Implications of Community Gardening for Land Use and Density

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THE IMPLICATIONS OF COMMUNITY GARDENING FOR LAND USE AND DENSITY

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This paper explores the implications of community gardening for land use and density, especially in relation to high density urban contexts. A review of literature addressing urban agriculture with respect to urban design revealed no quantitative or design vocabulary analysis of community gardening. To date, community gardening has been viewed as an infill strategy and is rarely considered early in the urban design process. This paper develops preliminary design tools for determining site coverage, sizing, and protecting solar access. It also identifies a set of simple community garden types for grid cities, develop block size parameters, and suggests development patterns for protecting solar access in open space.

INTRODUCTION

There seems to be no tools that are specifically intended to address the spatial aspects of designing either for urban agriculture or for community gardening in particular. Therefore, it has been necessary to begin relatively late in the beginning. The literature review revealed no quantitative or design vocabulary analysis of community gardening. To date, it has been treated solely as an infill strategy and is rarely considered from the beginning of an urban design project.

The primary determinants relevant to urban design that affect density and land use are the amount of land devoted to the community gardens, the placement of the garden space relative to its uses and to its built context, and the development patterns required to protect its access to sunlight during the growing season. The first section presents simple methods for determining the site coverage of community gardening, along with the site coverage of other major site elements. It seeks to determine the density limits of community gardening from the point of view of site coverage only and to provide a simple, schematic level design tool for balancing decisions about community gardening planning goals with other competing site functions, such as land for buildings and parking.

A simple rule-of-thumb method is also developed to determine the size (measured as area) of a community garden. Once a community garden is sized and placed on the site, its access to sunlight must be insured by limiting development that surrounds it. The form and density implications of solar access envelopes for community gardens are explored and a set of climate and latitude-specific solar access overlay tools is presented. The overlay tools allow the designer to determine building heights of surrounding buildings that will not shade the garden or open space during critical days and hours.

A set of possible simple community garden typologies is identified for gardens on a single block and for gardens that occupy an entire block and serve those blocks that surround it. These graphic patterns give the designer a sense of the formal schematic systems that are available when placing community gardens in grid cities or when designing a new urban pattern. Several factors set parameters for maximum garden and block size. These factors aim to be suggestive of community gardening as an urban design strategy and are explored in a series of matrices for concentrated community garden types in order to establish the upper limits of block dimensions as a primary determinant of urban structure.

The paper ends with an exploration of urban development patterns for a few community garden types when combined with solar access criteria. Density implications from these patterns are also discussed.

SUMMARY OF URBAN AGRICULTURAL LITERATURE WITH RESPECT TO URBAN DESIGN

The Idea of Urban Agriculture

The basic idea of urban agriculture is to grow a significant portion of a city's food close to where people live. Its goals are generally to reduce the environmental impact of the food production system, to reduce food costs, to increase urban self-sufficiency, to improve food quality by reducing transportation distances, to use urban resident labor, to reduce chemical inputs, and to eliminate much industrial processing and valuable retail distribution. As an ecological strategy for the design of cities, these aims, "is both ecological and economical to have the food made close at hand" (Curtis, 1978:xi). The city planning theoretic Richard Meier predicts that about one-third of the calorie value and two-thirds of the economic value of the urban dweller's diet will eventually be produced in the city (Curtis, 1982:206).
The following passage from Hough (1983) illustrates the underlying theory of ecological design that has prompted so many proposals for the ecological city to include an increase in the area of land devoted to agriculture.

"... In the 1950s, when millions of people were suddenly awakened to the earth's ecological limits, the idea of the city in the productive process has undergone world-wide revolution. The old assumption that food is only grown in the countryside is out of touch with reality and no longer fits our needs. What we require is, in fact, a whole new theory of urban design based on ecological awareness.

David Katz sees urban agriculture as a necessity, given growing urbanization and population increase, especially in developing countries. By the year 2000, 50% more food will be required than in 1980, severely taxing the food production system. At the same time, the real price of food is expected to rise by 50-115% (Katz, 1983; Lyle, 1995). A diverse urban agricultural system could emerge to meet some of this need. While not likely to replace rural agriculture, it could serve to moderate supply fluctuations. Indeed, urban agriculture, mostly as community gardens and individual kitchen gardens, what Olum and Thrift (1979) call "emerging overground farming," in rapidly growing popularity in the U.S. At the same time, such "food grown in the city" has become more common, their costs and in turn the costs of food grown by a system dependent on high subsidies of petroleum inputs will rise. "More and more land will probably be moved over to agricultural production" (Lyle, 1983:20). Regulating in the late 19th century and mounting in the 1970s and 80s, there is evidence of a historical relationship between food prices and the area of urban land in agricultural use (Lyle, 1983). Katz (1986:130) writes:

"If we are to have sustainable, viable cities in the future, it is necessary to create a monopsony that produces much of its own food while renewing the patterns of the natural world that led to subsistence and self-sufficiency.

An approach to urban vegetable gardening followed high food prices in Europe during the 1970s. At the same time, 100,000 families in Britain worked for urban gardens (Riley, 1979). Despite these somewhat obvious needs and demands from urban dwellers for an urban component to the agricultural system, Kumar (1986:151) notes that:

"Current insight into the future has either created a fantasy-like vision... or has maintained that the growth of agriculturists and the use of plenty of high technology will be the direction of the future.

Increased food self-sufficiency and decreased ecological impact are two primary goals of urban agriculture. One of the ways in which urban agriculture can increase general ecological health is that it tends to support the preservation of domesticated species diversity because many qualities specially bred into the few commercial species are not needed in small-scale farming. Today, human cities as eutrofite plant species for about 80% of their food (Hough, 1984).

"... food self-sufficiency is in part driven by the structure of social systems, the nature of the existing built environment, and, temporarily, by the economics of the present food system (Katz, 1986). The increasing trends towards modern agriculture toward increased efficiency and size and decreased human inputs, made possible by food firms, "have led to increased environmental, social and economic costs, both in the countryside and in the city" (Hough, 1986:122).

Precursors for Urban Agriculture

Urban agriculture is the practice of growing food in the city. There are numerous historical precedents for urban agriculture, both in the U.S. and abroad, especially in poorer cities with large populations. Chinese cities, through a centrally planned agricultural system, provide most of urban residents' vegetable needs within the urban municipalities, evidence that a significant proportion of a city's food can be grown in or very near its boundaries (Wade, 1986).

Several comprehensive visions have been put forth for the design of human populated landscapes that include agriculture as a wide range of scales. The most successful implemented example is in China, and the most comprehensive example of urban agriculture in the U.S. is Village Homes in Davis, California (Coburn, 1981). Integrated agricultural systems generally pair small scale production in kitchen and community gardens with larger plot farming in the suburbs or at the urban fringe. Organic, intermediate scaled technologies and/or intensive farming techniques are most often recommended. Linking urban agriculture with the motions, materials, energy, and water flows of the city is usually assumed to be necessary and beneficial.

In the Edible City concept of Britta (1981), a regional "Garden City" approach is argued, based on the Urban Block Farm concept as a building block for urban organization. The larger vision of the Edible City is based on the provision of satellite towns and strong urban growth boundaries of agricultural and forest greenbelts. The conceptual prioritization of open space as the framework for that which is built could be a useful approach to addressing land use planning for urban agriculture.

Forms and Growing Methods

A thriving urban agricultural system has many needs, such as land, water, air, nutrients, and labor. Most of these are easily found in the city. The most common current forms for urban agriculture are private gardens, but community gardens are also popular in the U.S. Other options for the form of city agriculture include rooftop gardening, greenhouse production, urban block farms, the use of public open spaces, and city farms.

Given that most proponents of ecological cities are calling for a general increase in urban density, for a variety of reasons including the provision of public transportation, the encouragement of pedestrain- friendly environments, energy conservation, and the preservation of urban fringes agricultural land, it is reasonable to assume that large space for private gardens will decrease as it has shrunk, until housing increases, and more housing is of mixed use, multi-story, or multi-family types. With this as a possible future for U.S. cities, demand for community garden space is likely to increase.

In the dense areas of cities, especially in commercially dominated areas, rooftop gardening appears to be the most practical way of utilizing the available space while allowing for maximum buildable area and achievable economic potential. Rooftop gardening, however, has many practical and technical drawbacks.

Larger scale agriculture in dense areas, such as urban fringe city farms, creates fewer solar access problems, and thus density and scale issues are less pressing for these forms. Agriculture in public spaces is generally a matter of public policy, resident preferences, and local economies. Its form is dependent on the social and economic needs, and the type of open space securely protected. Several of these physical issues can be associated with other urban agricultural forms in the appropriate scale. For these reasons, this study will focus on the density and land use implications of community gardens.

Several growing methods are in use for urban agriculture, including row cropping, intensive techniques, greenhouse production, and hydroponics. Of these, small-scale concerns with urban agriculture documented some forms of intensive cultivation for its characteristics of high production, environmental benefits, and ease of learning. Row cropping requires large land areas to be profitable and is associated with a high environmental and economic cost. Greenhouses production and hydroponics both produce high yields per acre but require high capital investments and a high level of technical horticultural skills. They are most appropriate in all but the most urbanized areas, for institutional operations. Successful examples of community greenhouses do, however, exist. For these reasons, this study will focus on the density and land use implications of intensive gardening and farming techniques used in community gardens.
METHODOLOGY

Research methods often assume that there is a particular, well-defined question to be answered, and that a methodology composed of a series of clear, linear steps can be outlined and followed to completion. In this case, however, the question was so arcane that few lines were known to exist. Therefore, the methodology that was used was similar to that of an architectural design process — each step in the process suggested the next, yet the overall process was not always apparent. The research was complex and in progress, as is typical. As a result, the definition of the process and the form of the outcomes were allowed to remain unresolved for a long time. In the end, the process could be pieced together in form what appeared to be a logical progression, yet one that could not have been conceptualized until later in the research process. Two related approaches were taken:

- Determining patterns of land use
- Determining measurements of density

Patterns of land use were studied by:

- Generating ideal block forms that optimized community gardening
- Generating sustainable building and green infrastructure for promoting solar access to gardens
- Defining basic typological urban patterns options for community gardening

Density implications for each strategy were determined by analyzing the following:

- The basic parameters affecting the density implications of the strategy, regardless of sector
- The maximum building envelopes that protect solar access to the garden

The design and development consisted of two parts:

- A set of basic graphic typological design choices for community gardening
- A simple quantitative method for testing the critical design elements

In addition, preliminary results are given for density limitations that support the strategy. A simple method is outlined for determining allowable density for a particular situation.

SITE COVERAGE OF COMMUNITY GARDENS

- During the earliest stages of design, it is important to establish the properties of the site devoted to community gardening. It is also important to understand the properties of the site covered by other primary site elements, such as buildings, streets, and parking. Guidelines for all of these, except community gardening, are available in various forms of site planning standards, usually in tabular or numerical form. This information is not usually presented in comparable form and is not necessarily in the form used by designers during preliminary design.
In schematic designs of large developments for medium and high density housing, designers attempt to balance the various site uses. These questions such as: How many stories should the buildings be? What proportion of cars to dwellings is appropriate? Can parking be on grade or should it be in parking structures or below buildings? How much space is required for pedestrian circulation and setbacks from property lines and streets? How much space can be provided for outdoor living and recreation? Can some of this space be provided on building terraces or rooftops? How does the size and mix of housing units affect site coverage? How much space can be provided for community gardening? How much gardening space per unit should be provided? How many households will actually garden? All of these questions and site uses must be balanced within a limited site area. During the schematic design stage many options are considered in rapid succession, therefore, quick and simple tools are needed. In order to provide a consistent set of graphic rules of thumb for the primary site coverage elements of residential land use, each element has been plotted as a function of housing density and site coverage ration.

Site Coverage for Community Gardening

The land area required to produce food for the human diet is significant. In a practical sense, community gardening can only provide some fraction of the total diet. A completely self-sufficient settlement pattern in which food production is entirely coincident with the location of population requires relatively low densities and a large amount of land devoted to food production. The result would be an inefficient settlement pattern and a loss of the concentration necessary to support the culture of the city.

The fraction of site coverage as a function of population density, in people per acre, can be roughly determined for various portions of a human diet and fractions of the population served. During the last two decades in the U.S., the percentage of households participating in some form of food gardening has ranged between 30% and 30% and is affected by the price of food and the general state of the economy (Butterfield, 1991). Figure 6 shows the density-to-site cover relationship for three extremes: 30% and 50% of households. The Green lines indicate the area required for leafy greens only in a mostly vegetarian diet. The Veg lines indicate the area required for all vegetables in a mostly vegetarian diet, and the Veg, Diet lines indicate the land area required for a full vegetarian diet that includes grains. Figures for an omnivorous diet are not shown, but this diet requires much more land area. All figures are based on the assumptions of intensive gardening or farming techniques and are quite optimistic. It can be inferred from Figure 6 that providing a large fraction of the diet in an urban situation is not feasible to the form of community gardening. For instance, at 40 persons per acre population density (about 20 d.a.), the minimum design goal of providing gardening land for 30% of households would require over 80% of the land area to allow enough land for production of 90% of a full vegetarian diet. Even a relatively low population density of 10 people per acre requires over 40% of the site area for minimum design goals and over 70% of the site area to provide land for 50% of households to meet their food requirements for a vegetarian diet. Agricultural site coverages this high do not allow for other important site uses. For this reason, the rest of this study is focused on the strategy of providing sufficient land area for community gardening, based on the amount of land that people in the last 20th century U.S. seem to actually be willing to cultivate. In the past two decades, the average size of a garden plot in the U.S. has ranged from 300-500 ft². The size of home gardens is said to fluctuate in the economy; in hard times, people tend to increase the size of their plots. Additionally, during those periods of a weak economy, more people take up gardening (Butterfield, 1991).

The fraction of site area for community gardens as a function of housing density can be roughly determined from Figure 7. The 300 ft²/30% line represents an average garden plot of 300 ft² with 30% of households given space for gardening. The 333 ft²/30% line represents an average garden plot of 333 ft² with 30% of households given space for gardening. The 500 ft²/30% line represents figures for both an average garden plot of 500 ft² with 30% of households given space for gardening and garden plots of 500 ft² for 30% of households. These two planning goals require approximately the same area. The 333 ft²/30% line increases plot size to 300
| Buildings, 1000 sf average dwelling unit, two-story | 28% |
| Parking, 52.5 car spots, 500 sf per spot | 21% |
| Walks and lawns, minimum | 8% |
| Outdoor living areas, minimum | 2% |
| Total | 79% |

*Table 1. Minimum site cover ratios (for cases, 0 d.s/a).*

- **Figure 8.** Community gardens size by plot size, average 98% gardens site utilization.

- **Equation.**

- It conventional wisdom about open space is reinterpreted, there are still practical limits to the use of community gardening. For instance, let us consider the following scenario at 60 d/sa using minimum assumptions the parking, walks and setbacks, and outdoor living area as shown in Table 1.

  - Community gardening under this quite conservative site coverage scenario is limited to 88% of the site coverage, or about 99.9% if all parking occurs under buildings. By looking at the graph of community garden site coverage to Figure 7, it can be determined that if parking is not coincident with buildings, the 300 ±20% planning goal is a maximum. In other words, 60 d/sa is the upper limit of community gardening with ten-story buildings and surface parking. The graph also indicated that the higher recomended community gardening planning goal, 500 ±20%, is not possible at 60 d/sa because it requires approximately 45% of the site.

  - Calculations of this type show that 99% of site coverage is an approximate upper bound for community gardening with the assumption of using ten-story buildings. Beyond this level, other essential site functions cannot be provided. In looking closely at Figure 7, an upper limit of about 38 d/sa can be determined by subtracting with a site area fraction of 0.20 and reading from the highest planning goal line, 500/50%. Cleverer housing density can be achieved with lesser planning goals of smaller gardens or fewer households. A density of 60 d/sa requires the main site area for two garden functions. If parking occurs under buildings, a maximum of 24% of the site area is available for community gardening.

- **Sizing Community Gardens.**

  - The actual area of a community garden is a function of the plot size and the number of plots, with the recommended number of plots being 25-300. The square footage of the garden can be determined from Figure 8 for 300, 500, and 800 ft² plot sizes. An 80% garden efficiency is assumed.

  - To size a garden, the first step is to determine the number of plots required by multiplying the number of dwelling units in the housing development by the percentage of households that the garden is to serve. If this product is greater than 100 plots, divide the number of plots into two or more gardens so that each garden has fewer than 100 plots. Using the rule-of-thumb graphs, a designer can determine the site coverage and the actual size of the community garden. The designer can also easily determine the relative proportions of the major site elements and balance values above open space, building height and development density early in the process before an actual building has ever been designed.

- **Protecting Solar Access to Community Gardens.**

  - Once a community garden has been sized and placed on the site, the development surrounding it must be controlled and limited in a pattern that assures the garden’s access to direct sun during the growing season. The intent is to construct building and other site obstructions in such a way that they will not cast a shadow on the garden during critical daylight hours. In order to do this, the times and dates for which access is required must be determined. From the apparent sun path relative to the site on the critical times and dates, a maximum building envelope may be constructed.

- **Critical Dates and Hours to Protect Access.**

  - Most plans need at least six hours of direct sunlight, so this may be taken as the minimum planning goal (Sittlow, 1984, Common Ground). The best hours are centered around solar noon; for the six-hour goal, protecting solar access from 9 a.m. to 3 p.m. is sufficient. The growing season is usually assumed to be the period between the first and last possible frosts for a particular climate (Sittlow, 1984). Although some crops will continue to grow after frost has set in, the first frost...
date (last guaranteed frost-free date) is a reasonable goal for dense urban situations. Since the sun is almost always lower in the sky at the first frost of the fall than at the last frost of the spring, this date may be used as the controlling solar access goal for a given location.

Dates for the first frost, or the end of the growing season, may be roughly determined from the map shown in figure 9. Contours are shown in 30 day increments, as simplified from Withrow (1972). Local microclimates may vary significantly, and the map should be used only as a general guide. More accurate information can be obtained from the local agricultural extension office or from local gardeners.

**Solar Access Overlay Tool**

The "solar access overlay" is a plan diagram that can be used to calculate the "solar access envelope" that projects a garden's access to sunlight. It is generated as a zone of rays, with each portion of the envelope being shaded.
governed by the sun angle, measured in altitude
and azimuth, between 9 a.m. and 3 p.m. on the
first frost day, the other by the sun angle at 9
a.m. and 3 p.m. for the days between the first
two days and the summer solstice. Unlike solar
access for the heating season, in which the criti-
cal day is at the beginning of the heating season
in the most extreme summer from south and the
winter solstice day the moment governing ad-
titude, in the case of protecting solar access in
the growing season, altitude is set by the end
day of the season and azimuth by the summer
solstice. Figure 10 illustrates the critical deter-
mation sun angles for protecting solar access to
a garden space when the first expected frost day
is September 30.

Using the sun angles for a given latitude and
first frost day, an overlay that shows the allow-
able building height around the open space can
be constructed. Figure 11 shows a solar access
overlay for a 40° latitude in a growing season en-
ding Sept. 30, with access from 9 a.m. to 3 p.m.
The contour lines show allowable building heights.
The overlay represents a maximum build-
dable volume that will not shade the garden,
represented by the inner square, during the criti-
cal times and days of the growing season. The
max (solar side) line is determined by the azimuth angle of the sun, with respect to an
equatorial orientation, on June 21 at 9 a.m. on
the east side, and at 3 p.m. on the west side.
Note that the solar access overlay is oriented
counter-clockwise. The other angular line, representing the intersection of two planes of the envelope, is
determined by the azimuth angle of the sun on Sept. 30, at 9 a.m. on the east side and at 3 p.m. on
the west side.

The points at which the contour lines intersect these diagonals can be calculated by using the altitude
angle for the time and date. The horizontal contour lines in the diagram are located by plotting the
heights along a vertical line from the base of the garden, representing even on September 30. The
solar altitude for this date is used for this calculation. Using this procedure, a solar access overlay for
any latitude and climate can be constructed.

The solar access overlay shown in Figure 11 and the method described to construct it are a simplifica-
tion of the actual projected contour generated by the sun angles. These contours and the degree of
simplification are shown for our half of the binomial symmetrical solar access overlay in Figure 12.
Figure 12 shows that the contour lines of constant allowable height are gently curved, indicated by the
dashed lines. The solid lines indicate the envelope that straight line contours. This method produces a
slightly conservative envelope but is much simpler to construct and to understand.

Solar Access Envelope

Figure 13 shows a solar access overlay pattern projected in three dimensions in order to define a
protective minimum building volume around a rectangular garden on the center of a block. The
result is a imaginary solar access envelope. If all building occurs within this envelope, then the garden will receive sun at the
specified times and dates.

Figure 14 shows the same solar access en-
velope placed over an urban grid. The
maximum buildable volume for each block
is determined by the intersection of the ver-
tical projection of its boundaries with the
solar access envelope.

Applying the Solar Access Overlay Tool

Solar access overlays have been constructed
for the most common Frost Zones for the 8
increments from 24° to 48° latitudes. In
rearranging blocks in the 80 day commi
shown on the map in Figure 9. R50 and
R90 are the most common frost line dates
at 48° latitude.

Overlays are drawn to scale and may be
proportionately reduced or enlarged by
photocopy process to any scale. Each over-
lay shows a square garden of a fixed dimen-
sion. Since the garden is open space in
question may be of different size or propor-
tions, a solar access envelope for any rectan-
gular garden may also be constructed.

The first step is choosing the appropriate
solar access overlay that corresponds to the
latitude and frost date closest to that of the
site (available from vendor). If an ap-
propriate overlay is not included, one may
be constructed using the procedure
described above. The easiest way to use the
overlay is to place it under a sheet of vel-

The solar access contours are then constructed by aligning the contour patterns successively in each

COMMUNITY GARDEN TYPES FOR GRID CITIES

The placement of gardens within a grid urban con-
can occur in two primary classes of form:
garden blocks and block gardens. Block gardens serve people living in buildings located on a single
block; unless the block is extremely large, there is no need for more than one garden per block.
Garden blocks can be defined as gardens which fill an entire block and serve people living in
buildings on a number of surrounding or adjacent blocks. Variations of block garden types are shown
in Figure 15; variations of garden blocks are shown in Figure 16.
Block gardens can be thought of as concentrated forms or as linear forms. Concentrated forms may be placed on the block in a central, corner, or peripheral location. This placement affects both the walking distance to the garden and the maximum allowable block size for a given walking distance planning grid. Placement also affects the size and form of surrounding buildings, if some access criteria are considered. Gardens in central locations have more impact on buildings sited on their own block and less impact on the buildings of adjacent blocks. Corner-sited gardens have the least impact on buildings of their own block of any concentrated form, but limit adjacent block's buildings the most. The use of concentrated garden types tends to produce a block-oriented organization and an emphasis on place over path. They can be designed as public or private open space, depending on the treatment of their edge elements along the street.

Linear community garden types limit block size to the walking distance planning dimension in one direction only. For linear types that are continuous from one block to the next, solar access envelopes are quite simple wedge forms, governed only by minimum altitude angle and not limited by external elements. Linear community garden types tend to produce area-oriented open space in the public realm and an emphasis on path through. However, they can create block-oriented spaces and emphasize circulation internal to a particular development.

For both concentrated and linear block gardens, a location along the north or west edge of blocks will give the greatest access to sun with the least limitation on development. Gardens can add a meaningful design element to the design of the city. Together with the blocks that they serve, these urban patterns can be formed. Ideally, the size and placement of the garden block should be matched to the density and distance of the blocks it serves. For a given pattern of garden blocks and serve blocks, there is a maximum housing density that can be supported by the garden of a fixed size for any given planning grid.

The density allowed by garden block urban patterns (for equal planning grids) is a function of the proportion between garden block area and the total residential area of lots served. In mixed-use zones, only the total residential area should be considered. Greater density can be accomplished by community gardening on each of the eight individual served blocks.

As the urban design scale, garden blocks can be used for various urban and regional determinations, such as demarcating an area, emphasizing a regular order, modulating a differentiated grid, or providing relief from the grid's monotony by creating an anomaly in the pattern.

**Block Sizes for Community Gardens**

If the city is to be designed as a pattern of gardens (or open spaces), streets, and blocks, then gardens should be sized or placed on blocks such that the walking distance from any residence to the garden is reasonable. If the garden is too far, it will not be easily accessible and will not be used as much. As a rule of thumb, a distance of 500' will ensure that the garden is experienced as local territory (De Chasas, 1984). This corresponds to a distance of about one block or less, and if designed properly, could be within visual contact.

Since linear community garden types, as considered in this study, are continuous from one block to another, they impact the size of the block on which they are sited in one direction only and are governed simply by the planning grid for walking distance, which will be the dimensions of the block face, or the dimensions of a half block in the case of alley-sided linear gardens.

Concentrated gardens, on the other hand, generate a maximum allowable block size when designed for a limited walking distance. Block dimensions are based on the location of the garden on the block, the community gardening planning grid, and the block proportion. Figures 17-20 show maximum block sizes for concentrated community gardens. Also shown are the garden dimensions, area, and size cover at three housing densities; 20, 40, and 60 dwelling units per acre. Maximum block sizes are determined by a 500' distance from the farthest point on the block to the farthest point of the garden. Housing densities include the garden, except in the case of the central garden type. These two factors are accounted for in garden size cover between types.
DEVELOPMENT PATTERNS
FOR SOLAR ACCESS

Each of the community garden types discussed above creates a distinctive pattern of urban development when arranged in an urban pattern and combined with solar access criteria. The solar access overlay tool can be applied to any of the garden block or block garden types in a grid-based urban environment to determine patterns of allowable building bulk and shaded open space. Each particular combination of garden types, block size, module of garden repetition or rhythm, density, street right-of-way dimension, latitude, and growing season criteria will generate a different urban development pattern.

Figure 21 shows an example of the urban solar access envelope for a pattern consisting of a corner garden on every block of a 1/2 proportion regular city grid. Illumination is a maximum building coverage for producing solar access to a regular pattern of community gardens. These utopian shapes are derived from solar geometry and not constrained to present actual building forms. Within the envelope, there is no restriction on building form. Figure 22 shows one possible urban building pattern that fits within the solar access envelope.

Figure 23 shows, for the same block pattern, the development pattern that will protect solar access to perimeter gardens on every block.

CONCLUSIONS

This paper has explored the impacts of community gardening on urban land use patterns and density. Simple tools for determining site coverage, for saving gardens, and for defining solar access envelopes have been presented. A vocabulary of community garden types has been proposed for grid organizations, and some of the limitations on block and garden size have been determined. Using these tools and information, designers should easily be able to determine the impacts and potentials of community gardening on urban patterns.


