Urban Agriculture

Food, Jobs and Sustainable Cities

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Chapter 1
Cities That Feed Themselves

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Cities That Feed Themselves

At first glance, the term ‘urban agriculture’ may appear to be an oxymoron. Agriculture is commonly considered the quintessential rural activity, and urban agriculture is often perceived as archaic, temporary, and inappropriate. Some consider it marginal at best, perhaps a constructive recreational activity or an aesthetic function that helps to beautify the ‘ugly’ city. In fact, urban agriculture is a significant economic activity, central to the lives of tens of millions of people throughout the world. It is a rapidly growing industry that is increasingly essential to the economic and nutritional security of urban residents, and has far-reaching economic, environmental, and health implications.

In an urbanizing world running short of natural resources, the possibility that cities can depend upon the ingenuity of their residents to generate food security for themselves is significant. In countries where hunger and malnutrition are predominantly urban problems, an activity that can contribute to nutritional self-reliance is compelling. In cities choking in their own waste and pollution, an industry that can use urban waste as a basic resource is significant.

Sometimes called metropolitan-intensive agriculture, urban agriculture can be defined as:

. . . an industry that produces, processes, and markets food, fuel, and other outputs, largely in response to the daily demand of consumers within a town, city, or metropolis, on many types of privately and publicly held land and water bodies found throughout intra-urban and peri-urban areas. Typically urban agriculture applies intensive production methods, frequently using and reusing natural resources and urban wastes, to yield a diverse array of land-, water-, and air-based fauna and flora, contributing to the food security, health, livelihood, and environment of the individual, household, and community.[1]

It is possible to define urban agriculture more narrowly as simply the agriculture that happens to fall within or at the edge of a metropolitan area, perhaps adding its relationship to urban populations. However, a richer definition would emphasize those elements that have come to characterize urban agriculture as it is practiced today — while recognizing the great variety within it.

A number of definitions have been posited in the half decade since the first edition of this book appeared. One survey of these (sometimes conflicting) definitions found five elements that tended to be present:

- the *location* in which urban agriculture occurs;
- the *types of activities* included under urban agriculture;
- the *legality* and type of *land tenure* under which the urban agricultural activities occur;

- the *stages of production* included in urban agriculture; and
- the *scale* of urban agricultural activities.[2]

To this list can be added two other crucial elements that are especially important for lower income groups — the *purposes* of the activity and the *types of groups* involved in agricultural production in urban areas (see Chapter 3).

Urban agriculture contributes significantly to the socioeconomic development of towns and cities throughout the world. In several economies, particularly developing ones, it is one of the largest productive urban industries. In low-income cities, it is a prime generator of jobs.

Urban agriculture is an easy-in, easy-out entrepreneurial activity for people at different levels of income. For the poorest of the poor, it provides good access to food. For the stable poor, it provides a source of income and good quality food at low cost. For middle-income families, it offers the possibility of savings and a return on their investment in urban property. For small and large entrepreneurs, it is a profitable business.

There is no average urban farmer. Frequently, the urban farmer is a woman who has lived in a town or city for five or more years, grows vegetables and raises small livestock to feed her family, and earns income from sales within the community. But urban farmers also include wealthy producers of specialty crops for expensive restaurants and export, agribusinesses with plantations and outgrower contracts, fishermen cooperatives, 'Saturday only' part-timers who grow cassava by the roadside, and market gardeners with yearly contracts with supermarkets and hotels.

Urban agriculture is a large industry that includes many small-scale farmers and some large agribusinesses. Urban agriculture takes place on smaller tracts of land than rural fields and on open spaces that are vacant, idle, or unsuited for urban development. Although the most common site is the household plot, urban agriculture can be found throughout the metropolitan area. A large-scale operator may rent 10 or more hectares in an industrial zone. A small-scale farmer may make a living on as little as 200 square meters. A household garden may cover 20 square meters or less.

Some typical examples of urban agriculture include:

- fish and other aquatic products harvested from tanks, ponds, rivers, sewage lagoons, and estuaries;
- community and allotment gardens on public and private land;
- small wooded areas producing fuel, reeds, fruit, nuts, and more;
- horticulture on excess vacant space at large facilities principally dedicated to other activities (for example, airports, or large factories);
- rabbits, guinea pigs, and chickens raised in bookshelf cages hung on walls;
- vegetables grown in hydroponic solutions on roofs, patios, and stairways; and
- market gardens on vacant plots, in the green wedges between urbanized corridors, or along highways and railroads in peri-urban areas.

Urban farming is intensive and makes the best use of space, with a predominance of shorter-cycle, higher-value market commodities. It employs multicropping and integrated farming techniques and makes judicious use of both horizontal and vertical space (through such techniques as chicken coops on shelves, multi-species fish ponds, and container farming). Because water is expensive and usually in short supply, urban farming often uses water more efficiently than rural farming.

Urban agriculture is, with exceptions, oriented to close-by urban markets rather than national or global markets. Proximity to the market predisposes crop selection to perishable products for which urban farmers have a competitive edge over rural farmers by being able to deliver fresh products to consumers. Urban agriculture also normally involves fewer middlemen between farmer and consumer than rural agriculture, and the transportation and storage needs of urban produce are much lower.

Intensive urban horticulture can yield several times as much produce per unit area as rural agriculture. Limited availability of land, water, and inputs in urban areas has led to the development of farming techniques that require only a fraction of the water and fertilizer needed for tractor-cultivated rural farms per unit of production. Urban farming can absorb a significant amount of urban solid and liquid waste, helping the city reduce its waste management problems and costs. In addition to providing crops and animals for consumption or income, urban farming contributes to environmental enhancement and disaster management (for example, by planting trees on steep slopes or deep-rooted tall grass on floodplains).

The resurgence of urban agriculture is taking place during a period of rapid urbanization, but this latest wave of urbanization is occurring selectively. The countries that experienced rapid urbanization from 1920 to 1970 are experiencing low or no urbanization in terms of an increase in urban population. The countries that were predominantly rural a generation ago are now urbanizing rapidly in population, geography, and economy. Urbanization everywhere, with very few exceptions, is occurring at a lower density, more spread out than at any time in history. This lower density enables more agriculture in the larger spaces between built uses. Frequently such additional possibilities do not apply to the districts occupied by the lowest income urbanites.

The United Nations Population Division predicts that from 1995 to 2030 the world's urban population will double — from 2.6 to 5.1 billion, by which time over three-fifths of total global population will be urban. As of 2000, 60 million new urban dwellers are added annually — 90 percent in developing countries. By 2030, 75 million will be added annually — 98 percent from currently developing countries. Urban population growth is benign compared to urban expansion into peri-urban and rural areas. It is commonly noted that peripheral areas are growing at 10–20 percent per annum. Urban agriculture is replacing rural agriculture in these zones, and is in need of policy direction and oversight.

Generalizations are dangerous, but it reasonable to say that in low-income countries urban population growth is about twice the national average. Urbanization in most cases is equally rapid in low-income, food-short countries as in other developing countries. This fact has obvious implications for urban agriculture. The phenomenon of urbanization includes the dire fact that poverty is changing from being predominantly

rural to mostly urban. Significantly, food insecurity and malnutrition are more widespread in low-income urban areas than in poor villages, calling for food production within urban areas to provide *non-money* benefits to the poor.

Myths and Reality

Despite all these benefits, urban agriculture is a poorly understood industry. Urban farming is often minimized as being merely 'kitchen gardening' or marginalized as a residue of rural habits. The benefits of urban farming are lost behind myths that are the products of cultural, planning, and policy biases. These biases and their consequences are considered in detail in Chapter 9. It is necessary, however, to identify and address the myths surrounding urban agriculture at the outset, since these myths misrepresent the significance of urban farming and hinder recognition of its potential.

Myth 1. *Urban agriculture means household and community gardening.*

Household and community gardening (whether to obtain fresher food, enhance nutritional intake, save on food expenses, increase income, or for pleasure) are important components of urban agriculture. But urban farming goes far beyond gardening, as will be seen.

Myth 2. *Urban agriculture is a temporary activity.*

In all cities, even the most dense, there is always idle or 'sleeping' land. In some parts of the city — along roads, in unbuildable or hazard-prone areas, in yards — farming is a long-term to permanent activity because the space either cannot or should not be used for other purposes. In other places — on rented land, on plots awaiting development — farming is a shifting land use. Some urban farming is always on the march, in central plots undergoing renewal and especially on the leading edge of urban growth. With land values increasing, a farmer first increases inputs and yields per square meter, and only later moves his or her farming operation to another location, as land costs become prohibitive or other pressures occur. The farming activity, however, does not die — it merely adapts and moves in response to changing conditions. (Chapter 4 provides examples of transient as well as permanent urban farming and explains why both have their place in the urban land economy and landscape.)

Myth 3. *Urban agriculture is a marginal activity or means of survival.*

Social scientists studying low-income urban groups have documented urban agriculture as a means of family food security and nutrition (Chapter 7). The contribution of urban agriculture is greatest in the poorer cities of the world, where the share of income spent by the vast low-income population on food and fuel is by far the largest household expense. Urban agriculture is also a major urban economic sector that supplies a significant percentage of the food consumed by a city and generates income and jobs, particularly for women. The sector provides economic opportunities for both small-scale entrepreneurs and larger enterprises, not only in agricultural production, but also in related input and output industries and services. It especially provides opportunities for the large numbers of part-time and low-skilled workers.

***Myth 4**. Urban agriculture preempts 'higher' land uses and cannot pay full land rent.*

As Chapter 4 demonstrates, urban farming employs land that is unused or unsuitable for other purposes, or it makes usufruct use of land allocated for other uses, thus returning extra land rents. Most cities have a large amount of such land that can be farmed. Moreover, some urban farming activities, such as peri-urban poultry co-ops, pay competitive land rent, and in addition, many cities are located on fertile soils that are highly suited for intensive farming.

***Myth 5**. Urban agriculture competes with and is less efficient than rural farming.*

According to this myth, urban agriculture has a negative effect on the incomes of rural farmers. But in fact urban farming thrives on products that are less suited to rural production or that might otherwise be too costly for many urban poor. By contributing to disposable urban income, it can lead to increasing demand for rural crops among urban consumers. Simultaneously, urban agriculture can reduce some of the pressure on marginal rural non-agricultural lands that may nonetheless be cultivated. (The relationship to rural agriculture is addressed further later in this chapter.)

***Myth 6.** Urban agriculture is not hygienic.*

Health problems are undoubtedly among the most serious consequences that can result from inappropriate urban farming practices (discussed at length in Chapter 8). Inappropriate use of fertilizers, pesticides, or untreated waste products, as well as farming along roadsides and other urban locations that typically receive higher amounts of pollution through the air, water, or soil, can lead to food contamination. Bad practices in the reuse of solid and liquid wastes, as well as in rearing livestock, represent additional potential to compromise the hygiene of the living environment. Urban farmers must take particular care because of the potential to affect large populations, but urban farming is not intrinsically unhygienic, nor do health concerns justify blanket bans on farming in the city. In fact, used as part of the land and waste management systems of the city, urban agriculture has the potential to improve hygiene in the city in a sustainable way because it uses polluting waste as a production input. This can complement the other health benefits (particularly nutrition) that urban farming provides to urban residents. The need is to recognize the role and benefit of urban farming and then control its potential risks (through regulations, enforcement, education, and other means) to ensure the production gains are acquired without incurring the hygiene hazards. Such measures are detailed in Chapter 8.

***Myth 7.** Urban agriculture causes pollution and damages the environment.*

Urban farming can pollute soil, water, and air and adversely affect open urban areas. The solution is to provide guidance and assistance to make it a safer industry for farmers, consumers, and the environment. Correctly practiced, urban agriculture has many more potential environmental gains than problems (Chapter 8). Farming in urban areas reduces truck traffic and the resulting air pollution, can prevent soil erosion, and helps rebuild urban forests. Expanding planted area can favorably affect the urban microclimate. Horticultural production of food and ornamental crops reduces air pollution close to the earth's surface where it is of most benefit to children. Most significantly, urban

agriculture is among the best, most sensible ways to dispose of much of a city's solid and liquid wastes (especially organic ones) by transforming them into a resource. Few activities contribute as efficiently to improving the urban soil, water, air, and living environment while closing the urban open-loop ecological system of 'resources in, wastes out'.

***Myth 8**. Urban agriculture is unsightly and aesthetically inappropriate in the city.*

Urban farming creates green spaces in the city, replacing vacant and unkempt lots and roadsides, thereby improving a city's appearance. Well-managed animal grazing can be more attractive than tractor maintenance of urban open spaces. Urban agriculture has vast potential and capacity to recycle waste and reduce the haphazard dumping of solid and liquid waste, which clearly improves a city's appearance and hygiene. Urban forestry in many forms — from berry bushes to vineyards to bamboo — does much to enrich the urban landscape. Finally, the issue of relative standards cannot be ignored — if fields of maize in the countryside are beautiful, why is a plot of vegetables in the city viewed as an eyesore?

***Myth 9.** The 'garden city' is an archaic, utopian concept that has no place in today's world.*

Western thought has nurtured a utopian tradition of 'garden cities' at least since the Age of Enlightenment. However, this book emerges not from ancient intellectual theories, but in response to real-world, present-day observations and concerns. The cities of developing countries are becoming garden cities in a very practical way. Meanwhile, concepts of 'modernity' are actually holding back agriculture by defining industry as the activity for urban areas and farming as the activity for rural areas. Planning concepts of 'city beautiful' relegate farming to the position of an outdated, backward activity that is not fit for the 'modern' city. This book shows that these assumptions are wrong and that agriculture has an important and beneficial place in the contemporary city.

Growing Phenomenon

The potential of urban agriculture is largely untapped and undervalued. In the past decade, however, and particularly since the publication of the first edition of this book five years ago, this potential is increasingly recognized. We intend for this new edition to contribute to this trend.

Despite the acceptance of some of these myths in many quarters, urban agriculture is a growing phenomenon. It is increasingly widely practiced, and its efficiency is continually improving through better organization and more advanced technology. The current level of urban farming in the world can be attributed largely to the individual, unaided efforts of urban farmers and local NGOs. Millions have noted the demand in the urban market or the food needs of their families and have taken action to meet those needs.

Many policymakers, planners, government entities, research institutions, development agencies, non-governmental organizations, and other possible promoters of urban agriculture have failed to see its potential and frequently obstructed its practice, although

others have begun to recognize it as an important development tool. By reporting on the positive benefits of urban farming activities across the globe and pointing out how appropriate policies can mitigate the potential negative aspects, this book should broaden acceptance and support for urban agriculture, especially by those who are critical to its success.

Basic Concepts

It is not possible to devise a single, comprehensive classification to encompass all urban agricultural activity. For this reason, the second part of this book is devoted to presenting a number of typologies that can be applied to urban agriculture. Urban farming can be categorized by product, complexity of the farming system, income of the farmer, purpose of production (home consumption, sale at market, sale to processor), type of space used, location, form of tenure, degree of permanence, organizational mode, or number of actors involved, among other criteria. The scope and variety of urban agriculture are discussed throughout this book, but first it is important to clarify how the words 'urban' and 'agriculture' are used in this book, and to define what is included in the realm of urban agriculture and what falls outside its scope.

Defining 'Urban'

Urban is used in a broad sense, to encompass the entire area in which a city's sphere of influence (social, ecological, and economic) comes to bear daily and directly on its population. An approximate definition of a city's zone of metropolitan intensive agriculture (differentiating urban from rural agriculture) is important to gain a sense of farming systems types and the contribution these provide to the city's system of food (and other materials). Recognizing the difficulties of agreeing on any single definition, urban is distinguished here as the agricultural product that can be available to city markets or consumers the same day it is harvested, whether produced in the city or transported there.[3]

Clearly, this is not an easy distinction. A demographically-based geographic definition of the urban region is generally adequate, but many countries do not have such a statistical definition, and cities of medium and large size are frequently divided into several municipalities that were defined long before the urban expansion since World War II. Moreover, where they are officially defined, metropolitan districts often cover more than the legal municipal bounds, comprising peri-urban areas with strong ties to the city. These districts may or may not correspond to the urban regions, which often stretch well beyond the officially designated metropolitan zones.[4]

The overall definition of 'urban' is not the only one that necessitates clarification. How the main parts of an urban area are considered in this book must also be clarified. In Chapter 4, we divide metropolitan areas into four constituent parts — core, corridor, wedge, and periphery. These areas have different names as used in different parts of the world and as assigned by different academic disciplines. Downtown/uptown, central business district, central city, and inner city all fall within what we are labeling the urban core(s). Corridors are sometimes referred to as spokes. Development corridors are often, but not always, radial, and have nodes that are sometimes called 'edge cities'. Cores and

corridors are in some places referred to as intra-urban. Wedge areas, corridors, and fringe areas (or parts of them at least) all fall within what is commonly tagged as suburban. Agronomists, however, are likely to refer to suburban areas as *peri-urban*. Sociologists sometimes call peri-urban areas 'rurban'.

We will concentrate on the four categories stated above, based on the nature of each zone and the way urban agriculture fits into it. In parallel, we will sometimes use — within the overall urban label — a more general distinction between intra-urban and peri-urban, where in the former, built structures clearly predominate, while in the latter, built, agricultural, and natural land uses are interspersed. At the same time, where we cite some researchers who have used another disaggregation of the metropolitan area, we will maintain their convention so as not to attempt to force them into our categories.

Defining 'Agriculture'

As for *agriculture*, it too is used in its broadest sense, embracing horticulture, aquaculture, arboriculture, and poultry and animal husbandry. Agriculture, farming, cultivation, and raising crops and animals are used interchangeably. Farmer refers not just to the agriculturist whose main occupation is cultivation, but also to the part-time or recreational one.

One term used here, however, requires significant clarification — *food production*. Agriculture is more than just a production process. As is made clear at the end of this chapter, the term agriculture also incorporates pre-production and post-production processes, as well as waste recycling processes. Furthermore, food production is encompassed within 'agriculture', but as used here, agriculture covers much more than just food. Agriculture includes a number of products that are not edible by humans, for example, fuel material, wood for other uses, and feed for animals (see Chapter 5).

Urban forestry goes beyond urban agriculture, including other types of urban greening efforts. What is of specific interest here is *urban agroforestry*, which produces food and non-food products. Common food products include fruit, nuts, mushrooms, and berries from trees, shrubs, and rhizomes. Non-food products include medicines and insecticides from flowers, foliage, bark, and roots. Wood is used for fuel, furniture making, basket weaving, paper production, and construction. The use of poplar for paper, bamboo for construction, and rattan for furniture and baskets is widespread. Related to these direct forest products are ancillary products such as honey, ornamental shrubs, and flowers. Urban agroforestry falls within the broader activity of urban greening, which steers forestry to bring a range of environmental benefits to urban areas. Given the multiple functions of urban agroforestry, its boundaries can be difficult to draw sharply.

Other Definitions

A few additional concepts deserve explanation (Appendix B defines more terms). Some terms such as *food security* will be introduced and discussed later in this chapter.

A basic concept for recognizing the importance of urban agriculture is the *food-shed*. The food-shed of a city includes all the areas that supply its food products — local, rural, or foreign. The food-shed could be defined for each food group (for example, the milk-

shed, poultry-shed, or produce-shed of a city). Generally, the richer the city, the larger its food-shed. Because transportation systems are less developed in poorer cities, and residents' food and fuel costs as a share of income are higher, the food produced within a daily food-shed becomes more important in poorer cities than in richer ones, and the food-shed itself tends to be smaller. Note that the urban food-shed encompasses more than just the urban farming region, since much food is imported from well outside that region.

Additional terms amplify the food-shed concept. A few in current use are *place-based food system*, *locally-grown*, *food miles*, and *slow food*. The first two are transparent. Food miles is a term coming into use in UK that measures the farm to market distance and cost for each and every product on the dinner plate. Slow food is a burgeoning movement (65,000 members in Italy) that favors local production, processing, marketing, and consumption. It includes an aversion to fast food.

Seventy-five percent of what is harvested and mined from the earth is shipped to towns and cities, an area that covers 2.5 percent of the earth's surface yet include one-half its human population.[5] Natural resources are moved with massive energy and pollution costs to satisfy urban consumer and corporate demands. William Rees has defined the concept of an *ecological footprint* as a means to characterize the impact of human consumption on the biosphere in a single figure.[6] More specifically, we can talk of an urban footprint. The 20th century trend to global wealth, promoted by so many good individuals and organizations, has in most cases increased the negative effects of cities on the earth's capacity to support life and civilization. Urbanization's present-day resource consumption patterns have a number of limits to their continued expansion. The single largest component of the urban footprint is food. By bringing food production back into the city, the degradation of the biosphere can be reduced. Sustainable cities are discussed later in this chapter, and Chapter 5 spells out some steps to reduce degradation.

Fungible income refers to the substitution of goods or labor for money that had to be earned to acquire these (or equivalent) goods. Barter, food for labor, and food for land access all create fungible income, as does growing food for family consumption (instead of buying it). The fungible income from urban agriculture is particularly important in places where a high portion of earned income (one half or more of family income) is spent on food and fuel purchases. The high fungibility of income from urban agriculture is an easily overlooked but very powerful tool in the fight against urban poverty and represents one of the activity's greatest benefits.

The legal concept of *usufruct* is also important to an understanding urban agriculture. Usufruct refers to the legal right to use and enjoy something that belongs to another person or over which there is a form of communal ownership. Generally, use can be enjoyed so long as the value of the good and its utility to the owner are undiminished. In urban agriculture, a usufruct grants a farmer access to the fruits of his or her labor on a public or private land or water body that he or she does not own. Usufruct arrangements were important in Roman law and are still important in many indigenous bodies of law worldwide. Much tribal law in Asia and Africa, for example, includes usufruct principles. Typically, a usufruct is given under certain guarantees of performance by the usufruct user or in return for maintenance of the good — in this case, land or water. Usufruct arrangements are a powerful resource where the land or water body is idle and could be

put to productive use. Undeveloped factory sites set aside for worker gardens in Russia and electric transmission line rights-of-way used by suburban weekend gardeners in the U.S. are modern variants of this principle.

Input-output theory offers an understanding of the *throughput* of resources in an urban ecosystem — the inputs (raw materials and products) that are brought in to support a city as well as the outputs (especially wastes) that are evacuated from it. The throughput of natural resources will need to be minimized in the future for human settlements to become sustainable rather than polluting. Urban agriculture contributes to this process by reusing its waste and the waste of other sectors to produce food and fuel. It reduces both the intake and the output in the resource stream, thus fewer resources are consumed and pollution is lower. Such reductions can make the city more ecologically balanced and more resourceful (both literally and figuratively).

A fundamental change is needed (and may be emerging) in the way *waste* is viewed globally. Waste must be regarded not as a disposal problem, but as a *resource* for sustainable development. Metropolitan areas must not be viewed as open-loop systems in which resources flow in and wastes flow out, but as *closed-loop systems* in which wastes and resources are one and the same (see Fig. 7.2). In an idealized closed-loop system, the output of one process is used repeatedly as an input to another process, therefore eliminating the need to export waste from the system.

Another useful concept in discussing urban agriculture is that of the *edible landscape*. In the urban landscape, industrial and commercial areas are often considered productive, while open spaces are regarded as recreational and aesthetic, but nonproductive. Urban agriculture creates a green and aesthetic landscape that is at the same time productive — street trees bearing fruit, ponds and rivers producing fish and water vegetables, hillsides yielding fuel, and formerly vacant lots growing vegetables. This landscape is then fecund and brings high returns to the cultivator or breeder.

A further extension of the edible landscape concept is the edible building. This concept is now being promoted by Sustain in London. At its simplest, vegetables are grown on the roof of a supermarket using organic waste as a growth medium and waste heat from refrigerators and freezers. Many architects are exploring this concept.

Taming the excesses of agriculture is a global challenge for today. The agriculture, fisheries, and forestry industries are all diminishing the earth's natural resources to meet market demand. Agriculture in human settlements has a special role to play in remediating the negative effects of human food production. The UN Food and Agriculture Organization (FAO) defines *sustainable agriculture* as: "The management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations."[7] In order to satisfy this definition, urban agriculture must to be able to conserve genetic resources, and be environmentally non-degrading, technically appropriate, economically viable and socially acceptable. Sustainable urban agriculture means closing ecological loops currently open, and integrating food, fuel, medicine, and ornamental production and processing into the urban fabric and community life.

Links and Differences Between Urban and Rural Agriculture

The authors assume that rural agriculture will continue as an important economic sector, and that rural agriculture will change as much in the current century as it did in the last one. Changes in rural agriculture will respond to the evolving global urbanization, global environmental degradation, and technological progress in many fields. Those changes will also respond to the transformations under way in urban agriculture. In this section, we address basic issues about the relationship between rural and urban agriculture.[8] Through the discussion, we hope to provide partial answers to four concerns that are sometimes raised about urban agriculture:

- Where is the spatial limit of urban agriculture, and how is it changing?
- Will the advance of urban agriculture contribute to rural poverty?
- Why does urban agriculture persist in regions that have rural food surpluses?
- Do urban agriculture and rural agriculture compete, and what advantages does each possess?

Continuum in Space and Time — Urban-Rural Food Systems

The urban-rural links within historical food systems are evident in many written and mapped records. Rome's imports of grain from North Africa and the Black Sea region are as well documented as its peri-urban market gardens and livestock ranches.[9] The fortified cities in medieval Europe had livestock pens and large storage facilities for rurally-produced grain. These provided carbohydrates and protein during siege and winter.

Until the 20th century, the urban vegetable producers in and around Paris, London, New York, and other cities shipped their products to rural towns and villages in the same carts that brought rural products into the city.[10] River cities from Southeast Asia to South America are known to have had trade in diverse agricultural commodities running in both directions.

The Industrial Revolution helped rail to replace river transportation, and two generations later, the highway replaced the railway in many countries. The food-sheds of our fathers are all history. Food-sheds in the 1950s tended to be 50-150 kilometers long, but geographers today have a much more difficult time in defining the geographic limits of a city's food system.

The peri-urban area poses a particular challenge in any attempt to answer the basic question: Where does urban agriculture end? Still, in the majority of countries, peri-urban zones can usefully be considered part of the urban area and the urban system. The food system flows through any definition of an urban boundary to rural areas. The urban-rural continuum of the food system serving the industrial city of 1850–1950 was sharply different from that of the post-industrial city of 1950–2000, and both bear little resemblance to the evolving *network city* of the 21st century.

Urban Agriculture and Rural Economies

As urban agriculture increases the wealth of urban citizens, they will be able to purchase more goods from rural farmers. Urban poverty does not promote rural development. As

urban farmers produce products that were formerly grown in rural areas for the urban market, rural farmers will then turn to product lines that have an increasing market demand and for which they hold a comparative advantage. For example, a rural tomato producer who finds a receding demand may turn to turkey production, which is increasing its market share as urban families spend more on turkey.

Another example of the compatibility of urban and rural agriculture can be stated at the commercial level. A city brewery is producing beer based on rural oats and hops. The brewery waste is used as both a poultry feed and to enhance the soil of nearby vegetable production. Urban poverty is diminished, the cost of disposing of the industry's waste is cut, and both the rural and the urban farmer benefit. In short, if urban agriculture promotes development, it will in turn promote rural agriculture.

Urban Agriculture and Rural Agricultural Surpluses

In the last 50 years, food surpluses have been a common phenomenon for certain crops, at certain times, and in certain places. The existence of such surpluses does not itself preclude the need to develop farming in urban areas. Urban agriculture can have an important role to play in the context of food surplus, primarily for three reasons.

There is always food insecurity in certain groups, even in the midst of a land of riches or a time of plenty. The current food system has certain distributional inefficiencies and inequalities. In many countries with food surpluses originating in rural areas, urban food insecurity persists among groups that remain in poverty. Urban agriculture can reach the urban poor who are not well served by the current system. This production is unlikely to diminish demand for rural products and therefore the profitability of rural agriculture. But in any case, the poor who depend on urban farming may not represent a major component of the market for rural or imported products.

Food surpluses are sometimes generated in environmentally unsustainable ways, causing ecological damage. The advent of industrial agriculture and some aspects of the Green Revolution have in many cases contributed to environmental degradation — polluted estuaries, erosion, soil salinization, etc. In certain locations and in the process of producing particular crops, appropriate urban agriculture practices can diminish environmental degradation caused by rural agriculture. Rural agriculture will in these instances need to change its practices and/or switch to different crops.

Food surplus and food quality are not synonymous. Food quality for everyone, especially the urban poor, is on a downward curve as increasing amounts of additives and levels of processing are applied to more and more of what we eat. Urban agriculture offers a possibility to enhance the quality of what we eat at home, in school, on the street, and in restaurants by putting *fresh from the farm* ingredients on our dinner plates. Particularly where the marketing infrastructure is insufficiently developed, there may not be a substitute for the freshness of local products. This is not a net deduction from rural agriculture, but rather a supplement to the urban diet, and will add urban vitamins and protein to rural carbohydrates.

Location Specificity — Comparative Advantages of Urban and Rural Agriculture

The nature of cities is changing. In 1940, the average density of America's cities was 25 people per hectare. In contrast, areas developed in the early 1990s generated an average density of 2.5 people per hectare, one-tenth of the density a half-century earlier.[11] The same type of reduction in urban density is occurring in the sprawling cities of Europe, Asia, Africa, and South America. With such sprawl, a new possibility for agriculture exists within the city as a symbiotic land use among many, as a *productive urban landscape*. With the unparalleled spatial reach and increasingly vast amounts of unbuilt (open) spaces in the midst of built environments, looking at space alone, a claim can be made that agriculture is becoming urban at an unprecedented scale.

At the same time, as the 21st-century city once again welcomes agriculture, the advances in transportation and communications technology are providing the agricultural industry greater choice in locating production, which means that certain crops can now be farmed at distances that were not imaginable in the past. The urban production of certain crops is now favored, such as flowers grown near South American airports for air transport to the USA, while it reinforces the rural production of others, such as soybeans in Kansas for slow shipping to China. Hence, the differences in urban and rural production of agricultural products are influenced by comparative advantage.

Differences between urban and rural crops begin in the nature of the crops themselves. Thus London's oranges come from Spain, while its mushrooms are grown in the city. A warm climate and a sturdy natural skin give an advantage to Spain for oranges to be shipped long distances, while fragile and highly perishable mushrooms that require limited production space are most efficiently grown close to consumer demand.

Many agricultural technology advances tend to favor intra-urban or peri-urban (close-to-market) locations. Five enhanced farming systems or technologies (see Chapter 5) are worth noting as being particularly suited for urban settings due to issues of freshness, intensity (in capital, land, or labor), market access, adaptability, or other factors:

- aquaculture — water crops produced in artificial water bodies, some under roofs;
- zero-grazing — production of livestock (poultry, rabbits, pigs, etc.) in cages and enclosed structures;
- plastic tunnels — production under plastic roofs that protect from weather and insects;
- hydroponics — production without soil; and
- drip irrigation — systems that use much less water per unit of production than trenches or overhead sprinklers.

Infrastructure has a strong influence on what farmers produce in rural and urban areas. Highways, the farm-to-market roads of the economists, are the most important infrastructure element serving our food systems. The efficiency of the highway system and the quality of trucks (including refrigeration, mobile phones, and global positioning devices) more precisely shape the location of what is produced, processed, and packaged than air, sea, or rail facilities.

Air shipments are much more expensive per mile compared to surface shipments, and generate approximately 14 times as much ozone-depleting air pollution per mile per pound as rail shipments. For a number of products, the time saving of shipping by air can compensate for the extra cost because it opens new markets. Airport locations are thus significant factors for relatively light and perishable products and high value products. New York's winter strawberries arrive by air from Central America, while New Zealand fish arrive in Paris by air. Many products are processed and packaged at the production site and flown to market.

Serving all transportation modes are webs of storage facilities, marshalling yards/transfer stations, wholesale markets, and information systems. The logic and practices of urban and rural farmers are substantially determined by capital-intensive infrastructure. Future policy and agricultural development plans for countries and cities with poor infrastructure will be different than for locations that are well endowed with infrastructure.

Landscape is another determinant of urban-rural splits in agricultural production. The urban area on a coastal plain will produce different products than farms on nearby hills, which may have less soil, less water, and more frost. This is evident in Beirut and other Mediterranean cities. Towns in deserts, on small islands, and in the mountains are more likely to produce food products consumed on a daily basis than those surrounded by extensive agricultural plains.

Analyses of the comparative advantage of urban/peri-urban compared to rural agriculture can well include the share of the profit, the range of selling venues, and the market information that is available to the producer. Producers in the community or the city can often capture 50-80 percent of the retail price, which is aided by marketing devices such as farm stands, farmers' markets, municipal markets, and sales to restaurants, street vendors, institutions, and retailers. The rural competitor will more often sell into a national, regional, or international market, two or three steps removed from the retail outlet, at a fraction of the retail price. The urban farmer is more likely to have up-to-date information about demand from the local markets, and sometimes from the international markets. The comparative advantage due to information differential, however, is declining as the Internet supplements radio.

Policy, administration, and education significantly affect the urban-rural split of agricultural production. The land-use policies and administration of many cities, small and large, are antagonistic to agriculture. Livestock are often not permitted in town, crops may not be permitted in public open spaces, and homeowners are sometimes not permitted to raise vegetables in their front yards. In the same countries, however, educational programs, infrastructure, price supports, input subsidies, and other factors tend to be conceived and oriented toward the development of rural farming.

Last but not least in our list of elements determining urban-rural agricultural product splits are soil and water. Urban agriculture benefits from the ready availability of organic (solid and liquid) waste products to feed livestock, improve soils, and irrigate land. Such use provides a substantial equalizing factor for many crops over rich agricultural soils in rural areas. Many cities have relatively good access to water compared to some rural

agricultural areas. Rural farmers are far more dependent on rainfall and more extensive/expensive irrigation infrastructure.

In sum, the allocation of agricultural production between urban and rural locations, and where agriculture occurs within urban areas, are in rapid flux and require specific and substantial study. Certain types of products, processes, and techniques will be favored in urban places, as will be discussed further in Chapter 10. For others, rural areas will maintain their advantage. To illustrate the split between urban and rural farm products, we can analyze the typical ingredients of a ham and cheese sandwich — bread (rural), cheese (rural), ham (peri-urban), lettuce (urban), and tomato (intra-urban). Ultimately both urban and rural agriculture have their place specificities, and with a little help from policymakers and educators, rural and urban agriculture will enjoy a healthy symbiotic relationship.

Urban Agriculture and *Sustainable* Urban Systems

Urban agriculture does not exist in isolation but occurs in the context of other urban activities and systems, particularly the local economic, land use, ecological, and urban management systems. It is also integrally related to the local, national, and global food systems. Any plans for managing, expanding, or transforming urban agriculture must consider the interactions among the urban agriculture industry and these systems.

The role of urban agriculture in the urban land-use system is detailed in Chapter 4, while Chapter 7 discusses how urban agriculture fits into the urban and global economies, as well as its actual and potential function within the urban waste management system. Here we briefly discuss the urban nutrient cycle, the hydrological cycle, and the urban food system, followed by a view of how urban agriculture fits into each. The complexity of the urban food system deserves more elaboration, and will be treated separately in the following section. We start with some observations on how urban agriculture fits more generally into the sustainability of the city itself.

Urban Agriculture and the Sustainable City

We have already noted the magnitude of urban settlements on this earth, as expressed in the concept of the ecological footprint. This can be fleshed out by the calculations that Herbert Girardet has made concerning the influence of London. He estimated that Greater London lives off an area 123 times larger than the surface of the metropolis.[12] It casts a shadow, not just on the use of land, but on water extraction and air pollution. The consumption of natural resources (petroleum, phosphate, wood, fish, soil microbes), the construction of the city (rooftops, paving, lawns), and pollution all diminish biodiversity. London's ecological footprint goes beyond the close and far places from which it extracts resources. It also casts a shadow over other cities that process and transfer resources — the reach ranges from towns and cities in the English hinterland, to Chicago and the U.S. Great Plains that supply its maize, to Bogota and the Colombian highlands that supply its coffee.[13] This inevitably raises the question of the extent to which such an urban pattern (and the lifestyle behind it) can be sustained without unacceptable environmental and social costs.

The *sustainable city* is the subject of considerable analysis as urban deconcentration continues into a third century. Grady Clay suggests that the goal of sustainable urbanization is "the creation of new landscapes to provide healthy life-systems, not merely to remedy urban malfunctions, so that . . . urban development becomes a participant in the workings of natural systems."[14] Herbert Girardet gives us a straightforward definition of a sustainable city, as a variant on the classic definition issued by the Brundtland Commission report in 1987, as one that is "organized so as to enable all its citizens to meet their own need and to enhance their well-being without damaging the natural world or endangering the living conditions of other people, now or in the future."[15]

For our purposes in this book, we chose a limited view of the sustainable city, and focus on ecological and social sustainability. Ecological sustainability requires that a city or urban region reduce its negative ecological footprint toward zero. This is consistent with Clay and Girardet. The principal tools we suggest are the reuse of waste as an input to the production of food for human consumption and the cleansing and reuse of water.

The sustainable human settlements of history (Macchu Picchu, Peru; Sanaa, Yemen) and today (Findhorn, UK; Auroville, India) include agriculture. Futurists and pragmatists who consider sustainable city designs will overlook a strong contribution if they ignore agriculture in diverse forms.

When well managed, urban agriculture contributes to closing now-open ecological loops, strengthening the city's economic base, and enhancing social cohesion. In the following chapters, we will consider the role urban farming plays in the sustainability of a community (and therefore city), and beyond that, how it can reduce the pressure exerted by a city on its region and on the biosphere.

The Urban Nutrient Cycle

Urban farming has existed throughout history and played roles in both feeding cities and recycling urban wastes. As shown in Chapter 2, intensive horticulture, dairy, and hog farms have been an intrinsic part of cities and played a vital role in their functioning since the dawn of urban settlements in Asia, Europe, the Middle East, and Latin America. The pre-industrial city was to a substantial degree an ecologically closed-loop system. City waste was primarily organic and suitable to regenerate the environment. The liquid and solid wastes of the city were returned to the land to enrich and build the soil, which produced perishable food for the city.

With the industrialization of the last two centuries came rapid urbanization and the development of a dichotomous planning concept that created a functional separation between the 'country' and the 'town', with the countryside producing food and the city producing industrial goods. Urban land-use planning and hygiene principles discouraged urban farming. The development of large-scale waste management systems that dispose of waste rather than recycle it, as well as the change in the composition of waste from largely organic to increasingly inorganic and toxic, made its recycling through farming a complex and more costly task.

The industrialized 'North' has largely separated food production and urban settlements. In the 'South', there has been less separation. In China and other Asian

countries, vegetable and small animal and fish production continues to flourish in urban regions, but globally, the food production function was reduced in numerous towns and cities.

What White and Whitney have referred to as "the traditional spatial nutrient cycling system of waste management" has thus disintegrated under multiple pressures.[16] Figure 1.1 illustrates the shift from one model of urbanization — the closed (sustainable) loop, which existed before the Industrial Revolution — to another model, the open (unsustainable) loop. An increase in urban agriculture activities would heighten the possibility for food and fuel production to once again transform urban waste from a problem to a resource.

A complete or ecologically sustainable design for a city would be a closed loop, with all the wastes from one process used as an input to another process. The city would be in balance. Because food and fuel are a major industry in a city, urban agriculture has a large role to play in closing open, polluting loops in the nutrient cycle. Simply put, waste makes a major contribution to food.

The Hydrological Cycle

The World Resources Institute found in 1996 that countries with a serious water scarcity included not just those that are well-known as for their aridity such as in North Africa and the Middle East, but also those with emerging severe water shortages, such as Kenya and China. One 1992 forecast estimated that 1 billion people would be living in water-short countries by 2025. Another study uncovered serious deficiencies in the water supply of two-thirds of African countries, in part due to urbanization.[17]

Moreover, over two-thirds of the water withdrawn yearly for public use (not irrigation) comes from groundwater.[18] The result of this pumping is groundwater pollution by industry and intensive urban/peri-urban agriculture, which dries out vast landscapes around large cities. The World Bank found in 1993 that Manila, Mexico City, and Bangkok, among others, were simultaneously seriously depleting their water supplies *and* contaminating them. These data on global water supplies point to how vital any savings in water have become, and the critical role that cities, and urban agriculture in particular, have in the hydrological cycle.

Rural water runoff is polluted primarily by agricultural practices such as large-scale poultry raising and the application of chemical fertilizers. Urban wastewater is polluted by a wide range of urban land uses including dwellings and industry. Much urban agriculture uses rural runoff as well as urban wastewater and runoff as an input during production, however, well-managed urban agriculture can be used to purify both runoff and wastewater.

Some ecological principles can be of use in considering the ties of urban farming to the hydrological cycle. One is that water is *the commons*, not just a resource.[19] Another ecological principle is for all water to be used — *seven times twixt mountain and ocean*.[20]

The urban design, planning, and management required by the limited fresh water supply and hydrological cycle — whether seen as commons or resource — is to use urban agriculture as a water-cleansing activity both above and below the town or city

(upstream and downstream). Quality control of farming systems is a necessary condition to ensure this works properly, otherwise these processes can and do result in water pollution and disease. The relevant principle must be, not just 'zero pollution', but 'negative pollution' as a net effect of urban farming. A good example of water management in urban agriculture is the use of fish manure as a prime source to fertilize lettuce at Tailormade Fish Farms in Newcastle, Australia, where little or no wastewater emerges from the aeroponics process in a fish tank flow of 30,000 liters per hour.[21]

Considering the range of urban farming sectors, as outlined in Chapter 5, some will be more effective at managing water pollution than others. Some urban agriculture practices that particularly pollute water sources in recent years include poultry in Delaware, USA, piggeries in the Netherlands, shrimp in Thailand, artichokes in California, and green leafy vegetables in Chile.

In contrast, other practices have been well documented as cleansing rural and urban water supplies. Duckweed, with less than a centimeter foliage and a meter of root system in water, is an excellent converter of pollution to edible calories for feeding animals (see Case 5.4)**.** Reeds (such a papyrus) have been cleansing urban effluent since the time of the pharaohs in Egypt. Urban agroforestry not only cleanses water but also the urban air. The French and Chinese biointensive vegetable production methods are known to efficiently convert dirty surface water to clean groundwater.

When well designed, monitored, and managed, urban agriculture can enhance the quality of water that enters the city and water that leaves the city. Poor practices can aggravate both supplies, thus urban agriculture is an integral component of a city's hydrological cycle.

Urban Agriculture and the Urban Food System

One way to understand urban farming is to study it as a part of the urban and national food supply and demand system, within the context of the urbanization process. The urban food system includes:

- food that urban residents consume,
- production location,
- means of production,
- transportation and storage options,
- food processing and packaging methods, and
- intra-community and global marketing systems that move food from producers to consumers.

Food Demand

Urbanization affects the demand structure for food in a country. In cities, consumption of traditional basic foods (staples) is often replaced by consumption of more processed — and often non-indigenous — foods such as cereals and livestock products, along with higher consumption of precooked and convenience foods. Thus demand for high-value crops, vegetables, and meat products increases.

Urbanization affects not only the types of food demand, but also the levels of demand. Urbanization in developing countries is occurring at far more rapid rates than in Europe and North America, and the speed of urbanization and sheer numbers of people being added to urban areas are staggering. Between 1990 and 2020, Africa will add 500 million people to its urban population. In comparison, between 1960 and 1990, North America and Europe together added 180 million people to their cities.[22] The consequence is self-evident — more and more urban residents need food, yet in many developing countries agricultural productivity and the agricultural transportation and marketing systems are not keeping pace.

Food Supply

Where do people obtain their food? Villages get the bulk of their food supply from farming within the settlement and surrounding countryside. In larger, more urban areas, however, the capacity of the immediate surroundings cannot keep up with the growing and changing food demand because nearby farmland is being taken for urban uses. Consequently, farming in the region intensifies and adapts its crops to the new demand. The food-sheds of the various crops expand along with the city they serve, and additional food is imported from other parts of the country or from abroad.

Thus urbanization induces the development of a more intricate national marketing and transportation infrastructure that can provide the city with food from remote rural and foreign sources. The urban marketing structures move gradually from the traditional petty trade structure — characteristic of smaller towns and villages — to more formalized and capitalized market structures. Extensive storage, refrigeration, and processing facilities develop to increase the shelf life of food.

A new food supply structure does not replace a traditional one, but rather complements it. Remote systems alone cannot nourish all urban residents at affordable prices. Remote food production now complements local ways of furnishing urban residents with their nutritional needs, thus greatly increasing the complexity of the urban food system.

Drakakis-Smith has presented a structural framework of the food supply system of cities (Fig. 1.2). It shows that urban residents acquire food through exchange (purchase or barter), production, or transfer (food aid, donation, food stamps, feeding programs). The sources of the food may be rural producers, urban producers, imports, food aid, or the residents' production.[23]

The food supply system can be viewed as a series of food-shed overlays of varying diameter, shape[24] and direction from the city,[25] depending on the type of agricultural product. One example is provided by a 1972 study of Hyderabad, India, which found that the 1.25 million population was served by three wholesale vegetable markets. Less perishable vegetables came from more distant sources, while almost the entire supply of more perishable products was grown within a 40-mile radius of the city. In the peri-urban zone, farmers practiced intensive farming using electric pumps, producing three to four crops a year. Eighty percent of the milk consumed was supplied from the vicinity of the city, as was most of the poultry. Fruit usually came from a farther distance than vegetables and poultry.[26]

The amount of food supplied by the various sources — urban, rural, and foreign — as well as the crops predominantly supplied by each source, varies depending on a range of factors, including:

- economic status of the country (developing, industrial, post-industrial);
- completeness of the food marketing, storage, and transportation infrastructure and system;
- agricultural productivity (per hectare, capital investment, per worker);
- availability of land, water, and other natural resources; and
- agricultural and urban development policies.

Wherever the national food marketing and transportation system is not well developed, urban farming is particularly competitive. For high-value specialty or perishable crops, urban farmers have the advantage of proximity to market as well as the means to follow the market closely.

The rapid growth of cities has been accompanied by a surge in urban poverty. The proportion of the absolute poor in developing countries living in urban areas was estimated to have risen from 25 percent in 1988 to 50 percent today.[27] Many poor urban households depend on cash income to obtain food, for which they often spend more than one-half of their income. The urban poor characteristically respond by growing food wherever they can find access to space — either to add to the family larder, to have something to barter, or to generate income.

The majority of urban farmers in low-income countries are poor. A prime reason these families become urban farmers is to gain food security, directly through the consumption of what they grow and indirectly through barter, fungibility, and market sales. What this study makes clear is that in developing countries, modern regional and global food systems (in both rich and poor countries) fail to achieve food security for the poor. Urban agriculture can ameliorate that crisis.

A common perception is that urban agriculture is appropriate for the urban poor and is questionable in urban districts not occupied by the poor. Recent studies in West Africa and India by Cardiff University and IFPRI (International Food Policy Research Institute) in eight African cities found that the locus of malnutrition and food insecurity and the locus of poverty in those cities are not the same. Ruel et al. at IFPRI found that the share of the poor in urban areas was increasing in seven of the eight countries studied.[28] Food insecurity and malnutrition are occurring in middle-class as well as lower-class portions of cities in low-income countries. The need for urban agriculture is neither poverty-driven nor poverty-located.

Maxwell at IFPRI and others have found that agriculture by the urban poor is an effective means to improve health and well being. Lee-Smith, working for the International Development Research Centre of Canada (IDRC), found the same to be true for low-income and middle-income families in Kenya. In wealthy countries, including particularly the United States, food insecurity and malnutrition are largely limited to poverty locations. The Brookings Institution found that a prime indicator of food insecurity is eligibility for a free school lunch, which is commonly 50 percent or more in

areas of relative poverty. Malnutrition is both a symptom and cause of poverty, and poverty is moving to the cities as the world urbanizes.

After 150 years of increasing separation between consumption and production, there is substantial evidence that production is returning to the city and its edges in many places. After generations in which the food industry and agriculture focused their attention on greater efficiency in distribution and marketing, there is a perceptible shift toward renewed investment in intensive, efficient, and integrated production systems within the expanding urban regions.

The shift has two components. The first focuses on the 'urban' aspect of the urban food system. The relationship between urban and rural agriculture and their purposes is changing, with each producing those products at which it is most efficient (considering all cost factors) and for which proximity to market is most vital (rather than simply where the best conditions exist for production). Urban demand for food is satisfied from both urban and rural supplies. This not only gives an important role to urban food production, but also changes the overall function of rural food production.

The second shift bears on the 'food' aspect of the system. As discussed above, food is not only a part of a demand-supply equation; it is also a part of a continuous cycle of nutrients generated and consumed by urban residents. This perspective on the urban food system reintegrates food with urban ecology, tying resources to wastes and inputs to outputs.

Beyond Food Demand and Supply — Urban Food Security

Food insecurity or food poverty exists when every person, whether infant, child, adult or elder, does not have ready/daily/sustainable access to nutritious, culturally acceptable food. Food security exists then when an individual, family, community, city, region, or country has adequate income and a stable food system that assures both individual and group sustainable daily and year-round access to a nutritious and culturally acceptable diet.

For the individual of any age or socioeconomic status, food security requires that the possibility of malnutrition does not exist. Food security means that not only is freedom from hunger a human right, but so is a healthy diet. As we move up the ladder to family and nation, the definition becomes more complex and demanding. At the community, city, and regional levels, it requires some power over the means of production, processing, and distribution.

Food insecurity exists in countries/regions/cities with food surpluses and in countries that are short of food. Food insecurity among some groups increased in some wealthy countries even as their economies boomed in the late 1990s. At the same time, many experts in places like Indonesia and Russia were surprised during their economic depressions of the 1990s, as food availability in urban areas (although not necessarily nutritional quality) was maintained at levels that defied expectations. Food security must be conceived, planned, and implemented in its own right. At the same time, however, food security must be an integral component of economic development, education, health, infrastructure, housing, etc., given its strong ties to all these related systems.

In the previous century, we generally perceived hunger as being episodic — the Irish potato famine, Bengal famine, dust bowl, Great Depression, world wars. In recent years, we recognize food insecurity as systemic and chronic. In the past, we looked for simple solutions, including economic development or food aid. Today, we often recognize that the system itself must change.

As the world we live in becomes predominantly urban, food security is being accepted as integral to our communities, whatever their size. Much of this book, and many of the publications referred to within it, are about urban food security, and therefore global food security. Urban agriculture is not the lone answer to urban food insecurity, but in many situations it is an essential element in the answer, which will be somewhat different in its application in each and every city and country.

Community Food Security and Food Systems

In the 18th and 19th centuries, the industrial revolution brought tenements and worker housing. Places of shelter and food were separated, perhaps for the first time in human history, and there was a backlash. Social and health activists, corporations, and towns invented allotment gardens. Workers were assigned farming space near where they lived or worked. The middle class raised vegetables, poultry, and small livestock in their backyards. These productive extensions of home continued to be common until World War II in Western Europe and North America, and until the present day in Eastern Europe and some developing countries.

In the 21st century, where we live and what we eat are being reconnected. Food production is increasing its presence in education curriculums at all levels.[29] The home or household garden and community garden are both becoming more popular. Food that is locally grown or on the market shelf the day it is harvested is gaining market share in rich and poor countries alike, as Chapters 2 and 10 make clear.

From the wealthiest to the lowest-income towns and cities in the world, community-based food systems are re-emerging. We generally identify the institutionalization of this trend as beginning in the middle 1970s. Some places preceded others. In Ghana, Operation Feed Yourself (OFY) began in 1974 (see Chapter 7). [30] In the late 1980s, similar programs were initiated in Côte d'Ivoire and Zaire. Across the world, the community garden program was being reborn in the United States.

In Asia, the 1970s witnessed the birth of the community-supported agriculture (CSA) movement in which a community supports a specific farmer. On the other side of the Pacific, the 'community kitchen' movement was being invented in Chile. This community-based food system expanded over time to include food production, processing, and distribution.

It seems likely that these cases and many others would have been perceived and reported as isolated and unique except for the UN University's Food-Energy Nexus project of the mid-1980s and the UNDP's Urban Agriculture Initiative of the early 1990s. These two global research activities said loud and clear — *something is happening here*.[31] Through this lens, many place-specific studies came into focus.

Several varieties of community-based food systems have been identified. Ecoville is a worldwide movement that includes the precept of using community land, recycled water, waste/reused/renewable heat and energy, organic waste, and community labor to produce, process, and distribute food. Permaculture is a worldwide movement with particularly strong chapters in Australia and Zimbabwe, aiming at sustainable agriculture within a sustainable human settlement.[32] Community kitchens have spread from Chile, reaching Canada and the Ecovilles.

Food production and processing are moving closer to the kitchen and dinner plate through millions of individual decisions. The homeward movement of the food system has not yet been explained scientifically, but it is linked to many concepts and actions — the environmental movement, a *good food* and *slow food* movement, the replacement of 'ending hunger' with the concept of establishing food security, a stronger role for women in household decisions, innovations in agricultural technology, and many more. These factors are an important part of the explanation, but something in the human psyche that finds the union of shelter and food to be attractive may also play a role.

In the 1990s, the concept of *community food security* has emerged to take a prominent position in the social justice, anti-poverty, and anti-hunger fields. It is defined as "all persons obtaining at all times a culturally acceptable, nutritionally adequate diet through local non-emergency sources".[33]

Relative to food security, community food security added several new concerns and objectives. These include:

- advocating solutions to address systemic hunger problems that rely more on the local food system than on national or global safety nets, including welfare and relief*;*
- addressing both the availability of and access to food along a continuum from the individual to global levels (with a particular emphasis on the community);
- dealing with where and how food is produced in addition to the more classic question of how much is produced (quality of diet, not just quantity); and
- empowering individuals and organizations through community food initiatives.

Beyond the issue of access to food, community food security "emphasizes the viability of the farms where the food was grown, ecological sustainability of its production, and more community control of food production and distribution among others".[34] Urban agriculture is clearly one of the foundation blocks on which the concept of community food security rests.

Hugh Joseph of Tufts University states that: ". . . community food initiatives can empower residents and community-based organizations and institutions by developing opportunities for them to have greater participation in and control over their food systems — including production, distribution, access, consumption, and disposition of food waste." He concludes that in the long term, this would "promote a truer sense of food security than does reliance on an externally-controlled food supply".[35]

Thomas Lyson of Cornell University goes a step further to identify *civic agriculture.* Relative to globalized commercial agriculture, he sees that there is "a counter trend towards relocalization of some agricultural and food production — a rebirth of *civic agriculture,* because in almost all cases these activities are tightly linked to a

community's social and economic development".[36] This document explores several elements of community food security.

Structure of Urban Agriculture

The urban agriculture subsector, like the broader agriculture sector of which it is a part, includes vertically integrated processes in three phases:

- pre-production — acquisition and utilization of the necessary resources, inputs, and services;
- production — generation of raw materials and finished goods; and
- post-production — processing, packaging, distribution, marketing, and recycling.

This classification is suggestive and may incur significant exceptions and overlapping elements. For one, recycling transforms waste into resources and inputs, and in that sense, is part of pre-production. Moreover, the three phases are rarely clear-cut. Pre-production is not really a process per se; this category of convenience serves to indicate the multiple elements that are necessary to enable agricultural production. The relationships between the processes are illustrated in **Figure 1.3.**

Most agricultural subsectors are oriented primarily toward serving the needs of rural farming, making it difficult for urban farmers to access these subsectors efficiently. Producers of agribusiness inputs (such as seeds, feeds, fertilizers, tools) manufacture for the rural market and do not cater to the needs of small urban producers. Similarly, municipal and district waste managers generally fail to take note of the large processing capacity and market for organic waste that urban farmers offer. Nor do many municipal markets and supermarkets consider small local producers when obtaining supplies, turning instead to large-scale suppliers or wholesalers who purchase mostly from rural farmers. Canneries, slaughterhouses, and other processors also tend to overlook small-scale urban suppliers. These and other constraints are detailed in Chapter 9.

Pre-Production

The need of urban agriculture for resources, inputs, and services — the necessities of production proper — can be quite different from those of rural agriculture. In both instances, however, when the supply of these necessities is not adequately organized, the industry suffers. Less than optimal seeds are planted, planting time is not well attuned to market demands, the growing season is foreshortened, inefficient tools are used, losses are high, and material that could be used to enrich the soil and water is dumped into the environment as pollution.

In urban regions, the requirements for *land* and *water* are less per unit of production than in rural areas. Intensive vegetable production in urban situations may use only 20 percent as much irrigation water and 8-17 percent as much land as rural, tractor-cultivated crops.[37] Raising microlivestock or poultry takes little space compared with that needed to graze cattle since it can be practiced in cages on rooftops and balconies. Fish ponds can produce up to 20 times more fish per cubic meter of water than stocked rivers and lakes.

Inputs such as tools, seeds, feeds, and supplies require a different distribution system in cities. Because most urban farmers are small-scale and scattered across the city, they need different seeds and supplies than rural farmers. They must cope with different disease threats and microclimates than rural farmers and more polluted soil and water. The crops, production techniques, growing conditions, fertilizing matter, and many other factors vary from those in rural areas and thus require different inputs and appropriate tools.

Urban agriculture has special *financing* needs. Other service needs of urban farming that differ from those of rural farming and improve its efficiency and performance include *training* of extension agents, *special information* programs, and focused *research* into the crops, farming systems, techniques, and problems that are specific to the urban setting. The technologies in a number of urban agriculture farming systems are improving in the 30 countries visited during the course of this study, especially in poultry, climate modification, and aquaculture, with more innovation and upgrading usually occurring in the farming systems favored by richer farmers.

Production

Some concerns of rural agriculture (such as transportation costs and getting the product to the market while still fresh) are minimized with urban agriculture. However, other production considerations are more serious when cultivation takes place in urban areas, such as tenure insecurity, theft, and environmental consequences. Of greatest concern is the assurance that the food is safe for producers to handle and consumers to eat (see Chapter 8).

Urban farming is highly demand- and market-oriented. The vegetable farmer who farms on roadsides, in the backyard, on the roof, or in a vacant plot plans cropping and production depending on what vegetables will be in demand when the produce is sold. The lower- or middle-income gardener cultivating for food security selects the mix of vegetables, fruits, or animals season by season, based on the nutritional needs of the household.

Urban farmers are frequently small-scale entrepreneurs. In some cases, the urban farmer produces for barter with input providers, landlords, other small business persons, or neighbors. This barter can be identified as either fungible or in the informal sector. The farmer may also work on direct contract for a retailer or food processing business.

Post-Production

Urban farm produce can be sold to a wholesaler or intermediary, directly to local markets or retail outlets, processing facilities, restaurants, or street vendors of cooked food.

- Poorer farmers in many cases will sell their own produce at the farm gate or local market. The two final forms of sale are freshly harvested at the market or store and ready to eat at a street vendor’s stand.
- Richer producers, such as poultry farmers, may have direct contracts with supermarkets or restaurants .Their primary form of *processing* is cleaning, but they may also *package*.

Food processing facilities are often located close to or in urban areas, offering urban farmers the advantage of proximity. Thus slaughtering and canning facilities may purchase animals, fruits, and vegetables directly from local growers, or have a seasonal contract with outgrowers. Products that receive further processing have additional *value added*, particularly in cities where refrigeration is lacking in many homes.

As a result of the simpler *distribution* system, fewer middlemen, and less storage, post-production is much less complicated than for rural farming. Most of what is grown and raised in cities is consumed by families and their friends and neighbors, or sold in the local market. Because *marketing* occurs close to the point of production and soon after harvesting, there is less vehicular traffic than for food produced in more remote locations.

In urban food marketing systems, both centralizing and decentralizing trends were detected. In several countries visited, including Nicaragua, municipalities were organizing centralized markets and moving petty traders off the roadside. As cities spread in other countries, government-organized markets at central locations and on major railways and highways are becoming less relevant to the newer and less formal parts of the city, where localized markets emerge within the communities.

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Urban farming makes increasing sense in today's urbanizing world. It is a realistic and necessary practice for the 21st century. As urban farming gains recognition as an industry with a role to play in the sustainability of cities and the sustenance of their residents, its full potential will become more achievable.

Notes

1. Since the first edition of this book was published in 1996, this definition has become the standard and most frequently adopted. We have fine-tuned it somewhat to respond to comments and make it reflect some of developments in the field. The definition hinges of course on how 'urban' and 'agriculture' are both defined. The interpretation of these terms is tackled in the Basic Concepts section later in this chapter. The concept of urban agriculture can be defined, not in itself, but in respect to its complement: rural agriculture. The discussion of the complex relationship between urban and rural agriculture, also later in this chapter, contributes to clarity. Finally, the entire Part Two of the book further describes urban agriculture.

2. Soonya Quon. 1999. Planning for Urban Agriculture: A Review of Tools and Strategies for Urban Planners. *Cities Feeding People Series* Report 28, Appendix A. Ottawa: International Development Research Centre. This appendix can also be accessed on the home page of the Cities Feeding People Program, www.idrc.ca/cfp.

3. Delineating urban agriculture by using a food system approach that considers the area of influence rather than an administrative definition is fraught with inherent complications, as can be illustrated by two examples. Rural farmers who come to the city to obtain composted urban solid wastes present one complication. Russian city

dwellers who travel quite far by train (sometimes well outside the urban area) to regularly produce crops that form a stable part of their family's daily diet present another. Despite these quandaries, a broader system definition is still more appropriate because it represents the true extent of urban agriculture. It is still worthwhile to note the difference between agriculture *in* urban areas and the far broader agriculture *for* urban areas.

4. There are exceptions to this general rule. For example, the boundaries of Chinese 'urban areas' are drawn administratively to include a hinterland that goes well beyond what is generally considered to be urban or even peri-urban.

5. Herbert Girardet. 1992. *The Gaia Atlas of Cities: New Directions for Sustainable Urban Living*. New York: Anchor Books, Doubleday.

6. He developed this concept fully in Mathis Wackernagel and William Rees. 1995. *Our Ecological Footprint.* Gabriola, B.C., Canada: New Society Publishers.

7. From the Den Bosch Conference, April 1991. See FAO. 1992. *Agricultural Sustainability: Definition and Implications for Agricultural and Trade Policy*. Economic and Social Development Paper 110. Rome: FAO. Cited in *Sustainable Human Development and Agriculture*. 1994. New York: UNDP, p. 27.

8. The relationship between urban and rural agriculture can only be understood within the broader framework of rural-urban links. Literature that provides useful overviews of the issues concerned includes: Cecilia Tacoli. 1998. *Bridging the Divide: Rural-Urban Interactions and Livelihood Strategies*, Gatekeeper Series No. 77. London: International Institute for Environment and Development; Urban Development Team 2000. *Rural-Urban Linkages: An Emerging Policy Priority.* New York: UNDP; and David L. Iaquinta and Axel W. Drescher. 1999. *Defining Periurban*: *Towards Guidelines for Understanding Rural-Urban Linkages and their Connection to Institutional Contexts*. Rome: FAO.

9. Girardet, 1992, op. cit., p. 42.

10. Peter Henderson. 1991. *Gardening For Profit: A Guide to the Successful Cultivation of the Market and Family Garden*. Chillicothe, IL.: The American Botanist, Booksellers. [Originally published in 1867.]

11. Data from the 1996 U.S. Housing Census.

12. Herbert Girardet. 1999. *Creating Sustainable Cities*. Schumacher Briefings No. 2. Devon, UK: Green Books, p. 29.

13. This is nothing new, of course. The relationship of Chicago and its hinterland, near and far, a century ago was at the heart of Cronon's now-classic *Nature's Metropolis*. William Cronon. 1991. *Nature's Metropolis: Chicago and the Great West.* New York and London: W.W. Norton & Company.

14. Grady Clay, Foreword to Michael Hough. 1994. *Cities and Natural Process.* London and New York: Routledge.

15. Girardet, 1992, op. cit., p. 13.

16. Rodney White and Joseph Whitney. Cities and the Environment: An Overview, *in* Richard Stren and others. 1992. *Sustainable Cities: Urbanization and the Environment in International Perspective.* Boulder, CO.: Westview Press, p. 15.

17. World Resources Institute. 1996. *World Resources 1996-97: The Urban Environment.* New York and Oxford: Oxford University Press; M. Falkenmark. 1989. The Massive Water Scarcity in Africa, *Ambio* 18:112-118; R. Engleman and P. LeRoy. 1993. *Sustaining Water*. Washington, D.C.: Population Action International. All quoted in Vaclav Smil. 2000. *Feeding the World: A Challenge for the Twenty-First Century.* Cambridge and London: MIT Press.

18. K. Batjer, K. et al. Wassermangel, ein Lebenselement wird knapp, *in* G. Michelson et al. (eds.). 1980. *Der Fisher Oko-Almanach.* Fisher, pp. 229-243.

19. Jean Robert. 1994. *Water Is a Commons.* Mexico City: Habitat International Coalition.

20. What Is The Natural Step. www.naturalstep.org/what/what_what.html**.**

21. Geoff Wilson, Barramuti and Lettuce. 2000. *Practical Hydroponics and Greenhouses.* July-Aug, pp. 36-42; see also www.hydroponics.com.au.

22. UN Department of Economic and Social Information and Policy Analysis. 1993. *World Urbanization Prospects: The 1992 Revision.* New York: United Nations.

23. David Drakakis-Smith.1992. And the Cupboard Was Bare: Food Security and Food Policy for the Urban Poor. *Geographical Journal of Zimbabwe* 23:38-58.

24. Food-sheds are often radial, extending along means of access such as roads, waterways, and rail lines.

25. Farming systems are frequently concentrated in certain districts for a number of reasons. Most poultry may be to the northwest, for example, most vineyards on the foothills of nearby mountains, rice in the floodplain, and aquaculture in coastal lagoons.

26. S. Manzoor Alam. 1971. Metropolitan Hyderabad — Its Pattern of Regional Influence and Delineation of its Primary Planning Area, *in* A.C. Sekhar (ed.). *Economic and Socio-Cultural Dimensions of Regionalization: An Indo-USSR Collaborative Study.* New Delhi: Office of the Registrar General, quoted in L. Minerbi. 1983. *Planning Parameters for Food and Fuel.* Honolulu: East-West Center and University of Hawaii.

27. Based on World Bank data, quoted in World Resources Institute, 1996, op. cit., p. 12.

28. Marie Ruel et al. 1998. Urban Challenges to Food Nutrition Security: A Review of Food Security and Health in the Cities. *FCND Discussion Paper No. 51*. Washington, D.C.: IFPRI.

29. GTZ, Germany's agency for foreign aid technical assistance, has long supported primary agriculture education. California has adopted an educational policy that seeks to place a garden plot at every school in the state.

30. Reported by the UN University's Food-Energy Nexus project.

31. This definition was adopted by the Community Food Security Coalition, which was formed in 1994 to promote comprehensive systems-oriented solutions to food and farming problems in North America. For more information on the CFSC, see www.foodsecurity.org. The Coalition is described in Case 6.8.

32. David Watkins. 1993. *Urban Permaculture.* U.K.: Permanent Publications.

33. Mike Hamm. 1999. Community Food Security and Anti-Hunger Advocacy: Similar Goals in Search of Unity. *Community Food Security News*, Summer, p. 4.

34. Hamm, 1999, op. cit.

35. Hugh Joseph. 1999. Re-defining Community Food Security. *Community Food Security News,* Summer, p. 13.

36. Thomas A. Lyson. 2000. From Production to Development: Moving Toward a Civic Agriculture in the United States, unpublished paper, USDA/CSREES NE-185 & NC-208. Washington, D.C.: USDA.

37. John Jeavons. 1974. *How to Grow More Vegetables than You Ever Thought Possible on Less Land than You Can Imagine*. Palo Alto, Calif.: Ecology Action of the Peninsula; and Jorge Zapp. 1991. *Cultivos Sin Tierra: Hidroponia Popular*. Bogotá: United Nations Development Programme.