CHAPTER THIRTEEN

# The Growth of Urban Agriculture

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In recent years a strong urban agriculture movement has developed in Cuban cities and suburbs.[1] The goal of this movement is to maximize the production of diverse, fresh, and safe crops from every patch of previously unused urban land. This urban production is based on three principles: organic methods, which do not contaminate the environment; the rational use of local resources; and the direct marketing of produce to consumers. Thus our urban agriculture fits the concept of sustainability, which in this context means the abundant use of organic matter and biological pest controls, and adherence to the principle of local inputs. The local sale of produce has played a significant role in meeting local food requirements (Companioni et al. 1997).

Urban agriculture has characteristics that differentiate it from conventional agriculture and large-scale production systems, such as the diversity of production and the many people who participate. This gives a special aspect to extension work, where new management models and work styles must be developed to achieve sustainable production levels in each neighborhood and region.

Urban agriculture is participatory, not only in the sense of the broad base of involvement, but also in demanding diverse responses to the heterogeneity of local conditions, requiring a variety of techniques to create the best possible conditions for production. Because of its geographical location and intended market, this movement must be low-input, use no toxic pesticides, make efficient use of water, and carefully manage soil fertility and the culti-

vation of its crops and animals. Urban agriculture has received and receives special attention from the highest levels of the Ministry of Agriculture and other government officials.

## Urban Agriculture Yesterday and Today

During the first half of the century, urban agriculture existed on a small scale, involving a few people, and was aimed at the production of a few plant species (mainly leafy vegetables), the rearing of domestic animals in backyards, and provisioning of foods for families.

Beginning in the 1960s, high-tech horticultural production techniques were introduced, based on complex technology and crop management systems with a heavy use of chemical products, as are found in hydroponics and "zeoponics" (production in zeolite susbtrate). The high degree of specialization in these production systems and the development of large enterprises for producing vegetables and other crops during the 1970s and 1980s monopolized the vegetable market, relegating small-scale producers to a second tier (Companioni et al. 1996a).

Like many other countries, Cuba after the Revolution opted to be in the vanguard of the "Green Revolution," which involved the industrialization of agriculture and the adoption of practices aimed at producing sufficient food for the country. After the Earth Summit in Río, Cuba moved with the world community towards a new emphasis on a more natural agricultural system, through which food quality, the nutrition of the population, and natural resources would benefit. Urban agriculture reemerged recently in this new context for several reasons: the economic difficulties of the 1990s; the low quality of vegetables on the market; shortages of traditional spices and seasonings; and the under-exploited production potential of cities. With a renewed emphasis on urban farming, relatively high levels of production in small areas were made possible by paying close attention to existing local resources, and the potential for selling goods locally.

The simplicity of this form of production, and the increase in yields while still improving the technology, allowed for the rapid development of the popular movement in urban agriculture. This new sector has created 160,000 jobs, taken by people of various occupations and backgrounds, including workers, masons, mechanics, housewives, retired people, and professionals (López 2000).

Employing a large number of people in urban agriculture is one of the greatest social impacts of this movement. Driving these changes was the potential for increased income generated by selling produce from urban gardens; this attracted the attention not only of workers, but also professionals from diverse backgrounds, who received state supports in the form of land, credit,


*Urban agriculture: public sales outlet, Havana.*

services, and/or inputs. This new agricultural labor force has brought dynamism and innovation to every municipality.

In each territorial unit, services for urban agriculture are grouped together in what we call a Municipal Urban Farm Enterprise. This administrative unit helps coordinate all urban agricultural activities in the municipality in a variety of ways. It is the source for extension and technical assistance, helps link urban farmers and gardeners with each other, and builds links with research, educational, and service centers (Ojeda 1999). Each Municipal Urban Farm also has the responsibility of organizing production and determining the appropriateness of different technologies for each of its subunits, taking into account local resources, inputs, and the potential of the land. Intense technical training for producers has played a decisive role in the achievements attained so far.

## Premises of Urban Agriculture

Several basic premises explain the strong potential of urban agriculture:

- Urban centers have the highest demand for those foodstuffs which are easily perishable when transported. Thus there is a basic logic to the

notion that perishable foods should be produced as near as possible to the consumer.

- Vegetables, fruits, flowers, spices, and intensive animal production all require a large labor force, which is available in towns and cities. In Cuba, 75 percent of the population is urban, most of which came originally from rural areas; thus, many urban dwellers have empirical knowledge about crop management and livestock production.
- The growth and spread of cities invariably creates many empty spaces in peripherial areas, which often become trash-dumps that are sources of disease vectors, are a danger to human health, and despoil the urban environment. Using such areas for food production has eliminated these dangers and has made Cuba's cities healthier and more beautiful.

## Basic Principles

Planning for urban agriculture in Cuba is guided by a set of basic principles defining its objectives and organization. Among them are the following:

- uniform distribution throughout the country
- logical correspondence between production and the number of dwellers of each region
- crop-animal integration with maximum use of synergies to boost the production of each
- intensive use of organic matter to boost and preserve soil fertility, and biological pest controls
- use of each patch of available land to produce food, guaranteeing intensive production and high yields of crops and animals
- multidisciplinary integration and the intense application of science and technology
- a fresh supply of good quality products, offered directly to the population, guaranteeing a balanced production of not less than 300g of vegetables daily per capita and an adequate variety of animal protein sources
- maximum use of the potential to produce food, such as the labor force available and the recycling of wastes and by-products for plant and animal nutrition

## Organizational Structure of Urban Agriculture in Cuba

In Cuba today there is an urban agriculture structure in all cities and towns, thanks to the impact and rapid development of this popular form of food production and to the degree of urbanization of the Cuban population (see Table 1).

### Table 1. Urbanization in Cuban provinces

| PROVINCE | % URBAN |
|---|---|
| Pinar del Río | 63.9 |
| Havana | 78.4 |
| City of Havana | 100.0 |
| Matanzas | 80.3 |
| Villa Clara | 77.5 |
| Cienfuegos | 80.7 |
| Sancti Spíritus | 69.7 |
| Ciego de Ávila | 74.6 |
| Camagüey | 75.0 |
| Las Tunas | 58.8 |
| Holguín | 59.0 |
| Granma | 57.6 |
| Santiago de Cuba | 70.2 |
| Guantánamo | 59.6 |

The National Urban Agriculture Group composed of specialists and government officials from different scientific and government institutions, and urban farmers—regulates and directs this effort, exercising its influence at different levels all to way to the grassroots through provincial and municipal groups. Regional and local groups are responsible for the organization, development, and regulation of urban agriculture in their zone, and the coordination between all entities and persons related to production, processing, and distribution of food within the boundaries of each territory and province.

Within each Popular Council (local government at the neighborhood level), a representative or agricultural delegate coordinates urban agriculture. Likewise, many activities related to urban agriculture—such as veterinary medicine, plant protection, and biopesticide production—are represented at the Popular Council. Different areas of responsibility are coordinated through the Popular Councils, which take into consideration the unique characteristics of local systems of production and oversee technical and service units such as the veterinary clinic, farmers' shop, nurseries, laboratories for the production of biological products, and others.

Within a municipality, the coordinating activities of the Popular Councils are carried out through the Municipal Urban Farm, which in addition to its coordinating role, has the infrastructure necessary to carry out technical and service activities, with the capability to gather together scientific and technical resources and farmers from different productive areas and related institutions within its territory.

Twenty-six administrative sub-programs attend to urban agriculture. These are tied to specific topics such as vegetable production, medicinal plants, herbs, grains, fruits, and rearing of animals (hens, rabbits, sheep, goats, pigs, bees, and fish), all of which can be found throughout the country (Table 2).

## Table 2. Current sub-programs of Cuban urban agriculture

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

(GNAU 2000)

### VEGETABLES AND FRESH HERBS (ORGANOPONICS, INTENSIVE VEGETABLE GARDENS, SMALL PLOTS, AND BACKYARDS)

This was the first urban agriculture activity carried out, and hence is the most developed. The goal for this type of urban agriculture has been set at producing 30 million quintals[2] (1,380,000 metric tons) of fresh vegetables per year, with yields above 20 kg/$m^2$ per year in organoponics (raised beds filled with organic matter), 10 kg/$m^2$ per year in intensive vegetable gardens, and 10 kg/$m^2$ per year in small plots and backyards. The goal for the end of 2000 was to have at least 5 $m^2$ per inhabitant dedicated to these types of production, making a substantial contribution to the national goal for all vegetable production of 300 g of fresh vegetables daily per capita.

*Organoponic intensive farming at the "Gilberto León" Cooperative.*

The heterogeneity of Cuba and the diversity of possible ways to grow vegetables have combined to generate distinct production systems. The most common are the following:

**ORGANOPONICS AND INTENSIVE VEGETABLE GARDENING:** These have been the most important methods over the past years, and have gone a long way toward helping us rediscover our horticultural traditions. These systems are an example of how scientists and gardeners can work together to develop new production methods (MINAG 2000). The main difference between these two systems of production lies in the fact that organoponics are generally located in areas with infertile soils or with production constraints. For example, organoponics can be built on artificial surfaces, on which containers are placed and filled with a mixture of organic matter substrate and soil, in which to grow the crops. The intensive vegetable garden is developed on parcels of relatively good soil, without using raised beds, though organic matter is applied directly during preparation for planting (Peña 1995, 1998).

**SMALL PLOTS, PATIOS, AND POPULAR GARDENS:** In this popular form of production, as a rule, the area cultivated is very small and is determined by how much useful or arable space exists between buildings, between houses and streets, or in a patio, or a state-owned urban space that can be converted to gardens. In general, the small plots, patios, and popular gardens situated in suburban areas are larger than those in the city centers. This type of production now makes significant contributions to household and regional food

supplies. At this point there are 104,087 parcels and patios under production, covering an area of 3,595 hectares, which produce more than organoponics and intensive gardens combined. This type of land use has several positive effects. The small plots, patios, and popular gardens have made it possible to feed the urban population; have promoted the development of an urban culture favorable to agriculture; have eliminated the abandoned spaces which in the past may have been breeding grounds for disease vectors and rodents; and have provided socially useful and productive employment opportunities (Ojeda 1997).

**SELF-PROVISIONING AT FACTORIES, OFFICES, AND BUSINESSES:** The concentration of industrial production and of innumerable educational, health, and service facilities in the main population centers demands the operation of hundreds of worker's cafeterias, whose food supply requires large quantities of diverse agricultural products. A considerable number of workplaces have organized agricultural production in areas bordering, or close to, their facilities. This helps to meet the cafeterias' demand for food without reducing the food resources available to others in the neighborhood. The magnitude of this form of production has reached a level such that it must be considered a separate form of urban agriculture, particularly because of the differences between these self-provisioning farms and others. In the country's capital alone, there are more than 300 such farms in production. They total an area of 5,368 hectares, on which large quantities of vegetables, root crops, grains, and fruits, as well as meat, milk, fish, eggs, and herbs are produced.

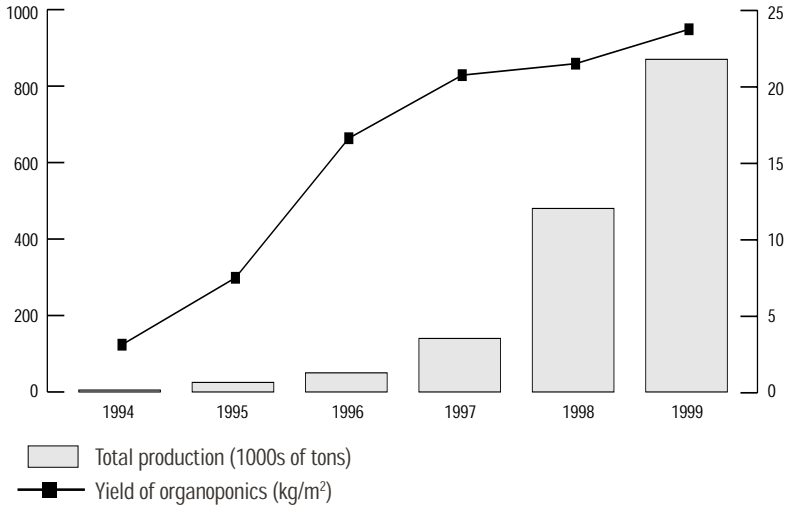
**SUBURBAN FARMS:** On the edge or outer ring of Cuban cities we find many integrated suburban farms. They grow from the urbanism movement, are considered part of the urban environment, and are a key feature in planning for urban growth and development. Although they could never meet all the food needs of the urban population, they are larger than, and have a higher degree of integration among their sub-components than do the small plots and intensive gardens in the interior of the cities. Typically they cover between 2 and 15 hectares. The type of production found on a suburban farm will be strongly influenced by the surrounding population. We can see this from the point of view of infrastructure, recycling of waste products, the crops grown and animals raised, how the products are marketed, etc. This form of agricultural production is characterized by intensive cultivation, efficiency of water use, and the maximum reduction of agrotoxins. Suburban farms have reached an important level in the past few years, particularly in the cities of Havana, Santa Clara, Sancti Spíritus, Camagüey, and Santiago de Cuba. In the city of Havana, 2,000 small private farms and 285 state farms are under production; together these cover an area of 7,718 hectares, and are highly productive.

**SHADED CULTIVATION AND APARTMENT-STYLE PRODUCTION:** These systems are in their initial phases of development. Covered or shaded production utilizes mesh tents or "shade houses" of Spanish, Israeli, or Cuban design for growing crops and germinating seedlings. Work is underway to develop a complete technology appropriate for Cuban conditions, allowing for the year-round cultivation of horticultural crops, especially during the hottest months when the sun is at its most intense. Apartment-style agriculture is very diverse. It includes a range of practices, including cultivation with diverse soil substrates and nutrient solutions, mini-planting beds, small containers, balconies, roofs, etc., with minimal use of soil. This type of production has its own unique technologies and forms of organization (Carrión 1996).

## RESULTS OF THE VEGETABLE SUB-PROGRAM

In recent years this program has experienced sustainable growth, both in production levels and in the yields obtained (see Figure 1). During 1999 vegetable production in organoponics and intensive gardens provided the population with 215 g/day per person of fresh horticultural crops (MINAG 1999), which represents a little more than half of the goals set (see Table 3). The most success has been achieved in Cienfuegos, Ciego de Avila, Sancti Spíritus, and Havana. This program has been the laboratory for testing, confirming, and consolidating the principles, objectives, and overall perspectives for urban agriculture in Cuba.

### Figure 1. Vegetable production from organoponics and intensive vegetable gardens




(MINAG 1994–1999)

Table 3. National vegetable production from organoponics and intensive gardens, 1999

| PROVINCE | POPULATION | AREA (HA) | PRODUCTION | G/DAY/PERSON |
|---|---|---|---|---|
| Pinar del Río | 726,929 | 602 | 73.0 | 274 |
| Havana | 689,364 | 712 | 88.9 | 351 |
| City of Havana | 2,197,706 | 462 | 70.2 | 88 |
| Matanzas | 649,994 | 382 | 59.2 | 249 |
| Villa Clara | 830,085 | 504 | 65.7 | 216 |
| Cienfuegos | 389,541 | 402 | 63.3 | 442 |
| Sancti Spíritus | 456,294 | 457 | 60.9 | 368 |
| Ciego de Ávila | 400,720 | 473 | 58.8 | 399 |
| Camagüey | 778,772 | 312 | 76.6 | 269 |
| Las Tunas | 521,793 | 314 | 36.9 | 193 |
| Holguín | 1,018, 899 | 663 | 58.3 | 153 |
| Granma | 823,481 | 366 | 56.1 | 186 |
| Santiago de Cuba | 1,022,105 | 398 | 47.9 | 128 |
| Guantánamo | 509,210 | 162 | 55.6 | 299 |
| Isle of Youth | 78,259 | 31 | 4.6 | 162 |
| Total | 11,093,152 | 6,213 | 876.0 | 215 |

## SMALL-SCALE "POPULAR" RICE PRODUCTION

This sub-program has made significant advances in the past three years. Small-scale rice production is growing in all of the country's provinces, and the use of local resources in crop management has generated rice yields above 5 tons/ha in many units, a higher level than that which is achieved on state farms.

## MEDICINAL PLANTS AND DRIED HERBS

Like the previous program, this is a recent one within urban agriculture. Herbs and medicinal plants are grown in organoponics and intensive vegetable gardens; yet they have their own program, which means their production is taken into account in regional planning according to local needs. In some cases, a portion of the production is sold via the Ministry of Public Health for processing into "green" medicines, which are distributed through the network of public pharmacies. The rest is sold fresh or dry for domestic consumption. Dried herbs are destined for Cuban kitchens; high levels of production make drying essential. Consumption of dried seasonings in Cuba has reached an annual per capita level of 120 g. An intensive educational and promotional campaign has been carried out to promote knowledge of their preservation, processing, and home use, through publications and radio and TV programs (Figueroa and Lama 1997, 1998, and 1999).

*Ornamental plant nursery at the Alamar UBPC in Havana.*

### ORNAMENTAL PLANTS AND FLOWERS

This is the least advanced sub-program in the majority of the provinces. There are only a few units dedicated specifically to flower production. This program has grown in areas around Havana and also others such as Camagüey and Ciego de Ávila. The initial goal is to produce five dozen flowers per capita per year.

### FRUIT TREES

Despite being a recent addition to the urban agriculture movement, the planting, care, and uses of a variety of fruit trees along urban perimeters has long been a tradition in Cuba. This sub-program has demonstrated a high productive potential, especially in mangoes, avocados, and citrus. Current plans contemplate a broad program of nurseries and grafting in future years in order to accelerate urban fruit production.

### POULTRY

This sub-program, specializing in hens and ducks, is the most advanced of the animal production programs in urban agriculture. Producers are assigned ten females and one male of the semi-rustic local chicken breed. This breed has been produced by crossing a locally adapted creole hen with a more productive line of hen, such as a Rhode Island Red. From this cross birds were

obtained that are characterized by their resistance to environmental adversity and high productivity of meat and eggs. During their adult stages, this hen, with good feeding (109 g/bird/day), will lay eggs year-round with an average annual production of 200 eggs/bird.

A certain amount of progress has been reached with rearing ducks, as it is the domesticated bird with the fastest growth rate. In just seven to eight weeks, ducks can reach between 2.8 and 3.2 kg (live weight), converting close to three kg of feed for each kg of weight gained. Ducks are also less sensitive to environmental stress and food quality, and more resistant to some infectious diseases that are common in birds. In addition to chickens and ducks, geese, turkeys, and guinea hens are also produced on a small scale (Companioni et al. 1996b).

### SWINE

This sub-program has special features because rearing pigs within city boundaries requires strict sanitary control measures and vaccination. This program is focused in suburban areas, under the following requirements defined by the Institute of Veterinary Medicine (IMV):

- adequate food supply
- sufficient water supply for drinking and hygiene
- confinement
- a residue pit or biogas digester
- a cement or tile floor, and a roof for protection from weather

To begin rearing pigs, the prospective producer must sign agreements with the swine production group and the Territorial Technical Service for Swine Production. Through these agreements the producer purchases 12–20 kg piglets at a reduced price, as well as part of the necessary feed for fattening. After four to five months, when the pig reaches 90 kg or more, the contracted quantity of meat agreed upon by the producer is purchased by the state at the official price, and the surplus is sold at higher prices.

If the new pig farmer can produce or find his own pig feed, he need only buy a vitamin and mineral supplement for his animals. To fatten 40 animals on a 140-day cycle, and to finish 100 animals in a year at an average weight of 90 kg, it would be necessary to plant 4 hectares of soybeans, 7 hectares of sunflowers, and 6 hectares of sugarcane.

### ORGANIC MATTER

Among the working guidelines for urban agriculture is "to systematically apply organic matter by using all available local alternatives, and to systematically develop local programs to assure adequate supplies of organic matter." In view of the importance of this activity, and to realize its potential, a sub-program was created in charge of organization, promotion and development of organic matter sources, and to assure their collection, processing, conservation, and distribution (GNAU 2000). The National Urban Agriculture Group (GNAU) coordinates these activities, supported by the Organic Fertilizers Reference Center, located at the National Institute for Fundamental Research on Tropical Agriculture (INIFAT) in the City of Havana, as well as by provincial and municipal organic fertilizer centers. This structure extends to the grassroots with centers organized by each Popular Council which receive technical assistance from a Technical Operations Group made up of specialists and farmers from different organizations and institutions. Territorial Organic Fertilizers Centers are responsible for organizing and advising the activities in their territory, geared toward the largest possible proliferation of small production units located at the sources of organic matter or at agricultural production units, to get this important input directly to the farmer or gardener. This activity is characterized by a great use of animal manures and sugarcane filter cake mud (*cachaza),* while the processing of urban agricultural wastes to turn them into organic fertilizers is still insufficient.

### SEEDS

This sub-program is aimed at regional self-sufficiency of seed production and distribution, which is critical to the success of urban agriculture and without which production would not be stable or sustainable, because it is essential to have the right seed at the appropriate time for sowing. A network of provincial seed farms has been created, whose job it is to keep the supply of seeds flowing. For seeds that are easily produced by farmers and gardeners, such as cucumber and cowpea, the goal of this program is to make production units self-sufficient for such crops. This has now been achieved in all urban farms.

### ANIMAL FEED

The jump in small-scale animal rearing cannot be maintained by solely recycling agricultural waste products as feed. To maximize production of animal protein per unit area, a program was created to supplement the use of all household scraps and crop residues with the production of feeds on urban farms. Typically these feeds consist of grains, tubers, roots, and sugarcane. Despite some progress, most units are still not self-sufficient in terms of animal feed.

### SCIENCE, TECHNOLOGY, AND TRAINING

Training of urban farmers is critical to perfecting the production technologies being employed. In the training sub-program we focus on practical training, which takes place right in the garden plot, raised beds, or animal rearing pens. We have built an extension system, which counts on the participation of its own extension agents, plus research centers, the most experienced farmers and gardeners, and other individuals and institutions related to urban agriculture. Extension is at all times tailored to local conditions and needs, providing farmers with the latest theoretical and practical information.

### OTHER SUB-PROGRAMS

The remaining programs are all of recent origin. These include the sub-programs on sheep and goats, bees, aquaculture, small-scale "popular" plantain production, trees, coffee and cocoa; tropical roots and tubers; oil seeds; irrigation; small-scale agro-industry; and land use. In most regions these programs are still in their formative stages, some more advanced than others (e.g., rabbit rearing in the western provinces of the country).

## Key Issues in the Development of Urban Agriculture in Cuba

As urban agriculture has grown in Cuba, it has become apparent that there are several key factors that must be borne in mind.

**CONSERVATION AND MANAGEMENT OF SOIL FERTILITY:** The productive potential of land available for food production is directly correlated with soil fertility. Although there are many factors that are important in fertility conservation, some require greater attention than others under actual field conditions. Central among these is the control of erosion—maintaining the structure and the physical condition of the soil. The intensity of rainfall in Cuba leads to the rapid leaching of soil nutrients and organic matter, and causes physical damage to soil structure and planting beds. It has proven essential to use a variety of agronomic techniques to protect soils from the effects of erosion. The periodic application of organic matter to soils, planting beds, and containers is also indispensable, as nutrients lost or removed by the previous harvest must be returned or recycled, building the fertility necessary for future sowings (Peña 1995). Finally, appropriate crop rotations and pest management systems adapted to local conditions have been essential.

**INTEGRATED PEST AND DISEASE MANAGEMENT:** Pest and disease management is based mainly on cultural techniques and biological pesticides. The former rely principally on site selection and planting dates, crop varieties resist-

ant to pests and diseases, adequate soil management, the elimination of alternate hosts of pests and diseases, crop rotations, elimination of infected plants, and thinning and pruning. During the spring and summer months when temperatures are at their hottest, seedling production is carried out in shadehouses, and the technique is employed of leaving clods of earth on the roots of the seedlings to be transplanted. INIFAT has developed totally organic seedling technology guaranteeing high-quality transplants with high yield potential, based on the local resources available in each area. This technique has reduced pest and disease problems due to the high level of vigor displayed by the transplants. The use of biopesticides and other biological pest controls is still being perfected, both in terms of guaranteeing an adequate and opportune supply, as well as with regard to application techniques. *Bacillus thuringiensis* and *Beauveria bassiana* have entered common use since the development and spread of artisanal production at the Centers for the Production of Entomophages and Entomopathogens (CREEs), and they are used against a variety of pests. *Trichoderma* spp. is used for the control of soil diseases. The introduction of new technologies such as neem (*Azadirachta indica*) extracts, and their artisanal and semi-industrial production, as well as of new biofungicides with demonstrated effectiveness, are critical for urban agriculture. Overall, food production in the cities is characterized by low pest and disease incidence, thanks especially to small plot sizes and the generous application of organic matter to the soil.

**CROP–LIVESTOCK INTEGRATION:** The nature of food production in cities pushes us towards high levels of production per unit area, facilitated by high levels of agrobiodiversity. The highest levels of productivity in organic farming are obtained when crop and livestock production are linked and fully integrated, a task which compels researchers, farmers, and extensionists to work in the closest possible degree of collaboration. Already over half of the urban farms have effective linkages between crop and livestock production.

## Urban Agriculture and Sustainability

The organic farming practices used in urban agriculture do not in and of themselves guarantee sustainability. To achieve sustainability all aspects of production must be rationalized and integrated, so that each component complements each other component, in such a way that each action leads to a better outcome at a lower cost.

The best example of this is found in the use of harvest residues and unmarketable portions as animal feed, in turn using the animals' manure to fertilize the crops. We have developed a set of indicators of sustainability to use

in perfecting urban production systems. Among these indicators are the following:

- amount of organic matter collected, processed, and applied
- use of soil conservation methods to prevent erosion
- degree to which seeds and starter-animals (i.e. chicks) are produced locally
- degree to which varieties and breeds are adapted to local conditions
- degree of crop–livestock integration
- local water availability and soil moisture
- efficiency of water use
- amount of food produced/hectare per year
- amount of food produced per capita
- use of integrated pest and disease management systems
- net profitability of production
- degree of participation of farmers in training courses and extension activities

By keeping track of these indicators we can monitor the development of urban agriculture. As the indicators improve over time, the sustainability of urban agriculture will be consolidated.

## Conclusion

Over past few years the urban agriculture movement in Cuba has clearly demonstrated the food producing potential of cities. Today it is an important source of food for our urban populations. This has been made possible by the decisive effort put forth by urban farmers, and by the support given them by the government to carry out their tasks. The high-level of organization that has been achieved should make it possible to successfully implement the ambitious plans that are currently on the drawing board. We expect that in the near future urban agriculture will satisfy a high percentage of the food needs of our population.

## Notes

1. Editor's note to the English edition: At the time of the final editing of this volume, an estimated 90 percent of the fresh produce consumed in Havana is being produced in and around the city (Egidio Páez, personal communication).

2. One quintal equals 100 pounds.

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