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Chapter 4
Where Is Farming Found in the City?

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Where Is Farming Found in the City?

A close look at most cities reveals that urban agriculture is everywhere. It is so much a part of the landscape that it often escapes notice:

- fruit trees along streets,
- a backyard vegetable garden,
- trees for fuel and construction wood in peri-urban areas,
- vegetables grown on slopes in low-density areas,
- fish ponds,
- a chicken farm inside an industrial district, or
- a greenhouse behind a petrol station.

The widespread perception, however, is that cities are solid with buildings, with no area to spare. Agriculture and urbanization are viewed as conflicting activities, and any non-built land use is seen as temporary. The World Bank, for example, in an otherwise perceptive analysis, labeled the considerable open space in greater Moscow as 'vacant'.[1] Yet most of this land is in fact agricultural and helped Moscow's population sustain itself as the Russian food system collapsed during the last decade.

In most cities in developing countries, considerable vacant and underutilized land and water surfaces in the urbanized sphere are or can be used for agricultural production (Tables 4.1 and 4.2). Furthermore, the agricultural use of areas at the edge of cities is not a marginal use, but rather is an integral part of an expanding productive system that exploits urban markets. As the city grows, agriculture can grow with it, even as the periphery extends and housing and commerce take over farm sites.

Historically, towns were established at a particular place for a variety of reasons, perhaps a strategic crossroads or sheltered harbor. No matter what the reason, the site typically had to be accompanied by adjacent surfaces that were sufficiently fertile to feed the settlement's population.

The towns that survived, flourished, and grew to be the metropolises of today were often situated in the most fertile parts of a country or region, especially those that grew as 'market towns'. It is no coincidence that capitals such as Bogotá and Cairo are located in the midst of productive plains. The most fertile lands are often the easiest places to extend infrastructure, and therefore the most suitable for urbanization.

Urban places have been the centers of a great deal of agricultural innovation, often within specific urban settings. Two former swamp areas — the *chinampas* of pre-Columbian Mexico (Case 4.9) and the *marais* of 19th-century Paris (see Case 2.2) — are

equally significant for biointensive agriculture. Other methods include mushrooms in sheds, zero-grazing in enclosures, hydroponics in greenhouses, and aquaculture in tanks.

The locations of food production and urbanization are intimately connected and should be evaluated jointly. In addition to the diverse types of characteristically urban sites described in this chapter, there are 'quasi-urban' sites where variations on the principles of urban agriculture apply. For example, if refugee camps are viewed as temporary cities, certain types of cultivation and husbandry are appropriate and help reduce dependence on assistance programs, as well as provide a worthwhile socioeconomic activity. Recent history includes Kurdish camps of a few weeks' duration in Turkey to Palestinian camps stretching over two generations.

Table 4.1 Percentage of urban land used for agricultural purposes in selected cities during the 1980s and 1990s

Country	Percentage of land used for agriculture
Africa	
Mozambique	In *Beria*, 88 percent of the 'green spaces' in the city are used for family agriculture
Nigeria	In *Zaria*, 66 percent of city area is cultivated
Asia	
China	In *Beijing*, 28 percent of the city is in agriculture
Fiji	In *Suva*, it is estimated that 50 percent of the open land on the peninsula is under cultivation
Hong Kong	Ten percent of the land is in agriculture, which produces 45 percent of the fresh vegetables, 15 percent of the pigs, and 68 percent of the live chickens consumed by its population. Vegetable growing and fish ponds occupied 31.1 percent and 18.7 percent, respectively, of all agricultural land use in Hong Kong.
Papua New Guinea	In the *National Capital District*, about 80 percent of all households take part in some food production with a mean area of 372 square meters.
Thailand	In *Bangkok*, 60 percent of land in the metropolitan area is in agriculture.
Europe	
Spain	In *Madrid*, 60 percent of the metropolitan area is in agriculture.
Americas	
Costa Rica	In *San Juan*, 60 percent of the metropolitan area is in agriculture.
Toronto	Over 40 percent of metropolitan Toronto is being actively farmed.

Source: Data compiled by The Urban Agriculture Network from various sources.

Table 4.2 Types of land used for urban agriculture in selected cities

Country	Type of land
Africa	
Kenya	Less than one-quarter of farmers surveyed in *Nairobi* use their own or their family's land. The lots are cultivated for an average of 7.2 years.
	Of the farm land studied in *Nairobi*, 41 percent was owned by the households, 22 percent by the municipality, 20 percent by the government, 7 percent by private firms, and 11 percent by other entities. Households obtained access to this land through purchasing (21 percent); gifts (59 percent); renting (4 percent); or other means (16 percent).
General	Nearly 60 percent of all urban farmers do not own the land on which they farm, and over 40 percent use public lands.
Americas	In *Rio de Janeiro, Brazil* and *Los Angeles, California*, thousands of acres under electric power lines are contracted to farmers.
Asia	
Fiji	In *Suva*, 20 percent of home gardeners plant along road frontages, and another 20 percent grow crops on unused open land.
Europe	*Zurich, Switzerland* and *Copenhagen, Denmark*, among many others, lease municipal land, parks, and land for future expansion to farmers.

Source: Data compiled by The Urban Agriculture Network from various sources.

Urban agriculture includes many farming systems with widely different demands for urban space. Horticulture without soil and small-livestock production are compatible with neighborhoods that are entirely built up and paved. Orchards and agroforestry require relatively large parcels of land with a long-term lease or permanent ownership. Thus, although the simple answer to this chapter's title query is 'everywhere', the more complete answer is that there is an appropriate place for many different kinds of farming systems somewhere in between the city center and the rural-urban fringe (see also Table 5.1).

In answering the question of where in the urban region farming occurs, this chapter addresses four issues:

- What types of physical space are used?
- How long are the growing surfaces available?
- Where within the metropolitan area are the growing surfaces located?
- Under what form of tenure are the land or water surfaces held?

Classification schemes set up in response to these questions are neither comprehensive nor mutually exclusive because categories overlap. Nevertheless, they provide a useful framework to examine the many different locations for urban agriculture.

Types of Spaces Used

Urban agriculture takes place in many different places, including spaces on and around buildings, community lands and parks, areas allocated to other uses such as road sides and other rights-of-way, and areas not suitable for building, such as floodplains, wetlands, steep slopes, airport buffers, and bodies of water.

Around the House

The best known place to grow food within an urban area is the yard around a house. While the backyard is the most significant yard for food production, side yards and front yards are also exploitable. The front yard, however, presents some particular concerns — it is more accessible and therefore more exposed to theft and vandalism, and the crops are more easily contaminated by lead from vehicle exhausts.

In Haiti, the German technique of shallow-bed farming was introduced by a Florida-based organization, Educational Concerns for Hunger Organization. Many low-income farmers now produce vegetables in shallow beds (1-2 inches of organic waste) in yards with no soil and on rooftops (see Case 5.2). Another project focusing on household gardens was organized by CARE and Haiti Gardens (Case 4.1).

Many urban residents, especially in larger cities, do not have yard space but do have other household surfaces where food can be grown. The potential to use rooftops, patios, or balconies to grow vegetables and raise microlivestock for consumption and sale is significant.

Vertical space can be used effectively to grow food. Walls can hold cages for poultry and livestock as well as vines. Recent hydroponic techniques minimize space needs with plastic tubes that can be suspended on brick walls. Some city farmers attach long, narrow planters or boxes to their walls. Others hang plastic pots or halves of plastic soda bottles. Plants such as cucumber and melon can grow up a wall or fence if supported with sticks or twine.

Residences have the potential to be three-dimensional places of agricultural production. Field visits to some homes provide an eye-opening experience in how resourcefully home surfaces, even in apartments, can be used. The range of what is grown in and around homes goes beyond just vegetables and fruit trees. Medicinal herbs are grown on rooftops in Santiago, silkworms on balconies in Old Delhi, pigeons in downtown Cairo, rabbits in Mexico City shanties, and orchids inside rooms in Bangkok. The organization SUSTAIN in London (Case 4.2) has a popular program called Edible Building, which promotes food production in three dimensions of a building — on the inside, walls, and roof.

In the early 1990s, COCODER, the agriculture department of Mexico's capital district, helped promote cactus farming as a low-cost fresh crop among urban households that do not have access to yard space. As a result, cactus is now grown in boxes and pots on rooftops and patios, with the department providing marketing assistance.[2]

Case 4.1 CARE/Haiti Gardens project in Port-au-Prince

In 1993, CARE-Haiti began studies of urban and peri-urban agriculture in Port-au-Prince. Based on the studies, a pilot program in urban horticulture was established in late 1996 in two *bidonvilles* of the city, in partnership with Haiti Gardens/ODEJHA, a local organization that has been promoting gardening in Haiti since 1986.

Initially, demonstration gardens — mostly on rooftops — were established with 14 participants. Interest grew rapidly, with a number of organizations and individuals from across Haiti inquiring how to get involved in urban agriculture. By mid-1999, about 200 gardens had been established in nine slum areas of Port-au-Prince and two in Gonaives.

Four extension trainers were hired to teach participants different forms of home gardening, including rooftop and container gardening. Building on the initial emphasis on home gardens, the program broadened its interest to also cover school and community gardens. The training takes place through a series of groups with shared characteristics. In May 1999, there were 26 active groups with close to 20 participants in each group. Plans are under way to increase the number of participants and expand the geographic scope.

Contact: Mildred Regis and Miradieu and Dieula Estinvil (see Appendix F for complete addresses).

One analyst has identified four advantages that household gardens have over other food production sites in urban areas. First, tenure of the land around a house is generally more secure relative to other locations. Second, proximity to the home saves time and effort — there is no 'commuting cost' to gardening. Third, water is more available for irrigation than, say, along roadsides. Finally, the homegrown crop is normally less prone to theft.[3]

What home gardens can contribute, however, is not limitless. Many homes are overcrowded and have little or no surplus space available. Even though the space in each home may be limited, many home sites exist without any home garden. In particular, the poorest households are least likely to have access to a home garden, so the household garden is often located away from the home. The full potential of home gardens remains to be exploited throughout the world.

Community Spaces

After the home, community gardens are the most common site for urban food production. A community garden is a condominium or cooperative, in which shareholders or participants each cultivate their own plots and share responsibility for common garden elements such as pathways, fences, water supply, storage, and security. Community gardens are particularly common in cultures where a long tradition of urban multicrop gardening exists.[4] Berlin has more than 80,000 community gardeners on more than 2,000 sites.[5]

Community gardens and allotment gardens have institutional, locational, and social characteristics. They are often supported by non-governmental organizations (NGOs) and local government. Some become a social center for their community. This was made clear by surveys prepared for the official development plan for Seattle, Washington,

which found that community gardens were the most efficient infrastructure to bring the community together. [6] In Asia, Africa, and Latin America, most gardens are first and foremost a center of production. Some are concerned more with the quality of production, others with the quantity. The ideal (though often not the reality) is to have the garden near the center of the community. Although many of these gardens are short-lived, some continue for generations (Case 4.2)

(photo 7.12 shows one dating to the First World War, in Zschortau, Germany).

Case 4.2 British allotment gardens

During the week of April 10, 2000, the British House of Commons heard arguments for both expanding and maintaining the status quo of allotment gardens in England, Scotland, Wales, and Northern Ireland. Around 200,000 individual allotments have been eliminated during the last 25 years. At the same time, 13,000 applicants are on waiting lists. There are approximately 300,000 plots at 8,000 locations. This deterioration is in contrast to an increase in allotments in several other countries, including France and the USA. (The environment ministry in France issued a decree establishing a new policy and government subsidies for allotments in 1979.)

British allotment gardening may have had its early roots in 'town commons'. Newcastle-on-Tyne traces its commons back to the 13th century. It was let annually for grazing cows and cultivation, which was formalized by the Parliament in 1772. Nottingham traces its allotment to 1605 wherein a site was divided into 30 plots. In 1842, this site was redivided into 400 plots rented for about 1 pound per year, typically to factory workers. In Birmingham as early as 1731, the allotments were known as 'small gardens' and 'guinea gardens'.

The Small Holdings and Allotments Act of 1908 consolidated all previous legislation obliging local authorities (urban and rural) to provide allotments for the 'laboring population'. World War I had a large impact on the allotment program, increasing the holdings from between 450,000 and 600,000 in 1913 to between 1,300,000 and 1,500,000 by the end of 1916, one for every five households. This wartime expansion took allotment farming beyond the working class. Estimates at the time of World War II indicate a similar level of allotments for a larger population, about 1,500,000 for a larger population.

In more recent years, allotment participation increased during the 1970s, then dropped off during the 1980s and early 1990s. In the late 1990s, there has been a resurgence of interest and applications. The current surge is fueled by an interest in good and safe food and community development. The decentralization of governmental authority has engendered support by some local authorities, particularly in Wales, to support locally-based food security and small-scale enterprise.

A portion of the impetus is to follow the lead of the United States in community gardening and farmers' markets. American entrepreneurs are helping their British cousins to organize and operate farmers' markets. Possibly the first British 'community garden' was established in 1987 as the Culpeper Community Garden in Islington in the heart of London. Urban farmers are petitioning their local councils to permit them to sell produce from their allotments, which is historically not allowed. Perhaps with the new parliamentary interest, the national government will once again, as in 1908, empower local authorities to establish new allotments.

Contact: James Petts (see Appendix F for complete address).

Community lands are usually owned by the government, public agencies, or social institutions such as schools and churches. Those used for farming may include land unsuitable for building, land awaiting future development, recreation areas, parks, and lots left vacant after building demolition. They may be as small as 20 square meters or as large as 20 hectares.

The farming systems of community gardens are usually mixed or multicropping horticulture, but there are no inherent limits except those of space. Community gardens in larger cities frequently help the individual farmer with access to water, security, technology, inputs, insurance, and most importantly, access to land. Many NGOs and municipalities charge a fee for services.

There is a significant amount of data on community- and household-garden farming systems, including from several FAO projects (beginning in the 1950s) and AVRDC projects (Asian Vegetable Research and Development Centre) during the past 40 years. Some data show that community gardeners eat more vegetables and that their families are healthier. The plot holder in a community garden can often raise one-tenth to one-third of his or her family's annual vegetable consumption.

Schools may have community gardens — their aims include improving the nutritional status of school children and instilling in them the techniques and habits of growing what they eat. In some cultures, elementary school gardens have been particularly effective in introducing urban farming to students' families. In Africa, some school gardens also raise money for the school. Hospitals and churches have gardens for similar purposes.

In some countries, including Peru, Brazil, Senegal, and Indonesia, there is a new tradition of women's community gardens. With an inherent link to gender, some special community gardens are extensions of communal kitchens — part of what is cooked and served to the members is what they have grown.[7] (Case 7.2 describes community kitchens in Peru.)

Community gardens have a long tradition in Europe and North America. They reached a peak during World War II with the famous 'victory gardens' (**Photo 3.8).** They declined after the war but have enjoyed a resurgence in developed countries since the 1970s, generating newsletters, associations, technical support, and recognition by municipalities.[8]

The socioeconomic changes of the late 1980s to early 1990s in central and eastern Europe have stimulated community gardens and attracted technical input from Western Europe and North America. The U.S. Agency for International Development has actively promoted community gardens in the region since early 1992.

Some planned neighborhoods have community gardens designated in the initial layout. In most squatter settlements, community gardens emerge more haphazardly along with houses. Community gardens are sometimes promoted by government, as in Mozambique and Cuba after independence and at the end of the cold war. Because community gardens may be located on land slated for later development, they sometimes have to move, disrupting the lives of the families that depend on them.

Surplus or Reserve Public and Private Spaces

Large tracts of public or quasi-public land that are reserved for landscaping or urban extension purposes can provide significant space for urban agriculture. Examples include universities, schools, factories, churches, ports, airports, hospitals, prisons, military bases, parks, and recreation areas. Putting this land into agriculture provides additional rents for the establishment as well as maintenance for the land. The rewards to both farmers and consumers can be significant, as was shown in Accra (Case 4.3).

Case 4.3 From urban wasteland to urban market gardens in Accra, Ghana

The Vegetable Growers Association of Accra (VGAA) represents an estimated 400 gardeners, most of whom are migrants from northern Ghana and Burkina Faso. Since the association's formation in the late 1970s, market gardening has become a legitimate practice with increasing support from city officials. Urban Market Gardens, a project of the VGAA, provides the city with vegetables and supplements the income of low-income workers. The VGAA helps them transform urban wasteland into vegetable plots that are watered with wastewater that the gardeners have filtered themselves. It is an innovative activity to earn formal and informal income, which simultaneously improves the urban environment by upgrading previously unattended land and adjacent drainage canals.

Gardens are cultivated on small, inaccessible, unserviced, and vacant areas, averaging 200-400 square meters. As a way to avoid maintenance responsibilities, property owners allow rent-free use by gardeners, often without a written agreement. Gardens have also been set up on government properties.

For irrigation and other reasons, market gardeners attempt to find plots that are located adjacent to culverts, canals, and storm water channels. In order to use wastewater, they construct filtration gates. Gardeners also rake the waste stream to gather organic material to be composted for fertilizer. In addition, they gather discarded materials to use as farming tools and fencing material.

No storage is necessary because the produce is sold directly at the farm. Clients include expatriates and other high-income residents, but the bulk of the produce is sold as entire beds rather than individual units to women who sell at the city markets. Relationships have developed not only with a regular clientele, but also with formal institutions. Farmers have savings accounts at the Agricultural Development Bank, and purchase seeds at shops established by the Ministry of Agriculture throughout the city. The Ministry of Health, instead of prohibiting gardening, now works with the gardeners to constantly improve their practices and reduce contamination.

Through vegetable production on marginal strips of land, gardeners in the metropolitan area are now able to provide Accra with about 90 percent of its vegetables. The average daily income of gardeners is up to three times higher than the average daily wages in the formal economy. The Urban Market Gardens have provided greater economic opportunities for market women and expanded this previously small sector of Accra's economy. They also have had significant positive effects on the city's drainage and wastewater system (at their own expense), and have put to productive use a considerable amount of marginal lands.

Contact: See source listed in Appendix C.

Public entities that have leases for urban agriculture include an airport in Cameroon, the University of Manila, hospitals in Lima, a racetrack in Jakarta, the Presidio military base in San Francisco, and the palace grounds in Bangkok. A golf course in Kampala ignored the presence of squatter farmers on land around the course. The golf course received the benefit of free maintenance because farmers kept it weeded and also controlled weeds around their plots, and therefore did not interfere with the golf.[9]

Similarly, vacant land held by large private corporations for speculation, later expansion, or landscaping purposes can also be farmed. Such land can be found, for example, at manufacturing complexes in industrial zones. It can be rented out, producing an income for the owner, or made available for employees to cultivate. In Durgapur, a large planned industrial city in West Bengal, India, the plant managers leased land to the workers' union for farming and provided access to a water reservoir used to cool the steel. Workers could thus supplement food and income by gardening at the job site without spending extra time and effort to reach a distant field.[10]

Another case is the petrochemical complex COPEC, located near Camaçari in the state of Bahia, Brazil. One of the largest complexes in Latin America at more than 8,000 hectares, hundreds of hectares lie fallow as green belt or reserve for the future. The PRONATURA project was designed to put this vast wasteland into agricultural production.

Its objectives included generating jobs for some of the unskilled workers who subsist on the periphery of the complex without being employed there; providing land and water to employees and their families to enhance their income, nutrition, and access to fuel; putting the idle, state-owned lands to productive use while discouraging their invasion by squatters; and converting some of the industry's own treated waste into inputs for energy and food production. The project foresaw multiple uses of the land — controlled exploitation of the forests; beekeeping; fish and frog breeding upstream of the complex; orchards upwind from it; raising some root crops (manioc and sweet potatoes) as raw materials for a micro-distillery; and production of certain vegetables based on their sensitivity to pollutants.[11]

Industrial and Brownfield Areas

Agriculture can have a place in industrial areas beyond temporary use of surplus or abandoned lands. Special types of industrial areas may be established, or at least accommodate, certain agricultural uses. Inactive industrial buildings may be adapted to such indoor crops as mushrooms. In Chicago, a sprout-growing business has been operating successfully for a dozen years inside an ordinary industrial building, employing a full-time staff of eight.[12] **(Photo 4.?).**

New photo 4.?: The inside of ?The Indoor Garden?, a hydroponic sprout plant in Chicago, IL, USA.

Singapore has taken the recognition of agriculture as an industrial-type activity to another level. It has set up six 'agrotechnology parks', run by the government's Department of Primary Production. They are organized on the model of classic industrial parks, but instead of widgets and microchips, the parks contain fish farms, hydroponic and aeroponic farms, poultry farms, and even a crocodile farm (**figure 4.?).**

New figure 4.?: Layout of Sungei Tengah Agrotechnology Park, Singapore.

Areas that have degenerated and are abandoned can also be used for farming, for example, deserted sections of neighborhoods and run-down factory buildings. Such areas are usually farmed illegally or informally. In many countries, legal procedures may not exist for land agreements that can provide secure tenure to the farmer and security against squatting for the landowner. A focused effort to use such space has the potential for enormous benefits, as demonstrated by Buffalo's Village Farms (Case 4.4).

Case 4.4 From steel plant to hydroponic farm — Village Farms in an old industrial area of Buffalo, New York, USA

The mission of the Buffalo Economic Development Renaissance Corporation (BERC) is to bring business and industry back to the inner city of this aging American factory town at the confluence of Lake Erie and the Niagara River. BERC spearheads business retention or development projects which otherwise would not happen. One of its major successes is Village Farms, a large-scale greenhouse facility that produces hydroponic tomatoes for sale to local food stores and smaller grocery owners.

The project's success is multi-faceted. The city invested almost nothing, yet receives rent from the site (which is still owned by the city). The former steel factory is surrounded by vacant lots on all sides, and was reclaimed by federal grants of US$ 850,000, given its 'brownfield' status. Village Farms received a bank loan (with backing from the city), and its owners have an option to buy the land in 15 years, with all their rent payments counting toward the final sale price. Even if the business does not last, the city would have a reclaimed and improved site.

From the company's perspective, the venture is profitable because it leased a reclaimed, cost-free site in the heart of the inner city that was partly funded through a bank loan arranged by BERC. Given the location, they also receive a number of special advantages to encourage such enterprises in inner city areas — reduced gas and electric rates and numerous tax benefits (investment tax credits, property tax abatement, capital tax credit, employee tax credit, and sales tax refund).

Greenhouses cover half of the 35-acre site. The rest of the land includes over 50,000 square feet of packing and support facilities. The 'factory' contains 175,000 plants, yielding about 8 million pounds of tomatoes annually. A state-of-the-art computer system controls ventilation, shading, heating, fertilization, water flow, carbon dioxide levels, recirculation, and pasteurization of the nutrient feed. Nutrients are fed to the plants in pipettes that are networked with computers that monitor the volume and strength of the nutrients. Workers carry pagers connected to the computers that beep whenever the nutrient level is too low or too high.

The plant has about 100 full-time employees. Pickers and packers (one-fifth of the workforce) come from nearby neighborhoods, the rest commute from elsewhere in the Buffalo metropolitan area. Some of the growers hired by Village Farms had been growing tomatoes on their own in the Buffalo area, but have opted to join the plant as growers, which they found more profitable.

Although the site has been reclaimed, the entire greenhouse floor is covered with plastic sheets to ensure the quality of the product. Parallel pipes on the floor heat the greenhouses, and also serve as tracks for the trolleys used carry the harvest. Blocks of special rock materials on the ground are the growing medium for the tomato plants, which are supported with string tied to overhanging heating pipes. The tomato seedlings are grown from seed and supplied yearly by the parent company, Eco Science Corporation. For pollination and pest control, honeybees and beneficial insects are used to keep the use of pesticides in check.

This enterprise has received national acclaim as a model for the redevelopment of urban vacant land. It was featured, for instance, in an exhibition on this subject at the National Building Museum in 2000.

Contact: Stuart Levy (see Appendix F for complete address).

Sheffield, Pittsburgh, Duisburg, and hundreds of other Industrial Revolution boomtowns now have thousands of vacant or derelict industrial, commercial, or residential sites. In a number of large American cities in particular, there are thousands of such lots in the city and the adjacent counties. Despite a recent revival in a number of these sites, considering the record of the past 50 years, these areas will require several decades to come back to life with new buildings. In many such cities, urban agriculture has appeared as an interim use. ‘Plant First, Build Later’ was a popular slogan as Germans reconstructed bombed out cities after World War II, and may be equally applicable today in many cities.

Producing food on the site of a former furniture factory or tannery or gas station requires careful planning and technology. The basic tool is *phytoremediation* — growing vegetation that removes toxic substances from the soil before planting food crops. Deep-rooted fescue grasses or fast-growing deciduous trees or shrubs may be cropped for a season or two until soil tests show that it is safe to grow vegetables or fruit. This sequence may require a government subsidy to the small-scale producer.

In some cases, one of the most appropriate production methods is agroforestry — trees cleanse the soil, yet saleable products such as wood or ornamentals are generated. Another alternative to phytoremediation is to bypass any direct contact with the contaminated soil by plants and animals. The most common form of brownfield urban farming may be to place clean soil on sheets of plastic, whether in the open air or in greenhouses **(photo 4.?).** Such an approach eliminates any waiting period to cleanse the soil. This approach can be found from the poorest to the richest countries.

In the year 2000, we are remediating or otherwise planting on old manufacturing and row house sites. Twenty-five years from now, the locus of brownfield urban agriculture may be former shopping malls and high-tech campuses.

Roadsides and Other Rights-of-Way

Roadsides and other rights-of-way are a special case of farming on public lands. Because such land is distributed in long, narrow plots throughout the urban area, farming in rights-of-way is usually on a wider scale than on other idle public lands. It can extend far outside the metropolitan area and still be part of its food-shed. The location along a road makes it easier to move fertilizer, water, and other supplies to the garden, which can be intercropped or monocropped. Roadside farmers can often sell their crops where they are grown.

Other rights-of-way include railroad tracks, electric transmission lines, natural gas pipelines, and other utility lines. The land is typically owned by a government or public or quasi-public agency. In Bombay, vegetables are grown along the entire length of the metropolitan rail system. In Rio de Janeiro and Los Angeles, the power company leases land under transmission lines for farming, providing the company with free land maintenance and rental income. In Europe, right-of-way farming can be found along 19th-century railroads and canals.

Right-of-way agriculture (especially horticulture and grazing) is increasing on all continents. It plays a particularly crucial role for lower-income farmers who do not have space to farm where they live (Case 4.5).

Case 4.5 Growing vegetables along roadsides in Dar es Salaam

In Dar es Salaam, Tanzania, vegetables can be seen growing along roadsides where strips of land are vacant. Roadside strips in the city are fairly wide and are kept vacant for future road expansion.

A low-income entrepreneurial farmer practices intensive, raised-bed monocropping of spinach on a 1-acre stretch along the roadside, in partnership with four or five other farmers. The land was not officially allotted to them. The farmer plants seed once a week and harvests spinach daily for sale at the local market. He transports water by hand from a municipal standpipe and pays for the water on an informal basis. Composting and chicken manure are used to fertilize the soil. The farming is efficient and productivity is high.

Contacts: Camillus Sawio and L. Keith Lilley (see Appendix F for complete addresses).

Right-of-way agriculture has several unique problems. Because it is principally rain-fed, farming is often seasonal, and conflicts can occur between farming and traffic. Because crops can be stolen, farmers tend to grow low-value crops. They do little to improve the soil because they generally lack secure land title. Passing traffic poses the risk of lead pollution for certain crops. However, the double advantages of ease of access and ease of marketing offered by roadside farming often overcome its drawbacks.

Typically, this kind of agriculture is not supported by either research or extension services, but solutions exist for many of its problems. Irrigation can be provided from streams and wastewater sources that follow utility or highway rights-of-way. Conflicts with traffic can be resolved through negotiation and restrictions on hours of farming. Theft can be reduced through a cooperative arrangement between farmers and public and

private agencies. When high-value crops are grown, a night guard is sometimes maintained.

Increased yields through better soil management and better selection of crops require tenure security for the farmer through usufruct lease agreements negotiated with government, NGOs, or farmer associations. Official rent agreements would bring some income to the city and tenure security to the farmers, thus increasing their efficiency. Careful selection of crops that are not susceptible to absorbing or adsorbing lead helps to increase safety.

In some countries, particularly in Africa, horticultural road shoulders have been observed extending radially for 20 miles outside major cities and five miles outside smaller towns. In other countries, roadside farming is intermittent. It is predominantly a low-income farming activity. Although most commonly practiced by small-scale individual entrepreneurs, highway authorities and utilities sometimes lease blocks of property to community farmer associations.

The policy of municipal governments toward right-of-way agriculture ranges from banning, to condoning, supporting, or leasing such land to farmers. In the planned low-income town of San Salvador in Peru where some streets are very wide, half the roadway is used to grow fruit, vegetables, and flowers. In Jakarta, farmers rent the space underneath and beside elevated toll roads. São Paulo has incorporated right-of-way farming into its long-term master plan. In Nairobi, most roads connecting the city center and its periphery have crops along their edges.

Because of its long-term nature, roadside arboriculture could not exist without government sanction. A few cities actually encourage the use of roadsides for fruit trees — examples include cities in China, India, Morocco, Argentina, and Chile. In Senegal, roadside trees and shrubs produce medicines, basket materials, and fuel. In wet tropical climates such as West Bengal, it is common to produce both a fruit crop and a grain crop on the roadside.

Streamsides and Floodplains

There are usually no buildings along streamsides and floodplains within cities because of hazards from storm water. These areas have some of the most fertile soils available as well as proximity to water, so they are well suited to farming.

Streamside agriculture, including creeks, rivers, and canals, differs from roadside agriculture in that it is irrigated, less subject to air pollution (although water pollution can be a concern), and less subject to theft. For these reasons, streamside horticulture usually has higher-value crops and farmers make a larger investment in soil preparation and terracing. Some of the outstanding examples of streamside horticulture include Baghdad, which farms the ancient floodplain with manual irrigation; Bangkok, which farms the banks of the klongs from boats and markets on the river; and Bamako along the Niger River (Case 4.6).

Case 4.6 Cultivation on the floodplain of the Niger River in Bamako

Bamako, the capital of Mali, is located on both sides of the Niger River. It has a large number of agricultural areas within its urbanized areas. One particularly significant area is the floodplain of the Niger (Fig. 4.1). In 1987, more than 1,000 hectares of floodplain were available for cultivation. With irrigation from the river and fertilizer from organic urban and local wastes, a complex combination of farming systems has developed in these areas.

Kalabancoro is a peri-urban village located on this plain, upstream along the Niger River just south of Bamako. Land use in Kalabancoro depends on its proximity to the river and the way it is held. Most interesting is village land located directly along the Niger, where use and users change between the rainy and dry seasons. During the rainy season, rice is harvested by women from the landowning families, taking advantage of the very wet conditions. During the dry season, the owners transform one portion of the land into a vegetable garden. The rest is open to the community for gardening after the customary request for approval from the owners.

The land is at the center of the local food production system. Surplus vegetables are sold at the market. The value of parcels located in the lowlands is much higher because of the wet-dry cultivation. Rice cultivation is conducted exclusively by older women, giving the riverside plots a unique gender role.

With the expansion of the Bamako urbanized area, conflicts over land in the area are increasing. However, most new housing construction is on the Kalaban plateau, away from the river. Cultivation in the *fala* (riverbank fields) continues, partly because of the land value and partly because, unlike ordinary fields, these fields cannot be sold freely. The fields are in 'bounded ownership', which means that the owners' property rights are acknowledged and respected by the entire community to the extent that they do not negatively affect the perceived benefits that the community accrues. The threat of ostracism by the community prevents individual members from openly selling their lands.

Contact: See source listed in Appendix C.

As with right-of-way agriculture, legal access to the land and security of tenure are concerns. Monitoring and extension services to prevent food contamination from polluted water are essential, particularly because many urban streams in developing countries are little more than drainage channels or open sewers. At these sites, agricultural development must include water treatment. Alternatively, farmers can bypass the problems of pathogen removal by planting crops that are more resistant to contamination. Aqua-terra farming systems, combining land and aquatic crops and animals, are especially well suited to floodplains.

Water Bodies and Wetlands

Contamination from city waste can make bodies of water dangerous for human use. Using aquatic plant and fish production to biologically treat the waste can mitigate this problem (Case 4.7). Streams can be diverted into sewage treatment ponds, and rivers — outside boating channels — can be tapped to transform wastewater into food for the city.

Case 4.7 Wastewater fisheries in China

Farmers in China have used solid organic waste to fertilize farmland and fish ponds for centuries. Modern use of municipal wastewater for aquaculture began in the early 1950s. Using wastewater reduces the cost of fertilizer (when treated sewage is used to irrigate crops) and commercial fish feed.

Most municipal wastewater in Chinese cities drains into various water bodies that are used as fish ponds (particularly grass carp), with about 10 percent used to irrigate or fertilize land. In the ponds, aquatic plants (for example, duckweed and lotus) remove various heavy metals and other pollutants, thus treating the effluent before it is used as fish feed. Fish production also reduces the pollutants in the wastewater.

Yields of fish raised in waste-fed ponds are reported to be 2-4 times higher than those raised in normal ponds. In 1985, China produced 30,000 tons of wastewater-fed fish — 1.3 percent of its freshwater fish production. Wastewater-fed fish accounted for more than half of the production for the cities of Wuhan and Changsha.

Wastewater-based aquaculture has declined significantly in a number of cities as a result of the increasing mix of industrial sewage with domestic sewage (three-quarters of all wastewater by one estimate). In cities such as Wuhan, the practice was even banned due to concerns about public health. At the same time, changes in sanitation systems have led to reduced availability of night soil, which is increasingly replaced by inorganic fertilizers and formulated feeds. China's centuries-old leadership in linking aquaculture to waste reuse is now being severely tested.

Contact: Peter Edwards (see Appendix F for complete address).

Bodies of water within urbanized areas — bays, rivers, lakes, canals, ponds, reservoirs — are often available for public fishing. Fishing rights may be leased by the authorities. In addition, fish farms are an important component of food systems in some cities such as Hong Kong.

It is ecologically vital to maintain sizable wet areas within each metropolis in 'wild' form. These areas are needed to conserve and regenerate natural resources, but of course it is impossible to preserve all wetlands in urban areas in an undisturbed condition. In Kampala, for example, farmers drain and reclaim swampy areas in the city for farming without help or permission from city authorities.[13]

Several forms of aqua-terra farming can help preserve wetland biodiversity. One of the best-known examples of appropriate use of wetlands for agricultural purposes is the centuries-old *chinampas* farming system in Mexico City, which combines aquatic, tree, vegetable, livestock, and flower production with recreation and tourism (Case 4.9). Equally ancient systems exist in other parts of the world. The *hortillonages* of the Somme River valley in northern France, which date to pre-Roman times, are today both an important tourist attraction and a productive market gardening district. Farmers resisted built-up urban uses of the area by forming an association to help improve maintenance of their properties and increase productivity.[14]

Not all wetland areas can or should be put into agricultural use. Because wetlands are extremely sensitive habitats and their biodiversity and long-term survival can suffer from harmful practices, cultivation requires special care. Thus the question becomes how they can be used with minimal environmental damage.[15] The cultivation of aquatic plants, if

practiced properly, can keep wetlands from deteriorating. Wetlands in East Calcutta, for example, have been converted to sewage-fed lagoon fisheries, thus maintaining the wetland habitat (see Case 3.5).

In all these examples, aquaculture is a presence in bodies of water in urban areas. Indeed, aquaculture is replacing fishing as the primary source of seafood in developed and highly urbanized countries, and the industry is discovering and inventing niches. From city reservoirs to sewage ponds to floating containers in peri-urban rivers, the range of locations for aquaculture is diverse. Conceptually, aquaculture is best sited 'below the city'. The city's wastewater can then be directed downstream to where aquatic plant and animal life can benefit from its nutrients, and where the aquatic production process can purify the water for another use.

The production of aquatic plants and animals is not restricted solely to bodies of water. Aquaculture is found on a rooftop in Brisbane and Heifer Project International raises Nile perch in 50-gallon drums in basements in Chicago.[16,] IIRR in Manila introduced raising eels in metal drums, which allows garbage to be used as food and supplies an excellent source of protein. Eels require little care because they can go without food for two weeks.

Steep Slopes

Steep slopes, like wetlands and water-logged areas, are difficult, expensive, and dangerous to develop and service for built-up urban uses. Unfortunately, these areas are often occupied by people who have no alternative places to live. Building on steep slopes may have disastrous effects such as deforestation, soil erosion, and excess water runoff, which in turn lead to houses cracking and sliding downhill, fires blowing out of control, and perhaps lives lost.

Steep slopes are often among the last areas of a city to be developed for built use, and thus remain available for agriculture. Mexico City, for example, is maintaining a 'green belt' on its surrounding mountains.

Some types of agriculture — especially forestry and terraced horticulture — are often the best use for steeply sloping land. They stabilize the slopes, prevent erosion, and absorb air pollution while providing jobs and food. The presence of tree cover improves the city's climate and temperature, and a managed forest on slopes can also be a good source of wood, crops, and animals (Case 4.8).

Case 4.8 Fruit production and erosion control through tree planting in Nampula City, Mozambique

The capital of Nampula Province, Nampula City, is the third largest city in Mozambique, with a population conservatively estimated at over 200,000. Mozambique's civil war has caused large numbers of refugees — *dislocados* — to flock into the cities, establishing homes in *bairros*, peri-urban squatter settlements. At least 80 percent of Nampula's current population lives in the *bairros*. Located on steeply sloping lands around the original hilltop city, the *bairros* have no proper drainage system, and are prone to soil and gully erosion so that houses and productive land are washed away in heavy rains. All registered *dislocados* are entitled to small plots of land for agricultural

production (*machambas*), but these are often located a long way from the city and are not served by public transport. There is also an increasing fuelwood problem in the area.

Since 1987, the Irish charity CONCERN has been working with local people to develop soil conservation and sustainable land-use techniques in the *bairros* through a project that includes horticulture (fruit trees), agroforesty, and the construction of non-erodible drains and check-dams. Overall objectives include improving farming practices, reducing rural deforestation and urban soil erosion, and promoting environmentally sustainable land-use practices. CONCERN tries to work with and strengthen the capacity of the relevant government bodies to ensure institutional sustainability once funding is withdrawn. An early part of CONCERN's work was to support the establishment of an Environmental Division of the Nampula City Council, known as GAMA, which has now become an official structure, and since 1991 has received its own funding.

Much of the agroforestry tree planting program focused on *Leucaena leucocephala*, a species that provides fuelwood and at the same time conserves soil. About half the seedlings were distributed free of charge in the *bairros* and to farmers interested in setting up alley-cropping trials. The balance were distributed to other projects. A wider variety of tree species is now available in response to local demand.

Demand for fruit and fuelwood tree seedlings has increased as a result of an awareness campaign funded by CONCERN. The campaign included radio coverage and a forestry play. Despite the positive response, it is uncertain whether the campaign will influence the behavior of all *bairro* residents. Willful damage to trees, and simple neglect or failure to protect saplings from browsing animals remain problems.

Contact: Jane Carter and Howard Dalziel (see Appendix F for complete address).

In the 1980s, a tree nursery with bamboo and other species used for animal feed, fruit, and fuelwood, was established in Mont Ngafulla, a squatter area on the outskirts of Kinshasa, Democratic Republic of Congo (formerly Zaire). Training, seminars, and site visits were organized for farmers to learn more about management of tree crops as well as how to prevent soil erosion. A committee of community members was responsible for overall planning of the farming activity to ensure prevention of soil erosion. [17]

Terraced farming is found in steep areas around the globe. Terracing is an ancient technique, capable of developing flat fields on slopes and increasing soil and water retention. Firm tenure arrangements are essential because of the high investment that terracing requires. When tenure is secure, terraces can be and are developed and maintained in many a hilly town.

Duration of Use

The length of time that a particular space is available to a farmer significantly influences the farming activity. The time period affects the choice of crops, the amount of care the farmer gives to the land, and the level of planning he or she undertakes. A plot may be available for permanent agricultural use, long-term use, or short-term use. All three are considered here. Figure 4.2 schematically represents some of the most important types of spaces available either permanently or for a long period.

Permanent Use

Some areas are permanently available to farming because they are not suitable for built-up uses. These include water bodies, streamsides, floodplains, wetlands, and steep slopes. Construction on these areas is not desirable because they are expensive to develop and service, and building on them is particularly damaging to the environment. For these reasons, it is often worthwhile to use them for agriculture in concert with recreational open-space activity. From the use of aquatic and marshy areas by pre-Columbian civilizations to the ancient Javanese, Chinese, Inca, and Maya mastery of intensive farming on steep slopes,[18] many historical practices in such areas are appropriate today and are being reinvented (Case 4.9 and Fig. 4.3).

Case 4.9 The *chinampas* of Mexico City

Integrated agricultural systems using alternating raised fields and canals were developed by various cultures in Latin America during pre-Columbian times. When the Spaniards arrived in the 16th century, 'floating gardens' among the waters of the five lakes of the Valley of Mexico were producing most of the food consumed by a city of 200,000 inhabitants.

A living example of these ancient floating farms is the *chinampas* at Xochimilco in Mexico City. Livestock, poultry, vegetables, ornamental plants, flowers, and trees for fuel are produced on land that is punctuated by canals that provide transportation, irrigation, pisciculture, recreation, and tourism.

The floating raised beds were initially created by the Aztecs by weaving thick mats of grass and other organic matter and covering them with mud from the lake. Over time, farmers kept adding layers of organic matter and mud, and the floating beds eventually took root. The canals were a source of nutrient-rich sediments, and a*huejote* trees were planted alongside the beds to stabilize them. The *chinampas* in effect functioned as a kind of hydroponic garden, wherein the maintenance of water levels had a particular relationship to crop roots.

After the arrival of the Spaniards, the waters of the lakes were drained or diverted for other uses, and most of the floating farms died over time. Pablo Torres, an expert on this farming system found that the production of the *chinampa* per unit of space increased with the introduction of European vegetables and livestock by the Spanish. The waters for Xochimilco were also cut off over time, and urban development took over much of the area. Sewage effluent was directed into the *chinampas* canals, choking the waters and harming the farming activity.

In 1987, UNESCO declared the area a World Cultural Heritage site, and the city began a program to restore the *chinampas.* Wastewater treatment was introduced, raised-bed fields were rebuilt, and the canals were cleared of the water lilies choking them. A flower market was built within easy access to farmers of the *chinampas.*

Today, hundreds of farmers are farming the *chinampas* and making a living. Farmers are again enriching and repairing the beds by lifting mud from the bottom of the lake and spreading it on the beds. Water pollution, however, is causing a continuous production shift from food to flowers, which are not only safer but more profitable. A shift is also taking place from the traditional reeds to water hyacinth to purify water in the canals. Xochimilco is a good example of urban agriculture that combines production, marketing, and recreation.

Contact: Alfonso González Martinez and Pablo Torres Lima (see Appendix F for complete addresses).

Because many unbuilt and unbuildable lands are permanently available public goods (commons), it is especially important for city governments to create long-term agreements to manage their use. Greater involvement of civic authorities is required because mismanagement of these resources could have environmentally disastrous consequences. For instance, the schedule of tree harvesting on a slope may need to be regulated by a municipal agency, even though tree orchards on the slope may be owned by several private farmers.

Long-Term Use

Some space in urban areas is reserved for eventual non-agricultural uses, but in the interim such land can be used for food production, biological waste processing, and other activities that both enhance the environment and provide rent from the site. These idle lands, covering vast areas, may be public, quasi-public, or private and include most community spaces, surplus or reserve lands, roadsides, and other rights-of-way (Case 4.10). The electric company in Rio de Janeiro, for example, allows farmers to use land under its transmission lines.

Case 4.10 Cultivation in industrial zones and highway rights-of-way along the Lebanese coastal area

The coastal zone of Lebanon is one of the most built-up areas in the Middle East, yet there is vibrant agricultural activity interspersed throughout this zone, in both the denser sectors of the Beirut metropolis and in the sprawling suburbs to the north and south. Part of this phenomenon — though not all — can be explained by the influence of the 15-year war and its aftermath (see Case 7.14).

Some of the agricultural activity has been maintained for years or decades in zones surrounding residential and commercial multi-story buildings, and may remain for years to come. Two types of such zones are described here.

Urban Planning. Rights-of-way for future roadways (including a bypass highway around the capital) were placed under reserve beginning in the 1950s. Most of these highways remained unrealized for decades. Some were built in the 1990s as part of the country's reconstruction, and others remain only on paper. Meanwhile, many of these land reserves are now long-term farms, and these farmers feel more security of tenure than many who plant on privately-held properties.

Industrial Zones. Some decades ago, numerous industrial zones were planned for the country, including its coastal strip, as part of the drive to develop industry. This activity never approached the levels conceived by the country's economic planners, and the war that began in 1975 set back ambitions even further. As part of the planning, a number of controls were imposed on these large industrial zones. As a result, much of the industry located purposely (and illegally) outside the designated zones to avoid controls. With residential and commercial uses precluded in these sectors, their value froze. These zones have become important agricultural reserves, and one is even located adjacent to the main airport, with only scattered industrial buildings sited among the fields (**photo 4.?).**

Contact: Joe Nasr and Habib Debs (see Appendix F for complete addresses).

New photo 4.?: Fields near Beirut airport

A change in thinking is needed to farm these spaces on a wider scale. If someone asked the question "Why is this land not being used productively" about every vacant piece of land — both public and private — many potential agricultural areas would be identified. The use of the legal system combined with assistance from NGOs and farmer associations is crucial to more systematic leasing of land and water for medium- and long-term farming.

Short-Term Use

The use of idle urban lands for agriculture does not need to be permanent or even long-term. As a city grows, its perimeter grows more rapidly than its built area, thus there is always new land available for the short-term at the edge of the city. Moreover, because cities also tear down and rebuild older neighborhoods, temporary sites for urban agriculture also exist near the center, for example, old factory buildings can be used for mushroom and greenhouse agriculture. Land held for speculation or future use can be put into agricultural production as well, although in most countries tenancy laws work against such use and farming occurs informally or illegally.

Lack of secure tenure may hamper farmers who do not know whether they will see the fruits of their efforts. However, tenure that is ensured for three or more seasons, whether informally or through a contract, may be sufficient (depending on the crop and the condition of the land) for a farmer to be willing to invest time, money, and effort in farming the land. The case of the Matalahib gardens in Manila illustrates that interim availability of land is sufficient to encourage farming, as long as the time period is understood (Case 4.11).

Case 4.11 Community gardens in Barrio Matalahib, Manila

Community gardens were started on unused and fallow land in the squatter area of Matalahib in 1980, with the assistance of two volunteer policemen. The objectives were to provide income and improved nutrition for the 2,400 residents, as well as to make productive use of a degraded and squalid area that had become a site of criminal activity.

Most inputs were obtained at no cost — permission to use the land was granted by the government, seeds were obtained from discarded market vegetables and from public and private companies, and water was delivered by the police department. Technical assistance was provided by the University of the Philippines at Los Baños and an NGO, the Earthmen Communications Foundation. The land was divided into small plots that were allotted to families interested in farming.

The program had its ups and downs, but through the involvement and enthusiasm of the community, three good crops were obtained. By the third crop, the 1.0-1.5 hectare area was producing enough vegetables to supply 80 percent of community demand, and some farmers sold fresh produce on the roadside near the *barrio*. The physical environment of the area was considerably improved and crime reduced, and the success of the Matalahib farm led the government to promote community gardens elsewhere in the city.

In 1982, the land was sold to a private developer and farming was abandoned even before the land was developed. Access to land has been identified in field interviews in the Philippines as one of the principal constraints to urban agriculture.

The project demonstrates the catalytic benefit that an NGO advocate can bring to a project which serves a perceived need. It also shows that urban farming has a short learning curve and rapid returns. Even though the life of the Matalahib gardens was short, the success of this case lies in the acceptance of farming as a profitable economic activity and in its replication.

Contact: Isabel Wade, José Deanon, and Mario Chanco (See Appendix F for complete addresses).

The concept of usufruct, essential for validating interim urban agriculture, is beginning to be accepted by a number of countries and local governments. Peru is urging public and private landowners to make 'free land' available to farmer associations. The government of Indonesia and the municipality of Jakarta have a policy and program to persuade public and private landowners to make 'sleeping land' productive.[19] New York City makes more than 1,000 vacant lots available to community groups through a municipal agency, Green Thumb.[20]

Locations within the Metropolitan Area

Large cities and metropolitan areas can be divided into four main zones:

- one or more city centers (cores) with offices and retailing activities;
- several high-density development corridors along highways and railroads;
- wedges of lower-density development between the corridors; and
- an urban-rural (peri-urban) transitional area at the metropolitan periphery **(Fig. 4.4).**

We have already said in Chapter 1 that we will not debate nomenclature — a number of other categories may appropriately be used to differentiate the components of an urbanized area. We also indicated there that the labels of intra-urban versus peri-urban provide another useful way to characterize a metropolitan area.

The principal differences among the four zones of core/corridor/wedge/periphery are the intensity and type of land use. Core zones have the highest population density, the greatest coverage of land surfaces by built structures, and the greatest mixture of land uses, followed by corridor zones. Wedges are patchy in character, and the periphery is constantly changing. Agriculture in each of the four zones thus displays a particular character derived from the nature of the zone itself.

The outer portions of a metropolitan area tend to have a greater presence of agricultural activity than the inner areas. It is in peri-urban zones that the most land is available, and where the presence of farming as an entrepreneurial activity by urban residents would be most likely. There are significant variations in what dominates where. For example, Table 5.2 shows that in peri-urban areas of Mexico City, there are far fewer hens than in inner suburban areas, and barely more than in intra-urban areas. Indeed, each zone in the Mexican capital is specialized in different types of productive processes:

- intra-urban (core and inner corridor) areas — family gardens, backyard poultry, and pigs;
- suburban (wedge and inner fringe) areas — legumes and flowers, family orchards, greenhouses, and market gardens;
- peri-urban areas (outer fringe) — nopal (cactus) production, orchards, maize, forestry, grasslands, bees, and sheep.[21]

Farmers often farm in more than one zone. A household garden in the core or in one of the corridors where high-value vegetables are grown for home consumption may be complemented by a streamside garden in a wedge or in the periphery that yields lower-value crops for sale at the market. Farming systems are chosen by farmers for each location based on, among other things, different land values and risk of crop loss. In some places local governments have been active in defining what kind of agriculture goes where. In Havana, Singapore, and Beijing, land use and other regulations specify the types of crops/products that can be produced in various parts of the city.

Before examining the nature of agriculture in each of these zones, it is useful to note that this is a simple model which cannot fully capture the dynamism and diversity of the world's cities.[22] One analyst notes that the classic model that predicts declining land-use intensity as one moves farther from a central point (the von Thünen model) does not correspond to the spatial distribution of urban agriculture in contemporary cities. Many large cities have a 'multicentered structure' with many lower-density spaces in the urban pattern.[23]

There are exceptions to the zone model. In the *Randstad* concept in the Netherlands, for example, several large cities encircle an agricultural core. Colonial cities, especially in Africa, featured an exceptional amount of open space between the 'colonial city' and the 'native city'. Much of this space survives today and is actively farmed (in Mozambique, for example, a golf course was converted to rice culture). Furthermore, agriculture undertaken by urban residents in distant peri-urban areas or rural areas, such as on the Russian *dachas*, would not be covered by this model. Despite these exceptions and the rapidly disappearing line between what is urban and what is rural, the four-zone model is still useful to examine where agriculture takes place in the urban context.

Core

The core (or cores) of a city has the highest population and building density, with a predominance of commercial space. At the city center and in the major nodes, urban agriculture is found most commonly on rooftops and balconies, on temporarily vacant lots, in converted buildings, and in public parks. Certain farming systems and crops that have a higher value and require greater investment naturally dominate— mushrooms, pigeons, flowers, and salad crops (especially for restaurants).

There is considerable scope for small-scale plastic greenhouse farming systems, including hydroponics. In older cities, redevelopment sites may be used temporarily for farming, with greater social and environmental benefits than the usual parking lot. Most of this cultivation is not expected to remain for long in a specific location due to urban renewal of the core.

In addition to these short-term uses, there is a surprising amount of permanent open space even within the dense fabric of cores. These usually include parks and a variety of unbuildable surfaces. In particular, agriculture can be found on the waterfront and within water bodies. Cultivated areas in wetlands adjacent to the city center can be found from Calcutta in India to Amiens in France. In Managua, unstable sections of the central part of the city were put into agricultural use following the devastating earthquake of 1972.

Corridors

Most interim farming takes place in corridors along main roads and railway lines because this is where most construction takes place, and large lots without buildings are common. These corridors have more developed transportation and are linked to markets, and the higher density of residential areas increases demand for produce.

As the city grows, the farming systems of the corridors become similar to those of nodes or city centers. Careful selection of pollution-resistant crops is as necessary in corridors as in city centers. Corridors are the site for ornamental horticulture, roadside horticulture and grazing, market gardening, greenhouse vegetables and flowers, and poultry and microlivestock. Farming at home is another major type of agriculture in residential corridors. Frequently, corridor agriculture includes retail outlets (roadside stands and markets).

In many cities and towns, these corridors have low-intensity crops, recycling little waste and producing low returns on labor because farmers are insecure about their tenure, or at least about how long they can hold onto their land. The authorities often perceive agriculture as an inappropriate long-term activity. Interim access to land can be efficiently brokered by a unit of local government or an NGO bringing together the owner, developer, and farmer.[24]

Wedges

The wedges between development corridors, together with the periphery, provide the principal areas of land for urban agriculture in most larger cities. This is the locus of milk and egg production, orchards, and fish ponds. Land use is mostly a mixture of residential and agricultural, with housing gradually replacing farmland.

Wedges are where the greatest amount of urban land not suitable for development is found, such as steep slopes and wetlands. These areas sometimes offer opportunities for specific types of urban agriculture. Traditionally, the wedges also contain low-intensity uses such as cemeteries, universities, military bases, solid waste dumps, and forest parks, creating a large area of unused or underutilized land that can be put to productive use through agriculture.

Some unbuilt wedge spaces are in the form of a ribbon. These linear strips often follow a natural element, such as a river or ridge. The 1986 plan for greater Beirut, for example, clearly shows an agricultural belt that partly follows the Beirut River **(Fig. 4.5).** That belt formed the periphery of the city decades ago, and later became an agricultural zone wedged between built-up districts. Since the fighting in Lebanon ended in 1990, parts of this wedge was built up, but much farmland remains. So while the continuous

agricultural stretch has been turned into a series of swaths, its function as productive a 'green lung' for the metropolis persists.

One of the oldest and best-known corridor and wedge plans is the so-called Finger Plan in Copenhagen, which was first adopted in 1948, and renewed in 1961, 1973, and 1989. It was the model for plans in Washington, D.C., Chicago, and many other cities. The majority of built urban uses there have been concentrated along rail and express highway lines, and the majority of non-built uses, including agriculture, are in the 'green' wedges.[25]

Cities in Asia, and increasingly in the rest of the world, today recognize that agriculture is an appropriate permanent or long-term land use in wedges, and that government and NGO programs are needed to help farmers adapt to the urban market. The contribution of farming in these areas can be measured in terms of environmental conservation and enhancement and food security, rather than purely as returns to land rent.

Periphery

The periphery is the rural-urban fringe or peri-urban area that surrounds cities in the majority of countries. This zone can usefully be considered part of the urban area and urban system. It is characterized by small- and medium-size farms oriented to the metropolitan market that are more diverse than those in rural areas. In the periphery, a large proportion of families have both farm and off-farm income. Typically, the agricultural industry in this area is constantly shifting to new sites and adapting to new opportunities.

In both developing and developed countries, metropolitan areas are always expanding. The periphery is fluid, always shifting outward. It is a transitional area, not heavily built up, and close enough to the city (based on time rather than distance) to be an integral part of its food- and fuel-sheds.

What is grown within the peri-urban area, how it is grown, and by whom are all directly responsive to the city or metropolitan market. Accessibility plays a determining role. The size of this urban agriculture zone is largely determined by transportation efficiency and landscape features. For example, in greater Calcutta where transport is congested and expensive, the rural-urban fringe may extend no farther than 25 kilometers from the center, even though Calcutta is at present a city of over 10 million people. Manila, with a somewhat smaller population, has built express highways and has an urban fringe that extends 50 kilometers or more.

In cases such as the savanna of Bogotá, the limits of the peri-urban farming area are determined by mountains surrounding the plain, although some urban farming climbs the hillsides. In some places, for example, near Nairobi, between New York and Philadelphia, along Japan's Tokaido (Tokyo to Osaka), and in the Dutch *Randstad*, the fringe urban agriculture zones overlap those of nearby cities.

Peri-urban regions frequently become zones of intensive vegetable production because transport costs are lower relative to rural areas given the proximity to town, higher land costs associated with this proximity, and quicker commercialization that is enabled by

that proximity — which is advantageous for fresh products. When the roads in a region are poor, vegetable production and other higher-value crops (such as poultry) tend to be more intensive and closer to the settled area.[26]

Within a peri-urban area, there can be considerable variation in what is cultivated in different locations. This can clearly be seen around the villages in Mexico City's periphery. There are still traditional practices within the villages — backyard animals, family orchards, milk production, and draft animals. Cultivation of nopal cactus (replacing maize) along with some market gardening forms a ring around each village, and further out is a ring of agroforestry systems. Finally, the forest often forms the outermost ring around each settlement, providing additional resources for the community (resin, firewood, timber, fungi, etc.).[27]

Access to Land and Tenure

In previous centuries, village elders, rulers, and other decisionmakers typically allocated land on a predetermined schedule to farmers (a practice that continues to the present in the mostly rural areas of some developing countries). When different civilizations started building towns and cities, the civic administration continued to allocate town land to farmers and foresters — as is still done in cities from Zurich to Singapore today. A particularly well-known case is the planning of town commons or greens by colonists in North America from the 17th century onward.

Beginning in the late 19th century, steam and electric railroads provided peri-urban and rural farmers in developed countries with improved access to city food markets. As 'industrial cities' rapidly grew to high density, land for home and community gardens became scarce, and many home and market gardeners lost their previously held right of access to land. Some public provision of farm land continued in various settings, and over the past few centuries, a range of organizations has provided access to land for farming to their members in and around settlements — religious groups, manufacturing corporations, military establishments, poor houses, and others.[28]

Urban farmers around the world today farm on land or in water under a variety of legal and extralegal arrangements. Some own the land on which they farm, while others rent, lease, or have access from a landlord that may be a private individual, public agency, or other government entity. Most, however, simply farm informally or illegally.

At times, illegal cultivation of land becomes such a common, unstoppable practice that government authorities bow to pressure by legalizing the practice after the fact. This usually leads to further expansion of the practice because it has become legitimate. Under some circumstances time-limited permits are issued by governments rather than more durable forms of tenure. This occurred in Jakarta in response to the economic crisis of the late 1990s. The capital's governor gave permission to use idle government land to grow food, but only after receiving a request for permission.[29]

Urban farming occurs under a variety of arrangements (Table 4.3). These include:

- Economic rent or lease — the farmer has official access to the land and pays rent as a share of income earned on it.

- Usufruct rent or lease — access is official and rent is decided on a usufruct basis. Examples include excess land around airports and other public facilities that would otherwise be unused.
- Farming under permit — the farmer has official access in return for maintenance of the land (for example, within rights-of-way, or on port authority land).
- Informal agreements — the farmer does not have official access or tenure but does have the landowner's permission.
- Unsanctioned farming — farming occurs without the landowner's consent.

The first three arrangements are good for both the farmer and the landowner as long as tenancy laws ensure the rights of both, yet much urban farming take place under informal and illegal arrangements. In the case of public lands, most farmers are squatters. Permits for farming on bodies of water are common in several Asian countries, but less so elsewhere.

Low-income families, often living in tenements and apartments or other dense neighborhoods, have less access to land in cities than single-family or free-standing home owners/renters. Refugees from environmental and civil disasters are the most in need of access to land for food security, and are the least likely to have such an opportunity. Thus we find that access to land has frequently an inverse relationship to need.

In a survey of urban farmers in Nairobi, one-half were farming on public land, one-quarter on their own land and one-quarter on land owned privately by someone else.[30] Most of the third group were farming informally or illegally (without the owner's consent). Typically, public land was simply occupied, without receiving permission or paying rent.

A survey in Kampala found that 60 percent of farmers used public land, 33 percent were farming their own land, and only 3 percent farmed land that was owned by another private individual.[31] Of those using public land, 65 percent had no formal agreement. Only 10 percent of the surveyed farmers held secure tenure to the land they farmed, and 40 percent could be considered as squatters. The survey also found tenure security to be most lacking for lower-income farmers.

There are many examples around the world of permits or leases arranged between local governments, large corporations, or national government departments on one side, and NGOs, cooperatives, or farmer associations on the other. The use of the land for a limited purpose and time is sometimes assigned by one entity to another. The organization managing the farming may in turn then lease certain limited rights and space. Thousands of farmers operate this way on the garbage dumps of Calcutta and in many other cities. Under such arrangements, the owner benefits from maintenance of the land and in some cases has other 'good-will' benefits, including employee well-being, improved relations with the community, and protection from competitors for the land.

Table 4.3 Ownership of land in urban settlements

Category	Subcategory	Access	Urban farming potential
Private land	Owner occupied	Closed. Usually strongly controlled by owner	High. Ornamental gardening and food production. Horticulture, livestock, and fisheries possible
	Tenanted (short term, perhaps one year)	Closed. Fairly controlled by owner and tenant	Low
	Leased (often long term	Closed. Controlled by owner and lessee	Medium. Less long term than owner-occupied land
	Illegally occupied	Variable, as is control by occupant and owner over land use	Low, unless tenure is perceived de facto as fairly secure
Company land	Large premises	Closed. Probably strongly controlled by company	High. Excess space can be farmed
	Small premises	Closed. Control by business owner probably varies	Variable. Depends on excess space
'Public' land	State/municipal control (highways, irrigation projects, excess public space	Often open. Control varies	Probably high. Vacant spaces can be farmed and trees planted
	Community land owned collectively under customary law or donated for use of local people	Usually controlled by common property arrangements	Collective farming possible
	Church, temple, or school land	Usually controlled by common property arrangements	Medium. Possibilities for community farming
	Illegally occupied (may fall under any of the above categories, but most likely state or council land)	Variable, as is control by occupant and owner over land use	Low, unless tenure is perceived de facto as fairly secure

Source: Based on E. Jane Carter. 1993. The Potential of Urban Forestry in Developing Countries. Draft. Rome: Food and Agriculture Organization, June, p. 20.

All these advantages have come together in a project that is providing secure tenure to workers in Zambia's copperbelt region. Through facilitation by the local office of CARE, agreements have been negotiated between a large mining company, ZAFFICO, and four farmer associations. Substantial expanses of unused land owned by the company near urban areas in the copperbelt have been made available to agriculturists. They are grouped into these four associations which ensure that their members adhere to specified terms of the agreement. The farmers are allocated land for agriculture under secure tenure, and ZAFFICO is happy to reduce the uncontrolled use of its land.[32]

In Denmark, the municipality purchases land that it intends to develop for other purposes at a distant date, and leases it to small-scale farmers.[33] In Ahmedabad, India the city leases vacant land, including greenbelt land, to community groups on 5-year terms under strict conditions.[34]

Public land management becomes more efficient where agriculture is considered one of the permitted land uses. Since much urban agricultural use is shifting or usufruct, agreements are required that provide security to both the landlord and the farmer.

There is seldom a lack of space, land, or water bodies to farm in urban areas. The problem lies in gaining legal access and secure tenure to farm the area. Once an entire urban sphere is explored for potential surfaces for farming and the appropriate arrangements are worked out to permit such an activity, the next question is "What can be grown or raised, and how". These alternatives are examined in Chapter 5.

Notes

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3. Friedhelm Streiffeler. 1993. *General Principles and Approaches for Sustainable Urban Greenbelts with Special Reference to Africa*. Department of Rural Sociology. Berlin: Technical University of Berlin, p. 9.

4. Isabel Wade. 1987. Community Food Production. *Food and Nutrition Bulletin* 9(2):29-36. She compares three community garden programs in Asia, Africa, and Latin America.

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7. School gardens have been supported in Asia and Africa by the Asian Vegetable Research and Development Center (Taiwan, province of China) and in Asia and Latin America by the International Institute for Rural Reconstruction (Philippines). *Comedores populares* gardens are being supported by CARE, HUFACAM in Peru, and others.

8. For a history of community gardening in the United States, see an unpublished 1980 paper by Thomas J. Bassett, Vacant Lot Cultivation: Community Gardening in America, 1893-1980.

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15. Daniel Maxwell, personal communication, 1993.

16. Geoff Wilson, TUAN-Western Pacific, Brisbane, personal communication, 2000; Alison Meares Cohen, Heifer Project International, Chicago, personal communication, 1999.

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22. Socioeconomic models can complement this spatial model.
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28. D. Crouch and C. Ward. 1988. *The Allotment.* London: Farber & Farber, Chap. 4.
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