; Altieri, et al. 1999; Companiononi, et al. 2002; Crawford 2003; Funes 2002; Gonzalez 2003; Koont 2004; Murphy 1999; Rosset 2000; Rosset & Bourque 2002). Peter Rosset (2000) describes the grassroots spread of urban agriculture: "Formerly vacant lots and backyards in all Cuban cities now sport food crops and animal farms, and fresh produce is sold from private stands throughout urban areas at prices substantially below those prevailing in the farmers' markets" (p. 210).

Originally, urban organic agriculture as a popular movement was "disorganized in both scale and type" (Crawford 2003:745). As there was no formal government oversight of the movement, every form of agricultural production – from roadside gardens and patio production to large farms outside the city center – was considered part of the urban agriculture movement. The movement extends beyond typical backyard gardening and urban agriculture provides a significant amount of produce for Cuban consumption (Crawford 2003; Koont 2004).

Urban agriculture has spread across Cuba in recent years, and has become a large contributor to food production. The urban agriculture movement has provided great assistance in the fight against hunger without petroleum and in the midst of economic crisis. As a popular movement, it emerged quickly (Crawford 2003; Koont 2004; McKibben 2005; Murphy 1999; Rosset 2000).

Formal government support followed the grassroots movement in short order. The *organopónicos* were “augmented by state support, both through technological and informational services and through the establishment of extensive state-run gardens, which produce horticulture products for local residents” (Altieri, et al. 1999:132). In 1993, the Cuban government introduced policy that provided access to land for food production to anyone not incorporated into another food provisioning system. Self-sufficiency was coordinated by the Ministry of Agriculture (MINAGRI) in an effort, as Laura Enríquez (2000) explains, to “ease the pressure on official channels of food distribution, as well as to reduce potential discontent about food shortages, by permitting people to grow their own food” (p. 7).

As the food crisis intensified, government support of urban agriculture expanded rapidly due to public pressure. The movement grew in both size and tangible success.

The Ministry of Agriculture (MINAGRI) took this popular movement very seriously, and by 1994 had created a specific Urban Agriculture Department. Together with the Provincial Office of Poder Popular, they set out to provide support services and material resources for the urban gardeners of the capital and other cities (Altieri, et al. 1999:134).

The oversight of urban agriculture by MINAGRI, beginning in 1994 with the creation of the Urban Agriculture Department, was strengthened three years later with urban land-reform policy. Crawford (2003) notes that the official step of government oversight was

strengthened in 1997 with Resolution No. 527/97, which formally provided up to one-third of an acre for urbanites to cultivate crops in and around major Cuban cities.

Urban agricultural programs were implemented using a variety of tools and diverse tactics to ensure success. The Cuban government supported urban agriculture through regulation, market incentives, voluntary partnership approaches, land reform, cultivation assistance, and by promoting education and providing public information (Companiononi, et al. 2002). According to Catherine Murphy (1999), MINAGI created the “world’s first coordinated urban agriculture program” (p. 11). It entailed: 1) land access for Cubans, 2) agricultural extension programs, 3) research and development for improving urban agriculture, 4) an extensive network of supply stores, and 5) marketing opportunities directed toward meeting urban needs.

Government support of urban agriculture was integral to the success of alternative agriculture in Cuba (Companiononi, et al. 2002; Enríquez 2000; Murphy 1999). In particular, the government guaranteed access to land, fundamental for food production. Access to land facilitated the successful development of urban agriculture throughout Cuba. According to Nelso Companiononi, Yanet Ojeda Hernandez, Egidio Paez, and Catherine Murphy (2002), government support is guided by certain principles, including:

Equitable food distribution

Local production linked to community needs

Animal and crop integration

Organic fertilizers, pesticides, and herbicides to protect future generations

Cultivation of all available land

Interdisciplinary research applied for the benefit of all

Direct access to fresh produce

Best use of production possibilities

The Urban Agriculture Department attends to all aspects of urban agriculture.

The department is comprised of a wide variety of participants in the movement – urban farmers, specialists, and members of the government from different scientific and government institutions. The Cuban government has twenty-six administrative sub-programs specifically geared toward supporting urban agriculture (see Figure 4).

1. Soil management and conservation	14. Oilseed crops
2. Organic matter	15. Beans
3. Seeds	16. Animal feeds
4. Irrigation and water	17. Apiculture
5. Vegetables and fresh herbs	18. Poultry
6. Medicinal plants and dried herbs	19. Rabbit breeding
7. Ornamental plants and flowers	20. Sheep and goats
8. Fruit trees	21. Swine
9. Shade houses	22. Cows
10. Small-scale “popular” rice production	23. Aquaculture
11. Trees, coffee, and cocoa	24. Marketing
12. Small-scale “popular” plantain production	25. Small-scale agro-industry
13. Tropical roots and tubers	26. Science, technology, training, and environmental issues

Figure 4. Sub-programs of Urban Agriculture

(Source: Companioni, et al. 2001)

Together, these programs provide support in a variety of agricultural sectors, for people engaged in urban agriculture at all levels, and use a wide array of means to facilitate this support. All of the sub-programs are aimed at providing direct support to areas most in need. As they are coordinated on a local level, the sub-programs are responsive to local needs (Companiononi, et al. 2002).

Popular Councils (local government at the neighborhood level) each have representatives and/or agricultural delegates to coordinate the local urban agriculture programs. This local control fosters understanding of the unique characteristics of local systems and provides the ability to adequately address the local needs. Popular Councils also oversee local service and technical provisions such as the extension services, research and development, and supply stores (Companiononi, et al. 2003; Koont 2004; Murphy 1999).

The Municipal Urban Farm Enterprise coordinates all urban agricultural activities of the Popular Council, including organizing production, determining appropriate technology for a given area, and choosing local inputs and local land potential. Additionally, Municipal Urban Farm Enterprises have the necessary infrastructure to provide technical and extension activities. Assistance is also provided through scientific resources, education programs, and service centers. Service centers offer technical advice and information along with seeds, organic compost and fertilizers, and natural pest and disease control (Companiononi, et al. 2003; Koont 2004; Murphy 1999).

Government support in the form of technology and research provides farmers with tools, knowledge and concrete assistance (i.e. seeds, pest control, management techniques, etc.) integral to the success of agricultural production. In 2003, one million

tons of natural compost was produced in hundreds of vermicompost centers, and distributed to urban farmers. The Crop Protection Institute provided farmers with natural pest control, such as insects and microorganisms (Koont 2004:15). Education initiatives share research, techniques, and knowledge with farmers and ensure that young people are equipped to carry on agriculture production in the future.

Training of urban farmers is critical to perfecting the production technologies being employed . . . We have built an extension system, which counts on the participation of its own extension agents, plus research centers, the most experienced farmers and gardeners, and other individuals and institutions related to urban agriculture. Extension is at all times tailored to local conditions and needs, providing farmers with the latest theoretical and practical information (Companiononi, et al. 2002:233).

A basic goal of the agricultural component in the Special Period was to improve local food production and realize food security in Cuba through self-sufficiency. On the whole, this initial goal has been realized. Sinan Koont (2004) notes:

By the end of 2002, the goal of providing every settlement of over fifteen houses with its own food production capacity – whether *organopónicos*, group gardens, or individual plots – has essentially been met, and over 18,00 hectares were being cultivated in urban agriculture in and around cities (p. 13).

Urban agriculture now supplies an ever-larger amount of fresh produce for the Cuban population. “By the summer of 2003, the number of patios in production had exceeded 300,000, with a goal for the future of over half a million patios” (Koont 2004:13).

Growing food is now commonplace in urban areas and patios, yards, and balconies support the urban agricultural movement.

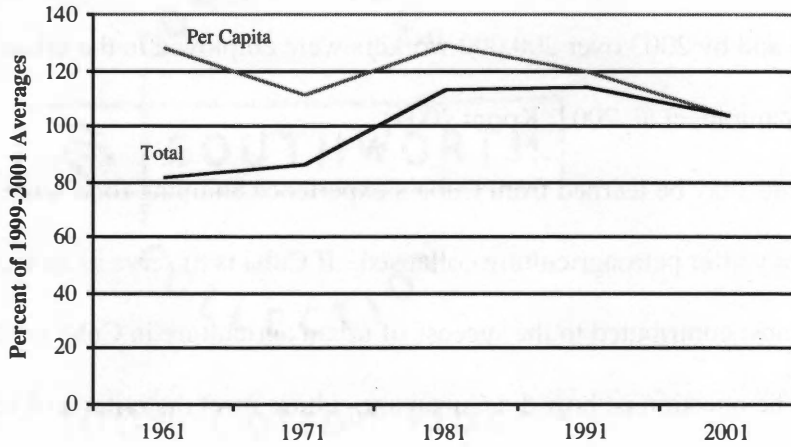
Evaluation of Achieved Food Security

By all accounts, Cuba's handling of the food crisis initiated by the collapse of the Soviet bloc has been a success. Cuba's aim was to change the mode of agricultural production in ways that did not depend on oil. This success can be measured in numerous ways. In concrete terms of food production, statistics indicate the achievement of the intended outcomes of the agricultural sector during the Special Period (see Figure 5). Cuba has overcome food shortages and actually reached record levels of food production in 1997 in ten of thirteen food staples (Koont 2004; Rosset 2000).

Urban farming has been crucial to this accomplishment. In 1999 the urban sector alone produced more than 800,000 tons of food. By 2000, food production exceeded pre-crisis levels on all accounts. And, by 2004, the City of Havana was essentially self-sufficient in the production of produce (Koont 2004; McKibben 2005; Nieto & Delgado 2001; Rosset 2000).

In addition to achieving the stated goals of maintaining food security through self-sufficiency, the agricultural shift in Cuba fostered unintended benefits, namely the improvement of the agricultural sector's impacts on the environment and the creation of jobs. Because of its proximity to large populations, urban agriculture needs to be organic. In fact, Cuban policy prohibits fertilizers within city limits. The agricultural shift has reduced groundwater contamination from pesticide and fertilizer runoff, facilitated biodiversity through the elimination of monoculture, and lessens soil erosion and degradation. Transportation changes due to local production have further reduced oil consumption (Altieri, et al. 1999).

Cuban Food Production Trends 1961-2001
 Percent of 1999-2001 Averages



Cuban Food Production Trends 1989-2004
 Percent of 1999-2001 Averages

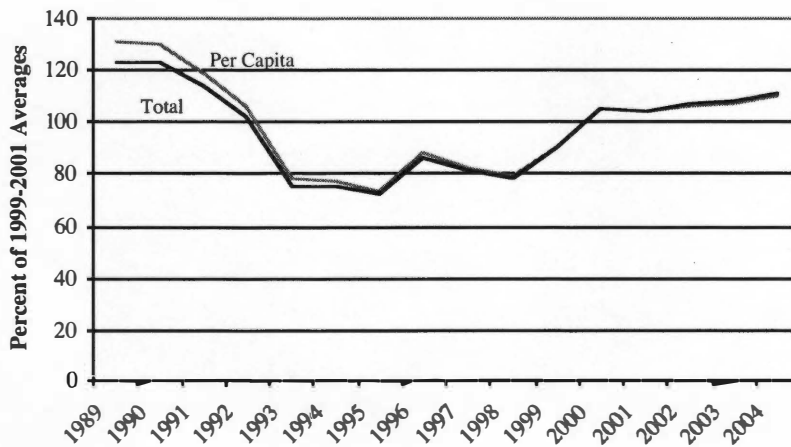


Figure 5. Cuban Food Production Trends in Historical Perspective

(Source: FAOSTAT 2005)

Small-scale organic agriculture is labor-intensive. Urban agriculture created many jobs across many sectors – from farmers to research and extension agents. In 2002 alone, 35,000 new jobs were created, amounting to approximately 22 percent of all new jobs in Cuba and by 2003 over 200,000 workers were employed in the urban agriculture sector (Companiononi, et al. 2002; Koont 2004).

Lessons may be learned from Cuba's experience attaining food security through self-sufficiency after petroagriculture collapsed. If Cuba is to serve as an example, the factors that most contributed to the success of urban agriculture in Cuba must be examined. The question is: how did Cuban agriculture meet the criteria of being organic, local, and non-capitalist – the requisites for a successful alternative to petroagriculture?

V. Agriculture Transformed: Analysis and Implications of Cuba's Experience

Between 1959 and 1989, food security was achieved in Cuba through the Revolution's commitment to social equity and robust agricultural yields using petroagriculture supported by the Soviet bloc. Once the Cuban oil supply was cut off, with the collapse of the Soviet bloc, Cuba was no longer able to participate in the so-called Green Revolution. Cuba lost access to oil imports traded for sugar exports, sugar production itself reliant on the imported oil as an input. And, Cuba lost basic foodstuffs imported in exchange for both oil-reliant sugar exports and re-exported oil. Food security was jeopardized.

A major transformation in agriculture ensued. Food security was then achieved through the implementation of organic growing techniques, the local cultivation of multiple crops to support self-sufficiency, and the maintenance of provisions from before the Soviet collapse that ensured all citizens have access to food and/or to necessary resources for food production (Altieri, et al. 1999; Altieri, Rosset, & Thrupp 1998; Companioni, et al. 2001; Crawford 2003; Enríquez 2000; Koont 2004; McKibben 2005; Murphy 1999; Nieto & Delgado 2001; Rosset 2000; Rosset & Benjamin 1994).

Here I highlight how Cuba accomplished a transformation in the mode of agricultural production to achieve food security following the elimination of petroleum. By identifying some of the conditions that sparked and sustained urban agriculture in Cuba, lessons emerge for urban agriculture and food security elsewhere following the global peak in oil production.

The Dialectical Emergence and Development of Urban Agriculture

Understanding the Cuban case hinges on uncovering how Cuba transformed the mode of agricultural production, from petroleum-reliant to organic and local, and retain the characteristic of being non-capitalist, so quickly and without advanced planning. I suggest that Cuba's success is largely the result of a dialectical process by which urban agriculture first emerged and then developed within Cuba. By dialectical process I mean a "process of constant transformation driven by the contradictions internal to and constitutive of successive social and political forms" (Callinicos 1999:78). It was, as Laura Enríquez (2000) argues, the underlying tension of the "limitations inherent in the model of agricultural development" employed by Revolutionary Cuba, exposed by the Soviet collapse, that stimulated a change in agricultural production (p. 1).

Food security was originally achieved in Cuba through the use of Soviet-supported Green Revolution prescriptions – monocrop production for export and the use of earned revenue to import foodstuffs – and the equitable distribution of food that was thus plentiful. This equitable distribution was achieved via various techniques discussed previously, namely a rationing system that provided basic foodstuffs to citizens, the maintenance of affordable food, the provision of meals at work and schools, and the grey and black markets. A notable achievement, food security was attainable because food was not completely commodified. The non-capitalist state of Cuba prized equality over ever-growing capital accumulation.

However, a contradiction emerged when the petroleum-dependency of Cuban agriculture was exposed with the loss of Soviet bloc trade relations and the tightening of restrictions imposed by the United States. The food security enjoyed in Cuba prior to

1989 depended entirely (and unsustainably) on petroleum. Cuba was no longer able to rely on external trade to maintain its long-standing dedication to food security. The availability of imported foodstuffs was drastically cut by the loss of oil imported in exchange for sugar exports. Both petroleum-dependent sugar exports and the re-export of oil generated revenue for the import of basic foodstuffs.

Without oil, agricultural production levels decreased immediately. The government-initiated Special Period in Peacetime was an austerity program aimed at reorganizing the entire social structure of the country to adapt to the changing conditions. Cuba's achievement of food security between 1959 and 1989 was both a badge of pride and a foundation of its legitimacy, and because of this, when the Special Period began, Cuba remained dedicated to preserving that security (Altieri, et al. 1999; Nieto & Delgado 2002; Pérez 2002).

Organic agriculture was widely implemented after the collapse of the Soviet bloc as a necessity. Synthetic inputs were simply no longer available to Cuba. The country was forced to look inward and devise solutions with the resources available locally. Koont (2004) explains: "Cuba has become a gigantic laboratory for farming without petroleum and petroleum derivatives" (p. 15). This conversion was enabled by the extensive scientific knowledge developed in Cuba throughout the second half of the 20th century.

Cuba had developed national technological capabilities for 30 years, since the onset of the Revolution. The vast population of scientists and the extraordinary array of research were well suited for employing organic techniques during the Special Period. In

this respect, Cuba was well prepared for the end of cheap, abundant oil. The role of education in transforming Cuban agriculture, McKibben (2005) posits:

turns out to be important, because farming, especially organic farming, especially when you're not used to doing it, is no simple task. You don't just tear down the fence around the vacant lot and hand someone a hoe, quoting him some Maoist couplet about the inevitable victory of the worker. The soil's no good at first, the bugs can't wait to attack. You need information to make a go of it. To a very large extent, the rise of Cuba's semi-organic agriculture is almost as much an invention of science and technology as the high-input tractor farming it replaced, which is another thing that makes this story so odd (p. 64).

However, a contradiction emerged in that the conditions that spurred the Cuban government to initiate the Special Period also limited the abilities of the government to achieve food security across the nation. The Cuban government was unable to provide direct hunger relief fast enough. Food shortages, particularly within urban areas, remained a troublesome feature of Cuban life. The continued lack of food security during the early stages of the Special Period gave rise to urban agriculture.

Early in the crisis, urban agriculture first emerged as a popular movement; people needed food fast, so they grew it. The collapse of the Soviet bloc and subsequent U.S. reaction to push Cuba deeper into crisis limited the ability of the Cuban government to respond to the crisis. Thus, the policy prescriptions of the Special Period were insufficient to provide immediate relief to urban areas. The acute grievances of urban food shortages in Cuba during the early years of the Special Period mobilized urbanites to take action. Food production within urban areas expanded rapidly. In fact, Murphy (1999) posits:

With the onset of the crisis, urban gardens sprang up all over Havana, a massive popular response by the residents themselves to the food shortages . . . In the abrupt absence of food previously guaranteed by the

government at very low prices, thousands of urban dwellers began to cultivate it for themselves (p. 12).

As many analysts have demonstrated, urban agriculture emerged first and foremost as a popular movement (Altieri 2002; Altieri, et al. 1999; Companioni, et al. 2002; Crawford 2003; Funes 2002; Gonzalez 2003; Koont 2004; Murphy 1999; Rosset 2000; Rosset & Bourque 2002). In the early days urban agriculture was not a coordinated response. The production of food occupied any and all available space within urban centers; from balconies to schoolyards, roadsides to factory lots, gardens sprang up almost overnight (Altieri 2002; Altieri, et al. 1999; Companioni, et al. 2002; Crawford 2003; Funes 2002; Gonzalez 2003; Koont 2004; Murphy 1999; Rosset 2000; Rosset & Bourque 2002).

At the time of the Soviet collapse in 1989, Cuban policy actually prohibited food production in front of urban residences. Murphy (1999) explains, “all food crops were relegated to the back or side yards, kept out of sight” (p. 12). Cuban policy supported the separation between town and country, particularly in terms of food production, as an inherited feature from colonial rule.

The Cuban government responded to the burgeoning urban agriculture movement by officially including urban agriculture into the Special Period. Murphy (1999) notes, “The Ministry of Agriculture and Havana’s city government responded to the enthusiasm of Havana’s residents by providing needed services and facilitating the expansion of the movement. This greatly accelerated the popular movement already underway” (p. 12). While the exact characteristics of the public movement and pressure for state support for urban agriculture is a question best left for additional research, we know that the Cuban

government supported the urban movement, for example, by formally establishing the Urban Agriculture Department in 1994 – chronologically later than the appearance of urban agriculture.

State support complemented the popular origins of the urban agriculture movement. The overall success of urban agriculture is based on the collective efforts of both government bodies and local grassroots initiatives. The grassroots emergence of urban agriculture was aided by government actions, particularly the guarantee of access to the most fundamental necessity for food production – land (Koont 2004; Nieto & Delgado 2002).

The dedication of Cuba to food security prior to the forced end of petroagriculture paved the way for food security post-petroagriculture. The Cuban state remained committed to food security after the Soviet collapse, and thus supported the popular initiatives under new and challenging circumstances. The government, not directed toward facilitating capital accumulation, could support the urban agriculture movement. Cuba had subscribed to the Green Revolution and used petroagriculture as a means to achieve food security, not as an end-goal to generate profit. Although Cuban agriculture before the Special Period used a lot of the same tools, inputs, and techniques as capitalist agriculture, this in and of itself did not make Cuban agriculture during this time *capitalist* in any sense. The Cuban commitment to the Revolution and food security after 1989, however, is as much a result of unique historic, national, and political forces as it is the result of socio-economic conditions (Pérez 2002).

The question arises: why did Cuba remain committed to the socialist project and not follow the same path as other former members of the Soviet bloc or former states of

the Soviet Union toward neo-liberal capitalism? It is precisely the nationalism and commitment to self-determination of Cuba that shaped development following the Soviet collapse. In Eastern Europe similarly strong nationalist traditions characterize the region. Countries in Eastern Europe, however, rejected socialism in the wake of the Soviet collapse. This trajectory of this development is in many ways a response similar to that of Cuba. In the case of Eastern Europe, socialism was largely imposed from without. The rejection of socialism was thus as much an affirmation of self-determination as rooted in socio-economic structures. For Cuba, the continued dedication to socialism served as a means to assert self-determination and to insulate itself from U.S. influence and/or outright control (Pérez 2002).

The collapse of the Soviet bloc, coupled with increased U.S. aggression, could have just as easily undermined Cuba's commitment to food security. Instead, these developments actually affirmed Cuban dedication to self-determination. The U.S. pressure limited the options of Cuban development. The dire conditions in Cuba coupled with the U.S. stance pushed the appeal to defend the Cuban nation against imperialist aggression. The worse the conditions in Cuba turned and the more the U.S. pushed, the more Cuba resisted. U.S. policy toward Cuba is aimed toward bringing Cuba to its knees by making material conditions for Cubans too difficult to survive. Pérez (2002) explains, "The intent was to *politicise hunger* as a means of promoting popular disaffection, in the hope that driven by want and motivated by despair Cubans would rise up and oust Fidel Castro" (p. 241, emphasis added).

The contradiction, however, of immigration policy that allows Cubans to remain in the U.S. once inside U.S. territory serves as a pressure valve in many respects; the

external pressure on Cuba from the U.S. does not reach point of internal conflict as long as Cubans can emigrate to the U.S. Pérez (2002) explains:

The concept of sanctions, from the early 1960s up to the 1990s, was deeply flawed. The pressures created by four decades of sanctions – and these pressures were at times real and substantial – were in large part relieved by Cuban emigration. Even as the United States tightened economic pressures on Cuba, it also and at the same time loosened immigration restrictions for Cubans, thereby providing relief from the very distress it succeeded in creating” (p. 249).

If U.S. policy was reflective and not just reactionary, the pressure on Cuba would be redirected to build opposition to the Cuban government and the nation might very well develop in accordance to U.S. desires. Instead, the U.S. holds steadfast to contradictory policy that encourages enduring Cuban resolve (Pérez 2002). However, ongoing U.S. pressure remains as a constant challenge to Cuba’s successful alternative to petroagriculture.

Continued Challenges to Urban Agriculture

Some challenges remain to the long-term sustainability of urban agriculture in Cuba. The problems faced by Cuba are not unique. Urban agriculture anywhere, particularly if practiced on a large scale, faces similar limitations and concerns (Altieri, et al. 1999; Crawford 20003; Murphy 1999).

Ecological constraints, such as water shortages, lack of adequate soil for production, and pests and diseases, are the most pressing challenges to urban organic agriculture. Water shortages are particularly problematic for urban agriculture in Cuba, as water has always been a major concern for Cuban municipalities. Trepidation over land availability and the adequacy of soil to maintain crops fall close behind water as a

major worry for urban food production in Cuba (and elsewhere) (Altieri, et al. 1999; Crawford 2003; Murphy 1999). These ecological limitations, however, did not impede the Cuban transition, indicating that they can be managed.

Urban air and water pollution, along with contaminated soil, pose great problems to urban food production. Lead, in particular, is a dangerous contaminant in Cuba and elsewhere in the global South. Many types of produce, especially green, leafy vegetables, easily transport such heavy metals. The problem of urban pollution is a great threat to urban agriculture. Crawford (2003) explains the dangers, “At the very least, such contamination threatens any designation of locally grown food in urban areas as ‘organic.’ At the most, it threatens the integrity of a healthy food supply” (p. 753).

Urban agriculture is also continually undermined by popular perceptions. This challenge faced by urban agriculture, Crawford (2003) notes, “is the need to convince citizenry that the practice is both desirable and viable. This appears to be true even in developing countries, like Cuba, that face serious food self-sufficiency challenges” (p. 751). Urban food production is often viewed in Cuba as a sign of poverty or serves to evoke the repression of slavery and colonialism in Cuban history. Colonizers historically viewed urban agriculture as “primitive” and such practices were thus shunned. Food production in former colonies tends to remain modeled on the colonial power; in the case of Cuba, the town-country divisions characteristic of Cuba today were established by Spain during early colonization. The negative perspective of urban food production remains as a historical legacy of colonialism (Crawford 2003).

The success of urban agriculture, however, is beginning to change popular perceptions in Cuba. Beyond perceptions, remaining obstacles within the population at-

large are the scarcity of workers educated and experienced in diversified agricultural production. Crawford (2003) observes that “the difficulty in making urban agriculture permanent in Cuba is more than merely making it seem worthwhile; it is a matter of educating the population as to the variety of opportunities urban agriculture can offer” (p. 752). Thus far, the government’s urban agricultural initiatives have struggled against this challenge and both popular perceptions and public knowledge regarding urban agriculture is moving steadily forward.

Finally, coordination and planning between farmers, state officials, and other key players in the urban agriculture endeavor remain somewhat problematic. Although planners now recognize the importance of urban food production, land-use planning impedes the development of urban farming as agriculture is often excluded from urban designs. Often, local officials stand at odds with centralized state oversight. Coordination between stakeholders then becomes a troublesome feature (Altieri, et al. 1999; Crawford 2003).

Coordination problems between farmers and key government officials are specifically socio-ecological, rather than environmental and/or technical in nature. However, it is precisely the manner in which socio-ecological challenges of an urban agriculture system are handled that determines the manageability of other obstacles. The compatibilities and tensions between what central planners and local experts can or want to do with ecological limitations and various environmental and technical inputs into urban agriculture influence the degree to which urban agriculture succeeds or fails.

In Cuba, the same dialectical process from which urban agriculture emerged, developed, and ultimately succeeded has mitigated the coordination problems; that

dialectical process fostered collaboration between the Cuban state and Cubans. Despite the ideological commitment of the state to food security, the Soviet collapse created conditions that the state, no longer knowledgeable and/or able to fulfill the needs of Cubans, was receptive to popular pressure for food security. That Cuba was not a capitalist state shaped debates regarding agriculture to ensure that the needs of Cubans are central to decision making processes. Richard Levins (2002) explains:

Decisions about pesticides, about specialization, about livestock technology and mechanization followed prolonged debate which is still taking place. In Cuba, as in the United States, the debate can be frustrating. We can find stubbornness, conservatism, ignorance, and even stupidity in any country. But what is different is that in Cuba the debates were expressions only of differences of opinions and therefore reason can eventually prevail. In capitalist countries, debates about technology are often weapons in the conflict of interests. The makers of pesticides never ask what might be the best way of reducing pest damage while protecting soil and people, but rather, what is the best way to turn oil into marketable commodities to sell to farmers, and they defend their products with a ferocity driven by the bottom line (p. 279).

As difficult as the challenges to urban agriculture in Cuba may be, the country and its citizens press on to maintain food security for all as a basic human right. Cuba was compelled by political and economic forces to reorganize agriculture to become organic and local. The global peak in oil production may provide a similar catalyst for change in agriculture elsewhere.

Lessons from the Cuban Experience in Transforming Agriculture

Cuba is a unique case. The Special Period in particular was distinct to Cuba. But, as McKibben (2005) notes, “There’s always at least the possibility . . . that larger sections of the world might be in for ‘Special Periods’ of their own” (p. 62). I suggest that the

global peak in oil production will serve as a catalyst for ushering in a sort of global Special Period. Agriculture reliant on petroleum will face the same imperatives as were faced in Cuba. Thus, important lessons for an alternative agriculture may be learned from the Cuban example. In particular, urban agriculture can become a planned part of the inevitable transformation in the mode of agricultural production when peak oil is reached, to minimize disastrous food insecurity that would accompany an unplanned transition. Cuba suggests the potential of urban agriculture in facilitating food security after the global peak in oil production.

The changes necessary to avoid expanding hunger after the global peak in oil production are necessarily organic, provide local self-sufficiency, and are non-capitalist. Urban agriculture is a means of food production that does not rely on oil and is founded upon all three criteria.

Cuba was prepared for the end of petroagriculture, through the development of national capabilities between 1959 and 1989. This preparation is concrete, in terms of actual development of the Cuban infrastructure necessary for the shift, and in the broader sense of Cuban history, upon which the achievement of food security was possible in the first place. As these circumstances are quite unique to Cuba, countries wishing to follow Cuba's lead must plan for the transition in agricultural production. Cuba was well prepared to adapt to the unforeseen event of the Soviet collapse because the population was well educated, the Cuban state enjoyed legitimacy unparalleled in the state socialist world, and because the state was willing and able to support popular initiatives to ensure survival of the Revolution. These conditions do not apply to other societies. Thus the early warnings of the global peak in oil production should be heeded – it would be best to

plan the transition to a post-petroagriculture production. An unplanned transformation of agriculture will exacerbate the current trends of food insecurity, as production levels will drop without vast petroleum inputs.

Cuba was not only prepared for the end of petroagriculture, but was also able to reorganize social systems to achieve food security and meet the criteria of being organic and local more easily than most other nations because it was already non-capitalist. Even under socialism, Cuba's agricultural system prior to the Special Period used the same productive forces as those used by capitalist agriculture. However, it was not capitalist precisely because production was not geared toward accumulation – where growing food is just an incidental step toward selling the food for profit and then reinvesting that profit in further and ideally larger-scale production – but toward food security.

A first step toward realizing food security is the end of commodified agriculture. Although it appears unlikely (at this point in history) that a socialist revolution will sweep the globe, food may – and, I maintain, must – be removed from the capitalist market. Similar to calls for nationalized healthcare, the basic right of all humans to adequate food could conceivably be incorporated into the capitalist system. In fact, food security might very well be adopted as a long-term survival tactic of the capitalist system, as a way to simply reduce discontent in a manner similar to the social security policies of the 1930s in the United States. However, this step toward food security would not facilitate the transition away from petroagriculture in and of itself. Pesticides and herbicides, genetically modified organisms, and the transport and distribution systems could, and would, remain reliant on petroleum if subsequent steps are not taken.

This project may have raised more questions than it answered. My findings are preliminary, but draw some important conclusions regarding urban agriculture and indicate the need for further study.

The exact factors facilitating the emergence and nature of the popular movement for urban agriculture and the eventual success of the movement are difficult to grasp through secondary analysis. Additional primary research aimed at uncovering the specific characteristics of urban food production and the movement that spawned it, would be useful for grasping more fine-grained lessons from the Cuban experience. Further research is also needed to better assess the continued challenges to urban agriculture in Cuba. The options that will best facilitate longevity need to be uncovered to assist the continued development of urban food production. Finally, comparative research examining urban agriculture elsewhere will provide useful insights for the successful adoption of urban agriculture as an alternative to petroagriculture under different ecological, economic, geographic, historical, and political circumstances.

Cuba demonstrates that there are no easy solutions for the complex problems of food security. However, there are basic tools that emerge as useful to transition agricultural production toward food security today and away from petroleum dependence tomorrow. Cuba demonstrates that today's popular protest call rings true – another world is indeed possible.

VI. Postscript

I have no misgivings – this project did not adequately grasp the intricacy of Cuban agriculture and food security after 1989. The history of Cuba and Cubans greatly influenced the ability to achieve self-sufficiency during the Special Period. In-depth understanding of the factors involved in that success is not easily captured by a limited project such as this. Additionally, the role of oil in the contemporary “globalized” world is extremely complex, and thus difficult to adequately analyze as well. As I write, current events unfold hourly and oil plays a large role in shaping the ever-changing world. In short, it is difficult to remain abreast of current issues within any given research agenda. As this research examines currently unfolding socio-ecological, geophysical, and geopolitical conditions, a postscript is necessary to incorporate some of the continually unfolding factors involved in this project.

The Future of Cuba’s Success

This research aimed to examine food security in Cuba, a struggle that is still unfolding daily. The future of Cuba and of the Revolution is entirely uncertain. Many issues impact the ability of Cuba to realize the goal of food security. The situation faced by Cubans is ever changing. Endless U.S. aggression and the growing potential of increasing U.S. violence toward the nation threaten Cuba on a continual basis.

In another scenario, the long-standing call for the U.S. to end its barbaric embargo against Cuba would likely have drastic ramifications for Cuban food security. The influx of cheap agricultural commodities from the U.S. could completely undermine Cuba’s

agricultural sector and plunge the island deeper into economic crisis. Despite Cuba's relative isolation within the capitalist world system and the impoverished state of the nation, food security is fully realized within Cuba, a feat no other country in the same economic situation has achieved. If, and when, the U.S. embargo ends – an action all supporters of social justice demand – Cuban development will enter uncharted territory and Cubans will face unknown consequences.

As close as global peak oil production is, the certain passing of Fidel Castro, the leader of the Revolution since its victory, appears much closer. The path of a post-Castro Cuba is uncertain, particularly in terms of the social services available to Cubans and the continuation of the Revolution. The U.S. will most certainly interfere with the development of a post-Castro Cuba.

Finally, there is the question of the emerging ties between Cuba and Venezuela (McKibben 2005). In late April 2005, Cuba began receiving 90,000 barrels of oil from Venezuela daily, up from the 53,000 barrels of oil provided on favorable terms of trade in 2000 (Associated Press 2005). There is always the possibility that the new source of oil provided to Cuba and the developing relationship with Venezuela might spur the return to petroagriculture, thus undermining the success of urban agriculture.

Moreover, the rapidly expanding relationship between Venezuela and Cuba draws attention to one thing I did not consider within this project: the extent to which petroleum-exporting countries like Venezuela will *not* need to change patterns of development and food systems as they could use monopoly rents generated from petroleum reserves to import agricultural commodities and/or continue petroagriculture. The Venezuela relationship could conceivably mark this emerging possibility.

It is too soon to say with certainty, but possibilities exist that burgeoning relationships with Venezuela might actually be an example of a successful planned transition away from petroleum dependence. In the first place, peak oil represents that point at which half of all petroleum reserves are exhausted. A successful transition from petroagriculture will need to begin prior to the complete end of oil. Following the global peak of oil, existing reserves may be reallocated to areas of agriculture that necessitate oil use, such as rice production in Cuba. The trade relationship forged between Cuba and Venezuela are on more equal terms, politically speaking, and with greater ability to negotiate than the former ties with the Soviet bloc. Cuba is not producing one crop for export to Venezuela on favorable terms for oil and other necessary imports. Instead, Cuba has sent tens of thousands of doctors and educators to Venezuela, and has helped to develop the same intellectual infrastructure as enjoyed in Cuba. Along with doctors and teachers, there is also an emerging export of urban agriculture from Cuba to Venezuela, and food production is now found in Caracas.

In the end, there remain countless reasons to remain optimistic that alternative agriculture and food security are mainstays in Cuba. The educated youth committed to self-sufficiency in food production, the resolve of Cubans, the success of alternative agriculture in Cuba, and the imminent peak in global oil production should ensure longevity of alternative agriculture in Cuba. Cubans have demonstrated time and again that they can survive, and even thrive, under the most adverse of conditions.

Petroleum's Endless Volatility

Oil remains at the forefront of the global consciousness. Soaring petroleum prices and ongoing U.S. military action that is directed toward strategic control of known petroleum reserves serve as daily reminders of the role oil plays in contemporary society. With petroleum priced well over \$50 per barrel and rising daily, the direct effects of costly petroleum are being felt worldwide. Oil hit a record price on June 26, 2005, exceeding \$60 a barrel for the first time in its history of trade on the New York Mercantile Exchange (Reuters 2005b).

The global market price of crude oil is not directly tied to supply, but it does indicate the importance of oil for the global economy and hints at the consequences of rising oil costs that will accompany the peak in global production. One indication of the effects of high oil costs is evident in the Labor Department's consumer price index where most prices have remained constant over the past year, with the exception of food and energy costs, which are the only reported indicators that continue to rise rapidly (Reuters 2005a).

Another sign of oil's near future is China's recent offer of \$18.5 billion for Unocal, which touched off a bidding war for the U.S. oil company (Kahn 2005). Many analysts view China, the world's fastest growing economy, as a threat to the future of U.S. economic dominance. The Chinese bid for Unocal signals the growing importance of *direct* control over energy sources, particularly petroleum, as the global peak in production nears.

Most alarming, the Exxon Mobil Corporation itself recently predicted a peak in non-OPEC oil production in *just five years*. The global peak in production, according to

Exxon Mobil, will occur soon thereafter, most likely within another ten years as a direct result of the increasing demand expected of OPEC to produce more oil. The entrance of Exxon Mobil into discussions of a global peak in oil is the first of any major oil company and serves as the most alarming signal of petroleum's future to date (Cavallo 2005).

The transition away from petroleum dependence is a geophysical necessity; the sooner that transition begins, the more likely negative consequences can be averted – particularly for the future of food production. Increasing recognition that the global peak in oil production is close at hand, coupled with increasing demand for crude and the escalating conflict over global petroleum resources, signals the need for society to divest its appetite for oil immediately.

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