Cuba's Agricultural Revolution: A Return to Oxen and Organics

The fall of the Berlin Wall in 1989 and the subsequent demise of communism in the Soviet Union occurred half a world away from Cuba. But the repercussions of that revolution directly affected Cuban soils: it transformed Cuba's agricultural lands by forcing a radical shift to organic inputs and farming methods on a scale unprecedented worldwide.

Cuban Agroecosystem Management from 1959 to 1989

From 1959 through the 1980s, being part of the socialist trade bloc significantly influenced Cuba's economic development and ecosystem management. Though a highly industrialized country that produced pharmaceuticals and computers as well as crops, sugar was the staple of the Cuban economy. By 1989 state-owned sugar plantations covered three times more farmland than did food crops (Rosset 1996:64). Sugar and its derivatives constituted 75 percent of the total value of Cuba's exports, purchased almost entirely by the Soviet Union, Central and Eastern Europe, and China (Rosset and Benjamin 1993:12). High crop yields were attained through agricultural methods that were more mechanized than in any other Latin American nation, in addition to extensive use of pesticides, fertilizers, and large-scale irrigation.

In return for its exports of sugar, tobacco, citrus, minerals, and other items, Cuba imported about 60 percent of its food as well as crude oil and other refined products, all from the socialist bloc at favorable terms of trade. Forty-eight percent of the fertilizer, 82 percent of the pesticides, and much of the fuel used to produce the sugar crops were imported as well, along with 36 percent of the animal feed for Cuban livestock (Rosset and Benjamin 1993:10, 15).

This trade regimen–though highly import-dependent–enabled Cuba's 11 million people to achieve economic equity, rapid industrialization, and advancements in quality of life. In the 1980s, Cuba exceeded most Latin American countries in nutrition, life expectancy, education, and GNP per capita. Sixty-nine percent of the population was urban, with virtually no unemployment (Rosset and Benjamin 1993:12). Ninety-five percent of Cubans had access to safe water and 96 percent of adults were literate (FAO 1999:20).

The Advent of Alternative Agriculture

The crumbling of the socialist trade bloc in 1989–91 brought upheaval to the Cuban economy and its conventional model of agricultural production. Cuba lost 85 percent of its trade (Murphy 1999). The United States tightened its already stringent economic blockade against Cuba, compounding the country's difficulties.

Cuba's access to basic food supplies was severely threatened. As food imports were halved, caloric intake dropped 22 percent, protein 36 percent, and dietary fats 65 percent (Bourque 1999). According to the FAO, Cuba endured the largest increase in undernourished people in Latin America in the 1990s–a jump from less than 5 percent to almost 20 percent (FAO 1999:8). Imports of pesticides, fertilizers, and feeds were reduced by 80 percent and petroleum supplies for agriculture were halved (Rosset 1996:64).

To avert widespread famine, Cuba had to find a way to produce twice the amount of food with just half of its previous agricultural inputs. The result is that Cuba is now in the midst of the largest conversion from conventional high-input chemical agriculture to organic or semiorganic farming in human history (Rosset 1996:64). Cuban farmers are attempting to produce most of their food supply without agrochemicals.

Cuba's prior investments in science, education, and agricultural research and development proved a great asset during these dire economic straits. In the 1980s, concerned by Cuba's vulnerability as the sugar plantation of the eastern bloc, government leaders had invested $12 billion in training scientists in biotechnology, health and computer sciences, and robotics

Cuba's Dependence on Imported Food, pre-1990

Imported foods accounted for 57 percent of Cubans' total caloric intake.

Food	Percentage of Food Imported
Beans	99
Oil and lard	94
Cereals	79
Rice	50
Milk and dairy	38
Animal feed	36
Meat	21
Fruit and vegetables	1–2
Roots and tubers	0
Sugar	0

Source: Rosset and Benjamin 1993:10.

(Rosset 1996:65). Although Cuba comprises only 2 percent of Latin America's population, it is home to 11 percent of the region's scientists (Rosset and Benjamin 1993:4).

Agricultural scientists influenced by the international environmental movement of the 1970s had begun to criticize Cuba's dependence on foreign inputs and the toll that conventional cultivation techniques were taking on the island's agroecosystems. As they noticed increasing pest resistance and soil erosion, many shifted their research in the 1980s to alternative methods of crop production, particularly the biological control of insect pests (Rosset and Benjamin 1993:21).

Most important, Fidel Castro gave his full support to the "alternative model" during this "Special Period." The government emphasized the importance of using Cuba's own scientific expertise instead of imported technology. "Cuban scientists will create resources that will one day be more valuable than sugarcane" Castro said in 1991. "Our problems must be resolved without feedstocks, fertilizers, or fuel" (Rosset and Benjamin 1993:24).

That was easier said than done. Cuban scientists had developed several alternative agricultural techniques during the 1980s but they were largely untried. Plus, the transition from chemical to organic agriculture takes time–roughly 3–5 years to regain soil fertility and re-establish natural controls of insect pests and diseases (Rosset and Benjamin 1993:25). Cuba did not have the luxury of 3–5 years.

Cuba's Access to Selected Imports in 1989 and 1992

Item	1989	1992	Percentage Decrease
Animal feeds	1,600,000 MT	475,000 MT	70
Fertilizer	1,300,000 MT	300,000 MT	77
Petroleum	13,000,000 MT	6,100,000 MT	53
Pesticides	US$80,000,000	>US$30,000,000	63

Source: Rosset and Benjamin 1993:17.

The first challenge was soil fertility. Fertilizer availability dropped 80 percent after 1989. To fill the void, Cuban farmers have employed a variety of "biofertilizers" and soil amendments, including composted animal wastes, cover crops, peat, quarried minerals, earthworm humus, and nitrogen-fixing bacteria. Though the *Rhizobium* bacterium has long been known to help legume crops obtain nitrogen from the atmosphere, Cuban scientists also have used *Azotobacter*, a free-living nitrogen-fixing bacterium, to supply nitrogen to many nonlegume crops. *Azotobacter* offers added advantages of shorter crop production cycles and reduces blossom drop, helping Cubans achieve a reported 30–40 percent increase in yields for maize, cassava, rice, and other vegetables (Rosset and Benjamin 1993:43). Similarly, the substitution of worm humus for chemical fertilizers increased yields of various crops by 12–46 percent (Monzote n.d.:9).

Intercropping, once rare in commercial scale farming, is being revived to diversify crop production and boost soil fertility. Another key component of Cuba's soil management efforts is reforestation; many forests were razed after the 1959 revolution to plant sugarcane and provide fuel for sugar manufacturing. In 1989–90, more than 200,000 ha were reforested (Rosset and Benjamin 1993:50).

The country is recycling its waste products on a massive scale, including household garbage and composted livestock and human waste. Wastewater is used to irrigate cane fields. Filter press cake, a by-product high in phosphorous, potassium, and calcium, serves as fertilizer. Bagasse, or dry pulp, is fed to livestock and burned to generate electricity for machinery in many sugar mills.

Cuba has a history of using biological controls for insect pests that dates back to 1928, when growers began releasing mass-reared parasitic flies (*Lixophaga diatraeae*) into sugarcane fields to control cane borers. Since the food crises, however, use of biological controls has intensified. Growers have been releasing predatory ants (*Pheidole megacephala*) to control the sweet potato weevil (*Cylas formicarious*), a method that has proven 99 percent effective (Rosset 1996:66).

Cuban researchers have focused also on the use of entomopathogens–bacteria, fungi, and viruses that infect insect pests but are nontoxic to humans. *Bacillus thuringiensis*, Cuba's first commercially produced biopesticide, is a soil bacterium widely used to control lepidopteran pests in pasture, cabbage, tobacco, corn, cassava, squash, and tomatoes, as well as mosquito larvae that transmit human diseases. The fungus *Beauveria bassiana* has also been used successfully against sweet potato and plantain weevils (Rosset 1996:67). In contrast, prior to 1989 the most common pesticide used in Cuba was methyl parathion, one of the most acutely toxic pesticides in the world (Gellerman 1996). By the end of 1991, an estimated 56 percent of Cuban cropland was treated with

such biological controls, representing savings of US$15.6 million per year (Rosset and Benjamin 1993:27).

Overall, nonchemical weed control has been less successful than pest controls in Cuba, as elsewhere. Nevertheless, researchers continue to develop methods that hold promise—crop rotations based on mathematical modeling, methods involving weed densities, and traditional methods used by peasants before the advent of herbicides.

Perhaps the most striking change in the agricultural landscape was the return to the use of oxen in the fields while Russian tractors, lacking parts and fuel, were idle. Though more labor-intensive, ox traction actually provides advantages to Cuban farmers. Oxen are cheaper to operate, do not compact the soils, can be used in the wet season long before tractors, and their fodder provides much-needed organic fertilizer. New ox-powered plows, planters, and cultivators were developed, and the government encouraged oxen breeding programs to expand the herd.

Promotion of Small Farms and Urban Gardens

Alternative farming methods alone couldn't bring Cuba out of its agricultural slump. Huge Soviet-style state farms controlled 80 percent of the nation's agricultural land. The vast monocultures of sugarcane, pineapples, citrus and other crops they once produced with chemical fertilizers and pesticides were incapable of developing the natural pest controls or soil fertility produced by smaller, more dynamic organic systems. As a result, the state farms became extremely vulnerable to pests and disease (Rosset 1996:65, 69).

By contrast, *campesinos* were quick to adapt the new technologies, and their productivity soared. Many were descendents of generations of small farmers with long family and community traditions of low-input farming, and they remembered techniques that their parents and grandparents used

In the 1980s, Cuba used highly mechanized agricultural methods. After the economic crisis, oxen teams were substituted for tractors on both small and large farms. The number of oxen teams has tripled in the last decade. There is also a growing network of small workshops producing implements for farming with oxen teams.

such as intercropping and manuring. Even before the country-wide emphasis on organic agriculture in the 1990s, the small farmers had proven their efficiency: they worked only about 20 percent of the land but produced more than 40 percent of the domestic food supply (Rosset 1996:65, 68–69).

In 1993 the Cuban government broke up the unproductive state farms into Basic Units of Cooperative Production—worker-owned cooperatives that controlled about 80 ha each. Although the government still owns the land and sets production quotas for key crops, coop members own everything they produce above the quotas and can sell it in new farmer's markets. Sales at markets flourished and severe food shortages disappeared by mid-1995 (Rosset 1996:69–70).

Intensive, raised-bed agriculture is the model for urban agriculture in Cuba. These farms, called *organoponicos,* are approximately 1 ha and produce, on average, 20 kg of vegetables per square meter (Bourque 1999). Farmers rely on large applications of organic fertilizers from local sources and only use biologically based pest controls when absolutely necessary.

Another factor that helped stave off hunger was the promotion of urban agriculture by the Cuban government on private and state land, which gardeners can use at no cost. Today, Havana alone has more than 26,000 self-provision gardens (Moskow 1999:127) that produced an estimated 541,000 tons of fresh organic fruits and vegetables for local consumption in 1998. Some neighborhoods were producing 30 percent of their food. Price deregulation provided another incentive, enabling urban farmers to earn two to three times as much as urban professionals (Murphy 1999).

Will the Organic Revolution Be Overthrown?

In the 1996–97 growing season, Cuba recorded its highest-ever production levels for 10 of the 13 basic food items in the Cuban diet, largely because of small farms and backyard production (Rosset 1998). But FAO data suggest that total Cuban crop production in 1996–98 was still 40 percent lower than in 1989–91 (World Bank 2000:122), perhaps in part because sugar crop yields have not yet recovered. Furthermore, pest and disease outbreaks continue. Many of the biopesticides require critical timing of applications to work, and the quantity and quality of materials produced by the cooperatives vary widely. At one point a shortage of glass jars needed to grow fungal spores held up production (Rosset 1996:72).

Such stumbling blocks have led outside observers to speculate that the organic revolution in Cuba may dissolve after the economy improves and trade barriers come down. The topic is a subject of debate among Cuban agricultural scientists and farm managers, many of whom remain dedicated to high-input chemical agriculture common in the West (Mueller 1999).

Whatever the outcome, Cuba's ongoing experiment with alternative agriculture has left a powerful mark. Even though Havana now enjoys increased food availability, urban agriculture is stronger than ever (Murphy 1999). In a recent survey, 93 percent of gardeners interviewed affirmed their commitment to producing food in urban areas and once vacant lots even after the "Special Period" ends (Moskow 1999:133). Cuban scientists are already exporting their expertise, working with Mexico, Bolivia, Brazil, Laos, and other countries to develop and export biological controls for the coffee weevil and other pests (Bourque 1999). Moreover, Cuba has succeeded in feeding its people without the high inputs of conventional agriculture, providing a model that other countries can follow.