LOCAL FOOD, SUSTAINABILITY AND CUBA'S NATIONAL FOOD PROGRAM

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Submitted to the Department of Geography
And the Faculty of the Graduate School of the University of Kansas
in partial fulfillment of the requirements for the degree of
Master's of Arts

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Abstract

There is a tendency in food systems research and planning to associate sustainable and socially just food provisioning with the local scale of organization. This thesis questions two assumptions that tie local food provisioning systems to sustainable food production: that localization is the key to environmental sustainability and that food security is best achieved through development of local food systems. I examine the relationship between scale and food provisioning by applying scale and politics of scale theory to a case study of Cuba's food system. I analyze several historical periods leading up to and including the Special Period which followed the collapse of the Soviet Union. During the Special Period Cuba transformed its food system from one based on industrial and export-based production to a system focused on achieving national food security and environmental sustainability. Analysis of the Special Period focuses on the changes that occurred in relationships among places involved in food provisioning at community, regional, national, and international scales. The thesis concludes with ideas about how to move beyond the argument for rescaling and forward to a discussion of how to actually create food provisioning systems that are sustainable and just.

Acknowledgments

It is a pleasure to express my gratitude to the many people who made this thesis possible. I particularly want to thank Dr. J. Christopher Brown, my advisor, for his insights. He has inspired me with his perpetual enthusiasm and energy and his efforts in making the world a better place for all of us. I also want to thank my committee members, Dr. Garth Myers and Dr. Terry Slocum, for their excellent teaching ability and for their support through the process of completing this thesis.

The Department of Geography at the University of Kansas has provided me with a series of incredible opportunities throughout my graduate career, ranging from researching ice sheets to learning about development practices in Cuba. I give a special thanks to the faculty and students of CReSIS and Haskell, for extending my graduate learning experience beyond the classroom. I would also like to give a heartfelt thank you to the entire faculty of The University of Kansas Geography Department for creating such a motivating and supportive academic environment.

A special thank you goes out to the people of Cuba for extending a warm welcome to me during my field research, as well as ICAP for promoting open exchange of culture and knowledge between Cuba and other countries. I also thank the Latin American Studies Department for its support of my research.

I want to express my deep and sincere gratitude to my family and friends for their love and support through my Master's education. I especially thank my grandparents in Texas for introducing me to farming; my father and brother for enduring countless conversations about scale and agriculture, and for sharing my ideals for the world; my grandparents in Kansas for their constant love; my mother for listening to my insights about the world for all these years; my aunt Judi for her passion for education; and Joe, Rob, Jason, Asher, Sophie, Skyelar, and the rest of my family for their positive influence on my life. I also want to thank especially Gustavo Diaz, my roommates throughout this time, Lisa Rausch and Heather Putnam, and the rest of my fellow geography graduate students for keeping my life interesting during these years.

I would also like to extend my gratitude to the work of all of the great thinkers that influenced my work. Finally, I give a heartfelt thank you to all farmers across the world for their work.

This thesis is dedicated to all of you. Thank you.

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Chapter 1: Introduction

"When could we therefore be called a completely revolutionary country? On the day when we resolve – listen closely – that even if no aid could ever reach Cuba from abroad, the country would continue to resist. In other words, we will only have the right to claim we are complete revolutionaries, that we are entirely sure of ourselves and entirely strong, once every revolutionary in this country believes that we can resolve all our problems with the resources of our own country, with the will and spirit of the people; and that with these resources and no others we could and would face all difficulties... Let's imagine the worst. Imagine that one day there would be a total blockade, through which no fuel, through which nothing could pass. I am sure, I have absolutely no doubt that the people would be able to withstand such a situation."

Fidel Castro, speech, "Apply theory to the particular conditions of each country", January 2, 1965

In 1990 Cuba found itself in the unenviable position that Castro foreshadowed in 1965; its major trading partner had collapsed, and the US trade embargo prevented many trade opportunities. Carlos Lage, Cuba's Secretary of the Executive Committee of the Council of Ministers, referred to the resulting economic situation as a "100 percent blockade" (Rosset and Benjamin, 1994, 21). Indeed, between 1984 and 1988 Cuba depended on the USSR for 99 percent of its crude oil (Mesa Lago, 1993, 162). Cuba's economy relied on Soviet petroleum to both fuel the nation and to export to other countries for trade income. Exports of Soviet petroleum accounted for 10 percent of total exports from Cuba in 1984, which declined to 3.9 percent in 1989, and disappeared altogether in 1990 when the USSR sharply cut oil supplies to Cuba (Mesa-Lago, 1993, 219). The island nation also relied heavily on the Soviet Union for trade related to sugar; between 1984 and 1989, 77 percent of Cuban exports were attributable to sugar and 70 percent of the import-export trade was with the Soviet Union (Pastor and Zimbalist, 1995, 3). During the 1980's, Cuba received a price for its sugar exports that was, on average, 5.4 times higher than the world market price (Mesa-Lago, 1993; Nicholls et. all, 2003, 2). During the 1970's and 1980's Cuba's agricultural system was heavily industrialized - it has been compared to California's

agricultural system with respect to technological sophistication - and was geared towards export. Three times as much agricultural land was devoted to sugar cane production as to food production, and food imports accounted for about 57 percent of the caloric intake of Cuba's population (Rosset, 1997, 291). There was no new trade partner that Cuba could turn to for trade of its sugar crop at prices close to what the USSR paid. The United States tightened its already existing embargo on Cuba through the Cuban Democracy Act of 1992, which among other restrictions, made it more difficult for other countries to trade with Cuba. Between 1989 and 1993, the Cuban GNP fell from $19.3 billion to $10 billion (Funes, 2001, 6). Thus, there was no easy way to generate capital to use for food or petroleum imports. Due to a lack of trading partners, it was difficult to obtain the petroleum and derivative products that Cuba depended on for industry, transportation, and most importantly, agriculture.

In 1991, the government declared a 'Special Period in Peace Time', which lasted through the decade of the 1990's. This was essentially a period of war-time economic austerity measures. During the early years of the Special Period, food imports were reduced by more than 50 percent, while petroleum available for agricultural production decreased by over 50 percent, and pesticides and fertilizer imports decreased by more than 80 percent (Rosset, 1997). The reduction in imported petroleum impaired Cuba's ability to manufacture agrochemicals. Due to the extremity of the economic shock that followed the collapse of the Soviet Bloc and

the trade blockade imposed by the United States government, Cuba was forced to quickly reinvent its agriculture system.[1]

In the years immediately following the economic shock, average daily caloric and protein intake by the Cuban population fell by as much as 30 percent, and protein intake dropped by 42 percent (Rosset, 1997, 293). By 1992, cases of a neurological disease were being reported in infants, and the cases were linked to malnutrition in the infants and their mothers (Rosset and Benjamin, 1994). A scientific delegation led by agroecologist Peter Rosset and sponsored by Global Exchange[2] visited Cuba in 1992 to learn about changes to the agricultural system. They reported "In short, food is now the Achilles' Heel of the revolution. It is the population's number one complaint." (Rosset and Benjamin, 1994, 26) The continuation of Cuba's socialist project depended upon the ability of the political leadership to provide food to its population. Lack of trade capital and partners limited the options available to Cuba's leaders, and generally meant their choices would involve technology that used little energy and could be adapted quickly, at low cost, and with local materials.

The system Cuba developed at this time is referred to as the 'Cuban Model' of agricultural development. The Cuban Model is based around ecological farming practices. Ecological farming practices are those that seek to strengthen soil, improve air and water quality, and encourage diverse ecosystems. See Appendix A for an overview of the characteristics of the Cuban Model compared to the

[1] From a conversation with Juan José Leon and Luis Ross, specialists in International Relations in Cuba's Ministry of Agriculture, 2/5/2008.

[2] Global Exchange is a non-profit research, education and action center based in California. It was founded in 1988 to help advance an internationalist citizens' movement in promotion of social, economic, and environmental justice around the world.

conventional system of agricultural development. The Cuban Model has been assessed as being highly productive. Sinclair and Thompson (2004) of Oxfam America noted that “Cuba has successfully turned a severe food crisis into a sustained recovery in food production”. An example of the success achieved in Cuba in the Special Period is that malnutrition levels decreased after reorganization compared to the levels prior to the collapse of the Soviet Union. See Appendix B for a series of indicators that show Cuba’s policies were successful in dealing with the challenges of the Special Period; throughout the period, Cuba was able to increase food production despite the reduction in supplies of petroleum and agrochemicals.

It is important to understand the Cuban model because it is the largest attempted conversion from conventional agriculture to organic or semi-organic farming in human history (Rosset and Benjamin, 1994). The challenges that Cuba’s agricultural system faced during the Special Period are not unique to Cuba; however, the way that Cuba was able to endure the hardship of extreme food and resource scarcity provides insight to overcoming a variety of food system and energy challenges. According to food rights activist and scholar Peter Rosset (2003, 301), “the ability of Cuba to weather a food crisis without substantial food aid or imports, or agrichemical inputs, helps put the lie to the claim that alternative agriculture cannot feed our populations. This increases the ability to take the ethical high ground in favor of biocontrol[3] over pesticides in policy debates over pest management policy.”

[3] Biocontrol is short for ‘biological control’, which refers to the action of parasites, predators, or pathogens in maintaining another organism’s population density at a lower average than would occur in their absence (Altieri, Rosset, and Nicholls, 1997 303).

Cuba's Special Period has been portrayed as an example to follow for responses to peak oil[4] as well as to food scarcity. For example, Community Solutions, an NGO which advises community based solutions for adaptation to peak oil, has made a documentary entitled *The Power of Community: How Cuba Survived Peak oil*. The documentary focuses on the response of the people of Cuba to its artificially induced peak oil crisis. Richard Heinberg, author of books on energy scarcity *The Party's Over* and *Powerdown,* has endorsed *The Power of Community* movie by saying "Everyone who is concerned about Peak oil needs to see this film. Cuba survived an energy famine during the 1990's, and how it did so constitutes one of the most important and hopeful stories of the past few decades." (Morgan, 2006) Similarly, scholar of Cuban agriculture Julia Wright said that "as and when the predicted global fuel supply crisis happens, Cuba's example provides lessons as to how it might be addressed." (Wright, 2006) The example of how Cuba responded to their peak oil crisis gives insight to the opportunities and challenges of dealing with peak oil.

I traveled to Cuba in February of 2008 to participate in the Global Exchange 'Agricultural Trends and Sustainability' delegation in order to better understand how Cuba managed to withstand the food system and energy crisis of the Special Period. Global Exchange began organizing research delegations to study Cuba's agricultural system in 1992. My research delegation consisted of graduate students, agronomists, and teachers from the United States. A list of the places and people that we visited in Cuba is provided in Appendix C. In each government meeting, I

[4] The term 'peak oil' was coined by geophysist M. King Hubbard to refer to the peak time of petroleum extraction in a national or global oil supply. Global peak oil is predicted to occur any year from 2005-2010, depending on which source is consulted. Peak oil does not mean that oil supplies will immediately run out, but that there will be a continuous decline in production from that point forward.

asked the question, “What do you feel most contributed to the success of the Alternative Model?” Without fail, government representatives and agricultural scientists answered that the strength of the people was the primary reason that the alternative model was successful. When I spoke with agricultural workers, I asked “What do you feel contributed most to the success of your project?” and they most often responded by saying that the success of their project was due to the support of the state. An example is Marta, a farmer at the award winning Casa de Posturas Plant Nursery in the Boyeros Municipality, who said that the success of their project was due to the sense of belonging that everyone feels, the support of the state through education, motivation and discipline of the workers, and the ongoing training that the workers receive.

The reciprocity of praise between policy-makers and farmers shows that collaboration was a key aspect of Cuba’s transformation. However, while researching Cuba’s transition to the Alternative Model, I noticed that the majority of research focuses on the changes which occurred at the level of production rather than at larger scales of food system organization. There is a plethora of research, for example, on urban gardening in Havana and self-provisioning. But there is little emphasis placed on the way that farmers and gardeners were supported during this transition period. *The Power of Community* documentary begins the film with the question, “What is it about the Cuban people that allowed them to respond to this crisis?” rather than asking what it is about the Cuban system that enabled success (Morgan, 2006).

In fact, popular media accounts of the transition often portray the Alternative Model to be 'community-based'. In an interview about *The Power of Community* documentary, outreach director Megan Quinn was asked if the change began with the people. Her response was "It really came from the grassroots in Cuba." This statement is partially true; however, to get to the reasons for the success of Cuba's nationwide transition we must go beyond the discussion of what happened at the grassroots level. Portrayals of Cuba's model as community-based often lead to recommendations for 'localization', a term which means organization of economic systems at the local scale, as the appropriate response to food system and energy crises. If Cuba's Alternative Model was organized primarily through communities, it would be unlikely that all communities on the island would develop along the same pattern. In fact, there is a high level of connectivity among the production units and other aspects of the food production and distribution system. Much of the success of Cuba's Alternative Model is attributed to national polices, integrated educational programs, and knowledge transfer and financial assistance among domestic and international NGO's. Thus, Cuba's Alternative Model provides a unique model of sustainable agriculture because the entire nation changed from an industrial system to an ecological system.

Cuba's Alternative Model contrasts with the pervasive theme that is often found in academic writings on sustainable food systems. As noted by Born and Purcell (2006), and the Iowa and Wisconsin working group (C. Hinrichs) and Wisconsin group (J. Kloppenburg, S. Stevenson, S. Lezberg, J. Hendrickson, and K. DeMaster) (1998), there is a tendency among food activists and food provisioning systems researchers to assume that the local scale in all things "food" is inherently more

desirable than larger scales. This tendency can be seen in literature on the globalization of agro-food provisioning systems (Hinrichs et al., 1998; see Bonanno 1994; Goodman and Watts, 1997; McMicheal, 1994) as well as through “a growing literature explicitly or implicitly promoting the local” (Hinrichs et al., 1998). Large-scale food provisioning systems are generally associated with unsustainable production and inequitable distribution; small-scale arrangements of food production are often associated with the opposite characteristics. See Appendix D for a list created by the Iowa and Wisconsin food systems working groups which illustrates the binary division between characteristics commonly attributed to local and to global scales of food provisioning systems organization (from Hinrichs et al., 1998). One example of the way that characteristics are assigned to scales is that the local scale of organization is often associated with protection and regeneration of resources, while the global scale is often associated with degradation of resources. Another is that devolving decision-making done at the community level will result in more democratic decisions and therefore more beneficial outcomes for the population of a community than decision-making done at higher levels of scale. The assignment of characteristics to scales gives rise to a number of problems; the danger is that by labeling scales with particular characteristics we risk confusing the term with the reality. These labels must be used cautiously, for they can lead to incorrect assumptions if they are not critically analyzed.

The equation of sustainable food with local food is largely a reaction to the ecological and social problems caused by the industrial farming system. Because the industrial agricultural system operates over a large scale, the solution to the problems of the industrial system is often seen to be a return to local scales of operation. Local

scales of production are perceived to strengthen communities through the use of local knowledge and materials. Local scales of distribution contain the perceived advantages of direct producer-consumer links which are seen to improve food quality, safety, and security, rather than focus on profit. Thus, proponents of sustainable agriculture systems often strategize development around community-based agriculture (CBA) production and consumption of 'local food'. This enthusiasm for localized production and distribution of food spills over into a desire for localized planning of food provisioning systems. Among the other benefits attributed to localized planning are that it enables communities to escape from the capitalist structure of the agricultural system in favor of their local economies, fosters the use of local knowledge rather than the scientific bases of industrial agriculture, and provides increased food security and safety for members of the community. While development of farming infrastructure at the community scale is one strategy to accomplish the goals of more ecologically sustainable and socially just agriculture, other strategies include building educational programs, institutional research facilities, urban horticultural clubs, etc. Further, if the goal is to empower farmers, support through extensive educational programs on ecological farming methods may in some cases be a more appropriate means to achieve this goal than through simply supporting farmer autonomy.

See Figure 1 below for a display of potential material and social requirements and outcomes of production centers. Much more goes into agricultural production than biological inputs; in addition to the material requirements of seed, land, and labor, there are social requirements including knowledge and knowledge development, financial resources and distribution services. The material outcome of production can

include food, biological inputs to future production, ecosystem health, and these material outputs cycle back to become material inputs for future production. The social outcomes of production units include increased knowledge which may foster public awareness and education programs and thus provides increased social support for future production. Thus, the type of inputs used in production can lead to outcomes that provide either positive or negative feedback loops.

Figure 1: Material and Social Components of Agricultural Production

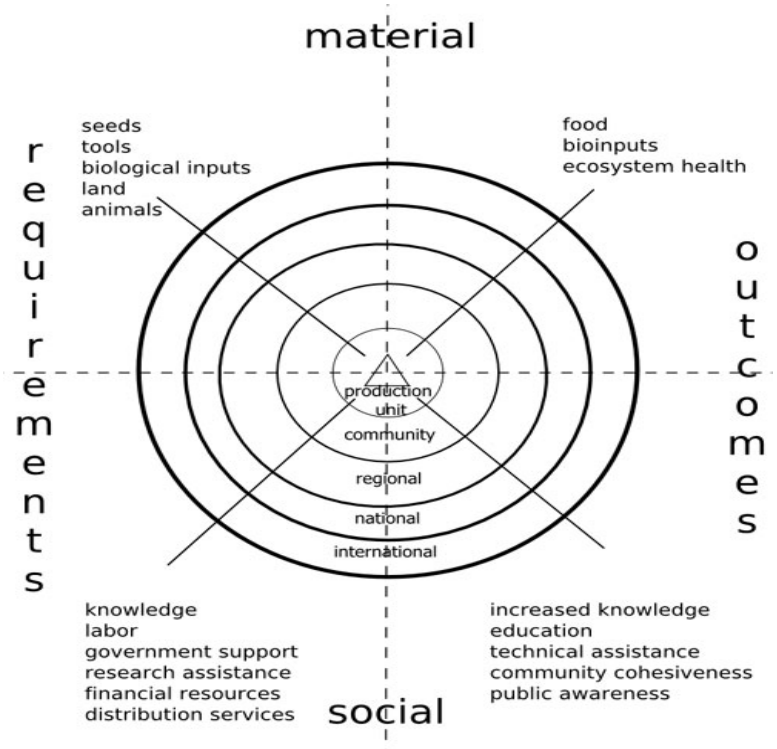


Figure 1 also displays the way that the requirements and outcomes of production may go far beyond the community scale with any style of production. There is nothing magical about a scale that generates positive interactions between production units and the places with which they are connected. The requirements of all types of agricultural production include both material components and social

inputs. These required inputs may come from places at the community scale or from places at larger scales; similarly, the production outcomes include material and social components that may benefit places at larger scales as well as places in the community.

My concern about the perceived equation of local-scale organization of food provisioning systems with sustainability stems from my interest in the development of alternative systems of agriculture and food provisioning in particular, and sustainable development in general. I argue that equating local food with sustainable food is an oversimplification that can lead food provisioning systems researchers and developers into error. While the benefits of local food are often tied in with an enthusiasm for local organization of food provisioning system, food provisioning systems do not necessarily need to be organized at the community level to take advantage of the benefits of local food.[5] Certainly, alternative systems must respond to local needs, but they also need to go beyond the necessity for the separation that local systems imply.

Additionally, the local scale is often assumed to be the scale at which food systems must be rescaled to in response to the peak oil crisis. Without petroleum, due to either economic cost or absolute scarcity, we can assume there are advantages to constructing some aspects of food and other systems on a local scale. Still, we cannot assume that local is inherently the best way to reorganize anything in response to peak oil. A re-organization to systems which have a reduced dependency on oil can potentially be more easily accomplished if policies supporting

[5] In many aspects, food production cannot be separated from food distribution. I will use the term 'food provisioning system' to describe the organization of the way that food is produced and distributed.

local organization are developed and/or supported at other levels of policy as they were in Cuba.

This thesis questions two assumptions that tie local food provisioning systems to sustainable food production; that localization is the key to environmental sustainability and that food security is best achieved through community and self-provisioning. The assumption that food provisioning systems organized at local scales are inherently better than systems organized at larger scales falls into a category of error termed the 'local trap' by Purcell and Brown (2005). The research cautions planners and academics to avoid the local trap by separating the fight for sustainable and socially just food from small scales of organization. The analysis focuses on two aspects of scale. The first is that scalar reconfigurations are dependent on the political agenda(s) of the actors empowered by the arrangement rather than upon the particular scale of organization itself. The second is that scales of organization are always embedded within other scales, and so scale cannot be viewed as an independent entity but instead must be understood as a relational concept.

I will examine the local trap in food provisioning systems research and practice through a case study of Cuba's agriculture history. I examine several historical scalar arrangements of food provisioning leading up to and including the Special Period. The research uncovers scalar organizations that contrast with the dualistic theories of large versus small scales of food provisioning, which currently prevail in food provisioning systems research and agricultural development practice. The Alternative Model of Cuba shows that benefits can be derived from the large-scale organization

of food systems. While communities within the nation of Cuba certainly played an essential role in the development of sustainable agriculture, it is important to understand the role national policies and international agencies played in the development of the system. Without this understanding, people who look to Cuba as an example of sustainable agriculture may assume that the local level is the key to sustainable development. While most descriptions of Cuba's Alternative Model focus on the changes that took place in production units, my analysis focuses on the relationships between community, regional, national, and international scales that made these changes possible.

My work does not suggest that I approve of all of Cuba's policies, or that I support Cuba's form of government. This thesis is not a statement of political ideology; rather, it is a critical evaluation of the way that Cuba developed a system of sustainable agriculture at the national scale. Cuba's system provides important insights about what may be possible to achieve with sustainable agriculture, because it reveals what such a system supported at multiple scales can look like. Analysis of the scalar arrangements which emerged in Cuba can serve as an instructive guide for people who wish to facilitate a new model of agriculture based on the objectives of food security and sustainable production. While production and sustainability are often pitted as conflicting goals, Cuba offers examples of place creation supporting both. There are alternatives to industrial scale development, found in experimental plots, organic farms, and traditional farming systems worldwide. But it is difficult to measure gains made by individual farmers and cooperatives in comparison with larger models.

The theoretical perspective that I use to explore the effects of rescaling Cuba's food provisioning system throughout time draws from scalar theory in political economy and political ecology research. The second chapter of the thesis presents a brief review of the "politics of scale" literature in political ecology and political economy and a discussion of its applications to development theory. This chapter will also apply the politics of scale theory to a discussion of perceptions of scale in food provisioning systems research and practice.

The third chapter applies the politics of scale literature to each of the scalar arrangements of Cuba's food provisioning history through three historical periods. The social forces that controlled major decisions about agricultural production, the agenda held by each of these social forces, the scales used to achieve these agendas, and the outcome of the arrangements will be examined for each period. This analysis will show how scales were used to achieve agendas of particular social groups, emphasizing that scales of food provisioning alone do not produce outcomes. Rather, people pursuing particular agendas produce outcomes.

The fourth chapter examines the shifting scales of food provisioning from the Special Period to the present time. This chapter models the reorganization of food provisioning in Cuba throughout the Special Period, when the system was reorganized to focus production on crops for national consumption rather than for export. The chapter examines the way that multiple scales were utilized for reorganization of the food provisioning system by examining changes to the style of production and the social organization at the level of the production unit and community, regional, national, and international scales. The analysis will conclude

with a discussion of outcomes from the transition along with factors which are contributing to a reorganization of the alternative system.

The conclusion explores ideas about how it is possible to construct systems which are ecologically sustainable and socially just. This chapter moves beyond the discussion of scale to talk about how we can create social interactions between people through connecting places that support sustainable production and equitable distribution. I will relate these ideas to Cuba's agricultural experiences and discuss how they can be helpful in the development of places which support sustainable agricultural production at any scale.

Chapter 2: 'Politics of Scale' and 'The Local Trap'

"Imagine a very large town, at the centre of a fertile plain which is crossed by no navigable river or canal. Throughout the plain the soil is capable of cultivation and of the same fertility. Far from the town, the plain turns into an uncultivated wilderness which cuts off all communication between this State and the outside world.

There are no other towns on the plain. The central town must therefore supply the rural areas with all manufactured products, and in return it will obtain all its provisions from the surrounding countryside.

The mines that provide the State with salt and metals are near the central town which, as it is the only one, we shall in future simply call "the town"

The problem that we want to solve is this: what patterns of cultivation will take shape in these conditions?; and how will the farming system of the various districts be affected by their distance from the Town? We assume throughout that farming is conducted absolutely rationally.

It is on the whole obvious that near the Town will be grown those products which are heavy or bulky in relation to their value and which are consequently so expensive to transport that the remoter districts are unable to supply them. Here also we find the highly perishable products, which must be used very quickly. With increasing distance from the Town, the land will progressively be given up to products cheap to transport in relation to their value.

For this reason alone, fairly sharply differentiated concentric rings or belts will form around the Town, each with its own particular staple product, and with it the entire farming system, will change; and in the various rings we shall find completely different farming systems.

Johann von Thünen, *Isolated State: The First Economic Model of Spatial Organization*, 1826[6]

Economist Johann von Thünen first established the idea that rents decline with distance from regional centers. This is the basis for the first economic model of spatial organization, as explained in his classic text *Der Isolierte Staat*. Though he makes many unrealistic assumptions in his model of the town, such as the assumption that there are no other towns on the plain, von Thünen suggested that locational distances alone are sufficient in the creation of a system of spatial organization of land use. Once von Thünen completed his model, he relaxed his assumptions and introduced other variables into the model. The most prominent

[6] Taken from Berry, B.J.L., Conkling, E.C., and Ray, D. M. 1987. *Economic Geography: Resource, Locational Choices, and Regional Specialization in the Global Economy*. Prentice-Hall, Inc., p. 225-5: Englewood Cliffs, N.J.; text cited from Hall, P. (ed). 1966. *Von Thünen's Isolated State*, Trans. Carla M. Wartenberg Oxford: Pergamon Press, p7-8.

contribution of his model was the determination of land use organization for multiple crops; he found that the site nearest to the market will be used for the product that can pay the highest location rent.

Von Thünen's rent theory, published in 1826, is a very early theorization contributing to issues of scale in the organization of food provisioning. Von Thünen's theory is an example of the way that scales can be conceptualized as an empirical measurement of size. During the 20th century, Marxist economists were the first to challenge the empirical notion of scale by asserting that development occurs through relationships between the core and the periphery which do not follow principles of linearity. Immanuel Wallerstein expanded upon the Marxist idea of scale with his 'world systems analysis', which views the world economic system as a set of mechanisms which redistributes resources from peripheral to core world economies. In 1982 Peter Taylor added to Wallerstein's conceptualization of scale with his 'three structure' models, which added an urban to global hierarchy onto the world systems model. The work of Wallerstein and Taylor, among other political economists, sparked a debate over theorization of scale among critical geographers. Neil Smith made an important early contribution to the theorization of scale in *Uneven Development* (1984) by elaborating on the relationship between scale and the nature of capital. Following Smith's work in the 1980's and 90's, geographers mainly in the field of political economy, such as Erik Swyngedouw, Helga Leitner, John Agnew, Neil Brenner, and Richard Howitt, have been developing a theoretical approach to the concept of scale (Swyngedouw, 1997; Delaney and Leitner, 1997; Agnew, 1997; Brenner, 2001).

One important lesson from reading scale theory is that the reader must let go of preconceived notions about the definition of concepts such as local and global; these terms are socially constructed, rather than defined measurements of space. This thesis applies the theoretical concept of scale, emerging from the recent (1980's to present) work of political economists and political ecologists, to a case study of Cuba's food provisioning system. I present the theoretical framework in the following four segments. The first segment reviews the debate over the concept of scale as it has evolved following Neil Smith's groundbreaking work to the present time. The second section provides a brief overview of agricultural development. The third section discusses scale theory in its broader application to food provisioning systems research. Finally, the fourth section outlines the need for empirical studies of scale in food provisioning systems. I also cover the process by which I apply scale theory to my case study and my research method in the fourth section.

This work contributes to both politics of scale research and to perspectives on development of systems of sustainable agriculture. Numerous academics, activists, and farmers have called for a reconstruction of the modern agricultural paradigm and its scientific base of knowledge.[7] These arguments vary from political economic critiques of the capitalist structure of the agricultural system to sociological critiques

[7] See: Kloppenburg, J. 1991. Social theory and the de/reconstruction of agricultural science: Local knowledge for an alternative agriculture. Rural Sociology 56(4), p. 519-548; Hinrichs, C., J. Kloppenburg, S. Stevenson, S. Lezberg, J. Hendrickson, and K. DeMaster. 1998. Moving beyond Global and Local. United States Department of Agriculture, Regional Research Project NE-185, working statement, October 2. Retrieved from: http://www.ces.ncsu.edu/depts/sociology/ne185/global.html; Whatmore, S., and L. Thorne. 1997. Networks: alternative geographies of food. In *Globalising Food: Agrarian Questions and Global Restructuring*, 287-304. New York: Routledge.; Altieri, M. A., and S. B. Hecht. 1990. Agroecology and Small Farm Development. Boca Raton, FL: CRC Press; Vandermeer, J., and I. Perfecto. 2007. The Agricultural matrix and a future paradigm for conservation. Conservation Biology 21 (1):274-277.

of knowledge production[8]. Often, these critiques call for local economies, and local knowledge production.

This thesis imagines alternative visions for the reconstruction of modern agriculture. The research arises out of the broader vision of critical social science, which seeks to critique and improve human society by reducing dominative forces. Critical social science is often identified as having four stages (Sayer, 1992, 159):

i. identifying problems – unmet needs, suffering, false beliefs;
ii. identifying the source or cause of those unmet needs, false beliefs, etc., such as a particular form of domination;
iii. pass into a negative judgment of those sources of illusion and oppression;
iv. favouring (certis paribus) the actions which remove those sources

My critique of the argument for development of local food systems utilizes the critical realist perspective, which theorizes that while some of our sense data does accurately represent external properties, perceptual illusions can distort our view of reality. The main premise of critical realist theory is that, while the world exists independently of our knowledge of it, science or the production of any kind of knowledge is a social practice, and so the conditions and social relations of production of knowledge influence its content (Sayer, 1992, 158). Critical realism looks at processes and the relationships driving them. It is used to bridge the gap between what society is supposed to be like and what it actually is. Attachment to rigid theories obscures vision of phenomena which fit poorly with them; therefore, as social scientists, we must evaluate social phenomena critically.

[8] The production of knowledge is a broad term that includes all forms of education, basic research, and applied research especially associated with industry.

I have identified a false belief which can be found in the work of academics, planners, and popular media – that small scales of organization in food provisioning systems will necessarily lead to socially just and ecologically sustainable food systems. This false belief is primarily a reaction to the negative consequences of industrial agriculture, which operates at a large scale of production and organization. The benefits of small scales of organization are often combined with small scales of production, although the benefits are not the same. This false belief is problematic in that it may hinder progress in the development of appropriate constructs of alternative systems of agriculture.

A. Scale Theory and the 'Politics of Scale'

"Much of the confusion in contemporary constructions of geographical space arises from an extensive silence on the question of scale. The theory of geographical scale – more correctly the theory of the production of geographical scale – is grossly underdeveloped. In effect there is no social theory of geographical scale, not to mention an historical materialist one. And yet it plays a crucial part in our whole geographical construction of material life."

Neil Smith, "Geography, differences, and the politics of scale", 1992[9]

Three major insights have resulted from the theoretical development of the concept of scales (Brown and Purcell, 2005). One early and important insight is that scale is socially constructed rather than ontologically given (Smith, 1992). Geographical scales are labeled by terms such as 'local' and 'global', and each of these terms can be used to refer to vastly different sizes of area. The term local can refer to a neighborhood, a town, a metropolitan area, or even a region; the term global may mean international, or it may refer to the entire world. Because scales are socially constructed, they do not have inherent qualities or characteristics (Smith, 1992; Agnew, 1994; Howitt, 1998; Marston, 2000; Brown and Purcell, 2005).

[9] Taken from Smith, N. 1992. Geography, differences, and the politics of scale. In *Postmodernism and the Social Sciences*, ed. J. Doherty, E. Graham, and M. Malek, 57-79. London: Macmillian.

The second major insight is that scale is both fixed and fluid. While scales of organization may remain stable for periods of time, because they are socially constructed rather than being a fixed or given category, they are subject to change and thus are also fluid and contingent. Neil Smith introduced this idea by stating that the 'scale of struggle and the struggle over scale are two sides of the same coin' (Smith, 1992, 74). With this statement, Smith said that the scalar characteristics of social struggles can have implications for the dynamics and outcomes of those struggles, and that scales are constructed simultaneously with social struggle (Leitner and Miller, 2007). The insight that scales are constructed and constantly remade through political struggle is the primary source of the catchphrase of 'the politics of scale' (Purcell, 2003). The term 'politics of scale' was first introduced by Neil Smith (1990, 172) in the 'Afterword' to the second edition of *Uneven Development*. The term is used to summarize the proposition that scales are socially constructed and thus historically changeable through contestation (Smith, 1993; Swyngedouw, 1997; Brenner, 2001).

The third major insight is that scale is fundamentally a relational concept (Agnew, 1997; Howitt; 1998; Kelly, 1999). We cannot ask questions such as 'how does the 'global' affect the 'national', for example, because this treats 'globalization' as an empirical object that can be identified and measured; saying globalization exists gives it ontological status that has causal power and concrete effects (Mansfield, 2005). The global scale only exists in relation to other scales. Richard Howitt (1998) first proposed that scales are a relational concept, rather than a conception of size or level. He explains that we need to think about what is being implied when we refer to a scale as a specific level. For example, when referring to issues of a national scale,

a number of relations between geopolitics, territory, structure, culture, history, and environment must be considered. Howitt explains his concept of geographical scales by saying that “adopting a musical metaphor to consider how these various sorts of and scales of analysis might intersect and inform each other facilitates a shift in understanding of scale from an (over) emphasis on scale as size and/or scale as level, to include aspects of scale as relation” (Howitt, 1998; 56). Brenner (2001) says that it takes a multi-scalar analysis to understand the relational nature of scales, which is necessary to understand how power is organized and transferred among scales.

Because there is no broadly agreed-upon definition of the meaning of scale or scale politics, some critical geographers are presently debating the significance of scale as a concept. Andrew Moore (2008, 204) introduced a recent summation of the theorization of scale and politics of scale by saying that this debate has “spawned an increasingly diverse - and often contradictory - set of understandings concerning the definition and fundamental properties of scales, and what constitutes scale politics”. Howitt (2002, 305; Marston et al., 2005) has noted that there is a substantial confusion between the meaning of scale as size (extensiveness) and level (‘nested hierarchical ordering of space’). Andrew Jonas (2004) argues that geographers often conflate abstract with metaphorical conceptions of scale, and thus use scales interchangeably as heuristics at some times and then as a way to characterize material processes, events, or spatial formations at other times (Moore, 2008). Neil Brenner (2001) argues that scale suffers from ‘analytical blunting’ because of an overstretching and blending of the term with other geographical concepts, which he has termed ‘*limits to scale’*. For an illustration of work that conflagrates scale with

other dimensions of socio-spatial structuration, Brenner has pointed to an article published by Sallie Marston (2000) that treats the household as a scale. And in a deconstruction of the term scale, Sallie Marston, John Paul Marston, and Kevin Woodward (Marston et al., 2005) questioned the utility of examining spatial politics of scales. These authors argue that scales should be 'flattened' (viewed as non-existent) because there is no consensus on what scale is or how it should be operationalized. Many geographers (notably Helga Leitner) have tried to understand the intersection of spatial politics between horizontal and vertical socio-spatial relationships by introducing network theory into scale politics (Marston et al., 2005).

While there is not consensus over what scale means or how it operates, there is general agreement among political economists that scales do matter. Commonly referenced scales, such as community or national, are often associated with characteristics. When particular scales become associated with desirable characteristics, then decisions may be oriented towards the creation of a particular scale rather than towards pursuit of the desired objectives. Neil Smith (1993, 105) discusses the community scale, for example, as "the least specifically defined of the spatial scales, and the consequent vague yet affirmative meaning attached to the 'community' makes it one of the most ideologically appropriated metaphors in contemporary public discourse." Scales cannot be simply replaced by a flat ontology precisely because scales are a tool used in social struggles; and preconceived notions about scale also affect development practice and academic research. In order to better understand social struggles, we must try to understand scale. The following discussion will illustrate the way that scales are used as a tool in the struggle over the way that food is produced and distributed.

B. A Brief History of Agriculture

To science we owe dramatic changes in our smug self-image. Astronomy taught us that our Earth isn't the center of the universe but merely one of billions of heavenly bodies. From biology we learned that we weren't specially created by God but evolved along with millions of other species. Now archaeology is demolishing another sacred belief: that human history over the past million years has been a long tale of progress. In particular, recent discoveries suggest that the adoption of agriculture, supposedly our most decisive step toward a better life, was in many ways a catastrophe from which we have never recovered. With agriculture came the gross social and sexual inequality, the disease and despotism, that curse our existence.

Jared Diamond, The Worst Mistake in the History of the Human Race, 1987[10]

In the above quotation, Jared Diamond asserts that the adoption of agriculture marked a step backwards for humankind. Whether or not agriculture has helped humans to progress to a better life, it remains an essential component in the organization of human society. Historically, progress in agriculture has been equated with an increase in technology applied to production. Yet this increase in technology, some argue, divides man from nature and stratifies human society. The problems resulting from these divides are accelerating due to global shortages in the ecological resources that modern farming systems presently depend upon. These resource shortages, along with the ecological and societal problems which accompany modern agriculture, have sparked a debate over the future of agriculture. The following section provides an overview of the distinct historical progression of agricultural development. It serves as a foundation for my critique of the bias towards local scales of organization in sustainable agriculture.

The invention of the plow, considered by many to be the spark for civilization, marked the first agricultural revolution. The plow required less manual labor in

[10] Taken from Diamond, J. 1987. The Worst Mistake in the History of the Human Race. Discover, 19 May, 64-66.

agriculture, which freed some individuals from agricultural work and thus allowed the creation of a more distinctly stratified social system. Over the last century a second agricultural revolution brought a sweeping change to food provisioning systems: the Green Revolution. This began with the invention of industrial agrochemicals during the first half of the 20th century. Agrochemicals[11] work symbiotically with specific breeds of crops, spread throughout the developed nations of the world during the second half of the 20th century. The use of agrochemicals is currently increasing in many developing countries.

The Green Revolution is altering human civilization in ways that are no less profound than the first agricultural revolution. The form of agriculture based on green revolution technologies is called 'modern' agriculture, also referred to as 'industrial' agriculture, and sometimes even as 'conventional agriculture'. While the invention of the plow initiated the creation of a stratified social system, the second agricultural revolution is reversing the proportions of people who work in agriculture from a majority of the world's population to a minority. Industrial agricultural systems are dependent on a variety of commercially produced resources, such as mechanized labor, petroleum, and laboratory-produced seeds and inputs. To acquire these resources it is necessary to accumulate capital. It is difficult for small scale farming systems to compete economically with the economies of scale that accrue through industrial production. Traditional agriculturalists face difficulties in holding onto their farmland since the cost of farming increases while the price of food drops. While a few profit immensely in industrial agriculture, most of the traditional work force is

[11] Agrochemical is a term which refers to chemical pesticides, herbicides, and fertilizers.

faced with the prospect of finding a new means for earning a living, and obtaining food (Moore-Lappé et al., 1998).

Systems of industrial agriculture are highly dependent upon petroleum, which is used in chemical-based pesticides and nitrate fertilizer, in tractors and other industrial equipment, and in transportation of food from field to market and from market to plate. This commodity is projected to reach a peak in world-wide productivity by 2030 by the EIA[12], and many economic analysts and research groups project that production will peak as soon as 2010. In fact, some economists project that we have already reached peak productivity. As this commodity reaches the downward slope in the supply curve the commodity is expected to fall short of demand and thus is subject to rapid price increases.

See Appendix F for a chart displaying data, retrieved from BP's Statistical Review of World Energy, showing the trend of world production, consumption, and price over the past 40 years. According to the data, since 1981 world consumption of crude oil has exceeded world production of oil. In 1981, the first year in this series in which oil consumption has outpaced production, oil reached its highest annual cost in this series at over $80 per barrel. In 1998, oil production nearly matched consumption, falling short by only 127 billion barrels. This match between production and consumption coincides with the lowest price of oil, at $16.69 per barrel in 2007 dollars, in the 1981 to 2007 timeframe. From 1998 to 2007 this gap has steadily widened. In 2007 the shortfall in production to consumption was 1.3 trillion barrels of oil, coinciding with the price increasing to $72 per barrel (in 2007 dollars). As

[12] See websites such as www.energybulletin.net and the www.theoildrum.com for projections on the year that worldwide production of oil will peak.

demand continued to outstrip supply in early 2008, oil reached a record $147 per barrel. Worldwide economic recession has since greatly reduced demand for oil, and prices have plummeted as a result, falling below $40 per barrel in December 2008. According to BP estimates there were 1,390 trillion barrels of proven reserves around the world at the end of 2007. In 2007, 31.1 trillion barrels of oil were consumed worldwide. If this pace continues, all proven reserves will be consumed within 45 years.

The price of crude oil is projected to be volatile due to difficulties in extracting a supply sufficient to meet demand and declines in demand as the price exceeds consumer's ability to pay for increased prices. Food prices are rising sharply worldwide and the increases are mainly due to the impact of the rising cost of fossil fuels, speculation on petroleum due to price volatility, and diversion of basic grains to alternative fuel sources. Between March 2007 and March 2008, the world market price of wheat increased by 130 percent, and in some places more than doubled (Via Campesina, 2008). The price of oil is subject to rapid price increases until the commodity is depleted or replaced with a substitute. Similarly, the price of food produced by methods that depend upon the availability of crude oil may be subject to volatility which fluctuates with the price of oil. Price volatility is likely to have the most severe impact on food availability for people living in impoverished regions; in Haiti, for example, mass demonstrations and rebellions were held in April 2008 to protest the rising price of staple foods and fuel, which has led to dramatic increases in the number of people who cannot afford food.

As the first agricultural revolution divided man from man through the creation of class, it also enabled a division between man and nature. The second revolution is rapidly accelerating this divide and spreading it throughout the world. While the plow shifted the relationship between people and their environment from one of symbiosis towards one of domination, the green revolution is quickly degrading the ecosystems that humans depend on for food. Industrial-style farming harms soil systems, rivers and their estuaries, groundwater systems, and even the oceans, through excessive irrigation, mechanical processes and pesticide and fertilizer runoff. Modern agriculture greatly reduces biodiversity due to the practice of monoculture and the decrease of traditional varieties of crops. Worldwide, yields are decreasing in response to agrochemicals; farmers must continually increase inputs of chemical fertilizers and pesticides in order to maintain the same yields (Rosset and Benjamin, 1994). According to agricultural specialists Peter Rosset and Miguel Altieri (1997), the techniques utilized for industrial agricultural practices threaten capacity of these ecosystems to be productive in the future.

At the present time, there are no known substitutes which come close to petroleum for energy efficiency and usage diversity. The depletion of our fossil fuel resources will dramatically change the possibilities that we have for food production. Industrial production systems are highly dependent on inputs of phosphate and petroleum-based fertilizers and mechanized plough and irrigation systems; without petroleum, or a significant breakthrough in development of an alternative energy resource, it will not be possible feasible to continue the practice of industrial farming.

Industrial technology supporters claim that use of these technologies is necessary in order to produce enough food for the large population of the planet. There is no doubt that modern systems of agriculture have been successful in increasing productivity. The world produces enough grain to provide every human being on the planet with thirty-five hundred calories per day and 4.3 pounds of food per day (Moore-Lappé et al., 1998, 8). Yet there are at least 800 million people suffering from hunger in the world, and each year 12 million children under the age of five die from hunger. Of these children, 78 percent live in countries that are net exporters of food (Moore-Lappé et al., 1998, 9). According to researchers at the food provisioning systems research institute Food First, global food shortages are not caused by an absolute scarcity of food, but instead by inequalities in the issues of who grows food, how and where it is grown, how it is distributed, and who has access to it (Altieri, Rosset, and Thrupp, 2000; Moore-Lappé et al., 1998).

In 1989, the National Academy of Sciences (NAS) of the United States published a study noting that it could find no evidence that the modern model actually produces better than alternative forms (Vandermeer et al., 1993). In fact, reports from institutions such as the IADB, USAID, and the World Bank have stated that the decision to 'technify' production has sometimes been a 'lose-lose' proposition. In many cases, increasing technology has not raised yields, while it has dramatically increased the cost of production. These reports have added credibility to groundbreaking environmentalist works such as Rachel Carson's (1962) *Silent Spring*, and more recent works such as Francis Moore-Lappé's (1998) *World Hunger: 12 Myths* and Andrew Kimball and Vandana Shiva's (2003) *Fatal Harvest*.

Many people around the world are becoming increasingly aware of the social and environmental problems associated with modern agriculture and of the need for an alternative system. Alternative agriculture cannot be defined as any particular approach to agriculture, but instead is any approach that operates in opposition to industrial agriculture. Alternative practices range from traditional methods of agriculture, which uses little to no technology but may use highly developed cultural knowledge, to sustainable methods of agricultural production using biological principles to design healthy ecosystems. Sustainable agriculture is a term used to describe agriculture ecosystems that are used to their full capacity without degrading the ecosystem. See Appendix E for a comparison of the characteristics of natural ecosystems, sustainable agro-ecosystems, and industrial agro-ecosystems.

There are many ideas about how to create a system of agriculture which is more humane and ecologically sound than the modern system which development agencies and industries currently promote. Many of the major ideas influencing the development of sustainable agricultural systems use the idea of biomimicry, an approach of science that, “studies nature’s models and then imitates these designs and processes to solve human problems” (Land Institute, 2007). An example of the sustainable agriculture movement that incorporates the principles of biomimicry into agriculture production is ‘Natural Farming’, an approach started by Japanese farmer and philosopher Masanobu Fukuoka, which promotes balanced ecosystems and a minimum of human interference and labor. Another example is ‘Natural Systems Agriculture’, founded by Wes Jackson of The Land Institute, an agricultural research center near Salina, Kansas. Jackson is trying to develop perennial grain crops, including genotypes related to sorghum, sunflower, and wheat, by mimicking the

prairie to reduce disturbances to soil. Another example is ‘Permaculture’, an approach created by Australian ecologists Bill Mollison and David Holmgren. Permaculture is an integrated approach to food management using design principles to create edible ecosystems. The techniques used in permaculture systems are based on ecological systems and include perennials, polycultures, and agro-forestry. Permaculture also integrates social principles, including ‘people-care’, and ‘fair share’, along with ‘earth care’.

The scientific application of biological principles to agricultural systems in order to create balanced agricultural ecosystems is called agroecology. Agroecology contrasts the conventional approach of agriculture that focuses on uniform technologies by instead emphasizing biodiversity, recycling of nutrients, synergy and interaction among crops, animals, soil, etc., and regeneration and conservation of resources (Altieri, 2000). Agroecological systems contrast the conventional approach to agriculture by prioritizing healthy ecosystems and supportive social systems as well as obtaining high yields through the use of scientific principles of analysis and management of agricultural ecosystems. The knowledge utilized is a combination of traditional sources and technological knowledge. Assessments of Cuba and other initiatives in Latin America show that agroecological technologies can bring significant environmental and economic benefits to farmers and communities (Altieri, 1999; Altieri and Hecht, 1990; Thrupp, 1996). Small farmers typically achieve yields as high as four to five times the productivity per unit area as large farms (Moore-Lappé, Collins, & Rosset, 1998). Though there have not been sufficient studies on productivity of agroecological systems, it is likely that the use of agroecological

techniques among small farmers is a factor in the trend towards higher productivity among smaller farming units (Altieri, Rosset, and Thrupp, 2000).

Despite knowledge that technification does not necessarily increase production, and that application of agroecological practices does, increased technification continues to be commonly prescribed as the development solution to food scarcity by development agencies. Yet there are various development initiatives, by NGOs - by the United Nations low-input sustainable agriculture program (LISA) for example - which support ecological farming practices. The most common application of ecological practices comes from farmers themselves who are concerned with the social and environmental degradation that accompanies industrial agriculture. These farmers are forming grassroots organizations worldwide to support each other in their practice of non-industrial agriculture. In developing countries, social organizations, such as the Brazilian MST[13], utilize agroecological techniques; in developed countries, such as the Italian Slow Food[14] groups use a low-input approach. To counter the global structure of the industrial system, advocates of non-industrial forms of agriculture often call for small scales of organization in food production. The following section explains why I caution planners and academics to separate the fight for sustainable and socially just food from small scales of organization.

[13] MST stands for 'Movimento dos Trabalhadores Rurais Sem Terra'; this is Brazil's Landless Workers Movement which seeks the redistribution of land in Brazil.

[14] The 'Slow Food' movement began in Italy in 1989 and has spread throughout many countries since; the movement seeks to counteract fast food and to restore local food traditions and people's interest in what they eat.

C. The Local Trap in Food provisioning systems Research and Practice

What You Can Do:[15]

VISIT LOCALHARVEST.ORG
The Web site provides an easy search option to locate markets, farms and eating alliances near you.

SHOP AT A NEARBY FARMERS' MARKET.
You'll learn which foods are in season for your region and have the opportunity to ask farmers and ranchers about their farms and growing practices.

TAKE A DRIVE TO AREA FARMS.
Most farmers are happy to directly sell you fresh eggs, milk, fruit and vegetables. Pick-your own berry farms also make for a fun weekend activity with the family.

JOIN A COMMUNITY SUPPORTED AGRICULTURE PROGRAM.
Pay a lump sum at the beginning of each growing season and then share in the program's products year round.

DON'T MISTAKE "ORGANIC" FOR "LOCAL."
While certified organic foods meet USDA regulations, they may have traveled hundreds of miles before reaching your grocer.

THROW A LOCALLY GROWN DINNER PARTY.
Challenge your friends to bring dishes that include at least one locally grown ingredient.

Jeanette Hurt, "Reap What You Sow", 2007

The suggestions about how to 'go local' listed above are taken from an article written to promote the merits of a restaurant in my town, Lawrence, KS, called 'Local Burger'. Local Burger is a fast-food restaurant built on providing fresh, organic, and local food to its customers – the average distance that food ingredients travel to this restaurant is 20 miles, compared with a national average of 1500 miles (Hurt, 2007). The restaurant is one of the many manifestations of the connection between local and sustainable food in Lawrence. The city contains the largest and oldest farmers market in Kansas, a strong Community Supported Agriculture (CSA) group, and three food cooperatives which focus on providing local food to their communities. In

[15] Suggestions from: Hurt, J. 2007. Reap What You Sow. Sept./Oct ed. My Midwest. Retrieved from <http://www.localburger.com/pdf/my_midwest_sept_oct_2007.pdf>.

Lawrence, as well as many other communities in the United States and around the world, food that is 'local' has in many ways become synonymous with food that is sustainable and socially responsible.

Just as sustainable agriculture systems are generally organized around the idea of reconnecting people and land, they are also often equated with small scale organization. Food provisioning systems have been rescaled throughout history as technological advances allowed them to operate beyond a personal/community scale. As a result, many organizations promoting sustainable food tend to equate the community (local) scale of development with sustainable development. For example, the homepage of the Michigan Organic Food and Farm Alliance (MOFFA)[16], a non-profit organization created in 1992, explains the organization as follows: [17]

> "We work to create more public awareness about the nature of industrialized food supply and its environmental and social hazards. We teach 'eaters' to value and to choose organically grown food produced in their own locales. MOFFA is a force for generating public awareness about the need for more decentralized food provisioning systems that allow for greater participation and choice on the part of all citizens."

Other organizations such as grocery stores, farmer's markets, restaurants, and community supported agriculture groups, community gardens, often promote local food as the socially responsible way to eat. A wide number of books have recently been published to promote the benefits of 'eating local'; for example Alisa Smith and JB MacKinnon's (2007) book *Plenty: One Man, One Woman, and a Raucous Year of Eating Locally*, Gary Nebhan's (2002) book *Coming Home to Eat: The Pleasures and*

[16] Retrieved from <http://www.miffs.org/index.asp>.

[17] For further examples, see organizations (among countless others) such as: Local Harvest: real food, real framers, real community, <http://www.localharvest.org>; BuyFresh BuyLocal, <http://www.foodroutes.org>, Ohio Produce Growers Marketing Association, <http://www.opgma.org>; Greater Grand Rapids Systems Council, <http://www.foodshed.net>; Slow Food, <http://www.slowfood.com>, and The Land Stewardship Council, <http://www.landstewardshipproject.org/csa.html>.

Politics of Local Foods, and Barbara Kingsolver's (2008) book *Animal, Vegetable, Mineral: A Miracle of Life*. Additionally, a myriad of internet groups such as 'The Local Foods Research Project: exploring localism in alternative food networks' exist. Examples of recommendations for local planning as the solution to energy crisis can be found in books such as Rob Hopkin's book *The transition handbook: From oil dependency to local resilience* and David Holmgren's (2006) book and film presentation entitled *Relocalisation: How Peak oil can lead to Permaculture*. An example of the localization applied to directly to planning recommendations is Daniel Lerch's (2007) guidebook on peak oil for local governments, *Post Carbon Cities: Planning for Energy and Climate Uncertainty*.

The technologies of the Green Revolution continue to be utilized and spread throughout the world by development agencies such as the World Bank and the International Monetary Fund (IMF) and the giant conglomerates of the agro-industry such as Archer Daniels Midland, Monsanto and Cargill. These corporations and development agencies claim that the solution to food scarcity is to increase global food production by continuing to use more chemical pesticides and fertilizers, mechanical equipment, specialization in production, and economic trade. For a review of the development polices promoted recently by the World Bank and the IMF see the World Bank Development Report (2003) 'Reaching the Rural Poor – A Renewed Strategy for Development,' and the IMF report by Nash, J. and Mitchell, D. (2005) 'How Freer Trade can Help Feed the Poor: An Agenda for Erasing Hunger Worldwide by Reducing Trade Protectionism'. Proponents of industrial farming are using the global scale as a strategy and technology to make profits, regardless of

broader social and ecological consequences, by claiming that international specialization and economic trade is the key to feeding the world.

Advocates of alterative agriculture have different goals for food provisioning systems than advocates of industrial agriculture, but both are promoting a particular scale as the solution to a problem or set of problems. The equation of sustainable agriculture with small scales of organization results from the political use of scale as a way to counter the industrial agriculture system. The success of efforts at the grassroots level has led many people involved in the development of sustainable agriculture to be locally trapped by confusing the goal of organizing sustainable agricultural systems with the small scale. Proponents of the industrial system are trapped by the assumption that large-scale production systems are necessary to produce large amounts of food. There are a number of problems with the assumption that either large scales or small scales of organization in food provisioning systems will lead to heightened food security or any other objective.

The assumption that scales have characteristics that produce fixed outcomes has been termed the 'scalar trap' by Brown and Purcell (2005).[18] The scalar trap operates when researchers assume that "organization, policies, and action at a particular scale are inherently more likely to have desired social and ecological effects than arrangements at other scales" (Brown and Purcell, 2005, 608). The idea that local agriculture is the scale at which the organization of food provisioning systems is most likely to be sustainable falls into a category of error which has been

[18] The 'scalar trap' is an adapted from John Agnew's well-known phrase "the territorial trap" (Brown and Purcell, 2005); see Agnew, J. 1994. The territorial trap: The geographical assumptions of international relations theory. Review of International Political Economy 1 (1), 53-80.

termed the 'local trap' by Brown and Purcell (2005). The local trap operates when researchers assume that local-scale decision-making is inherently more likely to yield outcomes that are socially just or ecologically sustainable than decision-making at other scales. Following this, Born and Purcell (2006) noted that the local trap applies to food provisioning systems research and planning as food activists and researchers have a tendency to prefer the local *a priori* to larger scales. According to these authors, what is found desirable about small scales varies and can include ecological sustainability, social justice, democracy, improved nutrition, enhanced food security, increased freshness, and better quality.

A fall into the local trap can lead development and food provisioning systems researchers, planners, and producers to false conclusions. The main problem, as noted by Hinrichs et al., (1998, 141) is that making “local” a proxy for the “good” and “global” a proxy for the “bad” may oversimplify actual experiences and outcomes for people, communities, and the environment. Food provisioning systems researchers from the University of Iowa and the University of Wisconsin caution that “Following romantic tendencies [about localism] too far can ultimately have debilitating effects: a slide into reaction or utopianism, commitments to pasts that never were or futures that can never be” (Hinrichs et al., 1998, 4). While many researchers assume that local control leads to greater democracy, assumptions about scales hide the fact that local control can also lead to more authoritarian or ecologically destructive outcomes; similarly, while control at larger scales can lead to ecological and social disaster, it can also establish a set of democratic and sustainable principles which challenge repression and destruction occurring on local scales (Purcell and Brown, 2005). A food system example related to this concept is that although local food is promoted

to be healthier for people and the environment, it is often more expensive than mass-produced food and is thus out of the price reach of many citizens. Because scale has no ontological nature, no scale has any inherent or eternal qualities that make it particularly suited to a specific social or ecological process (Smith, 1993).

Even if efforts are made to make development more democratic, there is no guarantee that increased democracy will lead to increased conservation. For example, through a case study of a community-based conservation-with-development project, Garth Myers (2002) found that democratization may actually introduce problems through community-based conservation efforts by polarizing members of the community. Research of a Chwaka village in Tanzania showed that "On the one hand, there are people in Chwaka who know what the village's environmental problems are and who may have ideas on how to solve them. On the other hand, inequalities in economic, political, or educational matters prevent those people from acting in the interests of development and conservation for the good of the majority, or even from becoming active participants…" (Myers, 2002, 158). This one example illustrates the underlying concern that, without some effort to secure social equality among members of a community, the outcome of a development project may be neither democratic nor ecologically sustainable.

However, rejecting the local trap does not mean that we should reject community level development; to Purcell and Brown (2005, 293), it means just the opposite: "rejecting the local trap means rejecting all preconceptions about all scales". While local scale development projects do provide the opportunity to develop sustainable agricultural systems within particular communities, the scale used in these projects

does not absolutely determine the outcome. Sustainability in food production is often measured by how far the food has traveled from field to plate. But the achievement of small transportation distances does not guarantee that the food produced is sustainable, nor does it mean that we must organize all aspects of food provisioning at community levels. The characteristics of a given scale or scalar arrangement cannot be inherently assumed, as the outcomes are the result of political struggles to achieve a particular goal rather than through scalar arrangements themselves (Brown and Purcell, 2005). Further, scales are relationally embedded into one another (Agnew, 1997; Howitt; 1998; Kelly, 1999). Community scales are embedded into regional scales, as well as national and international scales; the places that exist at the scale of the community change the places that exist at the national scale, and vice versa. Thus, we cannot study a local food provisioning system without placing it into the context of other levels of scale. The next section will discuss the method that I will use to apply scale theory to a study of a particular food provisioning system.

D. Research Method

"Our hope is that our theoretical approach to scale can help planners systematically avoid the local trap as they increasingly explore questions of food provisioning systems in cities and engage the food provisioning systems literature outside planning… Planners need not carry out extensive empirical studies to determine whether or not the local is inherently desirable. Rather, they can see scale as a strategy that can have a range of outcomes, both good and bad. Since the outcomes depend on the agendas of those empowered by a scalar strategy, planning research can make those agendas the subject of critical inquiry, answering questions such as the following: Who will benefit from localization (or nationalization, etc.)? What is their agenda? What outcomes are most likely to result from a given scalar strategy?"

Born & Purcell, "Avoiding the local trap: Scale and Food provisioning systems in Planning Research", 2006[19]

[19] Taken from Born, B. and M. Purcell. 2006. *Avoiding the local trap: Scale and Food provisioning systems in Planning Research*. Journal of Planning Education and Research. 26:195-207, 205.

While there is not broad agreement about the way that scale should be conceptualized, it is clear that biases towards particular scales of organization should be avoided. In political ecology research, there has been a tendency to latently imply, rather than explicitly analyze, the properties of scale (Brown and Purcell, 2005). Political ecology can actually contribute to the theory of social construction of scales by integrating nature into social constructions of scale. When talking about organizations in politics of scale, it is assumed that people can create any kind of scale they want. However, nature affects the decisions people make about scalar arrangements. For example, there is a limit to the amount of fossil fuel available to humans, which will impact the decisions that people make about food provisioning. While scales are socially constructed, nature helps to shape the way that humans create scales.

Many scholars involved in the recent debate over scale theory have concluded that empirical studies of scale are needed to further develop the concept, rather than further elaboration of theory. In a response to Marston, Marston, and Woodward's call for a flat ontology of scale, Leitner and Miller (2007, 122) suggested that grounded conceptual arguments about the spatiality of social life in the study of practices and power relations are more productive than abstract ontological debate. Moore (2008) published an article entitled 'Rethinking scale in geographic theory: from analysis to practice', which concludes that we should distinguish the practical from analytical aspects of scale, with research directed towards the practical.

There has also been call for empirical studies of scale within food provisioning systems research. According to a group of food provisioning systems researchers

from the University of Wisconsin and the University of Iowa (Hinrichs et al., 1998, 4), there is a growing literature promoting local food provisioning systems which has not yet specified the organization, nature, or dynamics of local responses, addressed the structural constraints imposed on local initiatives by “globalization”, or attempted to account for the success or failure of local initiatives. These researchers have called for studies on food provisioning systems and scale that focus on ‘changing types of relations’ by framing studies of food provisioning systems around social relations rather than scale. Born and Purcell (2006, 205) cautioned food provisioning systems planners about the local trap, but concluded that their argument against the local trap “is largely a theoretical argument, and what is needed in future work is empirical explorations of the above questions. The theoretical and methodological implications of our argument need to be grounded in and learn from particular food struggles”.

Some food systems researchers are also promoting the use of multi-scalar thinking. Kloppenburg (2006, 419) says that to reform our agricultural system “the proper approach is not advocacy of either local or national action, but the advance of mutually reinforcing processes at multiple levels of initiative and governance”. Similarly, Philip McMichael (2000, 31) says “There is a dialectical relationship between the greater abstraction associated with corporate foods and the intimacy of fresh and organic food that expresses both locality and sustainability. But this is not a zero sum game, in which one will eliminate the other – it’s more like an ongoing struggle between forms of social organization”. McMichael believes that counter-movements (to the industrial food provisioning system) cannot avoid engaging with policy-making institutions, as the food systems crisis is also symptomatic of the crisis of institutions of governance.

The recent debates on geographical scale have provided scholars with a theoretical lens for analyzing the processes of rescaling (Swyngedouw, 1997; 2000; Brenner, 2000; 2001). I will use several concepts which have been established through the debate over scale in my analysis of the rescaling of food provisioning systems in Cuba. My analysis will principally follow the directive on scalar analysis given by Brown and Purcell in their (2005) article 'There's nothing inherent about scale'. Brown and Purcell (2005, 611) say that if we unify the three established theoretical principles of scale into a single directive for research on scale "we might say that the analysis of scale should examine how the relationships among scales are continually socially produced, dismantled, and re-produced through political struggle. The analysis should always see scales and scalar relationships as the outcome of particular political projects. It should therefore address which political interests pursue which scalar arrangements. Furthermore, it should analyze the agenda of those political interests." Brown and Purcell (2005, 614) list five objectives of explicit analyses of scale:

1. Explicitly examine scale as an object of theoretical and empirical analysis.
2. Investigate how scales and scalar relationships are socially produced through political and economic struggle.
3. Analyze how scales and scalar relationships become fixed, un-fixed, and re-fixed as a result of that struggle.
4. Address which political interests advocate a particular scalar arrangement.
5. Analyze how the realization of their political agenda produces social and ecological outcomes.

In addition to following these directives, I will conceptualize scale as being primarily a relational concept, as discussed by Howitt (1998), Agnew (1997), and Brenner (2001). Neil Brenner (2001, 34) summed up the way that scale should be theorized as "something that is produced"; a process that is always deeply heterogeneous and contested. Brenner argues that the object of inquiry in scale research must be each

scale's relationship with other scales, because each scale cannot be comprehended as an independent entity, rather it must be understood with respect “to its embeddedness or positionality within a broader scalar hierarchy” (Brenner, 2001, 600; Purcell, 2003, 324). The relationships between scales, Brenner argues, define the particular specific qualities of scale.

By following Brown and Purcell and Brenner’s directives, my application of scalar theory to Cuba’s food provisioning system will analyze the agenda of political interests involved in rescaling Cuba’s food provisioning system and the outcome of each rescaling project. Throughout the analysis the scale of organization will not be viewed as a single entity but as a relational concept. The relational concept of scale is useful in defining the actual scale of food provisioning in Cuba because food provisioning systems include places which go beyond the production units, utilizing scales of research, education, and finance infrastructure that encompass multiple scales. Thus, I am not trying to determine what the hegemonic scale of organization was or has become in Cuba; instead, my goal is to outline the way that people at many levels acted together to create particular development outcomes.

To collect the information necessary to produce this thesis I have relied on a variety of primary and secondary sources. I began this research by learning about Cuba’s transition during the Special Period through secondary sources of information. Influential works include: *The Greening of the Revolution*, a work produced by the International Scientific Delegation and Fact-Finding Mission on Low-Input Sustainable Agriculture in Cuba, November 1992 (edited by Peter Rosset and Medea Benjamin), *Sustainable Agriculture and Resistance: Transforming Food*

Production in Cuba, a work written by a collection of mostly Cuban authors, including agronomists, sociologists, economists, ecologists, and others in the field of science and/or education, Sinclaire and Thompson's 2001 Oxfam America report *Cuba:Going Against the Grain* and journal articles such as Peter Rosset's "Cuba: Ethics, biological control, and crisis", Vandermeer et al.'s, "Cuba and the dilemma of modern agriculture", Nicholl's et al.'s "The development and status of biologically based integrated pest management in Cuba", and Altieri et al.'s "Biological control and agricultural modernization: Towards resolution of some contradictions". I also searched for accounts of Cuba's transition in popular media sources; some sources in this category which impacted the direction of my research include the documentary Community Solutions documentary *The Power of Community: How Cuba Survived Peak oil* as well as the documentary *The Greening of Cuba*, and articles including Dale Pfeiffer's 'Cuba: A hope', and Bill McKibben's 'The Cuba diet: What will you be eating when the revolution comes?". My ideas on agricultural development have also been influenced strongly by EM Schumacher's ideas on the use of intermediate technology in development as outlined in his work Small is Beautiful and by Paulo Freire's work Extension or Communication.

For information on Cuba's historical system of food provisioning I relied most heavily on the following sources: José Alvarez's historical analysis entitled *Cuba's Agricultural Sector*, MacEwan's *Revolution and Economic Development in Cuba*, Allahar's report entitled *Agriculture and the Peasantry in Cuba*, essays by Carmelo Mesa-Lago in *Cuba After the Cold War*, Bethall's *Cuba: A Short History*, and Jean-Paul Sartre's ethnographical work *Sartre on Cuba*. Other secondary sources that helped me to gather knowledge of Cuba's historical scales of food provisioning

include records of speeches by Fidel Castro and various persons in the Ministry of Agriculture and the National Institute of Agrarian Reform,

I also collected statistical information on key aspects of the transition to confirm what I had read about the success of the transition. The statistics that I gathered include information on access to petroleum (from the Energy Information Administration of the United States); information on food production, such as imports of agro-chemicals, food production index, percent of cropland dedicated to sugarcane and non-sugarcane crops, from the United Nations Food and Agriculture Organization (FAO); and further information on food production, such as agricultural production for selected crops, from Cuba's National Office of Statistics.

I collected further primary data through participation in a research delegation to Cuba. From February 3 to February 12, 2008, I traveled with a research delegation in western Cuba. The research was conducted as a set of informal interviews with a variety of people involved in Cuba's food provisioning sector, including farmers, managers of cooperatives, agricultural researchers, and representatives from both domestic NGOs and government organizations. In each meeting with representatives of an agency I asked the people that I spoke with what they thought was the key to their success during the Special Period. I also asked questions in each meeting about the organizational structure of Cuba's system, Cuba's system of education and training, the challenges provided by peak oil during the Special Period, the problems that arose through organic farming, and was or is being done to ameliorate the problems. In discussions with farmers I asked virtually the same questions, but with respect to the cooperative/farming unit as opposed to for the national system as a

whole; for example, I asked what they felt contributed to the success of their project, and about linkages between the cooperatives and other institutions. The project was reviewed and approved by the Human Subjects Committee of The University of Kansas. Appendix C provides a list of the organizations that I visited and people I spoke with in each organization. Appendix G provides a map showing the municipalities in which I conducted field work in Cuba.

The delegation was organized through a partnership between the United States fair trade group Global Exchange and the Cuban Institute for Friendship with the People (Instituto Cubano por Amistad con los Pueblos, ICAP). As the delegation was sponsored by ICAP, a Cuban government organization, this form of research did not allow me to gain an unbiased view of all aspects of Cuban agriculture as it is in 2008; however, that was not the focus of my research. I do not feel that sponsorship by the Cuban government compromised my research. The primary purpose of my research in Cuba was to learn about the scale of organization which emerged from the Special Period it was necessary to have contact with a wide variety of decision-makers, and the research delegation allowed me this contact. Another purpose of my research was to gather ideas about how to create sustainable and socially just food systems. I have focused my research on learning about the support systems that helped farmers to be successful in the use of sustainable techniques by talking with production managers and farmers at the most highly regarded production units. My discussion of agriculture during the Special Period relies on information gathered through these interviews and my observations while in Cuba as well as secondary sources and statistical data.

Chapter 3: Historical Scales of Food Provisioning in Cuba

When we sailed from Tampa Bay,
"Cuba Libre!"
And our ships got under weigh,
"Cuba Libre!"
As we floated down the tide,
Crowding to the steamer's side,
You remember how we cried,
"Cuba Libre!"

When we spied the island shore,
"Cuba Libre!"
Then we shouted loud once more,
"Cuba Libre!"
As we sank Cervera's ships
Where the southern sea wall dips,
What again was on our lips?
"Cuba Libre!"

These are foreign words, you know-
"Cuba Libre!"
That we used so long ago;
"Cuba Libre!"
And in all the time between
Such a lot of things we've seen,
We've forgotten what they mean
"Cuba Libre!"

Let us ask the President,
"Cuba Libre!"
What that bit of Spanish meant,
"Cuba Libre!"
Ask McKinley, Root and Hay
What on earth we meant to say,
When we shouted night and day
"Cuba Libre!"

But alas! They will not speak
"Cuba Libre!"
For their memories are weak,
"Cuba Libre!"
If you have a lexicon,
Borrowed from a Spanish don
Send it down to Washington,
"Cuba Libre!

Cuba Libre, A poem by Ernest H. Crosby, 1921[20]

Cuba is the largest country in the Caribbean. The island consists of 11,000 hectares, which is about ¾ of the size of Florida, and has a current population of about 11.5 million people. The island is 90 miles south of Key West, Florida. The climate is tropical, moderated by trade winds, and has a landscape varying from rolling plains to rugged mountains. More than 60 percent of the island, about 6.6 million hectares, is arable land. Cuba's history has been influenced by the suitability of the climate, soil, and topography for sugarcane and tobacco production. Since the arrival of

[20] Taken from website <http://www.historyofcuba.com/history/scaw/scaw5b.htm>.

Europeans, agriculture has historically been the dominant sector of the Cuban economy.

Much of Cuba's history can be readily understood through a review of its agricultural development. Beginning in the 18th century, sugar was the primary mechanism connecting Cuba to the world economy, and the class structure of Cuba has been profoundly shaped by the country's economic dependence on the export of sugar. In fact, the economic history of Cuba can largely be told as the history of sugar. This chapter presents an overview of Cuba's food provisioning system from the middle of the 18th century until the Special Period which followed the collapse of the Soviet Union. The chapter is not intended to give a thorough overview of Cuban agricultural history, but rather to show that the political interests and agendas that shape the scalar arrangements of a food provisioning system are what determine whether it is socially just and/or ecologically sustainable.

Four distinct scalar organizations of Cuba's food provisioning system will be examined in this thesis. The narrative will examine how these scalar arrangements were fixed, unfixed, and re-fixed through continual political struggle as particular political interests pursued the scalar arrangement that would best help to achieve their agenda. For each period of Cuba's history I will examine the social forces that controlled major decisions about agricultural production and food distribution, the agenda held by each of the actors that controlled decision-making, the scales used by these actors to achieve these agendas, and the outcome of these scalar arrangements. The periods are distinctly marked by changes to the arrangement of land tenure, the focus of production, the distribution of food within Cuba, and the

techniques used in production. The arrangement of land tenure provides an indicator of who makes production decisions; the focus of production is an indicator of the social agenda of the decision-makers; the distribution of food within Cuba is an indicator of the social outcome of the agenda; and the style of production is an indicator of the ecological outcome of the agenda. For each scalar organization I will use these indicators to illustrate that the agenda of the decision-maker, rather than the scale, was responsible for producing the outcome of the food system arrangement.

The first scalar organization discussed is the Spanish colonial period and the period of U.S. dominance over Cuba and its affairs. The scalar organization used during this period was similar in the fact that an outside power was essentially in control of decision-making about agricultural production. During this period agricultural production became based on a single crop, sugar, which was traded for a price that was effectively controlled by the receiving nation. Peasants produced much of food that was consumed by the national population; additionally, much food was imported from the United States. Thus, the food provisioning system during this time period was organized predominantly by actors at the local and the international scales as the owners of estates partnered with colonial and then international capital and market forces.

A reorganization of Cuba's food provisioning system occurred with the change of political power in 1959. The initial primary agenda of the new leadership of Cuba were agrarian reform measures to raise the standard of living of all Cubans. A number of changes occurred in the organization of agricultural production in the first

years after the revolution. One major goal of the new leadership was a move away from dependency on sugar and towards diversification in production. This anti-sugar platform was a strong factor in the reorganization which took place at a national scale following the revolution. Another was land redistribution pursued with the goal that farmers would have ownership of the land that they worked and would receive the benefits of the products that they produced. This system was organized at mainly the national scale.

Due to internal and external forces, a new reorganization occurred around 1963, when Cuba returned to a focus on sugar production for export to allied Soviet countries. Most of the production was exported to Cuba's allies for favorable terms of trade; in exchange for sugar, Cuba received food, petroleum, and other agricultural production inputs from the Soviet Union. The food provisioning system during this time period was organized as a partnership between the national and international scales.

Analysis of the scalar arrangements during these three historical scales of food provisioning follows the discussion of the three periods. The final scalar reorganization which will be discussed is the Special Period, the decade of the 1990's, when Cuba was forced to become much more self reliant due to the collapse of its trade alliances with the Soviet Union and the United States embargo. During this interval, known as the Special Period, a relationship was developed among the country's national, regional, and local scales which reinforced the agenda of sustainable and socially just agriculture. This time period was also characterized by the beginning of a new set of relations between Cuba and the rest of the world with

regard to agriculture production. While this chapter focuses on scalar analysis, Chapter Four will focus on the way that new relations formed between places of food production to help generate new ideas about the way that places at different scales can work together to help create sustainable and socially just food systems.

A. The Colonial Scale (1494 to 1958)

"A country which trades with only one country dies"

- José Martí[21]

Cuba was claimed as a Spanish colony by Christopher Columbus following his voyages in 1492 and 1494 to the Americas. At the time of colonization, the island was inhabited by the Guanajatabey, Taíno, and Ciboney peoples, who were tribes of hunter and gatherers. It is believed that the native population originated from the South American mainland beginning around 5300 BC and numbered about 100,000 people. By most accounts, the native civilization was mostly destroyed in the early part of the sixteenth century through intentional massacres by the Spaniards, diseases such as smallpox, and enslavement. Agriculture for export was concentrated mainly under a small group of large-landholders and labor was supplied by slaves; initially, the slaves were natives, but following a sharp decline in the native population many slaves were brought from Africa. Most export crops were produced by a handful of powerful Spanish landowning families that controlled much wealth in Cuba for generations. They lived full-time on the island, and in this way differed from the absentee landlords that characterized many Caribbean colonies. Spain flexed a strong control over all of their American colonies by prohibiting trade

[21] Taken from Sartre, J. 1960. *Sartre on Cuba*. Westport, CT: Greenwood Press, p.23.

amongst them; until 1720 Spain was the only nation with which Cuba could legally trade.

After 1720, Cuba was allowed by Spain to trade with other countries, though Spain remained the largest export market for Cuban landowners. In the decades leading up to the mid 18th century, a rapidly growing sugar market in Spain sparked the emergence of a class of landowners that increased their wealth in Cuba through development of sugar plantations. By 1750, there were about a hundred small sugar plantations which produced about 5,000 tons of sugar per year, although at this early stage in development of sugar cane production only about 500 tons was officially exported (Bethell, 1993, 5). The island was underdeveloped economically, and was mainly valued by Spain for the natural beauty of the island and for its strategic location for a military outpost (Allahar, 1980).

In 1762, during the Seven Years War between Britain and Spain, Havana was captured and occupied by Britain for nine months. The British occupation marked the departure point for Cuba's plantation economy. During the occupation nearly 100 British trading ships came to the port of Havana in contrast to the 5 or 6 Spanish ships per year which came on average prior to the occupation (Allahar, 1980, 3). When Spain regained possession of the island it began to invest heavily in development of sugarcane plantations. Spain gave every fiscal encouragement possible to produce and export sugar, including aiding the import of slaves from Africa on a much larger scale than what had occurred before this time period.

Towards the end of the 18th century, Jamaica, the largest sugar producer in the Caribbean, began to decline in production due both to soil degradation and the slave

rebellion. Additionally, the Haitian rebellion of 1792 prompted many Haitian plantation owners to flee to Cuba to start new plantations. Further encouragement for growing sugar came from the American Independence, which had opened a vast new market for Cuban sugar and tobacco since trade with the Spanish colony had formerly been prohibited to the colonies of the United States. By 1800, Cuba was poised to overtake Jamaica as the biggest producer of sugar in the Caribbean. The export of sugar exceeded the export of hides, tobacco, cane brandy, wax, coffee, and nuts from Cuba to Spain (Bethall, 1993, 7). Tobacco was another important export crop because it was very profitable; however, since tobacco is a very labor intensive crop, it was generally cultivated either as a secondary product of large estates or on small plots by individual families.

Production techniques in Cuba were the same as those which led to declining soil fertility in Jamaica and other Caribbean Islands. In 1862, Francisco de Frias y Jacob, the Count of Pozos Dulces, was quoted as saying “intercropping and crop rotation in Cuba will reverse the rampant land degradation caused by ignorance and greed” (Funes, 2002, 3). While the land degradation that had preceded the Count’s remark was largely caused by clearing land for cattle farming, sugar cultivation was responsible for clearing even more large tracts of land. Since high profits could be made in sugar production at this time, sugar companies began to buy large tracts of land. By the mid-nineteenth century, the sugarcane companies had begun to directly threaten the interests of coffee growers and cattle ranchers.

The island remained a colony of Spain until receiving independence in 1898. Between 1762 to 1892, the time period between the British occupation and

independence from Spain, Cuba's agrarian sector centered around three main interest groups: coffee growers, cattle ranchers, and sugar producers. In 1840, the United States raised its tariff barriers against Cuban coffee to protest the protectionist trade policies of Spain; the coffee crop plummeted from sixty-four million pounds to five million pounds by 1850 (Allahar, 1980, 5). In response to the increased tariff, a group of coffee planters drafted Cuba's first Declaration of Independence in 1868. Unlike the coffee planters and cattle ranchers, the sugar planters were not affected by the new U.S. tariff restrictions. The sugar industry also differed from the coffee and cattle industries by being a highly labor intensive industry which favored the retention of slavery. Slavery was abolished in Spain in 1820, and the question of slavery caused much unrest in Cuba. Many sugar estate-holders began fear that Spain would make slavery illegal in Cuba, and advocated a release from Spanish colonization in order avoid the pressure to free their slaves. Some influential plantation owners applied pressure to Spain to keep slavery legal in exchange for their allegiance. Meanwhile, political leaders in the United States noticed an opportunity for annexation of the Island.

By 1868 the major groups of landowners were divided between desires for independence from Spain, allegiance to Spain, and desire for annexation by the United States. While most of the people of the coffee and cattle industries were fighting for Cuban independence, many people in the sugar industry favored an annexation with the United States. Annexation would give a bigger market for their product and a cheap source of labor in the form of ex-slaves from the United States. This division in the interests of large land-holders led to a full-scale civil war and war with Spain from the years between 1868 and 1878 known as the Ten Years War.

The Spanish won the war and was able to keep Cuba as a colony, defeating the interests of the coffee and cattle industries, and paving the way for increasing dominance of the sugar industry. However, one victory was won by the fighters for Cuban independence, many of whom fought for the abolition of slavery as well as independence. Although slavery was abolished in Spain in 1820, it had remained legal in Cuba due to the power of the sugar industry until the Pact of Zanjon freed the majority of Cuban slaves in 1878; by 1886 all vestiges of legal slavery were ended by a royal decree. That slavery remained legal until after the Ten Years War attests to the power of the sugar growers during this time. Spain was disposed to abolish slavery in Cuba prior to 1878, but kept slavery legal to avoid angering the sugar growers, which would give increased strength to the independence movement (Allahar, 1980, 5).

Spain was reluctant to give up its last and extremely profitable Caribbean colony, but the struggle for independence continued with renewed strength during the 1890s. A rivalry over Cuba's export products had existed between the United States and Spain since the time of American independence, and after the war the rivalry grew. In 1895, trade reprisals of the U.S. against Spain were extended to include sugar, and the value of Cuban sugar exports fell by 33 percent (Allahar, 1980, 6). The sugar planters of Western and Central Cuba joined the Independence movement, and revolution broke out again in 1895. This revolution was led by José Martí, a poet, writer, and fighter. Martí promoted the idea that Cubans must educate themselves and develop their own internal economy rather than depend on trade with other countries for economic security. A new war for independence began against Spain in 1895 with a small uprising against Spanish authorities. The uprising escalated into a

civil war, with groups of Cubans fighting for independence while others fought on the side of Spain. Much of the funding for the independence fighters came from the United States. The United States directly intervened in the war in 1898 by declaring war against Spain after the US Battleship Maine exploded in Havana Harbor; the United States government attributed the explosion to a mine laid by Spain. Spain surrendered all of its colonies to the United States after losing battles in Cuba and the Philippines. Cuba formed its own government under the occupation of the US military and gained independence on May 20, 1902.

During the time of Spanish colonialism there was a trend towards increasing the size of landholdings and consolidating land ownership. Most landholders in Cuba lived on their estates and directly managed their properties, unlike landholders in many other Caribbean colonies. Throughout Spanish occupation of the island, the estate-holders had become increasingly rich through sugar production, and wealth became increasingly consolidated. As Cuba fought for independence at the turn of the century, landholdings became further concentrated due to the deaths of many of the landholders. At the beginning of the War of Independence (1895) there were 90,700 working farms, and by the end of the war (1898), there were 60,711 farms with about 50 percent of the agricultural land in the country occupied by small landholders that owned 13 hectares or less (Funes, 2002, 3). Throughout Spanish colonialism, most of the food consumed in rural areas of Cuba through the time of Spanish colonization was grown through subsistence agriculture and cultivation of small plots of food crops on the large estates. However, during this time period crops were increasingly produced in monoculture arrangements for export; the trend among landowners during this time period was to increasingly produce more of profitable export crops

and less food for local and national consumption. The Cubans that lived outside of cities mostly worked as agricultural laborers for a large landowner, and little was done to provide an education for them. Small farms generally produced the food that was eaten by people in cities. Most land was used for export crops, and the arrangement of land ownership led to a sharply divided class system whereby the majority of the Cuban population struggled to find employment.

Despite the hopes that revolutionary fighters such as José Martí held for an independent Cuba, the United States had pre-established interests that shaped the future of Cuban development. The United States helped Cuba to gain its independence through the Spanish-American War and occupied Cuba from 1898 to 1902. During this time, a series of agreements were struck between the U.S. and Cuba, including the Platt Amendment, which gave the United States the right to intervene in Cuba's affairs whenever the United States deemed necessary and prevented Cuba from ceding land to the control of any country other than the United States. The United States also prohibited Cuba from forming alliances with other countries. During this time, the sugar beet and cane operations in the Southern United States were incapable of producing enough sugar to satisfy the national demand for sugar in the States. The United States paid sugar producers according to the cost of production rather than at the world market price, and struck the same deal with Cuba in order to avoid collapse of the market price of sugar within the States. While the trade agreement initially existed informally, the Jones-Costigan Act of 1934 created a formal 'sugar quota' agreement with Cuba to purchase a pre-agreed amount of raw sugar for the United States at market price. The quota amount was generally more than half of Cuba's total sugar production, supplying the United

States with about one-third of its sugar needs (Alvarez, 2004, 16). The United States prevented Cuba from creating similar trade agreements with other countries.

United States direct investment in Cuban operations grew substantially following Cuba's independence. In 1900, US foreign investment in Cuba totaled $50 million; in 1913, $220 million; by 1929, US investments had risen to $800 million (Allahar, 1980, 12). Beginning in the early 20th century, expansion of the sugar-cane industry reduced small landholdings. By 1934, only 38,130 medium and small-scale farms remained, a drastic reduction from the 60,711 such farms that had existed in 1898 (Funes, 2002, 4). Prior to independence from Spain most of the food consumed in Cuba had been grown on small and medium-scale farms which produced a variety of food crops. The reduction of diversified farms encouraged Cuba to become dependent on imports of food from the United States. The dominance of one crop per farm was present not only in sugarcane, but in also tobacco farms, cattle ranches, and coffee plantations during the early half of the 20th century (Alvarez, 2004).

Cuba's economic system became increasingly intertwined with the United States during the first half of the 20th century. Although the United States paid above world-market prices for sugar, Cuba's economy hinged on this one commodity; by 1953, sugar accounted for 80-90 percent of the country's exports and for one-third of its income. Both the price of sugar and the amount of sugar which would be purchased fluctuated yearly. Large tracts of land were left uncultivated or not harvested as large companies speculated about the price of sugar. Due to this uncertainty, production was not maximized and unemployment steadily increased. All sectors of the Cuban

economy were vulnerable to fluctuations in the price of sugar. Trade agreements penalized Cuba if the country did not import a required amount of grain and other food stuffs from the United States, and throughout most of the first half of the 20th century Cuba imported more than one-half of the food consumed by the national population from the United States. The sugar plantations, sugar mills, boats, ports, and railroads were owned in great part by United States corporations. Sugar was grown and extracted in Cuba and was mostly shipped to the United States to be refined; as refined sugar is a much more valuable commodity than raw sugar, the United States industries which processed the sugar received large profits. Throughout the time period of 1901 to 1959 Cuba's balance of trade with the United States became progressively more negative due the high cost of imports of food and manufactured goods and the comparatively low income that sugar exports supplied to Cuba. By the 1950's sugar was no longer a source of economic growth and could not sustain continued economic development.

A more balanced production of crop types and of industry was badly needed for the economic health of Cuba, but the dominance of the sugar industry in Cuba discouraged diversification. The agricultural sector became organized by several powerful groups, most notably The Mill Owners Association, the Sugar Stabilization Institute, The Cuban Cattlemen's Association, and The Tobacco Growers Association. The interests of these groups gave them a class position that dominated the interests of the unorganized masses of small producers, renters, sharecroppers, and squatters. The large landholders held the power to make decisions about the way that food was provisioned for the island, and they were also the ones who held the capital, and therefore held access to technology, credit, and were able to build

and make use of infrastructure. Agricultural products and other basic goods were sold to people in rural areas through monopolistic stores that charged high prices.

In 1958, 56 percent of the Cuban population lived in the countryside, and this part of the population faced acute social problems; in the rural sector just 9.4 percent of the landholders owned 73.3 percent of the land, and there were more than four million hectares left uncultivated on large estates while 200,000 families were landless (Funes, 2002, 4). The peasant class relied on both subsistence farming and/or overpriced, monopolistic stores which imported food from Cuba's trade partners; peasants lacked access to education, and in most cases did not have access to adequate housing, water, or healthcare (Alvarez, 2004; Sartre, 1960). Most peasants did not have access to proteins such as milk or meat and subsisted on an average of 1300 calories per day. After a series of rebellions against the leadership of Cuba throughout the 1930's, 40's, and 50's, a group of revolutionists took power on the first of January, 1959.

While a national state did exist after Cuba won its freedom from Spain, the control of the agricultural system was in the hands of the land-owners. These landowners had fought for the independence from Spain. The large tracks of land were held by both the wealthy Cuban elite and foreign corporations who produced agricultural products mostly for export. An example of the ineffectiveness of national policy is found in the neglect of Article 90 in the 1940 Constitution, which failed in its purpose of eliminating latifundias[22]. Article 90 prescribed limits on the acquisition and possession of land by foreign companies and limits for the maximum amount of land

[22] Latifundias are large, planned agricultural estates geared towards high production and large profits.

that any person or entity could possess for each type of agricultural activity. The article also allowed for the seizure of land from those who exceeded the limit. However, a comparison of the agricultural censuses taken in 1946 and 1959 shows patterns of land ownership became increasingly concentrated into large holdings (Alvarez, 2004, 10).

During both the Spanish colonial period and the period of US influence over Spain Cuba's food provisioning system was predominantly organized through a partnership between wealthy landowners and foreign governments or corporations. During this period of agricultural development, decisions about food-provisioning were made by local land-owners, yet these landowners formed powerful interest groups which allied with international groups. This alliance undermined the interests of farmers who wished to produce food for local or national consumption and effectively rescaled the food provisioning system towards an ever greater focus on production of export products. Even while individual landholders produced food products for local and national consumption, this period of time was characterized by social injustice through the use of slave labor and later by poor conditions for agricultural laborers. It was also characterized by unsustainable production practices through clear-cutting of forests for rangelands and sugar plantations; to make way for the monoculture plantations, large areas of the country were deforested. When the Spanish arrived, it is estimated that 80 percent of the island was forested, but by 1959 only 17 percent of the island was forested (Rosset and Benjamin, 1994, 64).

B. The Revolutionary Scale (1959 to 1963)

The stated principle objectives of the reform, taken from the preamble to the first agrarian reform, follow:

The agrarian reform has two principle objectives:
a) To facilitate the planting or the extension of new crops with the view of furnishing raw materials to industry, satisfying the food needs of the nation, increasing the export of agricultural products, and, reciprocally, the import of foreign products which are essential for us.
b) To develop the interior market (family, domestic) by raising the purchasing power of the rural population. In other words, increase the national demand in order to develop the industries atrophied by an overly restrained consumption or in order to create those which, for lack of customers, were never able to get started among us.

From the First Agrarian Reform, Cuba, May 1959[23]

The above quotation is taken from the preamble to the First Agrarian Reform, the first major change made by the revolutionary government which took power on January 1, 1959. This group of revolutionists worked to re-scale power away from wealthy national landholders and international corporations by organizing the country to operate at a national scale which would empower the peasants. The leaders of the revolution had been strongly influenced by thinkers such as José Martí and Karl Marx and advocated a strongly centralized and authoritarian strategy for development in order to achieve social equality. Many of the fighters of the revolution were farmers, and agrarian reform was one of the primary goals of the new leadership. The administration was headed formally by Manuel Urrutia Lleó for the first six months of 1959 and directed by a cabinet which contained the revolution leaders, most notably Fidel Castro, who has led the country since the time of the revolution to the present day, and Che Guevara. The national project of these

[23] Taken from Sartre, J. 1960. *Sartre on Cuba*. Westport, CT: Greenwood Press, 71.

leaders included the two major goals of ending Cuba's economic dependency on the United States and bringing social equality to the island. While the revolution was not proclaimed as socialist, the ideology the revolution was founded upon was a desire to increase the productivity of Cuba by increasing the productivity of all Cubans, first and foremost by curing the peasants of poverty, disease, and ignorance (Sartre 1960). During this phase of nationalism, the hegemonic scale of food provisioning systems organization was the national scale, yet the new national power was partnered with an expanded class of landholders at the local scale.

Among the first actions carried out by the leadership to achieve the goals of the national project was redistribution of land tenure. A special office of the Ministry of Agriculture (MINAG), the National Institute of Agrarian Reform (INRA) was established under the direction of geographer Antonio Nuñez Jiménez to implement agricultural reform policies. On May 17, 1959, the first agrarian reform was instituted. This reform law represented a major break in relations between the government and the large landholders; these remaining large and middle farmers formed a group of political and economic resistance. The principles of the reform consisted of the following:[24]

1. Properties in excess of 402.3 hectares – 30 caballerias[25] – were proscribed (1 hectare is equal to 10,000 square meters and equivalent to 2.47 acres)
2. An exception to the upper limit on land holdings was established for especially productive land. (On sugarcane and rice lands, the upper limit was raised to 1342 hectares – 100 caballerias – provided yields were 50 percent greater than the national average).

[24] Taken from 2 sources: MacEwan, A. 1981. *Revolution and Economic Development in Cuba*. Hong Kong: The MacMillan Press Ltd, 39.; and Sartre, J. 1960. *Sartre on Cuba*. Westport, CT: Greenwood Press, 69.

[25] A caballeria is a measurement of land area; it is the system of land tenure used in Spain and its former colonies. In Cuba, one caballeria is equal to approximately 33 acres.

3. Large estates that had been worked as a single unit would not be divided up, but would be worked as cooperatives.
4. Every person – tenant, sharecropper, squatter – cultivating up to 67 hectares of land would be given ownership of that land.
5. Every person who worked the land was entitled to a vital minimum of 27 hectares.
6. The owner of land must work the land personally.
7. No person could own both a cane plantation and a sugar factory.

If these laws were violated, the land would be redistributed by the nation. The government distributed the land to approximately 150 thousand farmers. Those who received land were those who had worked it and paid rent or had owned their land. In many instances, renters, sharecroppers, and squatters were given title to land they already operated, and in other cases small operators were given additional land or the state took control of large estates (MacEwan, 1981).

Another major aspect of the plan of the Revolutionary government was to diversify agricultural production in order to reduce economic dependency upon trade of sugarcane. The long-range objective of this plan was to transition away from trade in agriculture and towards trade in manufactured goods (MacEwan, 1981). The plan would also increase production of food for national consumption. This development program was known as the ‘Anti-Sugar’ policy. In July of 1960, President Eisenhower had canceled the Cuba sugar quota. The sugar which had been allocated for the U.S. was bought in entirety by the U.S.S.R., China, and East Germany. The United States initiated a trade embargo against Cuba in August 1960. The next year, Cuba arranged for sale of the entire sugar crop with the U.S.S.R., China, and other communist countries. Because sugar represented both the orientation of the nation towards the world market rather than towards its own internal needs, the leaders connected sugar with dependence on imperialism and the misery in rural areas. By 1961, the policy of diversification had led to taking 200,000 acres, about 15 percent

of the area that had been cultivated with sugarcane, out of cane production with the intent of devoting this land to other crops (McEwan, 1981, 63). To diversify crop production, the government invested large sums of money into production equipment for many different types of agricultural crops with the exception of sugar. Mechanized agriculture was seen as a highly desirable way to reduce the burden of the peasant and to increase productivity.

Another major task was to reorganize food distribution so that it was easier for the poor to access food. The first step taken by the INRA to resolve the problem of distribution was to set up a 'People's Store' in each village which sold basic necessities at cost of production. These stores were set up to counter the monopolistic grocery and basic goods stores which dominated agricultural areas. The second step the government took to increase equality was to implement a food rationing system; this system was also set up partially in response to food shortages in 1962. In contrast to most agrarian reforms, production did not drop in the first years of the reform, but production did decline in 1962. The food rationing system was planned to ensure that when food was in short supply it would be equally distributed.

An evaluation of the impact of the first agrarian reform laws was conducted by INRA in 1961. The major findings of the report as published by the government organization were: the large sugarcane estates had been converted into 622 sugarcane cooperatives, large cattle ranches and rice plantations had been converted into 622 people's farms, 31,425 title deeds to parcels of land had been handed to peasants, US properties amounting to 1,260,000 hectares had been

nationalized, INRA had built over 500 public buildings in rural areas, 1,996 retail people's stores had been opened, and a variety of projects had begun to bring services such as schools, housing, medical services, credit, and rural electrification to rural areas (Alvarez, 2004, 35). With the accomplishments of the initial goal of land reform, Cuba's leaders continued to press for further equality. The reform of rural areas continued with the establishment of the National Association of Small Farmers (ANAP) in May of 1961. The organization is a farmer's group which is intended to represent its own interests within the political space opened by state policies. At the time of ANAP's establishment, the government began to encourage landowners to pool their land into 'associations', which would be held collectively and farmed as cooperatives.

While many successes were reported, the initial policies did not result in entirely desirable consequences. The revolutionary government had been forced to implement change quickly with little experience in planning. In order to remain in control, the leaders had to institute reform quickly enough to remain in favor with the people but without moving so quickly that their policies ended in disaster. Agricultural production increased between 1959 and 1961, due at least partially to an increase in morale caused by the success of the revolution and the land redistribution, but it decreased sharply from 1962-64. According to Che Guevera, the diversification policy led to a decline in agricultural production because no other crop gave profit returns as high as those yielded by the cultivation of sugarcane (McEwan, 1981, 96). A large amount of resources had been expended in the encouragement of crops other than sugarcane, with little to no return on the investments. Additionally, sugarcane had been viewed as the key indicator of the overall condition of the

Cuban economy, so the low sugar output reflected badly upon the new leadership. For the three years of 1962-64, sugar output averaged 4.3 million tons, which was lower than any three year period since 1945-48 (McEwan, 1981, 65). In land reform, about 40 percent of the land initially distributed in the first agrarian reform was returned to or confiscated by the government because the agrarian reform laws were violated.[26] The government had left most middle and some large farm operations intact, and many of these landholders purposely left their lands fallow and contributed to counter-revolutionary operations. Additionally, a problem arose as a result of the improved living standards: consumer demand increased too quickly for proprietors to match in supply. A seller's market arose, speculation increased, and trade through illegal markets became common. To combat these phenomena state functionaries sometimes took actions which negatively impacted productivity.

During the revolutionary time period, the food system became organized at the national scale. The national leadership attempted to increase social equality by redistributing land to agricultural workers; thus, the national scale give organizational power to a larger group of landholders than the group which emerged from the first period. The national government also encouraged diversification in production in order to provide food for the national population. However, production levels declined in this period. While advances were made in social equality during this time period, food production was below expectation, which meant that national food security was not achieved. The reduction of sugarcane for export, combined with the emergence of an ally which shared the goals of the revolutionary government, led the

[26] From a conversation with Juan José León, specialist in International Relations at the Ministry of Agriculture, Cuba, February 5, 2008.

government to rescale the food system to one which focused on export production in exchange for trade currency that could be invested in social programs and development of industry.

C. The Soviet Scale (1963 to 1989)

"The entire economic history of Cuba had demonstrated that no other agricultural activity gives such returns as those yielded by the cultivation of sugarcane… hard facts have shown us, both the errors and the road toward their correction, which is the road the Cuban revolution is at present following in the agricultural sector. Sugar now has the first priority in the distribution of resources and in the assessment of those factors which contribute to the most efficient use of those resources."

Che Guevara, 1964[27]

The state implemented a series of policy changes beginning in 1963 both to combat internal problems which resulted from their earlier policies and to respond to external circumstances which carried Cuba towards a more radical political and economic stance. A second agrarian reform law was enacted in 1963, which redistributed the land that had been confiscated by the government between 1959 and 1963. This reform was intended to further break up large land-holdings, in an effort to give small parcels of land to more farmers. This law expropriated the land of farmers that held more than 67 hectares, which brought over 70 percent of farmland to government control (Alvarez, 2004, 40). The maximum land holding for an individual has remained at 67 hectares to the present time. Small landholders were encouraged to grow a variety of crops, while state farms produced much of the sugarcane and other export oriented crops.

[27] Taken from MacEwan, A. 1981. Revolution and Economic Development in Cuba. Hong Kong: The MacMillan Press Ltd, p 96.

In 1964, national policy renewed Cuba's relationship with sugar. Rather than redistributing all of the newly confiscated land, the government decided to keep much of the land under state control to be farmed collectively. Since sugar production had historically been used as a criterion for the economic health of the country, the leaders decided to embrace sugar production as the way to prove to both the population of the nation and the rest of the world that the revolution was successful. Che Guevera cited three reasons for rescaling the agricultural system from one centered on small landholders that produced a diversified set of crops for national consumption to one focused on state farms and cooperatives that produced sugarcane for export. These reasons were that the geographic-climatic conditions of the island were right for production of sugarcane, that the Soviet Union was willing to enter into a long-term trade agreement by which it would purchase sugar on favorable terms, and that boosting sugar production would be favorable for the revolution ideologically by indicating that agriculture was becoming more successful, which was especially important because reforms had always emphasized increasing living standards for the rural population (MacEwan, 1981, 63-4).

Four different forms of production units were arranged, the main difference being the degree of state intervention, following the second agricultural reform. The state sector contained the large state farms, which produced mainly technology-intensive products which benefit from economy of scale such as sugarcane. The non-state sector consisted of agricultural production cooperatives (CPA) formed of farmers which pooled their private lands voluntarily, cooperatives of credit and service (CCS), an organization formed for farmers who hold lands privately to organize collectively for purposes of shared irrigation, facilities, and services, and the private producers

on small dispersed farms. All forms except for the private producers were required to negotiate contracts with the state for the sale of their products. Preceding the next scalar reorganization which occurred in 1993 in response to the collapse of the Soviet Union, the breakdown of land holdings by agricultural organization for all agricultural lands was 74.3 percent controlled by the state, 11.4 percent by CPA's, 10.9 percent by CCS's, and 3.4 percent by dispersed farmers (Alvarez, 2004, 44). In terms of access to productive resources such as inputs, machinery, and technical assistance, preference was given most to the socialized forms of organization, the State farms and CPA's, and least to the private landholders; these advantages were rationalized because the state had larger contracts with CPAs and state farms than with private farmers.

The revolution had been inspired by fear over the potential of the United States to cut the sugar quota, harvests dependent mainly on this one export crop, and the number of catastrophes which could result from trade with just one country. However, in response to external and internal pressure to prove that the revolution was a success, Cuba quickly fell back into its pattern of co-dependency. In his annual New Year's Day speech, Fidel Castro termed the year 1965 'The Year of Agriculture'. The agricultural plan for 1965 was to boost sugar production. This plan was a tremendous departure from the initial goals of the revolutionists. The Soviets and Cuba were connected through ideology, and so became connected through trade. The Soviets continued the pattern of the United States subsidization of Cuban sugarcane through paying above world-market prices for sugar.

The economic program of the rest of the 1960's was dominated by the emphasis in sugar production. The new goal of the national program was to increase production to 10 million tons in the year 1970. This represented an increase of more than 30 percent over the amount of sugar produced in 1961, 6.8 million tons, which was previously the highest year of production in Cuba's history. Fidel Castro stated the importance of this goal in a speech on March 13, 1968 in saying "The question of a sugar harvest of 10 million tons has been something more than an economic goal; it is something that has been converted to a point of honor for this revolution; it has become a yardstick by which to judge the capability of the Revolution… and, if a yardstick is put up to the Revolution, there is no doubt about the Revolution's meeting the mark." (MacEwan, 1981, 117-8)

While the agricultural sector did grow during the 1960's, the production goals were not met in either the sugar sector or in other parts of the agricultural sector. The 1970 sugar harvest was 8.5 million tons, which was the largest harvest of Cuba's history. This harvest led to a major growth spurt in the economy. But agricultural production per capita throughout the 1962-1970 period had been substantially below the level of the mid-1950's. The poor performance of the economy during the 1960s and the failure to meet the production goal of sugar in 1970 led to serious criticisms of the revolutionary government's theory and practice. But the economy of the early years of Cuba's revolution was subject to much volatility, and most critics of the government found their analyses quickly contradicted. In the early 1970's, Cuba's economy grew very rapidly; from 1969 to 1974, Cuba's gross material product expanded more than 10 percent each year, although the agricultural sector grew only at an average of about 4.5 percent per year (MacEwan, 1981, 123). The commitment

to sugar production had entailed large investments during the 1960's and early 1970's, and the Soviet Union continued to provide favorable terms of trade to Cuba for its sugar. In 1972 Cuba became a part of the socialist trade bloc, the Council for Mutual Economic Assistance (COMECON), which had been organized by the USSR. The country's economic focus remained on sugar production throughout the 1970's and 1980's.

Trade patterns were so beneficial to Cubans that most food for consumption was imported, and farmers mostly produced export-oriented crops. By 1980, Cubans were dependent upon imports for 70 percent of their food consumption (Alvarez, 1994, 168). Cuba received an average price for its sugar exports that was, on average, 5.4 times higher than the world market price during the 1980's (Nicholls et. all, 2003, 2). Cooperatives and private farmers had small contracts with the state and were able to sell most of what they produced on the private market. While the food provisioning system was mostly organized at the national level, it was organized in cooperation with an allied power, so during this time period the food provisioning system was organized at both the national and the international level. Additionally, individual farmers did have some say in what they produced, but they controlled a small percent, around 3.4 percent prior to next reorganization in 1993, of the agricultural land.

Despite the outward appearance of contentment with agricultural policy, there was a deep divide between agricultural policymakers and some agricultural scientists. Farming practices used in the Soviet Union were characterized by industrialization and monoculture. Soviet bloc advisors recommended the same pattern of

development for Cuba, and as a result, in the 1980's Cuba had a more mechanized agricultural sector than any other country in Latin America. As an outcome of the national education project enacted by Castro and his administration in the 1960's, Cuba had a well educated population with many scientists. Many of the scientists engaged in agriculture research were unhappy with being dependent on outside sources for food production and agricultural inputs and were also disillusioned by the environmental degradation caused by traditional modern agriculture. Some Cuban agro-scientists had been working on less intrusive methods of pest control and soil improvement. Despite the success that had been realized in experiments with alternative pesticides, little was done with this information until the late 1980's. With signs that the trade partnership with the Soviet Union could falter, Cuban policy began to support the principles of bio-control agents.

At the time of the collapse of the Soviet Union, the food provisioning system in Cuba was organized at the national scale and heavily dependent upon an international trade partner for both a export market for its agricultural production and an import market for the tools of production and food for consumption. Castro's alliance with the U.S.S.R. had allowed him to achieve the primary goal of increased social equality, although the method for achieving his agenda had radically changed from building a national economy to building a stronger, but still dependent, economy. Evidence of the nation's increased social equality is that between 1965 and 1988-9 the daily caloric intake per capita increased from 2,500 to 2,898; life expectancy increased from 55 to 73 years; and infant mortality decreased from 44 to 13.6 per 1000 births (Rosset and Benjamin, 1994, 10). It is estimated that the majority of Cuba's population had access to only 1200-1300 calories per day prior to the

revolution (Rosset and Benjamin, 1994, 23). Greater equality in food distribution was achieved through the wage policy of a 5:1 spread in wage levels instituted by the government, whereby the highest-paid workers could earn no more than five times the amount of income as the lowest paid workers, and by the food rationing policy which ensured that access to food was not determined by class (Rosset and Benjamin, 1994). By 1989, Cuba ranked first in Latin America and eleventh in the world in the Overseas Development Council's Physical Quality of Life Index (which includes infant mortality, literacy, and life expectancy), while the USA ranked fifteenth (Rosset and Benjamin, 1994, 11). Because of the relatively favorable terms of trade, the Cuban economy did not develop along the program of resource extraction and export to first-world countries to the extent that the other Latin American and Caribbean economies did. Cuba was able to partially escape from the 'uneven development' trap in which in which developing countries contribute to the prosperity of developed countries while failing to achieve a higher standard of living.

The political leadership of the revolution achieved their goal of improving social equality, primarily by leveling the social injustices that had been caused by the prior agricultural structure. Although food production and distribution was organized by individual landowners prior to the revolution, the trend during this four hundred year period was to increase consolidation of landholdings while the majority of the population experienced a declining ability to access food and other basic necessities. While there was certainly a faction of Cuban citizens who were unhappy with the changes made by the revolutionary government, the food provisioning system which emerged from the rescaling of the revolution was arguably more socially just than the previous system for the majority of the population thanks to national controls on land

holdings and food distribution. However, it was not more environmentally sustainable, due to increased mechanization and dependence on agrochemicals.

D. Scalar Findings

"I am against privatizing things that should be for public use. Now, the government owns the land and decides what is produced. But, the people who work the land should be the owner of 90% of what they produce. There shouldn't be an extreme between who the government and the farmer (public or private) but something in the middle. You cannot give prices total freedom, because that would make the people poor. I know people whose land does not produce anything. It is the government's responsibility to make sure that all people have enough food; they have to produce for the schools, universities, and hospitals which are run by the state."

Greco Sid, Institute for Irrigation Research, 8 February 2008

This historical analysis of Cuba's food provisioning system shows that outcomes are not determined by a particular scalar arrangement but rather by the agenda of the social groups which pursue the arrangement. The profit-based agenda of the food system as it became organized during the time of Spanish colonization came at the price of slavery and environmental degradation through clearing forests. During the time dominated by US relations the price was poor conditions for agricultural workers and further environmental degradation. In both cases the general trend during this period was for landowners to cater to international interests rather than developing a socially just and/or environmentally sound system, leaving a disenfranchised majority out of decision-making about food provisioning. During the revolutionary time period, the food system was organized at the national scale; the primary goal of decision-makers at this scale was to increase social justice. To achieve the goal, the government distributed land to farm workers and empowered a new class of landholders. However, the government saw a new opportunity to achieve their primary goal of increasing social equality by allying with the socialist trade bloc. In

the third period, the government prioritized sugar cane production in order to gain currency to invest in social programs. In this period, the food provisioning system was still organized at the national scale, but the decision-makers at the national scale allied with a new international interest group and geared production towards sugar cane for export. While the scale of food provisioning had returned to producing export products and importing food, decision-makers at the national and international scales had the same agenda for improving social equality. This scale resulted in more equitable food provisioning and better conditions for agricultural workers but it also resulted in reduced environmental sustainability.

The argument for localization rests on the premise that devolution of power to a local scale will always result in desirable social and environmental outcomes compared to arrangements where decision-making occurs at larger levels of scale. From the examples given by these three historical periods, we can see that this is not always the case. Over the first period the decision-makers at the local scale produced for international interests, and for both groups the goal of production was profit. During the second period a national scale empowered a larger group of people at the local scale in an effort by both groups to increase social justice within the nation. In the third period the national scale again organized production systems with the goal of increasing social justice, but this time produced for international trade partners and used profit to increase social justice. The goal of the decision-makers of the second and third scalar organizations was to increase social justice, and the food system did become more socially just between the first and third periods discussed in the case study. It did not, however, become more environmentally sustainable, as sustainability was not a goal of decision-makers. Thus, the case study also shows

that systems which are socially just are not necessarily environmentally sustainable. Thus, the case study shows that outcomes of scalar arrangements are produced by the agenda of the decision-maker rather than through scales of organization.

Finally, this historical analysis provides an example of the way that scales do not exist in isolation; in the first period landholders had power to make decisions about production, yet their decisions were heavily influenced by powerful interests at the international scale. Many small and medium-scale landholders who provisioned food for themselves or their communities had their interests trumped by the agenda of export-based producers and corporations and were forced or chose to sell their land. Those landholders who followed the agenda of national interests were given increased power, and this cycle reinforced the trend during this time period of increasingly creating monoculture farms that produced products for international export at the expense of meeting the needs of the majority of the national population. During the second period of analysis, a new national leadership reorganized the food provisioning system by giving organizational power to a larger number of farmers. However, because of actions performed by people and groups of people, spanning the range from the level of production to international governments, the leadership of the nation again reorganized the food provisioning system. The following arrangement, during the third period of analysis, was organized by the national government, but the decision-makers at the national level, similar to those at the local level in the first period, had their decisions shaped by the interests of their international trade partners. Finally, because the interests of these trade partners changed, Cuba was forced to reorganize their food system a fourth time. I will focus the analysis of this next period of rescaling, the Special Period, on the relationships

which developed among scales of organization when the agenda of the decision-makers at all scales was to create an ecologically sustainable and socially just way of producing and distributing food.

Chapter 4: Food Provisioning in the Special Period

"While it is currently fashionable to deride central planning (not to be confused with centralized production), it is clear that the highly organized nature of Cuban society greatly facilitated the collaboration necessary to rapidly develop new technologies and bring them online in production quickly enough to stave off the sort of famine that most countries would be faced if they lost 85 percent of their foreign trade and assistance overnight."

Rosset and Benjamin, *The Greening of the Revolution*, 1994[28]

Despite the revolutionary government's goal of reducing economic dependence on another country, throughout the 1960's, 70's, and 80's, Cuba became heavily dependent on the Soviet Bloc for all aspects of their economic system, including agriculture and fuel. The Cuban government had some forewarning during the late 1980's that the socialist trading block on which it was heavily dependent was faltering; many Eastern European countries had reneged on trade agreements in the late 1980's, and throughout the 1980's the USSR increased the price for oil. The price increases for petroleum declined terms of trade between the USSR and by Cuba nearly 30 percent over the decade (Rosset and Benjamin, 1994, 20). With the collapse of the Soviet Bloc and its economic union (COMECON) Cuba lost its trade partners, and with the loss of trade capital the country lost the ability to purchase petroleum, machinery, and other inputs needed for its system of industrial agriculture.

Effects from the collapse of the Soviet Union extended beyond the immediate need for trading partners to the reformation of the socialist agenda. Because Cuba was no longer a part of the Soviet project, it became an island both physically and politically. The United States began to tighten its trade embargo policy on Cuba in the hope that

[28] Taken from Rosset, P. M. and M. Benjamin. 1994. *The Greening of the Revolution: Cuba's experiment with organic agriculture*. Melbourne: Ocean Press.

the starving population would revolt against Fidel Castro and push for new form of government with a new amendment to the trade embargo, titled the Cuban Democracy Act, which was approved in 1992. This Amendment extended the US trade embargo to overseas subsidiaries of US firms and also prohibited ships that had docked in Cuba in the previous 6 months from entering the United States. In 1996, the embargo was tightened with the new Helms-Burton act, which further restricted foreign investment in Cuba.

Due to the severity of political and economic constraints, Fidel Castro had the responsibility of constructing a new socialist agenda which could only take the form of a national program; an internal economic system had to be created. The initial plan made by the government in response to the impending collapse of the Soviet bloc was to increase national production of food and reduce dependence on imported food and agricultural inputs. At the same time, the government wished to maintain export crop levels in order to generate some foreign currency. These goals conflicted with each other, and both were difficult to achieve with reduced levels of chemical inputs, less tractor power, less irrigation, and a reduced ability to transport food.

The initial reformations made by the government to adapt to the Special Period focused on researching and distributing knowledge of input substitutes for agrochemicals, implementing a soil management program, mobilizing labor, promoting a new science of agriculture, and strengthening measures to guarantee food access to all of the population. In 1989, the Cuban government started the National Food Program. A priority of the National Food Program was to make the

area around cities, particularly Havana, as self-sufficient as possible. The government also began taking immediate steps to reduce the need for imported production inputs, such as importing hundreds of thousands of oxen to substitute for tractors which could not be operated due to lack of fuel and spare parts, ordering a national soil survey to determine what areas most needed fertilization, and strengthening the pre-existing national pest monitoring system to reduce the need for pesticide use. The shift to this alternative model was “at the heart of issues of national sovereignty – being regarded as a way forward for Cuban agriculture as well as the citizenry’s desire to achieve non-aligned economic independence” (Vandermeer, 1993, 5).

For help implementing the new system the government leadership turned to the agricultural scientists of Cuba. As discussed in the previous chapter, many agricultural scientists in Cuba were disillusioned with industrial agriculture due to the external economic dependency and the environmental damages that this style of agriculture fosters. During the Special Period a window of opportunity had been opened for the agricultural scientists in favor of techniques of low input sustainable agriculture. A group of professors including academics and researchers joined together at the Agrarian University of Havana (UNAH) in 1992 to discuss low input farming in Cuba. They formed a group called the Asociación Cubana de Agricultura Orgánica (Cuban Association of Organic Agriculture, ACAO). This group was the main force for integrating agroecological production systems into the government program of reducing overall dependence on off-farm chemical and inputs and machinery. The group, headed by Fernando Funes and Maria del Carmen Pérez, won the Right Livelihood Award (alternative to the Nobel Peace Prize), ”…for

showing that organic agriculture is a key to both environmental sustainability and food security."[29] Many scientists had been pushing for policy change for years, some even for decades, and "suddenly these scientists found themselves at the top of political and administrative agendas" (Rosset and Benjamin, 1994, 75). Funes (2002) refers to the changes that took place during the Special Period, which officially ended in the year 2000, as "the first phase" in the transition to sustainable agriculture; while the government sponsored programs for production for national consumption and manufacture of biological inputs, the government did not officially adopt sustainable agriculture as a national policy until 1997.

Development of biological inputs fit well with the government's economic development program larger vision to develop and export technological expertise. This vision was already well established within the medical industry; in the 1980's, the Cuban government had invested an estimated $12 billion in developing human capital and infrastructure in biotechnology, health sciences, computer hardware and software, and robotics (Rosset and Benjamin, 1994, 27). Between 1990 and 1996, despite the severe economic crisis, the government invested 1 billion dollars in biotechnology (Lopez et al., 2002, 1). The government's strong focus on scientific training and technology development was thus extended to the agricultural industry.

This chapter explains the major steps taken by educators, scientists, the government, the people of Cuba, and the international community in order to create a new national food provisioning system based on ecological farming of crops produced with a focus on national consumption. Section A discusses the immediate

[29] Taken from http://www.rightlivelihood.org/gao.html.

changes made to production. Section B discusses the social measures taken to adapt the system. Section C discusses the way that changes were coordinated among local, regional, national, and international scales. Section D provides a mini-case study of the UBPC Alamar to show linkages between the cooperative and the places with which it interacts. Section E provides an overview of the outcome of the Special Period. Finally, Section F describes the conflicts of this new system and the reformations which are being discussed to counter these conflicts. Unless otherwise noted, the information contained in this chapter comes from a series of informal interviews that I conducted in conjunction with a research delegation sponsored by Global Exchange in February 2008; Appendix C lists the dates and participants of these interviews. See Appendix H for a summary of the roles of major government agencies involved with the food provisioning system during the Special Period.

A. Ecological Farming

"Apples are host to a wide variety of pests and blights, and if you want advice about what chemical to spray on them, the local agricultural extension agent has one pamphlet after another with the answers, at least in part, because pesticide companies like Monsanto fund huge amounts of the research that goes on at land-grant universities. But no one could tell my poor orchardist anything about how to control the pests on his apples, even though there must have been a huge body of such knowledge once upon a time, and he ended up relying on a beautifully illustrated volume published in the 1890's. In Cuba, however, all the equivalents of Texas A&M or the University of Nebraska are filled with students looking at antagonist fungi, lion-ant production for sweet potato weevil control, how to intercrop tomatoes and sesame to control the tobacco whitefly, how much yield grows when you mix green beans and cassava in the same rows (60 percent), what happens to plantain production when you cut back on the fertilizer and substitute a natural bacterium called A. chroococcum (it stays the same), how much you can reduce fertilizer on potatoes if you grow a rotation of jack beans to fix nitrogen (75 percent), and on and on and on."

Bill McKibben, The Cuba Diet: What will you be eating when the revolution comes?, 2005[30]

[30] Taken from *The Cuba Diet: What will you be eating when the revolution comes?* Harper's Magazine, April 2005, 61-69.

Biological Controls

Biological control was originally defined in 1964 by Paul DeBach as “the action of parasites, predators, or pathogens in maintaining another organism’s population density at a lower average than would occur in their absence” (Altieri, Rosset, and Nicholls, 1997 303). As envisioned by its original proponents and practitioners, ‘Integrated Pest Management’ (IPM) was a system of managing and diversifying agricultural systems so that pesticides would be used only in ‘emergency situations’ (Altieri, Rosset, and Nicholls, 1997, 304). This vision eroded, and now when biological controls are featured in IPM programs in monocultures, they are often used as a strategy to “patch up” monocultures rather than playing a natural role in a diversified agroecosystem. In this way they are used as a substitute for agrochemical inputs, and have a diminished capacity to help develop a sustainable system (Altieri, Rosset and Nicholls et al., 2002). Throughout the world, an input substitution industry is emerging and internationally funded IPM programs, government extension agents, and commercial sales representatives urge farmers to use products based on biological control methods, such as Javelin®, which may cost 150 US dollars a liter, or Avermec®, which may cost more than 400 US dollars, because these products are safer and often are more effective, than chemical insecticides (Rosset, Altieri, and Nicholls, 1997, 307). For farmers in both the first and third world, commerical products are not an alternative to chemical inputs due to their high cost.

Cuba’s system of agriculture has followed the historical trend of using biological controls to fix problems with monoculture based agricultural systems rather than developing diversified systems. Cuba’s use of biological control methods dates back

to the 1930's, when parasitoids were evaluated as controls for the sugarcane borer and the citrus blackfly. In 1930 a parasitoid fly, *Lixophaga diatraeae*, began to be used against the sugarcane borer. However, in the 1940's agrochemicals were introduced to Cuba on a wide basis and quickly became the main source of pest management for most crops. For sugar production, however, *L. diatraeae* was found to be an effective biological control to be used against the sugarcane borer and in 1954 six laboratories were built to rear the parasitoid fly. Also in 1954 MINAG created a National Biological Control Program (Nicholls et al., 2002, 2). These labs became six regional centers which experimented with other insect-based predators of parasitoids, known as entomophages. In 1960, the first biological control based on an entomopathogen, which is an organism (such as a fungi, bacterium, virus, or protozoan), appeared on the market (Nicholls et al., 2002, 2).

While some biological controls were used, during the 1960's and early 1970's Cuba sprayed pesticides on a regular schedule rather than on an as-needed basis. In the 1970's the State Plant Protection System was established by MINAG with the help of the Soviet government so that the nation was able to model the threats for each region to control principle plant crop pests and diseases. The system was developed to monitor resistance to pesticides in pests and pathogens. To monitor resistance, a set of research centers were developed. These centers grew crops that were important to the local area. The researchers sampled each crop periodically for the onset of pests and diseases, and recorded crop phenology, pest phenology, disease onset and development, and crop yield data. As resistance was found to particular a particular pesticide the pesticide would be taken out of used and replaced with other control methods in the area of the research center. Reports from the local centers

were compiled at provincial centers, analyzed, and then sent to a national center. The data collected was used to develop pest management programs which determined how often pesticides needed to be sprayed. In 1975, the first year of its existence, the program reduced national pesticide consumption by one half; use of pesticide reduced from 40 thousand tons of pesticides in 1974 to about 18 thousand tons in 1975 (Pérez, 2002, 110).

Use of biological controls to combat pests in monoculture production increased during the late 1970's and early 1980's. Still, many agricultural scientists expressed concern over the high degree to which Cuba's food provisioning system depended on imports for both food and production inputs. Several members of the 1992 Global Exchange delegation met representatives of scientists and technicians in 1982; these researchers reported that the representatives they met with were increasingly concerned over the impacts of modern agriculture to human health and the environment as well as its long-term viability (Vandermeer et al., 1993, 3). However, many agricultural scientists were still in favor of chemical methods, and little effort was made to put the knowledge gained through research of biological controls into practice. Much of the leadership of Cuba associated modern agriculture with 'progress'. In fact, Fidel Castro is reported to have once cited the amount of pesticides used in the country as evidence of Cuba's progress (Vandermeer et al., 1993, 2).

The same leadership, however, that promoted chemical agriculture and a move away from agriculture to industry was forced to rapidly change its position. A substitute for chemical inputs was clearly needed as the relations between Cuba and

the Soviet Bloc changed, and experiments with biological control methods, particularly during the 1980's, had shown impressive results. In 1989, the government created a new National Program for the production of biological agents and began to quickly expand the already existing network of laboratories which raise entomopathogens and entomophages, (called Centers for the Reproduction of Entomopathogens and Entomophages – CREEs). The CREEs produce microbial products for local use and low prices. By 1992, 227 CREEs had been built for decentralized production, 29 biopesticide plants with semi-intensive reproduction techniques were created by using brewer's yeast factories on their idle days (these factories had previously been in use for only four days per month), and one pilot plant w/ industrial techniques was built to experiment with large-scale production (Nichols, 1997, 4; Rosset and Benjamin, 1994, 41).

During the Special Period the use of entomopathogens as biopesticides significantly accelerated. The initial plan of the government was to create centralized input substitution production centers, but due to transportation logistics during the Special Period, a center was developed in each municipality. The biopesticides take advantage of the most adequate but locally abundant substrate; for example, *Bacillus thuringiensis* (Bt) is produced with fruit juices, and rice production waste is used in fungi production (Nicholls et al., 2002, 7). By 1997, 280 CREEs had been developed. These centers, together with the industrial plant, covered most of Cuban's requirements for bio-pest control agents (Nicholls, 1997, 4). Another form of biological control that is widely used is insecticidal plants such as the Neem tree, which boost the immunity of some crops for a wide variety of infections. In the

production and use of entomopathogens Cuba has a lead over many countries in the world, developing or developed (Rosset, 1997).

Additionally, the State Plant Protection research project was expanded. Farmers were trained to collect data, and these farmers worked in conjunction with researchers to plan studies and record results for biocontrol products and sample crops for pests and pathogens. This collection method increased data collection and involved farmers in planning for pest control. The data is compiled at the national level and the government includes all data to predict pest problems for the following year so that appropriate plans can be made for pest control production and the products can be most appropriately allocated according to local and regional needs. Farmers also use the data they collect to help researchers develop new solutions to pest problems.

Soil Management

One of the first steps that the government took during the Special Period was to reclassify soils for the whole nation. A map was created at the scale of 1:250,000 by national scientists, followed by more detailed maps at the scale of 1:25,000 with input by farmers, in order to facilitate sustainable management throughout the nation (Rosset and Benjamin, 1994, 52). There is great variation in soil productivity among the 14 provinces. Maps are used to centrally plan production so that each region grows the crops best suited to each locations climate and soil type. Areas with low fertility are given priority in fertilization and soil restoration efforts. See Appendix J for a map of soils by type and ‘agroecological’ zones in Cuba.

Soil management was transformed from chemical application of fertilizer to an integrated plan for the conservation of soil. Products based on biological control have been developed to substitute for chemical fertilizer as well as for pest management. Chemical fertilizer was replaced by biofertilizer (microbial products), earthworm and other forms of compost, other organic fertilizers, natural rock phosphate, zeolite, animal and green manures, and other soil amendments (Rosset, 1997, 53-4). Cuban researchers have evaluated minimum fertilizer input needs and have coordinated intra-institutional efforts to produce fertilizer in Cuba to meet those needs.

By 1992, Cuba's biofertilizer program was able to make up about 30 percent of the deficit of fertilizer inputs (Rosset and Benjamin, 1994, 56). Biofertilizers in Cuba are produced by a wide variety of techniques, including Nitrogen-fixing organisms such as *Rhizobium innoculum* and Azobacter, bacteria of the genus *Bacillus* to promote the solubilization of phosphorus in soils with high contents of aluminum and iron oxides, and *Vesicular Arbuscular Micorrhizae* (VAM), a fungi that penetrates roots and helps with uptake of phosphorus and other nutrients (Rosset and Benjamin, 1994, 56-7). By 1992, The National Soils and Fertilizers Institute (CNSF) produced 80 percent of the nitrogen required by leguminous crops, 40-50 percent of the nitrogen needs of non-leguminous plants, and had identified 53 species of VAM in Cuba (Rosset and Benjamin, 1994, 56-7).

Vermaculture, which is Earthworm humus, is another widely used source of fertilizer. Cow manure is used to feed the earthworms, and the resultant compost is mixed into the soil or used as top dressing on the farm. Cuba's vermiculture program started in 1986 with two small boxes of redworms and five experimental stations in different

parts of the county which were responsible for training new worm growers in their regions. In 1992, 172 vermiculture centers existed that produced 93,000 tons of worm humus. (Rosset and Benjamin, 1994, 59). In addition to its use in fertilization, the earthworm excrement as a substrate for bacteria can be used both as a biofertilizer and a high-protein supplement animal feed. The worm humus also provides an important source of additional income through sales to farmers in the area of production. There is high demand for the product from urban agriculture producers in cities. The compost is sold in both Cuban and convertible pesos. Technical knowledge of vermiculture production is also contracted out to help farmers in other countries establish their own production systems.

Diversification

While many export-based crops, such as sugarcane and tobacco, are grown in monoculture form and rely on biological controls, the diversification of agroecosystems is a key strategy in food production. Diversification means using a variety of seed types and promoting plant-plant and plant-animal synergisms within the farm, thus using ecological services to minimize the use of external inputs. Cuban scientists are using intercropping and crop rotation to increase the amount of available nutrients to plants and to reduce pests and disease. Cuban scientists and farmers are experimenting with combinations of crops with grasses and legumes as green manures. One significant early development came from interplanting soybeans with sugarcane. Soybeans were used for animal feed, which had been reduced by about 30 percent at the start of the Special Period, and intercropping reduced the

nitrogen fertilizer use in sugarcane (Rosset and Benjamin, 1994, 58). Combining legumes with food crops also reduced erosion by protecting the soil surface.

System Efficiency

Another important adaptation to agricultural production was the adoption of the policy to increase efficiency by using all byproducts for a secondary purpose. Recycling nutrients from of plant and animal wastes provided an important key to fertilization. In addition to fertilization, sugar cane byproducts were used to produce energy, animal food supplements, and irrigation water. Livestock breeds were chosen for their adaptability to the climate and vegetation, and in this way required less material input. At the beginning of the Special Period many cattle died due to lack of feed; Cubans had primarily been using Holstein cattle, which do not survive well on Cuba's native grasses. A national program began to breed cattle which can survive in the climate by feeding on natural grasses. In response to feed shortages, cattle began to be managed through a technique called Voisin Rational Pasture Management, developed in the 1960's by a French immigrant to Cuba. The technique uses movable electric fencing to confine cattle to small pasture areas so that their manure re-fertilizes the forage plants; the enclosures are then moved around the field on a tight schedule. There was also an effort to promote pork as the principle source of protein, which could be produced at large-scale production centers, as the liquid and solid byproducts were used as material for many applications, including vermiculture composting material, biogas energy, supplemental animal feed, and aquaculture (Rosset and Benjamin, 1994, 62).

Appropriate Technology

In addition to the use of modern scientific techniques and recovery of traditional methods for production, Cuba has instituted a focus on appropriate technology. Appropriate technology is technology that is designed with special consideration for the cultural and economic needs of the place that it will be used. Due to petroleum and part shortages, tractors could not be relied upon during the Special Period. In 1991, MINAG and the Ministry of Sugar (MINAZ) established a new program promoting the use of draft animals as a replacement for tractors, providing an initial supply of 100,000 bulls by 1992, and an additional 100,000 by 1995 (Rìos and Ponce, 2002, 156). The use of oxen was necessary due to shortages in petroleum and spare parts for tractors, yet it also reduced soil erosion. Similar to tractors, rototillers, machines which are commonly used to till small areas, were not used, but in substitute, discs, rotation discs, and a Cuban-engineered tiller called a multi-plow were used. These tillers were made locally and drawn by ox. While the animal traction and tilling equipment used was not as labor efficient as machines run by petroleum, it did provide substitutes while petroleum was not available and provided ecological benefits as a bonus.

Reforestation

Finally, an effort has been made to restore the health of soil through reforestation. Trees have been planted to help recover and restore farmland that was damaged by the decades of intensive Green Revolution Technology and also land that was damaged through intensive mining activities. In a program called ‘Plan Manati’, the government provides plastic bags and seeds to interested people who plant and care

for trees in degraded areas. Similarly, the City of Havana sponsors a program called 'My Greener Havana', aimed at planting trees in open spaces in Havana. In 1989-1990, over 200,000 hectares were reforested – in 1992, 18 percent of Cuba was covered with forest, which was a net increase over the 17 percent of forest land in 1959 (Rosset and Benjamin, 1994, 65). The increase in forestation sharply contrasts the trend for most developing countries over this time period

B. Social Adaptations

"As a general process agrarian reform cannot be limited to unilateral actions in the sphere of production – commercialization, techniques, etc. It should rather unite such efforts to other equally necessary forms of action: deliberate, systematized, planned, cultural transformation. Hence, in agrarian reform in Chile, the "settlement", precisely because it is a production-unit (I repeat that production does not exist without the man/woman-world relationship), should also be a pedagogical unit, in the broad sense of the tem. This pedagogical unit is one in which the educators are not only those who happen to work with what is usually termed education but are also agronomists, administrators, planners, researchers, peasants – in fact all those who have some connection with the process.."

Paulo Freire, *Education for Critical Consciousness*, 130-1

Bioinput Production

The CREES program provides one example of the social benefits that can be derived from ecological farming practices. Cuba has recognized tremendous economic benefits from the production of bioinputs. In 1991 national spending on chemical pesticides was $80 million per year, but through the adjustments to farming practices spending was reduced to $30 million per year by the end of the special period (Nicholls et al., 2002, 13). Additionally, the formation of CREEs has contributed to social benefits such as creating job opportunities and reducing the negative impact of chemical pesticides on the population's health.

Some, but not all, production units produce bio-inputs. Farmers that don't directly produce inputs contribute by selling waste products such as manure to the CREEs. Each municipality in Cuba contains a CREE that produces for farming units at the municipal level. While the first CREE centers were government research institutions, the CREEs built during the Special Period developed from a combination of grassroots effort and government support. Government support ensured that no municipality was excluded from the ability to purchase local biocontrol products.

From Nicholls (2002, 14), the factors that account for success of Cuba's IPM program are:

- High level of education and significant numbers of IPM professionals directly involved in research and implementation
- Organized nature of rural Cuban society, especially the spread of cooperatives
- Broad collaboration, exchange and partnerships among institutions, researchers and farmers
- Supportive governmental policies
- Extensive infrastructure of CREEs

According to Rosset and Benjamin (1994), by 1992 Cuba was already receiving worldwide recognition for plant protection research and application. Cuban government agencies and NGOs are now exporting knowledge about how to set up CREEs centers and monitoring projects to many Latin American countries, expanding the country's reputation as a leader of biotechnology to agricultural technology (Nichols et al., 2002, 14; Altieri, Rosset, and Nichols, 1997, 308; Funes, 2002).

Labor

In addition to the education programs designed for biocontrol preparation, the government implemented a series of reforms to adapt the workforce to the new system of production. As noted in the previous section, Cuba's alternative method of agriculture is a low input system in terms of petroleum, chemicals, and finances. The inputs that are required for Cuba's alternative system are labor and knowledge. Unfortunately, finding agriculture laborers was a problem. In 1956, 56 percent of the population was rural; by 1989 only 28 percent was rural (Wolfe, 2004, 2). The revolutionary government had formerly promoted gardening as something done in underdeveloped countries, not as work for Cubans (Rosset and Benjamin, 1994). In their study of Cuban food security in the 1980s, Benjamin et al. (1984, 43; Chaplowe, 1998, 49) said that "Urban Cubans seem to feel it is the government's job to provide food: to them, urban vegetable gardens smack of underdevelopment." Thus, to city dwellers, progress was linked to moving away from rural areas and agricultural work. Also, agriculturalists had been taught that modernity meant industrial technology; to promote agroecological principles, the popular conception of what progress meant had to change.

Initially, incentives in the form of good housing and high pay were given to workers who were willing to move to rural areas and work in the field of agriculture. The government built a series of planned communities in rural areas which contained community centers and newly built houses. Another way of creating a labor supply was to ask Cubans to volunteer as agricultural labor for a time period ranging from for two weeks to two years. Labor camps were built to house urban workers who

“volunteered” their time while being paid at least their normal salaries. A further arrangement, the Turquino Plan, made agriculture work necessary for the completion of military service that is mandatory for males. These plans helped supply some labor, but they did not cover the needs of production. Instead, two significant changes in the style of production greatly helped to ease the severe labor shortage present during the early years of the change to the alternative system: these changes were the development of urban gardens and the restructure of land tenure.

Self Provisioning

One major boost to the labor supply came from people self-provisioning. The self-provisioning arose both spontaneously and through the support of the government. People were hungry, and they grew food where they could. To help them, the government set aside land on all farms for self-subsistence production; on this land, the farmers had the opportunity to grow food for themselves and their families rather than for the state. Usufruct land was also guaranteed to be available by the government for any citizen who wished to grow food for self-provisioning. By law, all residents of urban areas are provided with the opportunity to farm up to one-third of an acre of vacant land. More than 190,000 people had applied for and received these personal lots by the end of the Special Period. Also by law, all production in urban gardens is organic to protect the health of the people living in urban areas.

Four types of gardens were officially promoted during the Special Period. These include:

1. Organiponicos are intensive production sites generally located in areas with infertile soils or other constraints to production. They are often built on raised beds filled with organic matter substrate and soil.
2. Autoconsumos are gardens cultivated by an institution or workplace on state land for consumption in the work place and sometimes for the families of the workers.
3. Popular gardens are private gardens cultivated on state land by individuals or communities. They emerged during the Special Period.
4. Private gardens are small plots that exist in small arable spaces in between buildings, houses, and streets, on patios.

In 1994, the government created the Department of Urban Agriculture to support the efforts of urban farmers. According to Chaplowe, (1998, 55), who visited 24 gardens in Havana from 28 July to 24 August 1995, “the urban gardens of Havana are not only endorsed by, but are a product of the state”. As urban gardens were established, MINAGRI (the regional division of MINAG) sponsored education about gardening through extension agents, television shows, and radio programs. Urban gardeners began to form clubs in the early 1990’s to share knowledge. The success of these clubs prompted the government to extend them to each urban municipality in Cuba to establish communication links between urban gardeners and farmers, and linking them to extension and technical assistance, research, educational, and service centers. The Institute for Tropical Plant Research (INIFAT), the oldest research institution in Cuba, was given the responsibility to help coordinate the urban agriculture program. In each municipality, services for urban agriculture were coordinated by the Municipal Urban Farm Enterprise.

In addition to helping reduce the labor shortage, urban gardens solved another problem. The lack of petroleum caused difficulties with transportation, refrigeration, and storage of food from rural to urban areas. Havana was designated as a top priority area in the National Food Program due to the challenges of feeding the city population of 2.5 million people which had formerly depended on food imported

internationally and from Cuba's rural areas. In 1994, as the urban gardening program began, 400 tons of produce were grown in urban centers throughout the country[31]. By 1996, Havana's urban farms provided the city's urban population with 8,500 tons of agricultural produce, 7.5 million eggs, and 3,650 tons of meat (Altieri et al., 1999, 131). By 2004 over 104,000 private gardens in the form of parcels and patios were under production in Cuba, covering an area of more than 3,600 hectares (Wolfe, 2004, 7). Currently, an estimated 90 percent of Havana's produce comes from inside the city, and in most other Cuban towns and cities urban gardens produce from 80 percent to more than 100 percent of what they need[32].

Restructure of Land Tenure

Another major boost to labor productivity stemmed from a pilot program called 'Vinculando el Hombre con la Tierra' (linking people with the land), which began prior to the Special Period on several state farms. This program made each worker responsible for a specific plot of land rather than a specific task, which resulted in great increases in productivity. For years it had been apparent state farms were the least successful unit of organization, state employees rotated between farms. It was clear that state farms were inefficient was because the workers performed a task on a farm and likely never returned to see the fruits of their labor. Nevertheless, no major land tenure reforms occurred until 1993 because the political leadership considered socialist production to be the most desirable form of agriculture.

[31] From discussion with Rosalía Gonzolaz, INIFAT, February 6, 2008.
[32] From discussion with Rosalía Gonzolaz, INIFAT, February 6, 2008.

In response to the success of the Vinculando program and the relative success of the peasant sector and cooperatives, the Cuban government terminated the existence of state farms in 1993. Between 1993 and 1996, arable land held by the state decreased from more than 75 percent to 33 percent (Martín, 2002, 59). Most of the land held in state farms was turned into Basic Units of Cooperative Production (UBPCs), a form of worker-owned enterprise or cooperative. These units operated in a similar way to CSA cooperatives but were granted in usufruct[33] to those who had previously worked on the state farms. The UBPCs allow collectives of workers to lease state farmlands in permanent usufruct. Property rights remain in the hands of the state, but the cooperative is charged no rent for the land. The cooperatives produce a set of key crops for the state, but the collectives are owners of what they produce. Members of the cooperative elect management teams that determine the division of jobs, what crops will be planted on which parcels, how much credit will be used for the purchase of inputs, and how pay will be divided among the workers. The reorganization of production began with state sugar enterprises during the harvest of December 1993. Between September and December of that year, 1,576 sugar-cane UBPCs were formed encompassing 87 percent of the land previously held by the state sugar agro-industrial complexes; by the end of 1994, the cane and non-cane UBPCs held 40.6 percent of Cuba's agricultural land, and state enterprises formed 29.8 percent of the total (Deere, 1995, 14). With the exception of creating the UBPC's, the basic structure of the farming system did not experience major changes. Some state farm lands remained under control of the state in order to produce items

[33] Usufruct is the legal right to use and derive benefit from property without ownership; in Cuba, usufruct land used by UBPCs and individuals is held by the government but used by entitled people or organizations.

requiring expensive machinery or infrastructure, such as large-scale swine production. Reorganization was meant to promote decentralized decision-making regarding production while still allowing centralized planning in areas of biological diversity, pest control, and water and other resource management (Wolfe, 2004). See Appendix I for a summary of the structure of production units as it emerged from the Special Period.

The government provides accountants, lawyers, and doctors, to state farms and cooperatives. Most cooperatives are requesting these services. Lawyers arrange the contracts between the production units and the State, and for any contracts that the production units have with other entities. Many farms have contracts with the hospitals, for example, as well as with MINAG. Their job is mainly advising and legal representation. If a worker is not doing his/her job, disciplinary action is taken. Lawyers also negotiate actions with extension and support services. Doctors live near the farm and serve as the doctor for all of the workers and their families. Accountants help with the production plans, and for cooperatives, keep track of profit for division among the workers. Production plans are generally written by the workers of the farm, but must be approved by the overseeing branch of the state so that food needs may be coordinated at regional and national scales.

Market Reform

On October 1, 1994, 121 farmers' markets opened in Cuba. The urban agriculture and UBPC production units needed an outlet for production that exceeded the contracted amount. With the exception of private and popular gardens, all farmers sold a portion of their production to the state marketing board. The amount of food

that the farmers produce above their contracted amount with the government can be sold in the marketplace for ‘differentiated prices’, and these prices are often twice the contracted government price. Under this incentive, many farmers produce in excess of agreed upon amounts, and in many cases they triple or quadruple their income (Alvarez, 2004).

The farmers market also helped to solve a series of economic problems. The time prior to the Special Period was prosperous for Cuba, and because prices for goods were fixed by the State the cost did not rise as the supply of goods declined with the collapse of the Soviet trade bloc. As a result most Cubans had excess spending currency in relation to the availability of goods at the beginning of the Special Period. Farmers' markets have also helped alleviate the problem by providing an outlet for this currency by supplying a much needed commodity. The government also benefited from taxes paid on food sold in the market. When the markets opened, tax rates ranged from 5 percent of the value of projected gross sales in the city of Havana to 15 percent in the small, rural markets of the rural areas (Pastor and Zimbalist, 1994). Taxes were set at variable rates to channel food to where it was most needed.

Research and Education

The most important input for agroecology is an educated labor supply. While Cuba was short of willing laborers, the foundation of education was present in the available labor pool. Fidel Castro has argued that without the work carried out since 1959 to educate the Cuban population, it would have been impossible to survive the Special Period (Garcia, 2002). Education has always been a major focus of the revolutionary

government. In 1961, termed the 'Year of Education', the government set a challenge to wipe out illiteracy in Cuba. In that year the number of illiterate citizens decreased from 1 million to 250,000; between 1956 and 1966, enrollment in the education system doubled from 800,000 to 1.6 million students (MacEwan, 1981, 75). In the 1980s, the government invested heavily in technological and scientific training for the Cuban population. According to a scholar of Cuban agriculture, Lisa Reynolds Wolfe (2004, 13), "Education and identity have been critical factors in the transformation of Cuban agriculture in the 1990s. They have provided a framework within which new policies, new actors, and new agricultural systems gained acceptance and were implemented."

The ideas of national hero José Martí and education reformer Paulo Freire are central to the Cuban educational training program, which emphasizes participatory methods[34]. Both of these thinkers emphasized learning by doing rather than through memorization. Two ideas were central to Martí's concept of education, and they were that education should prepare man for life, and it should adapt him to the age in which he lives (Nassif, 1994). According to Martí, popular education is the starting-point for the progress of people, and is the only way to achieve democracy (Nassif, 1994). Martí emphasized the importance of science in education, saying that "to study the forces of nature and learn to control them are the most direct way to solving social problems" (Nassif, 1994, 5). He encouraged the establishment of agricultural schools in the countryside, with workshops attached to them so that

[34] From discussion with Yanesy Grana Rivero, ACTAF, City of Havana, February 5, 2008; also see García, L. 2002. "Agroecological Education and Training", in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 72-89. Oakland, CA: Food First Books.

students could learn through experimentation. Paulo Freire, a philosopher of pedagogy from Brazil whose ideas have influenced Latin America since the 1960's, developed a style of education which he called 'critical pedagogy'. The central concept to this pedagogy is the reconciliation of the divide between students and teachers so that both act simultaneously as students and teachers. Freire was from a poor family and he was often hungry during his childhood. Consequently, much of his work centered on reform of agrarian education. His view of farmer education is nicely summarized in the following quotation: "Agronomists are specialists who work with others on the situation influencing them. However, from a truly humanistic point of view, it is not for them to extend, entrust, or dictate their technical capacities, nor is it for them to persuade by using peasants as 'blank pages' for their propaganda. In their role as educators, they must refuse to 'domesticate' people. Their task is communication, not extension." (Freire, 1973, 97).

Agricultural education programs have been initiated by the government and by both Cuban and international NGOs. Methods to educate the public about agricultural production include education programs for children through schools, for the public through the television and radio, and for urban gardeners through clubs and extension services. Farmers learn about agroecological techniques through extension services, farmer-to-farmer programs, referential centers, workshops, conferences, technical schools, and the University system. Agricultural scientists in Cuba are also educated by the farmers; the development of new agroecological techniques is highly dependent on farmer experimentation and input. Knowledge is also traded internationally. Specialists are brought in from outside of Cuba to help expand knowledge, and Cuban agricultural experts are currently working in many

Latin American countries to help develop sustainable agriculture programs and to trade knowledge.

According to Fernando Funes (1992) of the Organic Farming Group (GAO[35], formerly called ACAO), “The de-emphasis of capital and energy intensive technologies requires new relations between scientists, extension agents, and farmers.” There was no ‘serious’ extension program at the beginning of the Special Period, and efforts to establish training programs to transition farmers to ecological methods were impacted. Investments were made to a governmental organization, the Cuban Association of Agriculture and Forestry Technicians (ACTAF), to increase extension services, but lack of transportation due to petroleum shortages resulted in periods of time where the agents were not able to work. There was success at this time through the National Association of Small Farmers effort to train farmers through the Campesino a Campesino (farmer to farmer) program, which involved centralized regional training centers for farmers who would then return to their farming unit to train the farmers in their local area. The farmers did more than to train each other; they assisted the government in research of agroecological techniques. Techniques passed down through farmers for generations helped solve many problems; for instance, the discovery that ants are a successful control for the sweet potato weevil was found through recovery of peasant knowledge. In addition to helping recover knowledge and produce new knowledge, farmers play an important role in developing solutions to agricultural problems through field monitoring. Farmers are asked to keep careful records of pest problems and report them to the government.

[35] GAO was formed in 1997; the organization is part of the state, while the former organization, ACAO, was a national NGO.

The government has set up a structured system which teams researchers and producers together to create new techniques by nominating production units that are considered to be excellent to be referential (model) centers of production. The people within the community agricultural organization suggest to the MINAG representatives which centers in their area should be visited for potential selection. The selected referential production centers are places that have outstanding results. Representatives of MINAG visit these sites every year for assessment of progress. Referential centers are used to investigate new production techniques, and results are communicated by these centers to other farmers. At the provincial level, there is a referential production system for every type of enterprise which is used as a guide and center of extension for all of the related production centers in the municipality. These can be nominated to be national centers, and there is also category of excellence centers. The referential centers are also used as models for the establishment of new agriculture production centers in the area.

Referential centers also operate at the international scale. With the help of Miguel Altieri, in 1995 three integrated farming systems (called agroecology lighthouses) had been built in the Havana province by the United Nations SANE (Sustainable Agriculture Network) program, and four additional centers had been planned throughout Cuba (Altieri, 2000). These centers experiment with agricultural innovations such as polyculture mixture, tree integration, planned crop rotation, and green manure, and they teach these techniques and function as a technical school for farmers in surrounding regions. The lighthouse centers were built at CPAs, and also functioned as agroecological education centers. Results are communicated to

the UN and in this way knowledge can be shared with other UN lighthouse centers that operate around the world.

Workshops and conferences are an important method of information exchange between farmers and agronomists at international, national, regional, and local scales. Workshops are held at all scales and are commonly sponsored by international NGOs, such as the Australian Permaculture Group (the Green Team) and the United Nations SANE program, in local areas; by national NGOs such as ANAP on local, regional, and national scales; and by government groups such as INIFAT. The Green Team, for example, has two Australian volunteers who work with the MINAGRI and Cuban NGOs to offer seminars and workshops (Chaplowe, 1998). Initially, conferences were sponsored by ACAO, the group of scientists and teachers that formed in order to promote alternatives to conventional agriculture at the beginning of the Special Period (1992). This group organized the First National Conference on Organic Agriculture in May 1993 at the National Institute of Agricultural Science (INCA), which was attended by 100 Cuban delegates and 40 from abroad (Funes, 2002). This conference joined leaders of the organic farming movement together, and included an international course on organic farming. The second conference of this organization added a variety of activities, including a study tour of different regions with organic farming experts from diverse countries, especially Latin America, two specialized workshops on bio-pest control and animal traction, two sessions on intercropping and design of agroecological systems, and a second organic farming course. The third conference was attended by more than 400 delegates (180 foreigners and 240 Cubans), and was held concurrently with the United Nations SANE project and Cuban Organic Farming Association and

juxtaposed to the Pesticide Action Network international meetings (Funes, 2002). This conference continues to be held and in 2007, 161 papers were submitted to it, another example of the variety of information exchange techniques. The Cuban Association of Agriculture and Forestry Technicians is a national NGO which works with the government but is self-sustaining through membership fees of one peso per month and connections with international NGOs. The organization sponsors a variety of programs, with a primary motivation of providing extension services which meet the needs of all types of food production. They provide workshops on areas such as soil restoration and water conservation. MINAG also sponsors farmer-to-farmer and farmer-to-agronomist workshops in each province on a regular basis.

At the beginning of the Special Period, agricultural and livestock specialists found themselves technologically unprepared for the new style of agriculture. To train the next generation of professional agronomists, agricultural programs throughout the country are now teaching the principles of agroecology rather than industrial agriculture. Agricultural programs of study were changed to view the agricultural landscape as an ecosystem rather than as a production unit. This effort was led by the Agrarian University of Havana, and soon after The Center for the Study of Sustainable Agriculture (CEAS) at the Agrarian University of Havana was developed. CEAS has initiated Master's and Ph.D. programs in agroecology. The programs at CEAS are the focal point dedicated to supporting the research and education needs at the national level, and work in conjunction with provincial university programs. Students in Cuba's agroecology university programs are generally required to spend approximately 50 percent of their time during programs of training and degree-oriented coursework doing hands-on activity. One large problem which was initially

faced in making the transition was getting the farmers interested in learning the new methods, but now enrollment in agroecology programs at universities and technical institutes is rapidly increasing because students enjoy being involved in research and critical thinking.

Knowledge about gardening is communicated by the government to the public through the public education system, workplaces, and popular media sources. Because the revolution was largely a rural movement, the revolutionary government has always tried to keep people connected to the countryside, particularly to agriculture. An emphasis on agriculture had been part of many urban school programs before the Special Period. For example, students would spend time periods from two weeks to an entire year in the country learning about and working in food production. More recently, many school programs have stressed ecological and agricultural principles in their curriculum, with visits from or to local gardeners in the community. Many schools now produce food from their own gardens. Along with the benefit of increased food production through school gardens, the education programs are meant to encourage children to teach their families to grow food at homes and to stimulate interest in agriculture as a career. Similarly, many enterprises (national businesses) maintain their own gardens. Agricultural knowledge is also given to the general public through informal methods. At the beginning of the Special Period, newspapers were not in circulation due to paper shortages, so informal education was reliant upon television and radio programs and on word of mouth. Havana's television station CHTV (Ciucat Habana Televison) airs a weekly show that teaches home gardening techniques, and a national broadcasting station also airs educational programs.

Both national and international NGOs have played a supportive role in the development and dissemination of knowledge. As previously noted, NGOs have developed referential centers, which also act as educational centers, sponsor workshops and conferences, and trade knowledge between international specialists in sustainable agriculture and Cuban farmers and agronomists. The domestic NGOs provide that support at the local scale include the Cuban Counsel of Churches (Consejo de Iglesias de Cuba), the Group for the Integrated Development of the Capital (Grupo de Desarrollo Integral de la Capital), and the Economic Counsel of Cuba (Consejo Económico de Cuba) (Chaplowe, 1998). International NGOs that provide support at the local scale include the Protestant Association of Cooperation for Development (Germany), Bread for Hunger (Germany), and the Australian Organization Permaculture International (the Green Team) (Chaplowe, 1998). Knowledge is traded between international NGOs and the national government. Specialists are brought in from outside of Cuba by government organizations to help expand knowledge. Cuba learned about medicinal plants from specialists in South America, urban agriculture from the Green Team of Australia, and beef and dairy production from the Canada-to-Cuba farmer-to-farmer program, to name a few examples.

The knowledge transferred has also made an impact on places outside of Cuba. Cuban specialists of agriculture extension are currently working in many Latin American countries, including Venezuela, Argentina, Bolivia, Peru, the Dominican Republic, Haiti, and Mexico[36]. According to Funes (2002, 14) “Cuban delegations of specialists and farmers have reported on our agricultural practices in Bolivia,

[36] From discussion with Yanesy Grana Rivero, ACTAF, City of Havana, February 5, 2008.

Colombia, Peru, Venezuela, Guatemala, Nicaragua, Costa Rica, Mexico, Haiti, Spain, the Netherlands, Australia, New Zealand, Laos, Malaysia, Nepal, Sri Lanka, the United States, and other countries, with exchanges with thousands of people in those regions." Trade of knowledge between international NGOs and national Cuban organizations is encouraged, and ANAP is currently the leading body of the international organization Via Campesina[37]. Collaboration between NGOs and Cuba has transformed places both inside and outside of Cuba. Farmers in both Australia and Canada, for example, began to integrate legumes into grazing pastures for cattle, which is a nitrogen-fixation technique, after observing the technique in Cuba. Additionally, a Canada-to-Cuba farmer-to-farmer program has facilitated farmer exchanges between the two countries since the mid-1990s.

Material Support

The relationship between the government and the farms extends beyond research and education. The seed centers are state organizations called 'House of Seeds' (Casa de Semillas), which serve as centers where agricultural supplies are sold to the public: vegetable and medicinal seeds and seedlings, biological pesticides, organic fertilizer, and tools. They emerged in response to the Special Period; by 1995 there were 8 Houses of Seeds in Havana (Chaplowe, 1998, 54). A current project is to create a seed center in every municipality. At the present time there are 208 seed centers at the municipal level. The nation is working towards self-sufficiency in seeds. The seeds that are sold have been tested to find the varieties

[37] Via Campesina is also known as the International Peasant Movement; its members come from more than 56 countries and are small and medium size producers, landless, etc.; these farmers are united to defend the interests of small farmers worldwide.

which grown best in the tropical environment. Plant biodiversity is a top priority in agriculture, and each farming unit is encouraged to grow many varieties.

International investment was an important component of the transition. In fact, many Cuban NGOs were created to channel outside funds to Cuba. These NGOs teamed up with larger sustainability groups such as German Agroaction (Germany), Bread for the World (Germany), HIVOS (Netherlands), and Oxfam America (United States) (German Agroaction, 2007; Funes, 2002, 12). The funds enter Cuba through ANAP, the collective organization of small farmers, and are distributed from ANAP to partner NGOs. The largest funding partner is Germany, and almost all funds come from European partners; there are currently forty-two projects between ANAP and other NGOs.[38]

International NGOs which focused on sustainable development provided new skills, ideology, and funding to specific groups within Cuba. NGOs often provide material assistance to farmers, such as horticulture groups that facilitate communication among urban gardeners. According to Chaplowe (1998, 52), “Some horticulture clubs exist only as a means to receive and distribute NGO donations, while other clubs meet regularly to exchange seeds, share produce, share tools, distribute literature, etc.” Because some horticulture clubs and cooperatives were being given financial assistance while others were not, the government began to regulate funding from international sources so that projects would be socially equitable. Before money can be distributed, the Ministry of Economic Collaboration (MIVAC) evaluates whether the funds being offered are being used in the best way for Cuba, rather than

[38] From discussion with Maria del Carmen Bahos, ANAP, City of Havana, 2/11/08.

in the interests of individual cooperatives. The representatives from ANAP that I spoke with said that over the last few years funding has dwindled, but the projects which were created during the Special Period have been very successful.

Food Rations

Just as the government relied on Cuba's strong educational system to its population help adapt to changes of production, it relied on its food rationing system to help adapt to changes in food availability. In 1962 the revolutionary government established 'The National Board for the Distribution of Foods' to oversee the rationing system in response to food shortages that year. In December of 1989, the government launched a National Food Program with the goal to make Cuba self-sufficient in most agricultural commodities (Alvarez, 2004, 66). The National Food Program has attempted to stimulate food production through a number of initiatives that work in conjunction with the new system of production. The strategy is to improve the Cuban diet through an increased emphasis on consumption of produce while diversifying agriculture and substituting food imports. Other efforts include decentralizing food production and distribution to improve the quantity and quality of foodstuff (Chaplowe, 1998). According to Nieto and Delgado (2002), representatives of MINAG and ACTAF, the adjustments to food system planning through the National Food Program explain why the decline food security was small relative to the magnitude of economic adjustment.

The government subsidizes a basic diet for all of Cuba's population which includes rice, beans, lard or cooking oil, sugar, a high-protein food, bread, flour derivatives, and dairy products. In response to the severe shortages of the Special Period, the

government added more than 200 goods to the list of rationed items and reduced the quotas to 2/3 of all rationed items in 1991 (Chaplowe, 1998, 48). The rations were set to the minimum level of recommended calorie in take per capita by the United Nations. Still, the average Cuban's diet was cut by about 30 percent of the calories that he/she had eaten prior to the Special Period. Programs are designed for special needs groups, including low-income groups, physically or mentally disabled people, children, pregnant women, and the elderly. Food is directly distributed to boarding schools, daycare centers, hospitals, maternity homes, homes for the elderly, and to the lunchrooms of state enterprises (Nieto and Delgado 2002). Also, in 1993, the government began to distribute multivitamins to prevent malnutrition (Alvarez, 2004). These social policy programs served the purpose of preventing further deterioration of food security by ensuring that each member of the Cuban population had guaranteed access to a share of the available food supply.

C. The Special Period Scale

"The challenge is to increase the investment and research into this strategy [alternative agriculture/ agroecology], and to scale-up projects that have already proven successful, thereby generating a meaningful impact in the income, food security and environmental integrity of the world's population, and especially the millions of poor farmers yet untouched by modern agriculture and technology… If we fail to seize this opportunity, the existing cases will remain as "islands of success" in a sea of deprivation, merely living testimonies of the potential of the "path not taken" to feed the rural poor. On the other hand, if we go forward to widely support and develop an agroecological approach, humanity can benefit from its potential to address the inequity, hunger and environmental degradation that so often accompany high-input, energy intensive, corporate-style agriculture."

Altieri, Rosset, and Thrupp, The Potential of Agroecology to Combat Hunger in the Developing World, 2000[39]

Connectivity is essential for the diffusion of political change; isolated and impoverished communities are the least likely to be reached by economic,

[39] Taken from Altieri, M.A., P.M. Rosset, and L.A. Thrupp. 2000. The Potential of Agroecology to Combat Hunger in the Developing World. Agroecology in Action. Online Journal, University of California, Berkeley. Retrieved from < http://agroeco.org/brasil/material/potential_of_agroecology.html>.

environmental, and social change (Friere, 1973). Connectivity between communities in Cuba had a major role in diffusing knowledge and material inputs among places of production. While some of these communities surely would have been successful, it is unlikely that all would have fared as well as they did without the support given through connected government agencies and NGOs.

The system which emerged through the changes of the Special Period shows a model for how sustainable agriculture can be organized at multiple scales. While attempts are made to produce and distribute food on a small-scale system, Cuban farmers and agronomists attribute the system of education and cooperation between farmers and researchers in knowledge development at all levels of scale to be the among the most important components of the success of the alternative system (Funes, 2002).[40] Farmers themselves did not generally make the decision to transition to ecological methodologies; the transfer to low input methods across the nation resulted from a directive issued by the government. Even while resources have become available to support a return to high input techniques, the government has instituted sustainable agriculture as a national policy. While many farmers welcomed the transition, others were opposed to using ecological techniques. If decision-making had occurred at local scales there is no guarantee that a large change to ecological farming would have occurred. Components such as CREES centers have been transferred from Cuba to other parts of Latin America, and techniques such as Permaculture have been transferred from international organizations to Cuba. Thus, international partnerships have transformed agricultural spaces outside of Cuba as well as within.

[40] Information is also from conversations with farmers.

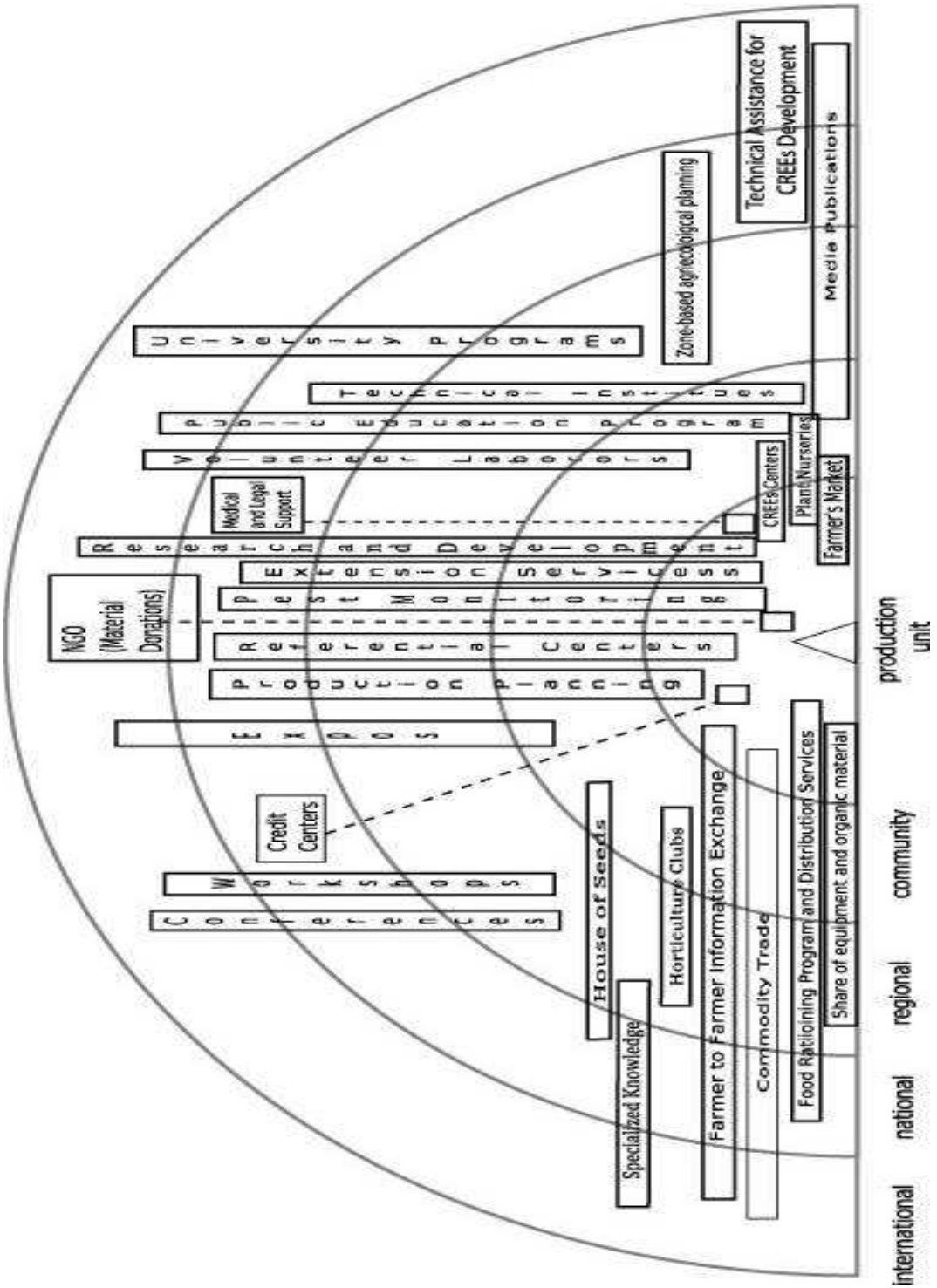
Some components of Cuba's agricultural system, such as the farm structure and the manufacture of biological inputs, are organized on small scales. However, these small scale operations do not exist in isolation; they are connected to other places at all levels of scale. Examples of connectivity between production units, and local, regional, national, and international scales can be easily seen through social programs such as the universities, technical institutes, public education programs, urban horticulture clubs, the farmer-to-farmer program, the extension program, the labor volunteer program, and the food rationing system. Each of these programs is organized so that knowledge and other social resources are transferred both from the top down and from the bottom up. Each individual unit of production is connected to a variety of places of support which operate at multiple scales, including government institutions (such as MINAG), NGOs (international and national), CREE production centers, universities, technical schools, and referential centers. Each production unit also provides support for a variety of places operating at multiple scales, including government institutions (such as the National Food Program), NGOs, farmers markets, and education centers.

Figure 2 models the way that the units of production (whether state farms, cooperatives, or urban gardens) are connected to places of support at the community, regional, national, and international levels. Cuba is divided into 14 regions[41] and 169 municipalities. I equate community with municipal and regional with provincial in the model, though these conceptions of scale are not fixed boundaries. The semi-circular representation of scales shows that scales are neither vertical nor horizontal in structure; rather, the flows among the places connected

[41] Cuba also has one 'special municipality', the Island of Youth.

through these systems of social support are circular. Each bar represents a mechanism of social support. The bars reach across the tiered scales to show the scales over which each social system operates. This model is not intended to show that any particular social structure is more important than any other or that any social structure operates more heavily on one scale than another. Instead, it is a demonstration of the multitude of social supports that were available to farmers, and of the variety of scales that most of these social structures operated.

Figure 2: Scales of Social Support



D. The Case of UPBC Alamar

"People wonder why Cuba can't harvest enough food to feed the people of the country? Sugar. We have theoretical reasons for ecological farming now, but in the 1990's it was done due to necessity. It was because there was no fertilizer, no pesticide, and no oil. The new system is based on soil instead of oil."

Miguel Salcines López, Production Manager of the UBPC Alamar,

While in Cuba I was able to personally see the benefits of multi-scalar organization. I will discuss findings from my visit to the UBPC Alamar on February 8, 2008[42], to provide a concrete example of the linkages that exist between places of production and places of support. This UBPC is a cooperative production unit located in the Alamar district of the Eastern part of Havana province (See Appendix H for location within Cuba). Alamar is located about 20 kilometers from central Havana with a population over 100,000 people. I have chosen this cooperative as an example because it is a highly publicized cooperative; the cooperative has been featured in a variety of international media sources, including *The Power of Community, How Cuba Survived Peak oil,* the BBC television program *Around the World in 80 Gardens*, and a Harper's magazine article entitled *The Cuba Diet: What Will You Be Eating When the Revolution Comes*.

Indeed, UBPC Alamar is an extraordinary example of a successful development project. The UBPC is a 'center of excellence' which serves as a referential center of production. The cooperative was founded on 0.8 hectares of usufruct land near the end of the Special Period with five members for the purpose of growing vegetables for the community. In 1999, the cooperative had 15 members and produced nearly

[42] The information for this section comes from my discussion with Miguel Salcines López, Production Manager, and Jose Morales, Human Resources Manager of UBPC Alamar, 2/08/08.

20 tons of vegetables, providing an average income of 425 pesos per month to each cooperative member. By 2006, the cooperative had expanded to 10.8 hectares of land and 133 members and it produced 240 tons of vegetables, providing an average income of 950 pesos per month to each member (German Agro Action, 2007). In 2007, the cooperative members had a goal to achieve 5 million pesos in sales, and they achieved 101 percent of their goal. A decade after its founding, the cooperative now has 161 workers: 16 have University degrees with 1 PhD; 38 of the workers are women; 28 are technicians; and 51 are retired workers. In the week before my visit, the cooperative had added 10 new members.

The cooperative runs a diverse set of operations. Ninety percent of the cooperative's food production in excess of state contracts is bought within the neighborhood. The cooperative buys staple foods from government stores at a bulk price and sells these products to the neighborhood for their purchase price in order to make shopping more convenient for their customers. It also manufactures high-quality vermiculture humus out of manure which is collected from nearby farms. The vermicompost is sold to farmers within the community. The UBPC sets a limit on the selling prices of their own products and sets price according to the cost of the item's production.

While the success of UBPC Alamar is clearly due in great part to the efforts of its farmers and managers, to fully understand the success of this cooperative it is necessary to examine the production unit in relation to social structures with which it is connected. The land it is built on was scheduled to become a sports complex until the Special Period changed the focus of Cuban development. In 1998, briefly after its foundation, the organization 'German Agro Action' (Deutsche Welthungerhilfe)

partnered with the cooperative, along with partner organizations ACPA (Cuban Association of Animal Production) and ACTAF, to provide financial support. The funds are matched between these organizations at 1 Cuban peso to 1 Euro; the matching of funds is a symbolic gesture. This support has allowed the cooperative to build a greenhouse for seedling production and another for vegetable production, efficient irrigation systems, a training facility for the members of cooperatives and exchanges of experiences with other cooperatives, a kiosk for direct sale of products, and a center for training and advice in production techniques, administration, and management (German Agro Action, 2007). The UBPC shares its greenhouse space with nearby producers to increase the survival rate of expensive seeds. The cooperative also has state-appointed lawyers, doctors, and accountants, and is also planning to request an agricultural economist. The cooperative is also linked to seed distribution facilities and training programs sponsored by the state, to ANAP, and to CREE centers and other referential centers in and around the city of Havana.

The cooperative is a pioneer in transferring techniques to Cuba from other places. One example is a bacterial disinfectant which was borrowed from the Mayan culture; practitioners burn a local tree and collect the smoke from the burn in a thin metal tube, gather the liquefied smoke, and apply it to crops. The liquid smoke is said to contain anti-bacterial properties. The cooperative also grows Neem trees and uses the leaves for an immune stimulant to crops, a practice which originated in India. The cooperative is presently building a human manure compost toilet, an idea the production manager was quick to point out came from China. The cooperative also uses electromagnetism for desalinization of irrigation water, a concept which is new to Cuba. It is thought this concept was used by ancient Egyptians and Mayans; it has

not been developed for use in systems of modern agriculture because it is not financially profitable.

The funds provided through partnerships and the strong culture of innovation has helped the UBPC Alamar to become a center of agricultural knowledge exchange. Production manager Miguel Salcines López said of the mission of the cooperative, "We work for production, but our emphasis is on research." The cooperative assists the government in research for innovative solutions to pest control, fertilization, and researching biodiversity. As part of the commitment to biodiversity, the cooperative grows over 300 plant varieties, researches which plant varieties are best suited to the area, and shares this information. The cooperative maintains a strong focus on education and is working to train the next generation of students about the benefits of organic agriculture. It has become an important training facility for area farmers and students worldwide. Student groups have visited from many educational institutions around the world, including the University of Georgia, the University of Essex (U.K.), and through ICAP. Our entire ICAP group was welcomed back to take part in the cooperative's training program for farmers.

E. Outcome of Special Period Scale

"Make human life more rational. Build a just international economic order. Use all science for a more sustainable development that does not contaminate the environment. Pay the ecological debt and not the external debt. Fight hunger, not people."

Fidel Castro, speech given at the United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, 1992[43]

[43] Taken from *Sustainable Agriculture and Resistance: Transforming Food Production in Cuba*, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. Oakland, CA: Food First Books, IX.

Fidel Castro's Food Program fit the development agenda that he outlined in the above quote. The program met its overarching goal; the nation survived the Special Period. By the mid-1990s the implementation of agro-ecological methods had resulted in a significant increase of the caloric intake in the average Cuban's diet with food grown internally in spite of the constraints on inputs. According to the United Nations Food and Agriculture Organization (FAO) productivity of crops for domestic consumption doubled and sometimes even tripled in the case of most tubers, plantains, vegetables between 1994 and 1999, and during the same time period, potatoes, cereal, beans, and citrus all experienced yield increases (Wolfe, 2004, 11). The gains in food production resulted largely from increasing productivity of the land under cultivation rather than from increasing the area of farmland. According to an Oxfam report, food security was returned to the island within five years – in 1994, Cubans had access to only 1,863 calories, while in 2000 they had access to 2,585 calories, per capita per day (Sinclaire and Thompson, 2004).

Among the benefits realized in Cuba from the changes to production include reduction in the cost of imports of chemical inputs, reduced food transportation distances, strengthened communities, job opportunities, healthier diets, and better soil and environmental health. Before the crisis, 1 million tons of synthetic fertilizer and 35,000 tons of chemical herbicides and pesticides were used; presently, Cuba uses 90,000 tons of synthetic fertilizers and 1,000 tons of herbicides and pesticides. During the Special Period, 350,000 jobs were created in agriculture[44]. Most of these jobs were created in urban areas, which reduced the need for much of the population to relocate to the country. Also, the trend of rural-to-urban migration which had

[44] From discussion with Rosalia Gonzolaz, INIFAT, February 6, 2008.

occurred since the revolution stabilized. And the diet of the average Cuban also improved. While the average Cuban diet consisted of mainly rice, pork, and beans before the Special Period, currently fruits and vegetables are a main staple.

The outcome of Cuba's agricultural system during the Special Period cannot be determined through an association with any particular scalar arrangement, but rather through looking at the motivations behind the scalar reorganization. Despite the claim made by proponents of the green revolution that without chemicals the world would starve, the motivation behind Cuba's change to agro-ecological methods was national food security. Most researchers agree that the nation achieved this goal. Political agendas organize scales of social organization; historically, Cuba's agriculture was organized around export based-production, while now it is organized to feed the national population without dependence upon imported agricultural inputs. Cuba was motivated to transform its agriculture system due to ecological necessity and political motivations. Sustainability was introduced because the people who made decisions about food production determined that ecological methods of production are best for the health of the people, the ecosystems, and for sovereignty in trade of agricultural inputs and products. The focus on national food security means that sustainable systems do not preclude use of chemicals if they are necessary and are not seen to compromise the health of the people or environment. Urban agriculture is by law organic for health and safety reasons. Production is largely organic but chemicals are used on crops, such as potatoes, for which successful pesticide substitutes have not been found. Although Cubans began growing local organic produce out of necessity, they have continued to develop their system of bio-pesticides and bio-fertilizers as petrochemical substitutes, and they

continue to incorporate more fruits and vegetables into their diets, even though the country now has access to oil, fertilizers, and other industrial technologies.

F. Conflicts and Reformations

"Nutrition is a difficult thing, and we may have to make concessions. We are considering using a 20 percent chemical base on our crops so that we can maximize production while minimizing the damage to soils. The problem is that we have the fundamentalists of chemical use and those of organic methods; both sides are extremists. If we try to feed the whole world organically, we will starve. Organic agriculture is not a gospel; people need to produce in order to survive."

Miguel Salcines López, Production Manager of the UBPC Alamar, 8 February 2008

The Special Period was, as the name implies, a temporary period in Cuba's development. The economy gradually stabilized and the Special Period formally ended after a decade of hardship. Cuba now has access to trade partners, petroleum, food, and agricultural supplies. The United States government lifted its ban on agricultural exports to Cuba in 2000 through the Trade Sanctions Reform and Export Enhancement Act. Cuba refused to import food from the United States because the trade is only permitted one way until 2001, when Hurricane Michelle caused severe food shortages. Since that time Cuba has imported grain and other staple crops from the U.S. when food supplies are short. Cuba again receives petroleum supplies for reduced costs from a close ally, Venezuela, and has formed a new set of economic alliances with various countries in Latin America. Many countries in the European Union, as well as Canada, Russia, and China are also strengthening trade relationships with Cuba. Now that the necessity of ecological farming practices has ended, many people question whether Cuba will continue to farm with sustainable methods or return to conventional farming. Just as politics and economics have produced Cuba's alternative system, its continued viability will

likewise be determined by these two forces as Cuba is inserted into a new global economy (Altieri, Rosset, and Nicholls, 1997).

On February 19, 2008, Fidel Castro announced his resignation as the President of Cuba. Raul Castro has discussed economic restructuring as a necessary reform, and indicated that changes to the agricultural sector will be among the first to occur. The official statement that I received from representatives of MINAG is that Cuba will continue to farm with ecological methods because it is better for the health of the people, it is how things are organized now, and it works.[45] However, due to a set of external and internal factors, the government is now in the process of giving more autonomy in decision-making to farmers. There is a faction of Cubans that is dissatisfied with the high level of state decision-making about production and the required contracts with the State. In March 2008 stores were opened from which farmers could purchase agricultural inputs and farm implements through currency rather than contracting with the State for a share of available products. A proposed government reform would reduce the percentage of production that cooperatives are required to sell to the state in order to stimulate production.

Both scientists and farmers are divided between the paths of agroecological and industrial farming styles. Many farmers in Cuba enjoy ecological farming due to the critical thinking that is required to be successful in solving agricultural problems. Cubans also are aware of the health and environmental benefits of organic food and so there is a demand for organic products at marketplaces. Similarly, a large portion of the academic community firmly advocates the health and environmental benefits

[45] From a conversation with Juan José Leon, specialist in International Relations at the Ministry of Agriculture, Cuba, February 5, 2008.

of ecological agriculture. However, some farmers adapted to, but did not grown to like ecological farming; many were trained to use machines and chemicals and prefer the labor tasks and production results from industrial technology to those from ecological farming. Many farmers were opposed to the use of biological controls, and those who had been trained to use methods of conventional agriculture often expected the same instantaneous control and zero pest population levels from biopreparations as from chemical products.

Perhaps the biggest limiting factor for agroecological production is the labor supply. Cuba has the land, but not the labor force, needed for a full-scale, long term transformation to agroecology (Wolfe, 2004). The government has raised the wages of farmers and allowed 20 percent of what cooperatives produce to be sold on the private market in order to attract Cubans to the profession. Farmers are one of the most highly paid professions in the country, but there is trend for city migration among the youth, and there is little interest among people from the city to move to the country; the most popular careers for young people are computer science, physical sciences, and social sciences.

Another issue which may complicate decision-making is the rapidly increasing international demand for biofuel made from sugar cane. Cuba still relies heavily on agricultural exports for the generation of hard currency in addition to food supplies. Thus, Cuba could once again be lured into producing sugar-cane for high export profits. While in Cuba I was repeatedly told that Cuba would not produce biofuels as long as there were hungry people in Cuba or around the world; people need food, while energy is a luxury. However, the policy to produce food for the national

population, rather than biofuels for national consumption or export, was set by the agenda of the government.

Perhaps the most important factor which may contribute to a change in agricultural policy is the recent downturn in agricultural production. While the Alternative Model resulted in increased yields each year for a decade, the agriculture industry has stagnated since 2004. The failure to meet expected production in 2004 was attributed to devastation caused by tropical storms; in 2005 it was blamed on a drought; but in 2006, the climate was favorable for agriculture, and production levels dropped yet again. At the present time the cultivated area is 3.1 million hectares, out of a total of 6.6 million hectares of cultivatable land. Of the farmed land, 1.3 million hectares are devoted to sugar cane, 806,300 hectares are used for fresh vegetables, roots and tubers, and grains, 104,000 hectares for plantains, and 169,200 hectares for citrus and other fruits; the remaining cultivated land, 720,500 acres, is used for growing coffee and tobacco; 2.3 million of the remaining acres are used for pasture, and the rest of the land is left fallow (Grogg, 2008).

Raul Castro has announced that structural and conceptual changes will be made to stimulate the agricultural sector. With increased autonomy among farmers in decision-making, food production could continue along the lines of sustainability and sovereignty, or it could lead to increased export production and/or decreased sustainability. If farmers are interested in retaining agro-ecological techniques they may decide to produce for a niche market for exports of organic goods which fetch high profit. If farmers are most interested in national food security, perhaps they will

create food for national consumption with industrial techniques. However, if they are most interested in profit, they will produce valuable export crops.

Scales of organization are not fixed; people constantly recreate them. The scalar organization of agricultural practices in Cuba will change as political agendas shift both in and outside of Cuba. As the system becomes increasingly decentralized in terms of organization, the only thing that can be sure is that the agenda of each actor empowered by the transformation will determine the outcome.

Chapter 5: Towards a More Sustainable Agriculture

"No less than those who would challenge the way in which the defense intellectuals have defined our world, we who believe that contemporary agricultural production is neither socially just nor ecologically benign also face dual tasks. In part, the deconstructive task entails the demonstration that agricultural science as currently constituted provides neither a complete, nor an adequate, nor even a best possible account of the sphere of agricultural production… The reconstructive task [of agricultural science] will be the more difficult, for it will entail the identification and legitimation of alternative sources of knowledge production for agriculture – sources which have no voice, or speak without authority, or simply are not heard in contemporary agroscientific discourse."

Jack Kloppenburg, Jr. "Social Theory and the De/Reconstruction of Agricultural Science: Local Knowledge for an Alternative Agriculture", 1991

In the preface of Paulo Freire's essay 'Extension or Communication', he says that while "all development is modernization, not all modernization is development". As long as progress is seen as a single pathway from less to more developed there will be no solution to the current problems of agriculture. A presumption of this thesis is that agricultural progress does not mean moving towards a system of industrialized agriculture. After all, an agricultural system that causes ecological damage, and undermines the ability to produce food in the future, is not progress. But progress does not mean moving back to self or community food provisioning either. The development of community-based systems will not necessarily solve the problems presented by the industrial agriculture system. The assumption that production is better organized by communities than by any other scale ignores important ways that ecology and social relations limit production in certain places, to the detriment of both human and environmental systems. Farmers who do not use industrial methods of farming will not simply stop being oppressed through a community scale of food provisioning; the community remains embedded in a host of other scales and community food systems must be able to compete economically with industrial food systems. Consumers, also, will not necessarily have their needs met by simply

returning to local scales of food provisioning. Places of water scarcity, for example, will not be able to produce certain types of crops, challenging the residents of these areas to access food. Rather than measuring agricultural progress as either a move towards industrialization or a return to community food systems, it should be viewed as a move towards a system that balances the needs of ecosystems and humans.

Cuba's alternative model provides an alternate theory of scalar organization to counter the dualistic large versus small scale theories which currently prevail in the debate over food security. While some people view a large scale of food provisioning based on industrial methods and economic trade as the way to achieve food security, others see small scales of food provisioning and ecological methods as the way to achieve this goal. Both groups view scales of food provisioning as intrinsically linked to the global capitalist market; the main difference between their positions is whether this link is considered to be positive or negative. Large scale interactions need not be focused on financial profit; Cuba set up a sustainable food system with a goal to feed its population, and the changes in Cuba's system were carried out on a national scale and assisted by groups that operate over an international scale. Yet the interactions between local, national, and international places of the food provisioning system were linked to help achieve the common goal of feeding Cuba's population with low input farming techniques of production.

The alternative model was considered to be successful because the decision-makers achieved their goal of feeding the national population. The outcome of scalar arrangements depends on the goal of the people empowered by the scale; a global scale of food provisioning is just as likely or unlikely to produce desirable outcomes

as a local scale. The national scale is created, it is fluid, and it can't exist without local scales of organization and other places which make it possible. The local scale is not only local, but is part of a much larger scale of people across the globe. It was not the national or the community scale that achieved the outcome of sustainability during Cuba's Special Period, and it was not the international scale that created forms of food provisioning before the Special Period that were environmentally and socially problematic. Instead, it was the agenda behind the various scalar arrangements which created these outcomes.

Political economy theory assumes that people can create any scale of organization which meets political and economic interests, but in actuality, places, and thus scales, are limited by aspects of nature. Cuba's oil crisis was caused by political, rather than ecological forces. However, the country's experience provides an opportunity to learn what places in food provisioning are necessarily organized around small scales of organization with limited fossil fuel supplies. The introduction of peak oil will greatly impact the organization of our agricultural systems regardless of human desires. Cuba shows that some aspects of food provisioning must necessarily be local in scale, but large-scale planning was also crucial to Cuba's transition. With the decline in available petroleum, it probably will not make sense to transport large quantities of foodstuffs over long distances in the near future. However, peak oil should not preclude larger scales of social organization.

Sustainable development initiatives are most likely to be successful by creating social structures which support the goal of the project rather than through simply adjusting the scale of the organizational structure itself. Although food security and

ecological methods of farming are often grouped together with the local scale of organization, they not the same goal; while it is possible to achieve both, it is also possible to develop a system which focuses on one to the exclusion of the other. For example, many countries, including Cuba during its time of alliance with the Soviet Union, have been able to create food provisioning systems based on industrial methods to produce export commodities and have achieved food security for their national population through imports. While decision-makers can arrange food systems around any particular agenda, in order to develop a truly sustainable system it is necessary to ensure that the needs of people as well as ecological systems are met. Food security is not possible if farmers are not able to access the land and resources needed for farming, and ecological practices are not likely to be used in production if food is in short supply.

To ensure that all communities have equal ability to access food in times of scarcity, it is important to provide social support for food production at every possible scale. Whether political arrangements provide people in agricultural places with tools and incentives to use chemical based, export-oriented approaches to agriculture, or with ecological bases of knowledge for food production, they are likely to choose the supported approach. However, people do not have equal ability to choose the methodology of agricultural production they use; people are bounded by political and economic policy and likewise by nature. The view that we must develop everything at a local scale of organization suggests that people are better off by closing their systems to the rest of the world, that we are better off not interacting, and that we have nothing to share with one another. Thus, the call for community self-sufficiency

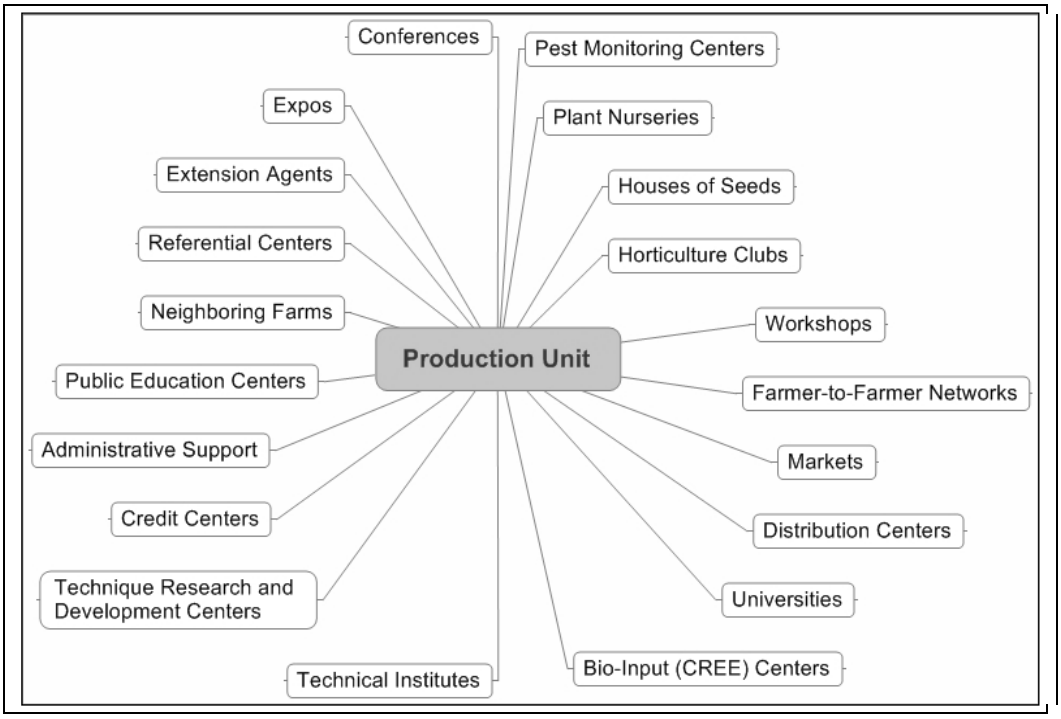
obscures the need to create broader development polices that support the goal of creating sustainable and socially just food systems.

Local needs must be met, but they must also be placed within the context of broader economic, social, political, and ecological pressures that shape change. To be sustainable, food should be produced with low chemical inputs and travel the least distance possible. To be socially just, people should have access to food, land to grow the food, and access to education. The most appropriate scale for support institutions will vary depending on the cultural and ecological needs and abilities of each place of development. Scale is simply the linking together of places (Sack, 1997). Given the multiplicity of scales possible in organizing sustainable agriculture projects, it may not even make sense to talk about scales in relation to sustainability or food security, but rather about how to construct the types of places that support these goals. Cuba shows that a variety of places of support are helpful in transitioning food production systems to agroecological methods.

Figure 3 lists the places that provided support to and were given support by production units in Cuba. These places exist at a variety of scales. In fact, scale is really a word that is used to convey the level at which places are connected across space. The diagram provides an example of the types of places and networks between places that can connect to production units in support of sustainable practices and equitable distribution. Most of these places exist already in both industrial and alternative farming practices; the challenge is to focus these places on support for sustainable practices. The diagram depicts the places and networks that aided Cuba's transition, but these places can be constructed anywhere. Diversity in

alternative systems should be created and supported in order to expand the possible techniques of agriculture and organization of agricultural systems.

Figure 3: Places and Networks of Support for Sustainable Practices



Cuba's ability to survive the food system crisis of the Special Period was supported by various aspects of its social policies. As the new system of farming developed in a socialist context, new farmers had the opportunity to be educated for free, and cooperative members were given resources and time to learn how to manage a cooperative without being expected to make immediate profit. Health is not considered an externality in Cuba; this is one of the reasons that ecological methods of farming were adopted in Cuba. And scientific research in Cuba is conducted for the purpose of improving quality of life, rather than for producing a profitable commodity. Productivity improvements in Cuba were only possible because the government, along with farmers and other agricultural workers, was willing to alter

previous policy and provide substantial resources to farmers (Wolfe, 2004). Cuba had to overcome a labor shortage for farming because it had a highly educated and urbanized population and an industrial farming system. Cuba overcame this obstacle through added economic incentive, free provision of academic and technical training, and attaching added meaning to agriculture as an important component of the national system. Further, the land reform which took place at the beginning of the revolution gave many more people the opportunity to farm plots they owned or were able to farm in usufruct. Clara Nicholls (2003, 14) says that "Whether the Cuban model can be replicated depends on the willingness of other countries to invest in human capital, agricultural research, land reform and change in the rural infrastructure, and social organization to the degree that Cuba has." Indeed, these investments are what allowed the transition to sustainable agriculture to be successful in Cuba. According to the 1992 Global Exchange delegation, (Rosset and Benjamin, 1994, 80) "If the unit of planning were not large, Cuba today might well be facing the sort of mass famine taking place in Somalia."

While Cuba's Alternative system provides ideas about how to construct sustainable food provisioning systems, no place can or should necessarily replicate Cuba's model; no two places are identical as each has different needs and abilities. The socialist political structure in Cuba has contributed to an ideology of unity in which the nation is really a scaled-up community. The spirit of cooperation with national policies helped to implement the organizational changes. In countries with an ideology of individualism, in which private interests and organizational structures prevail over public, the methods taken to achieve sustainable development will likely be different. For example, in countries where land is privately owned, agricultural

places will have to be restructured to either support expansion of labor at corporate farms or to create public spaces for farming. Places also have varying social needs; in some places; the cost of labor presents a major obstacle to transitioning developed countries to systems of ecological agriculture, while to developing countries it may be advantageous to use ecological methods rather than industrial due to a low cost of labor. Additionally, differences in ecological systems shape the production methods that can be used in particular places. While some techniques used in Cuba are based on immutable mobile knowledge[46], such as the use of shifting cultivation, intercropping, and use of animal traction, many of the techniques used in Cuba cannot be supported in non-tropical climates. The topical product NEEM, which enhances immune support in many plants, may need to be imported in some places because Neem trees can only grow in tropical and semi-tropical climates. Also, earthworm humus can be created during the warm periods of colder climates, but it would be much harder to produce an adequate supply.

Rather than trying to emulate the Cuban model, we can learn from the principal contributions to their success. While not all places share the same needs or have access to the same resources, they can learn from each other by sharing information. The use of education and other forms of support to foster farmers' ability in the use of sustainable practices is certainly not unique to Cuba. Miguel Altieri, for example, has written an extensive report on NGO efforts which support applications of agroecology to various peasant farming systems in Latin America. He found that if

46 Immutable mobile is a term coined by Bruce Latour (1986, 714), to refer to information which is invariant through change in spatial location; For further discussion of immutable mobile knowledge in agricultural production see Kloppenburg, J. 1991. Social theory and the de/reconstruction of agricultural science: Local knowledge for an alternative agriculture. Rural Sociology 56(4), p. 519-548.

peasant experiences with agroecological techniques “were to be scaled up, multiplied, extrapolated, and supported in alternative policy scenarios, the gains in food security and environmental conservation would be substantial” (Altieri, 1999, 198). To support a transition to ecological farming, Altieri has proposed creating an international training program to teach students from all over the world the skills to deal with the intricacies of sustainable systems and to guide agriculture in various temperate and tropical regions. Altieri (2007, 52) says that “The only way that the specificity of local systems – from regions to watersheds and all the way down to a farmer’s field – can be taken into account is through site-specific agroecological research. This does not mean, however, that agroecological schemes adapted to specific conditions may not be applicable at ecologically and socially homogenous larger scales.” While farmers are responsible for innovations, these innovations can be shared, adapted, and supported by research.

A final lesson from Cuba’s transition is that very real things are happening, many at a large-scale, that provide support for farmers interested in alternative agriculture. Cuba is one example of a place that is helping to raise consciousness about the benefits of ecological farming for other places that struggle to feed their population. Rather than merely selling biological inputs for profit, many Cuban agronomists assist farmers in other places in the creation of their own artisanal biological input production centers. Also, since 1993, Cuban professors, researchers, and producers in agroecology have contributed their knowledge through lectures or courses at Universities in Argentina, Chile, Uruguay, Bolivia, Brazil, Ecuador, Colombia, Peru, Venezuela, Mexico, Central American countries, Spain, the US, and Asia (García, 2002).

The principles of sustainable agriculture are applicable to more than just the local scale; they can be applied across scales to create places that work together at a multitude of levels. Examples include the vast connectivity between permaculture institutes across international territories, such as the organization 'Permaculture Across Borders'[47]; research and education centers sponsored by development agencies and NGOs, such as the United Nations Lighthouse Centers; and universities, extension agencies, and technical support groups across the world that teach agroecological techniques. Groups interested in building upon these endeavors can join together to work for support of sustainable agriculture practices In this manner, a large scale of organization in food provisioning can simply mean that many places work together to create a fluid rather than a fragmented approach to restructuring agricultural production and food distribution.

[47] See <http://www.permacultureacrossborders.org/>.

References Consulted

Agarwal, A. and C. Gibson. 1999. Enchantment and disenchantment: The role of community in natural resources conservation. World Development 27, 629-631.

Agnew, J. 1994. The territorial trap: The geographical assumptions of international relations theory. Review of International Political Economy 1 (1), 53-80.

Agnew, J. 1997. The dramaturgy of horizons: Geographical scale in the 'reconstruction of Italy' by the new Italian political parties, 1992-95. Political Geography 16(2), 99-121.

Allahar, Anton. 1980. Agriculture and the Peasantry in Cuba. Postgraduate Report, Series C, No. 5. University of Toronto.

Altieri, M. A. 1993. The implications of Cuba's agricultural conversion for the general Latin American agroecological movement. Agriculture and Human Values 10 (3):91-92.

Altieri, M. A. 1999. Applying Agroecology to Enhance the Productivity of Peasant Farming Systems in Latin America. Environment, Development and Sustainability 1 (3):197-217.

Altieri, M. A. Multifunctional dimensions of ecologically-based agriculture in Latin America. 2000. International Journal of Sustainable Development and WorldEcology 7:62-75.

Altieri, M. A. 2007. How to teach agroecology: a proposal. Agroecology in Action. Online Journal, University of California, Berkeley. Retrieved from <http://www.agroeco.org/doc/update_30oct2007/HowToTeachAgroeco.pdf>.

Altieri, M. A., and C. I. Nicholls. 2001. Ecological impacts of modern agriculture in the United States and Latin America. In Globalization and the Rural Environment ed, Otto T. Solbrig, Robert Paarlberg, and Francesco di Castri. 123-137.

Altieri, M. A., N. Companioni, K. Cañizares, C. Murphy, P. Rosset, M. Bourque, and C. I. Nicholls. 1999. The greening of the "barrìos": Urban agriculture for food security in Cuba. Agriculture and Human Values 16 (2):131-140.

Altieri, M. A., and P. Rosset. 1996. Agroecology and the conversion of large-scale conventional systems to sustainable management. International Journal of Environmental Studies 50 (3-4):165-185.

Altieri, M. A., P. M. Rosset, and C. I. Nicholls. 1997. Biological control and agricultural modernization: Towards resolution of some contradictions. Agriculture and Human Values 14 (3):303-310.

Altieri, M.A., P.M. Rosset, and L.A. Thrupp. 2000. The Potential of Agroecology to Combat Hunger in the Developing World. Agroecology in Action. Online Journal, University of California, Berkeley. Retrieved from <http://agroeco.org/brasil/material/potential_of_agroecology.html>.

Altieri, M. A., and S. B. Hecht. 1990. Agroecology and Small Farm Development. Boca Raton, FL: CRC Press.

Alvarez, J. 2004. Cuba's Agricultural Sector. Gainesville, FL: University Press of Florida.

Alverez, M. D. 2002. Small organization and sustainability of small farm agriculture in Cuba, in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 72-89. Oakland, CA: Food First Books.

Badgley, C., and I. Perfecto. 2005. Cuban science democratic and not tied to profit. Nature 437 (7056):192.

Bebbington, A. (1995). Rural development: Polices, programs, and actors. In Latin American Development: Geographical Perspectives, ed. D. Prestion. Longman: Harlow. 116-145.

Bebbington, A. (1996). Movements, modernizations, and markets: Indigenous organization and agrarian strategies in Ecuador. In Liberation Ecologies: Environment, Development, Social Movements, ed. R. Peet and M. Watts. Routledge: New York. 86-109.

Benjamin, M., J. Cikkubs and N, Scott. 1984. No Free Lunch: Food & Revolution in Cuba Today. New York: Grove Press.

Benyus, J. M. 1997. Biomimicry : innovation inspired by nature. Morrow: New York.

Berry, B.J.L., Conkling, E.C., and Ray, D. M. 1987. Economic Geography: Resource, Locational Choices, and Regional Specialization in the Global Economy. Prentice-Hall, Inc., p. 225-5: Englewood Cliffs, N.J.

Bethell, L. 1993. Cuba: A Short History. Cambridge University Press.

Birdsall, N., and J. L. Londono. 1997. Asset inequality matters: An assessment of the World Bank's approach to poverty reduction. The American Economic Review 87 (2):32-37.

Bolduc, A. 2007. Rebuilding community through small farm infrastructure. Acres USA. 38(7): 20-24.

Bonanno, A. (1994). From Columbus to ConAgra: The Globalization of Food and Agriculture. Lawrence, KS: The University Press of Kansas.

Bonsal, P. 1981. Cuba, Castro, and the United States. London: University of Pittsburgh Press.

Born, B. and M. Purcell. 2006. Avoiding the local trap: Scale and Food provisioning systems in Planning Research. Journal of Planning Education and Research. 26:195-207.

Boswell, T. and C. Chase-Dunn. 2000. The Spiral of Capitalism and Socialism. Boulder, CO: Lynne Rienner Publishers, Inc.

Brenner, N. 1999: Beyond state-centrism? Space, territoriality, and geographical scale in globalization studies. Theory and Society 28, 39-78.

Brenner, N. 2001. The limits to scale? Methodological reflections on scalar structuration. Progress in Human Geography 25(4), 591-614.

British Petroleum. 2008. Statistical Review of World Energy June 2008. Retrieved from <http://www.bp.com/statisticalreview>.

Brown, J.C. and M. Purcell. 2005. There's nothing inherent about scale: Political ecology, the local trap, and the politics of development in the Brazilian Amazon. Geoforum 36, 607-624.

Buttel, F.H. and M.E. Gertler. 1982. Agricultural structure, agricultural policy and environmental quality. Agriculture and Environment 7:101–119.

Carrobello, C. and K. Monteagudo. 2007. Bailar con la más fea. Bohemia. Retrieved from <http://www.bohemia.cu/2006/11/03/encuba/ubpc.html>.

Castro, F. 1965. Apply theory to the particular conditions of each country. Speech, delivered at Plaza del Revolucion, Cuba in commemoration of the sixth anniversary of the Revolution, January 2.

Centro de Estudios sobre Desarrollo Cooperativo y Comunitario. Retrieved from <http://www.upr.edu.cu/index.php?option=com_content&task=view&id=96&Itemid=214>.

Chaplowe, S. G. 1998. Havana's popular gardens: sustainable prospects for urban agriculture. The Environmentalist 18 (1):47-57.

Cole, K. 2002. Cuba: The process of socialist development. Latin American Perspectives 29 (3):40-56.

Companioni, N., Y. Ojeda Hernandez, E. Paez, and C. Murphy. 2002. "The Growth of Urban Agriculture", in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 72-89. Oakland, CA: Food First Books.

Deere, C. D. 1995. The New Agrarian Reform. NACLA Report on the Americas. 24(2):13-17.

Delaney, D. and Leitner, H. 1997. The political construction of scale. Political Geography 16(2), 93-97.

DeMar, M. 1993. Constraints on constrainers: Limits on external economic policy affecting nutritional vulnerability in the Caribbean. Latin American Perspectives 20 (2):54-73.

Diamond, J. 1987. The Worst Mistake in the History of the Human Race. Discover, 19 May, 64-66.

Diaz-Briquets, S., and J. F. Pérez-López. 1995. The Special Period and the Environment. Cuba in Transition 5. Proceedings of the 5th Annual Meeting of the Association for the Study of the Cuban Economy, Miami, Florida, 10th-12th August.

Duncan, R. C., and W. Youngquist. 1999. Encircling the peak of world oil production. Natural Resources Research 8 (3):219-232.

Energy Information Administration, Official Statistics for the US Government. May 16, 2008. “Cuba Energy Profile”, Retrieved from <http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=CU>.

Escobar, A. 2001. Culture sits in places: reflections on globalism and subaltern strategies of localization. Political Geography. 20: 139-174.

Escobar, A. 2007. The ‘Ontological Turn in Social Theory’, a commentary on ‘Human geography without scale’, by Sallie Marston, John Paul Jones III, and Keith Woodward. Transactions, Royal Geographical Society, with the Institute of British Geography, 32 106-111.

Farber, S. 1976. Revolution and Reaction in Cuba, 1933-1960: A Political Sociology from Machado to Castro. Middletown, CT: Wesleyan University Press.

Farber, S. 2006. The Origins of the Cuban Revolution Reconsidered, ed. L. A. Peréz, Jr. Chapel Hill: The University of North Carolina Press.

Feenstra, Gail. 1997. Local food provisioning systems and sustainable communities. American Journal of Alternative Agriculture 12 (1): 28-36.

Fertilizer Use by Crop in Cuba. 2003. Rome, Italy: Food and Agriculture Organization of the United Nations.

Freire, Paulo. 1970. Pedagogy of the oppressed. New York: Herder and Herder.

Freire, P. 1973. Education for a Critical Consciousness. New York: Seabury Press.

Freire, P. 1985. The Politics of Education: Culture, Power, and Liberation. South Hadley, MA: Bergin & Garvey.

Fukuoka, M. and F. P. Metreaud. 1987. The road back to nature: regaining the paradise lost. Kodansha International/USA, through Harper & Row: New York.

Funes, F. 2002. “The Organic Farming Movement in Cuba”, in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 72-89. Oakland, CA: Food First Books.

García, L. 2002. “Agroecological Education and Training”, in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 72-89. Oakland, CA: Food First Books.

German Agro Action. 2007. Organoponico Vivero Alamar: A little success story of development cooperation. Bonn, Germany: Deutsch Welthungerhelfe.

Gersper, P. L., C. S. Rodríguez-Barbosa, and L. F. Orlando. 1993. Soil conservation in Cuba: A key to the new model for agriculture. Agriculture and Human Values 10 (3):16-23.

Gliessman, S. R., E. Engles, et al. 1998. Agroecology: ecological processes in sustainable agriculture. Chelsea, MI, Ann Arbor Press.

Goodman, David and Micheal J. Watts. 1997. Globalising Food Agrarian Questions and Global Restructuring. New York, Ny: Routledge.

Gottlieb, Robert and A. Fisher. 1998. Community food security and environmental justice: converging paths towards social justice and sustainable communities. Community Food Security News (Summer): 4-5.

Green Left Weekly. Cuba Greens Its Agriculture. 1994. An Interview with Luis Sanchez Almanza. Green Left Weekly, January 10, 1994.

Grogg, P. 24 Jan 2008. Agriculture – Cuba: Waiting for Announced Reforms. Interpress Service News, Retrieved from <http://ipsnews.net/news.asp?idnews=40349>.

Hall, P. (ed). 1966. Von Thünen’s Isolated State, Trans. Carla M. Whartenberg Oxford: Pergamon Press, p7-8.

Harris, E. Local foods Research Project: exploring localism in alternative food networks. Blog. Retrieved from <http://localfoods.wordpress.com>.

Harris, J. and D. Dent. 2000. Priorities in Biopesticide Research and Development in Developing Countries, Biopesticides Series No. 2. Ascot, UK: CABI Bioscience.

Harvey, D. 1996. Justice, Nature and the Geography of Difference. Blackwell, Cambridge, MA.

Hausner, J., Jessop, B., and Nielson, K. 1995. Stategic Choice and Path-Dependency in Post-Socialism. Brookfield, VT: Edward Elgar Publishing Co.

Henn, P., and J. Henning. 2002. Urban agriculture and sustainable urban systems: a benefits assessment of the garden movement in Havana, Cuba. International Journal of Environment and Sustainable Development 1 (3):202-209.

Hines, C. 2000: Localization: a global manifesto. Sterling VA: Earthscan Publications.

Hinrichs, C., J. Kloppenburg, S. Stevenson, S. Lezberg, J. Hendrickson, and K. DeMaster. 1998. Moving beyond Global and Local. United States Department of Agriculture, Regional Research Project NE-185, working statement, October 2. Retrieved from <http://www.ces.ncsu.edu/depts/sociology/ne185/global.html>.

Holm, W. R. 2004. Sharing Secrets… Three Canadian dairy farmers bound for Cuba. B.C. Holstein News, Dec. 2004.

Holmgren, D. 2006. Relocalisation: How Peak oil can lead to Permaculture. Holmgren Design Services: Hepburn, Victoria.

Hopkins, R. 2008. The transition handbook: from oil dependency to local resilience. White River Junction, VT: Chelsea Green Pub.

Howitt, R. 1998. Scale as relation: Musical metaphors of geographical scale. Area 30(1), 49-58.

Howitt, R. 2002. Scale and the other: Levinas and geography. *Geoforum* 33, 299-313.

Hurt, J. 2007. Reap What You Sow. Sept./Oct ed. My Midwest. Retrieved from <http://www.localburger.com/pdf/my_midwest_sept_oct_2007>.

Institute, B. 2007. Biomimicry: A Tool for Innovation. Retrieved from <http://www.biomimicryinstitute.org>.

Jessop, B. 1998. Globalization and its (il)logic(s). In Globalization and the Asia-Pacific, ed. Olds, K. London: Routledge.

Jessop, B. 2000. The crisis of the national spatio-temporal fix and the tendential ecological dominance of globalizing capitalism. International Joural of Urban and Regional Research 24(2), 323-360.

Jonas, A. 1994. Editorial: the scale politics of spatiality. *Environment and Planning D*. 12, 257-64.

Jones, J.P., Woodward, K., and Marston, S. 2005. Human geography without scale. Transactions, Royal Geographical Society, with the Institute of British Geography, 30 416-432.

Kelly, P. 1999. The geographies and politics of globalization. Progress in Human Geography 23(3), 379-400.

Kimbrell, A., and Vandana S. 2003. Fatal harvest: why industrial agriculture has failed and how to resist. San Francisco, CA: TUC Radio.

Kingsolver, B., S. L. Hopp, and C. Kingsolver. 2007. Animal, vegetable, miracle: a year of food life. New York: HarperCollins Publishers.

Kloppenburg, J. 1991. Social theory and the de/reconstruction of agricultural science: Local knowledge for an alternative agriculture. Rural Sociology 56(4), p. 519-548.

Kloppenburg, J., J. Hendrickson, and G.W. Stevenson. 1996. Coming into the food shed. Agriculture and Human Values, 13 (3): 33-42.

Kloppenburg, J. and N. Hassanein. 2006. From old school to new school. Agriculture and Human Values, 23: 427-421.

Kibbens, Jaime. 1996. The Greening of Cuba. VHS. Oakland: Food First.

Kuntz, D. 1994. The Politics of suffering: The impact of the U.S. embargo on the health of the Cuban people. Report to the American Public Health Association of a fact-finding trip to Cuba, June 6-11, 1993. Journal of Public Health Policy 15 (1):86-107.

Latour, B. 1986. Visualization and cognition: thinking with eyes and hands. In Knowledge and Society: Studies in the Sociology of Culture Past and Present, 1-40. Greenwich, CT: JAI Press.

Leitner, H. and Miller, B. 2007. Scale and the limitations of ontological debate: a commentary on Marston, Jones, and Woodward. Transactions, Royal Geographical Society, with the Institute of British Geography, 32 116-125.

Lerch, D. 2007. Post carbon cities planning for energy and climate uncertainty : a guidebook on peak oil and global warming for local governments. Sebastopol, California: Post Carbon Press.

Lopez, E., B.E. Acevedo, R. Silva, B. Tormo, R. Montero, and L. Herrera. 2002. Development of Cuban Biotechnology. *Journal of Commercial Biotechnology*. 9(2), 1-5.

Mander, J. and E. Goldsmith., ed. 1996. The case against the global economy: and for a turn toward the local. San Francisco, CA: Sierra Club Books.

Marston, S. 2000. The Social construction of scale. Progress in Human Geography 24(2), 219-242.

Marchall, P. 1987. Cuba Libre: Breaking the Chains? Boston: Faber and Faber.

MacEwan, A. 1981. Revolution and Economic Development in Cuba. Hong Kong: The MacMillan Press Ltd.

Mander, Jerry and E. Goldsmith (eds). 1996. The Case Against a Global Economy and For a Turn Towards the Local. San Francisco, CA: Sierra Club Books.

Mansfield, B. 2005. Beyond Rescaling: reintegrating the 'national' as a dimension of scalar relations. Progress in Human Geography 29 (4) 458-473.

Mark, J. 2007. Growing it alone. Earth Island Institute. Retrieved from <http://earthisland.org/journal/index.php/eij/article/growing_it_alone>.

Marston, S. 2000. The social construction of scale. *Progress in Human Geography* 24(2), 219-242.

Marston, S., Jones, J.P., and Woodward, K. 2007. Flattening ontologies of globalization: the Nollywood case. 4(1), 45-63.

Martín, Lucy, 2002. "Transforming the Cuban Countryside: Property, Markets, and Technological Change", in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, edited by Fernando Funes, Luis Garcia, Martín Bourque, Nilda Perez, and Peter Rosset, 72-89. Oakland, CA: Food First Books.

Mayoral, J. M. El Mango, el médico y la constancia. Granma. Retrieved from <www.granma.cubaweb.cu/2007/03/15/nacional/artic01.html>.

McCalla, A. F. 2007. Reforming agricultural trade for developing countries. In Agriculture and Rural Development: The World Bank.

McGuinness, H. 1993. Living soils: Sustainable alternatives to chemical fertilizers for developing countries. Unpublished manuscript, Consumers
Policy Institute, New York.

McMichael, P. 1994. *The Global Restructuring of Agro-Food Systems*. Ithaca, NY: Cornell University Press.

McMichael, P. 2000. The power of food. Agriculture and Human Values 17 (3): 21-33.

Messner, B. M. 1976. Soviet Agriculture and the Third World: A Case Study of Cuba. PHd diss., The Ohio State University.

McIsaac, G. and W. R. Edwards. 1994. Sustainable agriculture in the American Midwest. Urbana: University of Illinois Press.

McKibben, B. 2005. The Cuba Diet: What will you be eating when the revolution comes? Harper's Magazine, April 2005, 61-69.

Mesa-Lago, C. 2003. Cuba after the Cold War. Pittsburgh, and London: University of Pittsburgh Press.

Mohan, G. and Stokke, K. 2000. Participatory development and empowerment: The dangers of localism. Third World Quarterly 21(2), 247-268.

Moore, A. 2008. Rethinking scale in geographic theory: from analysis to practice. Progress in Human Geography 32(2), 203-335.

Moore-Lappé, F, J. Collins, and P. R. Rosset. 1998. World Hunger: 12 Myths, 2nd Ed, ed. L. Esparaza. Oakland, CA: Grove/Atlantic/Food First Books.

Morgan, F. 2006. The Power of Community: How Cuba Survived Peak oil. USA: Community Services, Inc.

Moulaert, F., A. Rodriguez, and E. Syngedouw. 2003. The Globalized City: Economic Restructuring and Social Polarization in European Cities. Oxford University Press.

Myers, G. 2002. Local communities and the new environmental planning: A case study from Zanzibar. Area 34(2), 149-159.

Murphy, Catharine. 1999. Development Report No. 12, Cultivating Havana: Urban agriculture and food security in the years of crisis. Oakland, CA: Food First Books.

Nabhan, G. P. 2002. Coming home to eat: the pleasures and politics of local foods. New York: Norton.

Nash, J. and Mitchell, D. March 2005. How freer trade can help feed the poor: an agenda for erasing hunger worldwide by reducing trade protectionism. Finance and Development. Retrieved from <http://www.imf.org/external/pubs/ft/fandd/2005/03/pdf/nash.pdf>.

Nassif, R. 1994. José Martí. *Prospects: The quarterly review of comparative education.* XXIV (1/2), 107-19.

Nicholls, C. I., N. Pérez, L. Vasquez, and M. A. Altieri. 2002. The Development and Status of Biologically Based Integrated Pest Management in Cuba. Integrated Pest Management Reviews 7 (1):1-16.

Nieto, M. and Delgado, R. 2002. Cuban Agriculture and Food Security. in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 40-56. Oakland, CA: Food First Books.

Nova, A. 2002. “Cuban Agriculture Before 1990”, in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 27-39. Oakland, CA: Food First Books.

Oficina Nacional de Estadísticas República de Cuba. Producción agrícola por cultivos seleccionados de la agricultura no cañera, 2001 -2006. Retrievd from <http://www.one.cu>.

Oppenheim, S. 2001. Alternative agriculture in Cuba. American Entomologist 47 (4):216–27.

Otero, G., and J. O'Bryan. 2002. Cuba in transition? The civil sphere's challenge to the Castro regime. Latin American Politics and Society 44 (4):29-57.

Pastor, M. and Zimbalist, A. 1995. Cuba’s Economic Conundrum. NACLA Rep. Americas 24(2), 7-12.

Peluso, N. 1992. ‘Traditions’ of forest control in Java: implications for social forestry and sustainability. Natural Resources Journal, 32, 882-918.

Peréz, L. A. 1988. Cuba and the United States: Ties of singular intimacy. Oxford University Press.

Perz, S. 2001. From sustainable development to ‘productive conservation’: forest conservation options and agricultural income and assets in the Brazilian Amazon. Rural Sociology 66, 93-112.

Pretty, J., and H. Ward. 2001. Social capital and the environment. World Development 29 (2):209-227.

Pugliese, P. 2001. Organic Farming and Sustainable Rural Development: A Multifaceted and Promising Convergence. Sociologia Ruralis 41 (1):112-130.

Purcell, M. 2002. The state, regulation, and global restructuring: reasserting the political in political economy. Review of International Political Economy 9 (2), 284-318.

Purcell, M. 2003. Islands of practice and the Marston/Brenner debate: toward a more synthetic critical human geography. Progress in Human Geography 27 (3): 317-332.

Purcell M. and J. C. Brown. 2005. Against the local trap: scale and study of environment and development. Progress in Development Studies 5(4), 279-297.

Quinn, M, interview by Donaldson, J. June 2006. Peak Moment: Learning from Cuba's Response to Peak oil. The Post Carbon Institute. Transcription by Baldwin, K. Retrieved from: http://globalpublicmedia.com/transcripts/2802

Ramirez, M. and O. Acosta. 2007. Mision al 2007: Compromiso con el General de Ejercito y Segundo Secretario del PCC Raul Castro Ruz. Agricultura Organica, Asociacion Cubana de Tecnicos Agricolas y Forestales 13(3): 6.

Ríos, A., and Ponce, F. 2002. "Mechanization, Animal Traction, and Sustainable Agriculture", in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 72-89. Oakland, CA: Food First Books.

Robinson, W. I. 1999. Latin America in the Age of inequality: Confronting the new "utopia". International Studies Review 1 (3):41-67.

Rosset, P. M. 1997. Alternative agriculture and crisis in Cuba. Technology and Society Magazine, IEEE 16 (2):19-25.

Rosset, P. M. 1997. Cuba: Ethics, biological control, and crisis. Agriculture and Human Values 14 (3):291-302.

Rosset, P.M. and M. A. Altieri. 1997. Agroecology versus input substitution: A fundamental contradiction in sustainable agriculture. Society and Natural Resources. 10:283–295.

Rosset, P. M. and M. Benjamin. 1994. The Greening of the Revolution: Cuba's experiment with organic agriculture. Melbourne: Ocean Press.

Rosset, P. M., and M. Moore. 1997. Food security and local production of biopesticides in Cuba. ILEIA Newsletter 13 (4):18–9.

Sack, R. D. 1997. Homo Geographicus: a framework for action, awareness, and moral concern. Baltimore, MD: John Hopkins University Press.

Sack, R. D. 2001a. The geographic problematic: Empirical issues. Norsk Goegrafisk Tidsskrift-Norwegian Journal of Geography 55, 107-116.

Sack, R. D. 2001b. The geographic Problematic: Moral Issues. Norsk Goegrafisk Tidsskrift-Norwegian Journal of Geography 55, 117-125.

Sack, R. D. 2003. A Geographical Guide to the Real and the Good. New York: Routledge.

Sanchez, R. 1964. Sugar and Society in the Caribbean: An Economic History of Cuban Agriculture. New Haven, CT: Yale University Press.

Sartre, J. 1960. Sartre on Cuba. Westport, CT: Greenwood Press.

Sayer, A. 1991. Behind the locality debate: deconstructing geography's dualisms. Environment and Planning 23 (A): 283-308.

Sayer, R. Andrew. 1992. Method in social science: a realist approach. London: Routledge.

Schumacher, E. F. 1975. Small is Beautiful: Economics as If People Mattered. New York: Harper & Row.

Schwab, Peter. 1999. Cuba: Confronting the US Embargo. New York: St. Martín's Press.

Scott, A. 1998. Regions and the World Economy: The Coming Shape of Global Production, Competition, and Political Order. New York: Oxford University Press.

Scott, J. 1998. Seeing like a state: how certain schemes to improve the human condition have failed. New Haven, CT: Yale University Press.

Sherwood, S. and S. Larrea. 2001. Looking back to see ahead: Farmer lessons and recommendations after 15 years of innovation and leadership in Güinope, Honduras. Agriculture and Human Values 18 (2):195-208.

Sinclaire, M. and M. Thompson. 2001. Oxfam America. *Cuba: Going Against the Grain*. Retrieved from <http://www.oxfamamerica.org/newsandpublications/publications/research_reports/art1164.html>.

Smith, A., and J. B. MacKinnon. 2007. Plenty: one man, one woman, and a raucous year of eating locally. New York: Harmony Books.

Smith, N. 1990. Uneven Development: Nature, Capital and the Production of Space. Oxford: Basil Blackwell.

Smith, N. 1992. Geography, differences, and the politics of scale. In Postmodernism and the Social Sciences, ed. J. Doherty, E. Graham, and M. Malek, 57-79. London: Macmillian.

Smith, N. 1993. Homeless/global: Scaling places. In Mapping the futures: Local cultures global change, ed. J. Bird. 87-119. New York: Routledge.

Snapp, S. S. and B. Pound 2008. Agricultural systems: agroecology and rural innovation for development. Amsterdam ; Elsevier/Academic Press: Boston.

Snyngedouw, E. 1997. Neither global nor local: Glocalization and the politics of scale. In Space and Globalization, ed. K. Cox, 137-166. New York: Guilford Press.

Swyngedouw, E. 2000. Authoritarian governance, power, and the politics of rescaling. Environment and Planning D: Society and Space 18(1), 63-76.

Swyngedouw, E. 2004. Globalization or 'Glocalization'? Networks, territories, and rescaling. Cambridge Review of International Affairs. 17(1), 25-48.

The Right Livelihood Award: For outstanding vision and work on behalf of our planet and its people. Grupo de Agricultura Organica, GAO, Cuba. 1999. Retrieved from <http://www.rightlivelihood.org/gao.html>.

Thrift N, (1999). Steps to an ecology of place. D. Massey, J. Allen. and P Sarre. eds. Human Geography Today Polity Press, Cambridge.

Thrupp, L. A. 1996. *New partnerships for sustainable agriculture*. Washington, DC: World Resources Institute.

Thrupp, L.A. 1998. Cultivating diversity: Agrobiodiversity and food security. World Resources Institute, Washington, D.C.

Tsing, A., Brosius, J. and Zerner, C. 1999: Assessing community-based natural-resource management. Ambio 28, 197-99.

Tuan, Y. 1977. Space and Place: The Perspective of Experience. Minneapolis, MN: University of Minnesota Press.

United Nations Food and Agriculture Organization: UN Data: A World of Information. Food and Agriculture Statistics Division, Retrieved from <http://data.un.org/Browse.aspx?d=FAO>.

Vandermeer, J. 1995. The ecological basis of alternative agriculture. Annual Review of Ecology and Systematics 26:201-224.

Vandermeer, J., J. Carney, P. Gersper, I. Perfecto, and P. Rosset. 1993. Cuba and the dilemma of modern agriculture. Agriculture and Human Values 10 (3):3-8.

Vandermeer, J., and I. Perfecto. 2007. The Agricultural matrix and a future paradigm for conservation. Conservation Biology 21 (1):274-277.

Via Campesina. May 1, 2008. An answer to the global food crisis: peasants and small farmers can feed the world. Retrieved from <http://www.viacampesina.org/main_en/index.php?option=com_content&task=view&id=525&Itemid=1>.

Weir, D. and M. Schapiro. 1981. Circle of Poison: Pesticides and People in a Hungry World. San Francisco, CA: Institute for Food and Development Policy.

Whatmore, S., and L. Thorne. 1997. Networks: alternative geographies of food. In Globalising Food: Agrarian Questions and Global Restructuring, 287-304. New York: Routledge.

White, D. F. 2002. A green industrial revolution? Sustainable technological innovation in a global age. Environmental Politics 11 (2):1 - 26.

Wiesmann, D., A. K. Sost, I. Schöninger, H. Dalzell, L. Kiess, T. Arnold and S. Collins. Global Hunger Index. 2007. Annual Report: The Challenge of Hunger 2007. Bonn, Germany: Druckhaus.

Wolfee, L. R. 2004. Rural-urban migration and the stabilization of Cuban Agriculture. Consultant's Report for Global Exchange/Food First, Dec. 17. San Francisco: Food First/Institute for Food and Development Policy.

World Bank Development Report. August 1, 2003. Reaching the rural poor – a renewed strategy for development, #26763, Retrieved from <http://wwwwds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187282&theSitePK=523679&entityID=000112742_20060906121359&searchMenuPK=64187282&theSitePK=523679>.

World Resources 2000-2001- People and Ecosystems: The fraying web of life. Prepared by The United Nations Development Programme (UNDP), The United Nations Environment Programme (UNEP), The World Bank, and The World Resources Institute. UNDP, September 2000.

Wright, Julia. 2006. Cuba's Enforced Ecological Learning Experience. LEISA Magazine on Low External Input and Sustainable Agriculture June 2006, 22(2): 6-9.

Zimmerer, K. S., and T. J. Bassett. 2003. Approaching political ecology: Society, nature, and scale in human-environment studies. In Political ecology: An integrative approach to geography and environment-development studies, ed. K. S. Zimmerer and T. J. Bassett, 1-25. New York: Guilford.

Appendixes

Appendix A: Classical Model vs. Alternative Model (from MINAG)

"Strategy for the development of specific projects: most relevant considerations to keep in mind." Translation of Ministry of Agriculture chart circulated to planning staff.

CLASSICAL MODEL vs. *(originating fundamentally in developed countries)*	ALTERNATIVE MODEL
-External Dependence • of the country on other countries • of provinces on the country • of localities on the province & the country	Maximum advantage taken of: • the land • human resources of the zone or locality • broad community participation • cutting edge technology, but appropriate to the zone where it is used • organic fertilizers and crop rotation • biological control of pests • biological cycles and seasonality of crops and animals • natural energy sources: hydro (rivers, dams, *etc.*) wind solar slopes, biomass, *etc.* • animal traction • rotational use of pastures and forage for both grazing and feedlots, search for locally supplied animal nutrition
-Cutting edge technology • imported raw materials for animal feed • widespread utilization of chemical pesticides and fertilizers • utilization of modern irrigation systems • consumption of fuel and lubricants	
-Tight relationship between bank credit and production; high interest rates	
-Priority given to mechanization as a production technology	
-Introduction of new crops at the expense of autochthonous crops and production systems	-Diversification of crops and autochthonous production systems based on accumulated knowledge
-Search for efficiency through intensification and mechanization	-Introduction of scientific practices that correspond to the particulars of each zone; new varieties of crops and animals, planting densities, seed treatments, post-harvest storage, *etc.*
-Real possibility of investing in production and commercialization	
-Accelerated rural exodus	-Preservation of the environment and the ecosystem
-To satisfy ever increasing needs has ever more ecological or environmental consequences, such as soil erosion, salinization, waterlogging, *etc.*	-Need for systematic training (management, nutritional, technical)

	-Systematic technical assistance -Promote cooperation among producers, within and among communities -Obstacles to overcome: • difficulties in the commercialization of agricultural products because of the number of intermediaries. Control over the markets and its particulars. • poverty among the peasantry • the distances to markets and urban centers (lack of sufficient roads and means of transport, *etc.*) • illiteracy

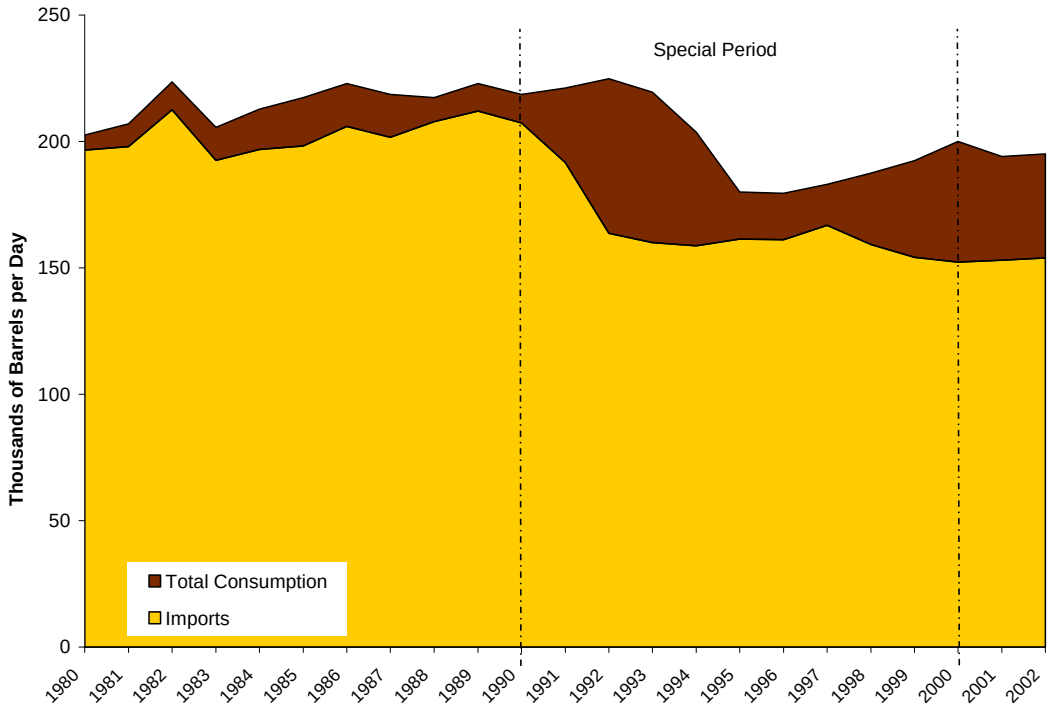
*Chart circulated prior to 1993

Chart reproduced as written in: Rosset, P. M. and M. Benjamin. 1994. The Greening of the Revolution: Cuba's experiment with organic agriculture. Melbourne: Ocean Press, 30-31; chart also in Vandermeer, J., J. Carney, P. Gersper, I. Perfecto, and P. Rosset. 1993. Agriculture and Human Values 10 (3): 3-8.

Appendix B: Measuring "Success" During the Special Period

The following charts present data that supports the claims that the system of agriculture Cuba devised during the Special Period was successful despite a lack of resources considered to be crucial for intensive agricultural production.

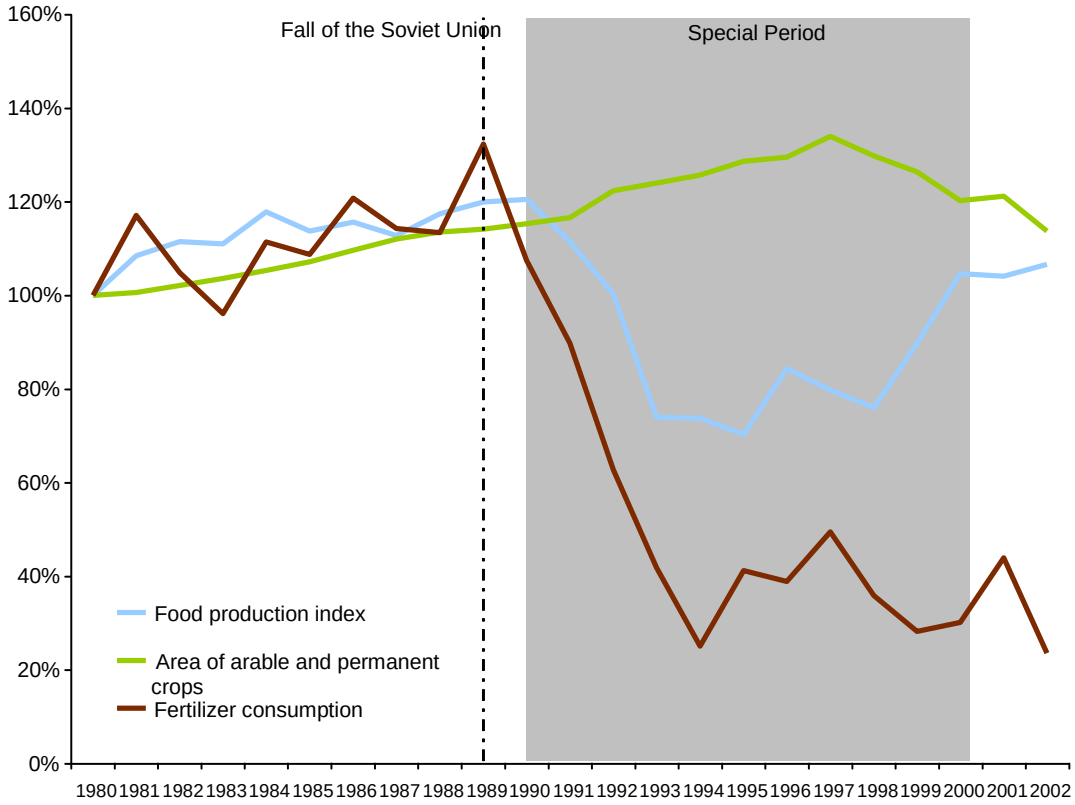
Figure B-1: Barrels of Oil Consumed and Imported in Cuba 1980-2002



Source: Energy Information Administration, Official Statistics for the US Government. May 16, 2008. "Cuba Energy Profile", <http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=CU>.

Figure B-1 shows a decline in petroleum imported and consumption in Cuba in the years leading up to the fall of the Soviet Union, during and shortly after the Special Period.

Figure B-2: Index of food production and resources 1980-2002

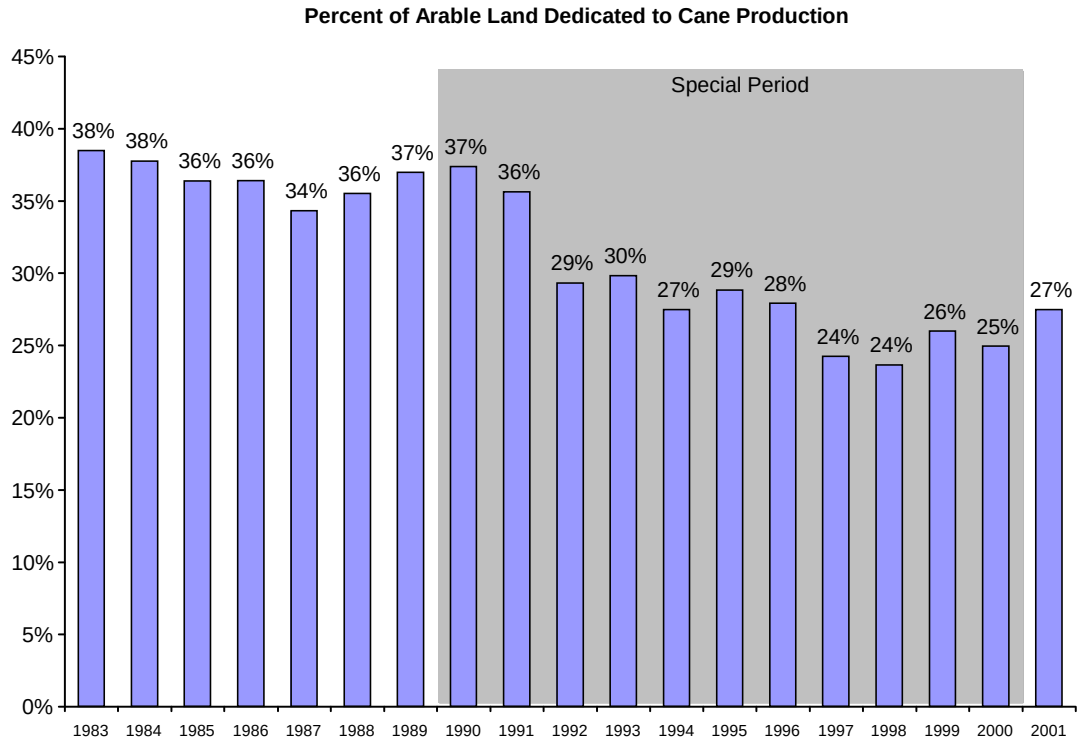


Data Source: United Nations Food and Agriculture Organization: UN Data: A World of Information. Food and Agriculture Statistics Division, <http://data.un.org/Browse.aspx?d=FAO>.

Figure B-2 is an index of food production developed by the United Nations Food and Agriculture Organization (FAO), with changes in arable cropland and fertilizer consumption. The chart shows that imports fell immediately and rapidly after the Soviet collapse. For a short time Cuba was able to make up for the reduction in imports, however, access to petroleum further declined in the late 1990s. In this chart 1980 is the base year for all values (100 percent), and each ensuing year is a ratio of its value to that of 1980. Figure B-2. Index of Food Production, Arable Cropland and Fertilizer Consumption from 1980 to 2002 (1980 is the base year of analysis). Figure

B-2 shows that fertilizer consumption increased during the 1980s up to the fall of the Soviet Union. After its collapse, fertilizer use decreased rapidly, reaching a small fraction of what it had once been by the mid 1990s. Food production decreased after the end of the Soviet Union, it increased substantially by the end of the Special Period. However, as of 2002, it has not reached 1989 levels of food production. Arable land in agricultural production has increased steadily both before the Special Period and during it. However, the amount of land dedicated to agriculture has declined from 1997 to 2002.

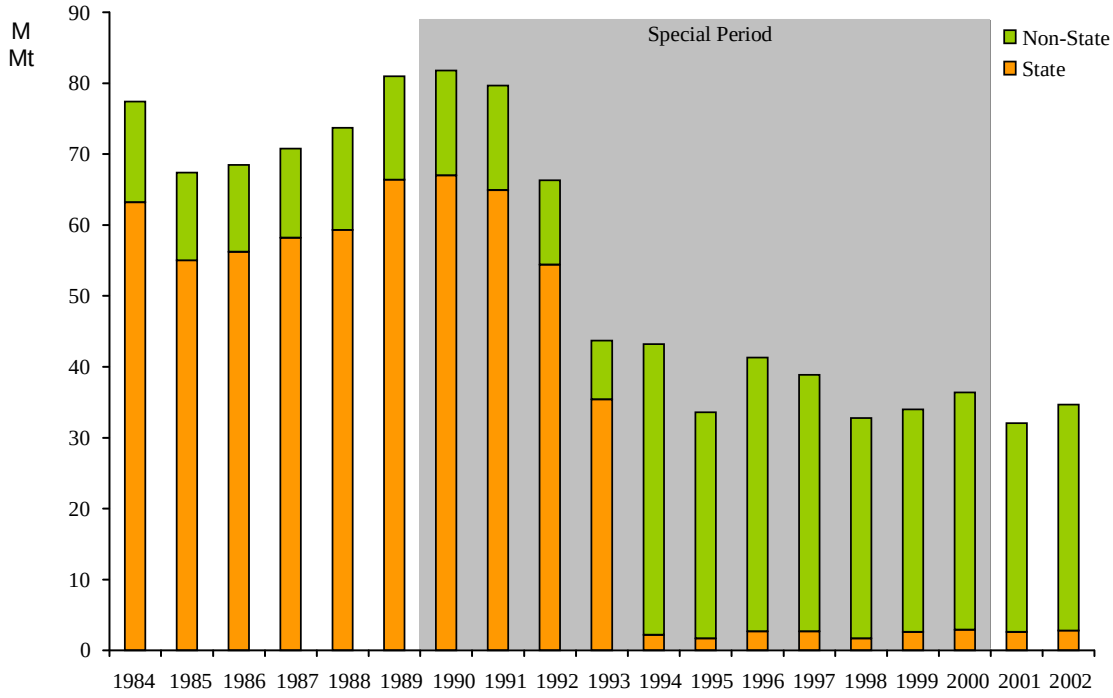
Figure B-3: Percent of Arable land Dedicated to Sugarcane Production



Data Source: United Nations Food and Agriculture Organization: UN Data: A World of Information. Food and Agriculture Statistics Division, <http://data.un.org/Browse.aspx?d=FAO>.

One response to the changing needs of food production in Cuba was to reduce the amount of arable land dedicated to sugarcane. This is shown in Figure B-3. At one point, the amount of arable land used in sugarcane production had declined by as much as 1/3rd. As a result of the agricultural land-production changes, sugar production declined throughout the Special Period. Even more critical is that due to reforms and policy changes at the federal level, the primary producer of sugarcane changed from state to non-state entities, see Figure B-4.

Figure B-4: State and Non-State Sugarcane Production 1980-2002



Data Source: United Nations Food and Agriculture Organization: UN Data: A World of Information. Food and Agriculture Statistics Division, <http://data.un.org/Browse.aspx?d=FAO>.

From 1993 to 1994, cane sugar went from being 80 percent state controlled production to only 5 percent. Such dramatic and rapid changes could not occur only at the local level. This change in production focus helped to improve food security for Cubans, as can be seen in Table B-5.

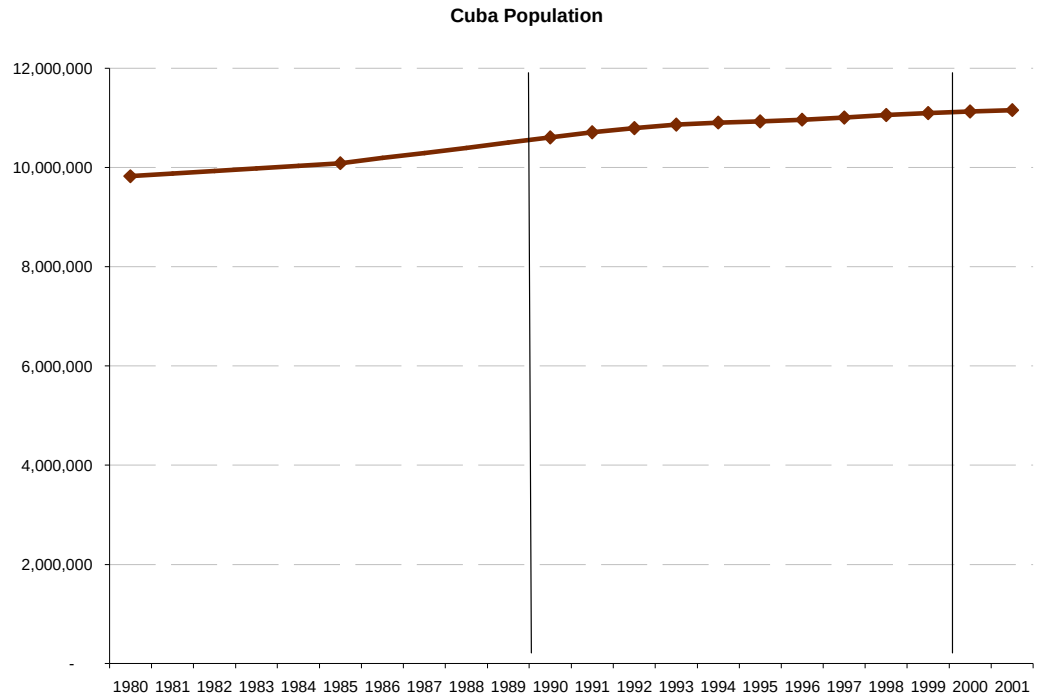
Table B-5: Nutrition During the Special Period

Selected statistics	1990-92	1995-97	2002-04
Population (million)	10.7	11.0	11.3
Food supply (kcal/person/day)	2720	2430	3320
Number of undernourished (million)	0.7	1.8	0.1
Proportion of undernourishment (percent)			
Cuba	7	17	<2.5
The Caribbean	5	5	5
Latin America and the Carribean	13	11	10

Source: World Resources 2000-2001- People and Ecosystems: The fraying web of life. Prepared by The United Nations Development Programme (UNDP), The United Nations Environment Programme (UNEP), The World Bank, and The World Resources Institute. UNDP, September 2000.

Table B-5 shows that while malnutrition increased during the early years of the Special Period, it quickly declined. By the end of the period malnutrition levels were lower than they had been prior to the Special Period. Additionally, malnutrition levels were much lower than the average malnutrition rate for the region of Latin America. Thus, malnutrition decreased throughout this time period while population increased. Figure B-6 shows the increase in population throughout the Special Period.

Figure B-6: Population throughout Special Period



Source: United Nations Food and Agriculture Organization: UN Data: A World of Information. Food and Agriculture Statistics Division, <http://data.un.org/Browse.aspx?d=FAO>.

The population chart shows that the population of Cuba increased throughout the Special Period.

Appendix C: Organizations and Contacts in Cuba

Date	Location	Organization	Type	Contact and Position
2/04/08	Boyeros Municipality (of Havana City Province)	Plant Nursery of Boyeros Municipality/ Casa de Posturas, Boyeros	State Farm, Department of The Tropical Plant Research Institute (INIFAT)	Marta, Farmer/ Spouse of Production Manager
2/05/08	Havana City	Ministry of Agriculture/ Ministerio de Agricultura (MINAG)	State Department	Luis Ross, Specialist in International Relations Juan José León, Specialist in International Relations
2/05/08	Havana City	Cuban Association of Agriculturalists and Foresters, City of Havana/ Asociación Cubana de Técnicos Agrículas y Forestales, Filial Ciudad de La Habana (ACTAF)	NGO	Yenesy Grana Rivero, Director of International Collaboration
2/06/08	Havana City	National Institute for tropical Agriculture/ Instituto Nacional de Investigaciones en Agricultura Tropical (INIFAT)	State, Department of Ministry of Agriculture/ Ministerio de Agricultura (MINAG)	Pedro Pablo, Director of International Collaboration Rosalía Gonzalez, Director of Urban Agriculture (City of Havana)
2/06/08	Pinar del Rio Municipality, Pinar del Rio Province	Production of Medicinal Plants, Pinar del Rio/ Producción y transformación de Plantes, Pinar del Rio	State, Department of Ministry of Health/ Ministerio de Salud Publica	Javier Traviezo Sanchez, Director
2/07/08	San Luis municipality, Pinar del Rio province	Cuchillas de Barbacoa (Tobacco Production)	Private Farm	Alejandro Robaino, Private Farmer
2/08/08	Pinar del Río Municipality, Pinar del	UBPC El Mango (Vegetable, Meat, and Medicinal Plant Production)	Basic Unit of Cooperative Production/ Unidad Básica de Producción	Nando Bobadilla Labrador, Director

Date	Location	Organization	Type	Contact and Position
	Río Province		Cooperativa (UBPC)	
2/08/08	Alamar (District of Havana)	UBPC Alamar (Vegetable and Municipal Plant Production)	Basic Unit of Cooperative Production/ Unidad Básica de Producción Cooperativa (UBPC) Partnered with German NGO German Agro Action/ Welt Hunger Hilfe	Miguel A. Salcines López, Production Manager José Morales, Human Resources Manager
2/08/08	Havana City	Institute for Irrigation Research/ Instituto de Investigaciones de Riego y Drenaje	Department of MINAG	Greco Sid, Soil Sciences Research
2/09/08	Havana City	National Association of Small Farmers/ Asociación Nacional de Agricultures Pequeños (ANAP)	NGO	Maria del Carmen Bajos, Public Relations Coordinator
2/09/08	Havana City	Cuba Solar	NGO	Bruno Henriques, physicist

Appendix D: Global/Local Binary

Global	Local
Market economy	Moral economy
An economics of price	A political economy of quality
TNCs dominate	Independent craft-artisan producers prevail
Large-scale production	Small-scale production
Industrial models	"Natural" models
Lengthy "commodity chains"	Relatively unmediated (i.e., direct) producer-consumer links
54Relations across distance	Relations of proximity
Big structures	Voluntary actors
Technocratic rules	Democratic participation
Resource consumption and degradation	Resource protection and regeneration
Commodities across space	Communities in place
Corporate profits	Community economic development
The homogenization of foods	"Regional palates"

Source: Hinrichs, C., J. Kloppenburg, S. Stevenson, S. Lezberg, J. Hendrickson, and K. DeMaster. 1998. *Moving beyond Global and Local*. United States Department of Agriculture, Regional Research Project NE-185, working statement, October 2. Retrieved from <http://www.ces.ncsu.edu/depts/sociology/ne185/global.html>.

Appendix E: Properties of Agroecosystems

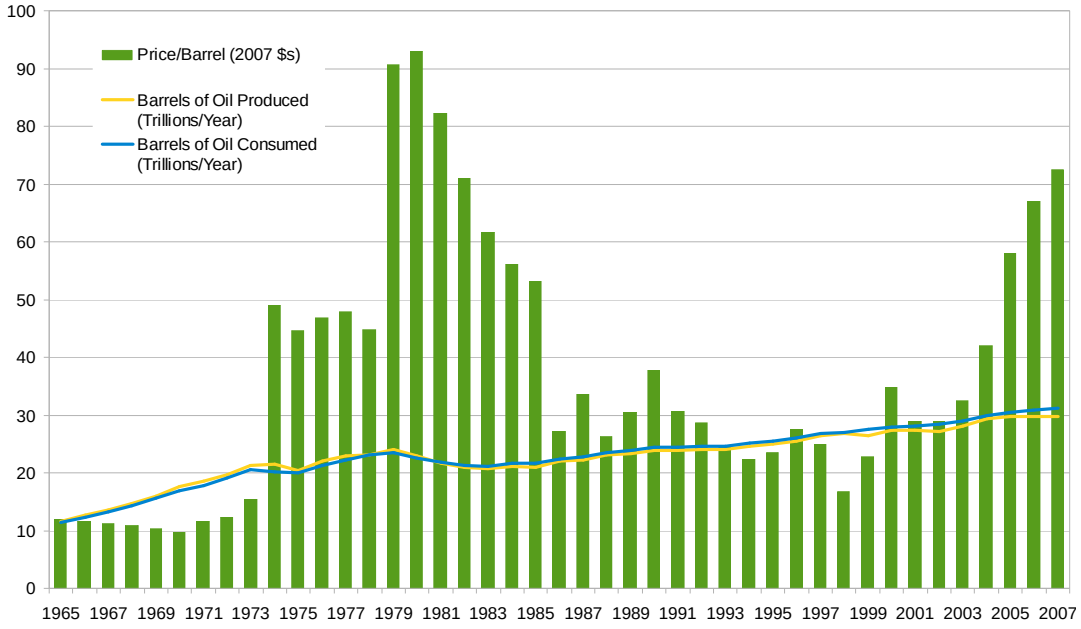
Property	Natural Ecosystems	Sustainable Agroecosystems	Conventional Agroecosystems
Production (yield)	Low	Low/Medium	High
Productivity (process)	Medium	Medium/High	Low/Medium
Diversity	High	Medium	Low
Resilience	High	Medium	Low
Output Stability	Medium	Low/Medium	High
Flexibility	High	Medium	Low
Human Displacement of Ecological Processes	Low	Medium	High
Reliance on External Human Inputs	Low	Medium	High
Autonomy	High	High	Low
Sustainability	High	High	Low

*Properties given for these systems are most applicable to the farm scale and for the short- to medium-term time frame.

Source: Gliessman, S. R., E. Engles, et al. 1998. *Agroecology: ecological processes in sustainable agriculture.* Chelsea, MI, Ann Arbor Press.

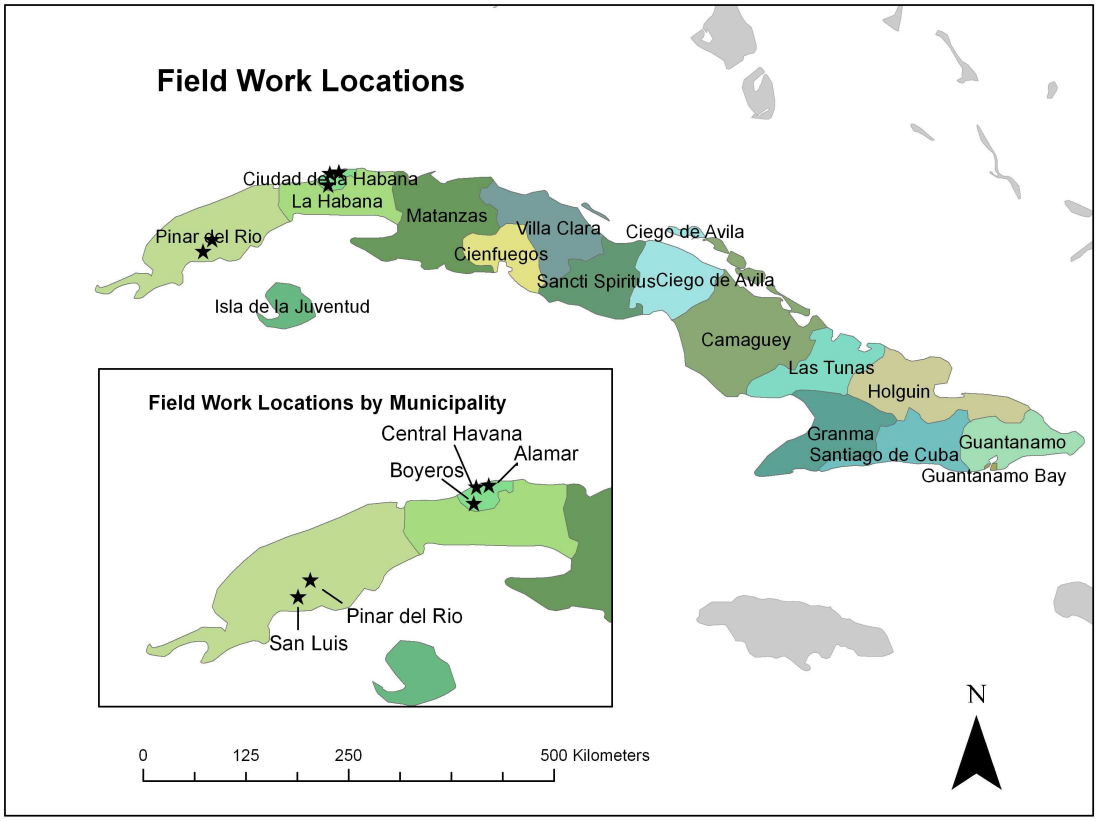
Appendix F: 40 Year Trend of Oil Production and Consumption

This chart shows oil production, consumption and price from 1965 to 2007. Consumption has outpaced production every year since 1981. As this gulf has widened, price has increased; as the gap has narrowed, price has decreased. This illustrates that gap between demand for oil and available supply is a major driver of price volatility.



Source of data: British Petroleum. 2008. Statistical Review of World Energy June 2008. Retrieved from <http://www.bp.com/statisticalreview>.

Appendix G: Field work locations in Cuba



Appendix H: Administrative Structures for Agriculture

The Ministry of Agriculture is the national organization with the overall charge of directing and regulating agricultural and forest production to meet the needs of the population, raw material needs of industry, and tourism requirements, as well as to substitute imports and to encourage exports with maximum efficiency. MINAG also guarantees services and inspections for animal and plant health, and environmental protection, and safe workplace conditions. Its total workforce consists of 1,153,000 employees (including UBPC workers). Giving the overriding importance of sugarcane and the sugar industry to the Cuban economy, the Ministry of Sugar (MINAZ) is responsible for an agricultural area of approximately 1,500,000 hectares, with functions similar to those of MINAG in the agricultural and agro-industrial sectors.

The National Association of Small Farmers (ANAP) provides organizational and productive support, as well as training, promotion, marketing, international cooperation, for small farmers, whether they are members of CPA's, CCSs, or individual farmers. It has helped its members preserve a large portion of Cuba's farming traditions, experiences, and culture, which have been and continue to be of great importance for the shift toward sustainable and agroecological agriculture.

The Ministry of Higher Education (MINED) is entrusted with technical education in the countryside, relying on a network of Agricultural Polytechnic Institutes (IPAs, essentially vocational high schools). These institutes have agricultural production areas that are looked after by their own students, providing both a theoretical and practical education, while at the same time providing food for both the students and professors.

The Ministry of Higher Education (MES) is responsible for university and post-graduate teaching. All agricultural universities are included in its structure, as well as several research institutes and experiment stations, some of them of great national and international prestige, that give important support to the activities of MINAG.

Source: Funes, F. "The Organic Farming Movement in Cuba", in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 72-89. Oakland, CA: Food First Books, 8-9.

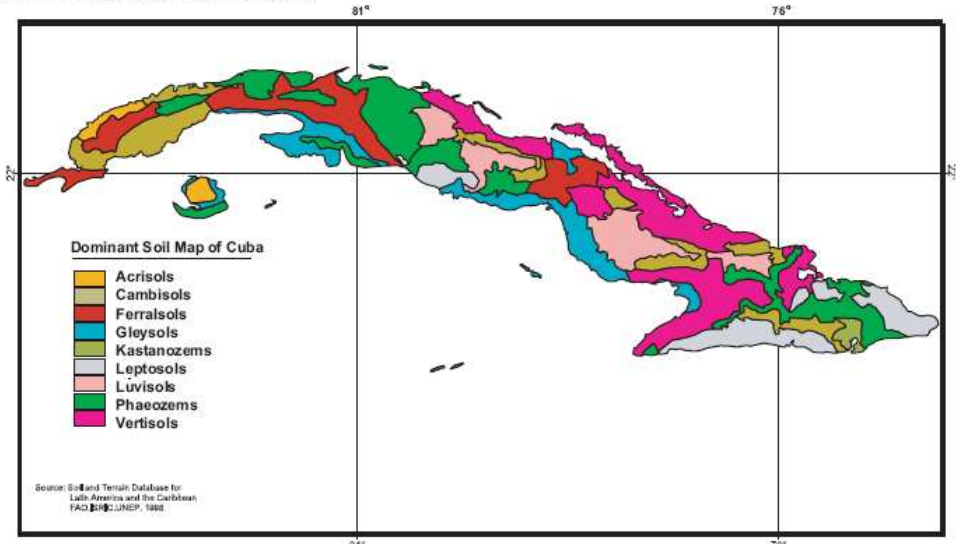
Appendix I: Land Tenure Structure

Structure	Origin	Tenure	Benefits
CPA	Individual landowners	Voluntary donation of land to form cooperatives and associations	Wages, based on efforts and participation
CCS	Former tenants, farm workers, partisans, sharecroppers, and small landholders	Private lands and in-usufruct lands	Bank credits, profit sharing
UBPC	Former state farm workers	Collective usufruct of lands with purchased means of production, animals, etc.	Wages, based on effort and participation
Lands in Usufruct, rural sector	State lands. Mainly in coffee, cocoa, and tobacco	Usufruct of state lands	Sale to the state of the principle crop, family subsistence production, and free market sale of surplus crops
Urban agriculture	Backyards, roofs, balconies, and urban and peri-urban plots	Usufruct of state lands	Family self-provisioning, neighborhood sales of vegetables, flowers, herbs, and animals
GENT	State farms lacking the conditions needed to form UBPCs	Private or usufruct up to 0.25 hectares	Wages, by type of work and production results
State Enterprise	State lands	All means of production belong to the state	Salaried workers, food and export production

Source: Funes, F. “The Organic Farming Movement in Cuba”, in Sustainable Agriculture and Resistance: Transforming Food Production in Cuba, ed. F. Funes, L. García, M. Bourque, N. Peréz, and P. Rosset. p. 72-89. Oakland, CA: Food First Books, 10.

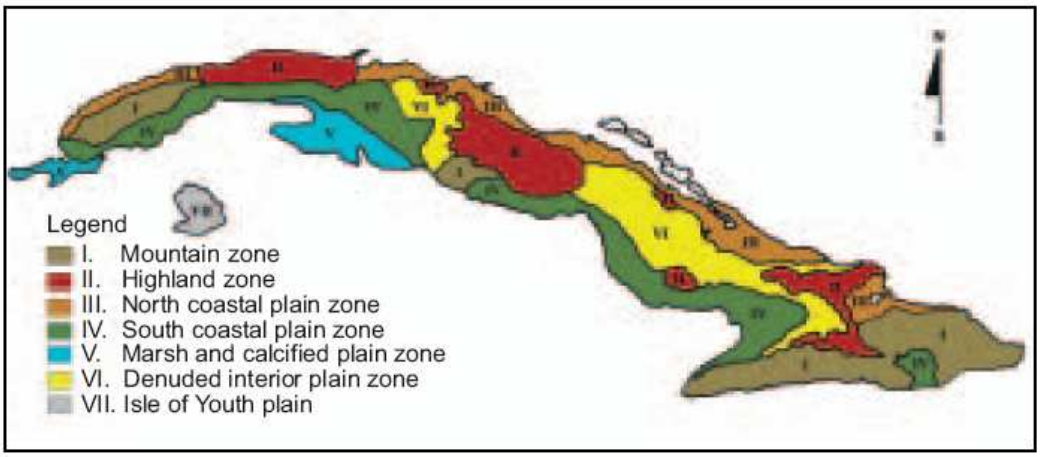
Appendix J: Soil and Agroecological Zone Maps of Cuba

Figure 1
Dominant soil map of Cuba



Source: FAO/ISRIC/UNEP/CIP, 1988.

Figure 2
Agro-ecological zones of Cuba



Source: Fertilizer Use by Crop in Cuba. 2003. Rome, Italy: Food and Agriculture Organization of the United Nations.

List of Acronyms

ACAO	Cuban Association of Organic Agriculture
ACPA	Cuban Association of Animal Production
ACTAF	Cuban Association of Agriculture and Forestry Technicians
ANAP	National Association of Small Farmers
CBA	Community Based Agriculture
CCS	Cooperatives of Credit and Service
CEAS	Center for the Study of Sustainability at the Agrarian University of Havana
CNSF	National Institute for Research of Soil and fertilizers
CPA	Agriculture Production Cooperative
COMECON	Council for Mutual Economic Assistance (economic union of the former Socialist Bloc)
CREE	Center for Reproduction of Entomopathogens and Entomophages
FAO	United Nations Food and Agriculture Organization
GAO	Cuban Organic Farming Association
ICAP	Cuban Institute for Friendship with the People
INCA	National Institute of Agricultural Science
INIFAT	National Institute for Fundamental Research on Tropical Agriculture
INRA	National Institute of Agrarian Reform
LISA	Low Input Sustainable Agriculture
MINAG	Ministry of Agriculture
MINAGRI	Provincial Ministry of Agriculture
MINAZ	Ministry of Sugar
MIVAC	Ministry of Economic Collaboration
MST	Brazil's Landless Working Movement
NAS	National Academy of Science (United States)
SANE	UN Sustainable Agriculture Network
UBPC	Basic Unit of Cooperative Production