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How can EcoCity get its food?

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Abstract

Designing an ecologically responsible EcoCity of 550,000 people begins by confining it to 8500 ha, which spares surrounding land for farming and for Nature. Because an American diet requires 126,000 ha and even a survival diet needs more cropland than can be found inside its boundaries, EcoCity will cast shadows of farming outside its limits. EcoCitizens will cast wider shadows if farmers grow food with the less intensive methods of simpler times, and they will cast narrower shadows if farmers use the more intensive methods of today. Cheap transportation scatters the shadows that, in the days of oxcarts, Von Thunen imagined would fall in concentric zones of farming and forestry. Industrial ecology, pleasing landscapes, coworkers along its sidewalks, and finally warm fellowships at its tables justify the bother of planning EcoCity.

Keywords: Ecologically responsible city; Land spared; Food; Cropland; Von Thunen

1. Introduction

To give specificity to the planning of an ecologically responsible city, let 550,000 in EcoCity be confined to 8500 ha. Restricting EcoCitizens to 8500 ha stops their sprawl on surrounding land, which spares one fifth for farmers and the remainder for Nature. The metric unit of land is hectare, one hundredth of a square km and 2.5 acres. To grasp EcoCity's scale, regard it as the 28th most populous US city inhabited at a density of 65 people per hectare, second only to the density in New York city and near that in San Francisco or Paterson, NJ. In the author's hometown, New Haven, CT, 130,000 live at 25 per hectare.

Planning eventually considers jobs and housing, air and water, and imported material and exported waste. But it begins with food. Starving citizens do not worry about full employment, empty gas tanks or foul air. Everyone must eat at least 2000 cal per day. Although Americans are

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relatively rich and well fed, their supply of 3697 cal per person per day is only 3% more than Frenchmen's and 33% more than the average for the world [1].

Below, tables compare EcoCity's specified population and density to real cities. Other tables present EcoCitizens' food requirement plus the cropland to grow it. Learning that growing EcoCity's food requires more land than it encompasses raises the question, "Where will it grow?" Today cheap transportation diffuses the neat, concentric zones of farming that Von Thunen envisioned, encircling and feeding an isolated city on a uniform plain. More or less technology shrinks or expands EcoCity's shadows of necessary cropland area. Finally, why bother about an EcoCity that cannot feed itself and thus casts shadows of needed cropland on the environment?

2. How much will EcoCitizens consume?

2.1. How crowded is EcoCity

Begin to grasp the scale of imaginary EcoCity by comparing its 550,000 people on 8500 ha to New Haven's 130,000 people on 4900 ha. New Haven's population density is 25 per hectare, which means 25 people per two and a half, 1-acre suburban building lots. The founders of New Haven laid out nine tic-tac-toe squares and reserved the central one for a common pasture, church ground, and burial ground. The central common of 3.8 ha, bounded on the north by Yale College, once held a state capital. It now holds three churches, frequent concerts, and a burial ground for one of Cromwell's Roundheads. If the common held New Haven's average density today, about 100 people would be there.

Next compare EcoCity with its 550,000 and New Haven with its 130,000 people to other American cities. In 2003 about one American in eight lived in more populous cities than EcoCity and one in four in cities more populous than New Haven. Table 1 shows several examples of inner cities that city halls govern, plan, and zone. The table expresses populations in thousands per city, areas in square km or 100-ha units, and population densities in people per hectare. The first five, most populous cities in the table have densities from 103 people per hectare in New York City down to an average of only 13 on each of Houston's 150,100 ha. The populations of the next five cities, which bracket EcoCity, have many fewer people per hectare than EcoCity; the union with Davidson County in 1963 diluted Nashville's population to only 4 per hectare. In the next five cities of about 300,000 people, densities range from 15 to 23 people per hectare. Although the final five cities in the table have populations bracketing New Haven or nearby Hartford, their 8 to 16 people per hectare is considerably less than the density in the two Connecticut cities and much less than EcoCity's 65 [2].

The boroughs of New York City demonstrate how densities change with time and how average densities fall when more land is encompassed. From 1910 to 2000, the population in the five boroughs rose 68%. Although people on the isle of Manhattan unpacked from a maximum of 410 per hectare in 1910 to only 270 in 2000, they remained packed on the island nearly three times as closely as the average density in the five boroughs of New York City. They remained packed on Manhattan more than twice as closely as in EcoCity [3].

The median area of the 239 American cities with more than 100,000 people is 14,500 ha. Only 22 cities in the group encompass smaller areas than New Haven and only 36 encompass smaller areas than EcoCity. Only New York City packs more people onto each hectare than EcoCity does. The citizens of EcoCity pack in as closely as people in Patterson, NJ and San Francisco, CA. They pack in twice as closely as people crowd around the capital in Washington,

Table 1
Populations in thousands, areas in square km and densities of people per hectare in real American cities in 2003 that show the scale of fictional EcoCity

City	Population (thousands)	Areas (sq km)	Density of people (per ha)
New York, NY	8086	786	103
Los Angeles, CA	3820	1215	31
Chicago, IL	2869	588	49
Houston, TX	2010	1501	13
Philadelphia, PA	1479	350	42
Washington, DC	563	159	35
Denver, CO	557	397	14
EcoCity	*550*	*85*	*65*
Nashville, TN	545	1226	4
Portland, OR	539	348	15
Pittsburgh, PA	325	144	23
Tampa, FL	318	290	11
Cincinnati, OH	317	202	16
Raleigh, NC	317	297	11
Toledo, OH	309	209	15
Fort Collins, CO	126	120	10
Concord, CA	125	78	16
New Haven, CT	*125*	*49*	*25*
Hartford, CT	124	45	28
Fayetteville, NC	124	152	8

Nashville is metropolitan Nashville-Davidson. Outside America, the thousands of people in cities in EcoCity's class are: Acapulco, Mexico 515, Arequipa, Peru 619, Bremen, Germany 540, Hong Kong, China 684, Newcastle, Australia 478, and Srinagar, India 586. *Source*: US Bureau of the Census and [2,3].

DC or beside the grain elevators in Buffalo, NY. They pack in twice as closely in EcoCity as beside the beaches in Los Angeles, CA and Miami, FL [2]. Think of EcoCity's density of 65 per hectare as putting 250 people on New Haven's common pasture that today only holds three churches.

As they crowd, EcoCitizens save land and the photosynthesizing solar energy that it receives, practicing landesque [4] conservation. As they crowd and "De-Land-ize", they follow the ecological precept to "De-Materialize".

2.2. Feeding EcoCitizens

Familiar objects help one grasp how much food EcoCity will consume. Visualize 1 kg as nine quarters of butter from the refrigerator, 1000 kg or a ton of meat as three beef carcasses for the cafeteria, and a truckload as 10,000 kg or ten metric tons of canned peaches and pasta sauce for the dining hall. An EcoCitizen could survive on a full pound of grain or a half-kg containing 2000 cal. The first row in Table 2 shows that all 550,000 EcoCitizens could survive on 28 ten-ton loads of the survival diet of wheat.

Meals count up relentlessly. On October 4, 2004 the Red Cross announced that it had served its ten millionth meal in the largest response in its history [5]. Feeding each of EcoCity's 550,000 people three meals a day will require 3 meals $\times$ 7 days $\times$ 550,000 people or about as many in a week as the record number of meals that the Red Cross dished out to Florida hurricane victims. Although EcoCitizens could survive on a half-kg of wheat or on the Red Cross ration, many

Table 2
The weight of food to feed a survival or an American diet to the 550,000 EcoCitizens daily, expressed as 10-ton truckloads

Food	Daily loads (10-tons)	2003 cropland (ha)	1920 cropland (ha)
Survival	*28*	*33,777*	*100,375*
Red meat	8	31,144	173,698
Fish	1	917	5116
Poultry	5	4131	23,039
Eggs	2	3626	20,226
Dairy	40	11,502	64,148
Fat and oil	5	45,392	147,640
Fruit and veg.	47	5273	5273
Flour and cereal	13	16,444	48,866
Sweet	10	4113	4113
Beverages	1	2349	2349
Nuts	1	696	696
Sum	133	125,587	495,163

The daily Survival diet is 2000 cal in a half-kg wheat; the daily quantities of foods for the average American diet in 2001 are calculated from the average US consumption. The quantities of food are converted to cropland at 2003 yields, and for animal products, fat and oil, and flour and cereal, at 1920 yields [6]. The consumption of animal products was converted to cropland area by 2003 yields and by the equivalent feeding value of corn [6, Table 1-71, 2004]. With 2003 yields and appropriate factors for conversion of crops into products, fats and oils were converted per soybean yields, fruit and vegetables per orange yields, flour and cereal per wheat yields, and sweetener per sugarcane yields. Beverages include coffee, tea, and cocoa. The cropland for 1920 was estimated by replacing 2003 yields of corn, soybeans, and wheat with representative yields during the 1920s. The above 125,587 ha estimated for EcoCity multiplied by the ratio of the USA to the EcoCity population *under*estimates the actual 2003 US cropland, demonstrating that Table 2 does not *over*estimate the cropland that EcoCity requires.

would soon vote with their feet, straggling off to better places. Sustaining EcoCity surely requires the average American diet.

To supply EcoCitizens the average American diet of eleven foods [6, Table 13-5, 2004], Table 2 requisitions 133 ten-ton loads per day for EcoCity, the sum on the last line of the table. Packaging, of course, would add more weight and trucks. Because they are bulky with water, dairy products, fruits, and vegetables fill the most trucks, accounting for much of the difference between the 28 loads of survival and 133 loads of the American diet—every day.

3. Where can EcoCity get its food?

3.1. Inside EcoCity

Table 2 also translates the truckloads into the land to grow the crops. The conversion of crop into food varies from a top near 10 kg crop to 1 kg product for meat and sugar, because animals and refineries lose calories converting feed to food for the table. Conversion ratios are 1:1 for fruit and vegetables, because we eat them as they come from the field. The ratio for dairy products is more than one because a well-watered dairy cow turns 70 kg of dry corn into 100 kg of fluid milk. The second determinant of land is the tons per hectare yield, which declines from a top near 80 tons per hectare for cane to near 8 for maize, to less than 3 for wheat and soybeans, and down to less than a ton per hectare for coffee. At 2003 yields, EcoCity's food requires 126,000 ha.

So, the 550,000 EcoCitizens require fully 15 times as many hectares of cropland as the 8500 ha within their walls. In no way can the city produce the average American diet inside its boundaries. Even the survival diet would require a multiple of the 8500 ha.

If nostalgia for simpler times inclined them to earlier methods, EcoCitizens might encourage farmers to use the methods of the 1920s, a time before the unemployment of the Great Depression, the battles of World War II and the intensification of agriculture. The final column of Table 2 translates EcoCity's diet into hectares growing 1920 yields. Only the yields of corn, soybeans, and wheat were changed. Instead of enabling EcoCity to feed itself, the yields of 1920 quadruple its demand from 126,000 to 495,000 ha.

If EcoCitizens chose an ecologically correct, vegetarian diet, could they grow their food inside the city limits? The biggest expanse of cropland feeds meat animals. But before planning vegetarianism for EcoCitizens, take care. First, the calculations above assumed all animals were corn-fed. Since many cattle and sheep graze rather than eat corn, this exaggerates the demand for cropland and omits the demand for grassland. Second, the higher yield of feed grain (corn) than of food grain (wheat or rice) tempers the difference in land between feed and carnivores versus wheat and vegetarians. The third warning is: "For fats, Americans are already nearly vegetarians." Butter and lard supply only 15% of the American consumption of fat and oil [6, Table 3-55, 2003]. Little butter or lard now grease skillets or shorten piecrusts in American kitchens.

Now, equate vegetarianism with the extreme survival diet of only 2000 cal per day from wheat yielding 3 tons per hectare, and ignore the warnings about the cropland for meat and fat. This exaggerated sparing of land by vegetarianism would still require more than 30,000 ha of crops, a multiple of EcoCity's 8500 ha. Even if melons grow in its streets, pig's root below its windows and radishes sprout on its roofs, EcoCity will have to import food through its gates.

3.2. Outside with Von Thunen

Focusing on the twin environmental factors of soil and climate, one can easily assume that those natural endowments determine where farmers, foresters, and ranchers will grow crops, trees, and animals. In 1826, however, Von Thunen's classic publication of "The Isolated State" added geography [7]. After studying his German estate during the era of Napoleon and Malthus, Von Thunen added distance to the other determinants, soil, and climate.

Avoiding distractions, Von Thunen imagined his city isolated, like EcoCity, at the center of a homogeneous region. He assumed that farmers and others would optimize their incomes by considering yield, price, and production expense. He added that they would also consider the cost of carting, driving, and dragging produce along the rutted roads to the city market plus its deterioration along the way. Producers will maximize income per hectare, Φ

$$\Phi = Y \text{ Yield kg/hectare} \times (P \text{ Price dollars/kg} - E \text{ Production expense dollars/kg} - r \text{ Transport rate dollars/kg/km} \times X \text{ km to city})$$

$$\Phi = Y \times (P - E - r \times X)$$

Thus Von Thunen added transportation and location to discussions formerly dominated by soil and climate.

3.3. The concentric zones

Carrying produce to a single market at the center of a homogeneous state rules that concentric zones of husbandry will encircle the isolated city [7]. Income per hectare falls away from the city at the center of Fig. 1. In the nearest zone, market gardening income tops other husbandry, but its income falls rapidly because fruit and vegetables deteriorate rapidly, and deterioration is part of transport cost. (Once upon a time, city dwellers grew vegetables in their back yards.) Because bulky wood is expensive to transport, its value is highest in the second zone. (Because Americans consume more timber products than anything else but gravel, wood, and trees matter to EcoCity. In Von Thunen's days before fossil fuel, the citizens of New Haven denuded thousands of neighboring hectares to build the Mt Everest of fuel wood behind their houses every winter [8].) Because dried grain contains many calories per ton and does not deteriorate, the income from extensive crops like wheat stands highest in the third zone. (Once upon a time, farmers in the Allegheny Mountains concentrated grain into whiskey that their packhorses could carry, economically. When a Federal tax on liquor ignited the Whiskey Rebellion, President Washington marshaled the largest army he ever commanded, just to put down the Rebellion.) Because cattle carried themselves to market on their own legs in Von Thunen's day, the pastoral region lies farthest from the city.

The introduction specified that EcoCity's surrounding zones be one-fifth farmland. American farmers, however, own some three times as much farmland as cropland [2, Table 789, 2004–5]. They own swamps, rocks and woods that they never plow. The scatter of crops across three times as much farmland multiplied by the specification that farmers own one-fifth of the zones surrounding EcoCity expands the needed 126,000 ha of cropland fifteen fold. The multiple of fifteen expands EcoCity's concentric zones to 2 million ha.

If farmers and foresters use the 2 million ha of EcoCity's surrounding zones as Von Thunen's model depicts, Sunday drivers outside EcoCity's 8500 ha first pass gardens, then motor through woods past three-crop rotations and enclosed fields and finally reach open range. If New Haven is a proxy for EcoCity, imaginary Sunday drivers heading north through the specified isolating region will reach the Commonwealth of Massachusetts in less than 100 km. Heading southwest instead, they will reach New York City after somewhat more than 100 km of gardens, forests, crops, and grass.

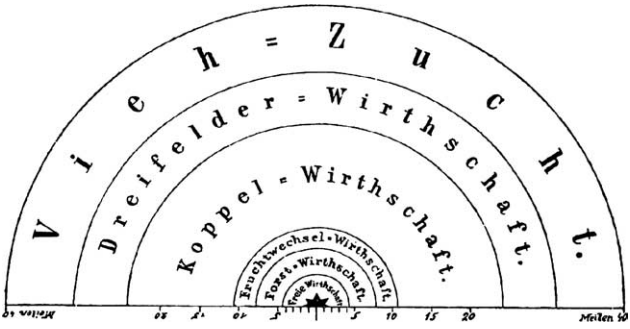

Fig. 1. Von Thunen wrote, "Envision a great city lying in the middle of a fruitful plain, with no river or canal through it. The plain has absolutely uniform soil, making all husbandry possible anywhere. Farther from the city lies uncultivated wilderness, leaving the city wholly isolated from the rest of the world." Around his imaginary city, Von Thunen drew circular zones, first gardens, then woods, fruit trees, enclosed fields, three-field rotations, and finally cattle [7].

Where will the nutrients that EcoCitizens eat end up? Although they will exhale the calories as carbon dioxide, they will excrete much of the nitrogen in the protein they eat. Even vegetarians' vegetables contain protein. If EcoCity's 550,000 eat an average American diet for a year, their daily 110 g of vegetable and animal protein will contain 3500 tons of nitrogen. The annual 3,500,000 tons would supply 200 kg nitrogen to 18,000 ha, roughly one hectare in seven of the 126,000 ha to feed EcoCity. Sprinkled on 18,000 ha, wastewater containing 3500 tons would fertilize one-seventh of EcoCity's crops and one percent of its surrounding zones.

Now, return to the ideal zones around EcoCity. Within his assumptions, Von Thunen's ideal zones are logical. But remembering that logic is an orderly way of going wrong, how could assuming a uniform, isolated state around the city lead the reader astray? Readers commonly complain about the assumed isolation of Von Thunen's city and the specified homogeneity of its surrounding plane. The proximity of Hartford to the north and New York City to the southwest of the proxy of New Haven illustrates the unreality of assuming isolation.

Instead of homogeneously, Nature bestowed her endowments irregularly. Some soils and their drainage plus climate make better places for crops. And climate makes better and poorer places for crops. Wheat grows in dry places, corn in moist places and blueberries in very moist places. Cattle graze where only grass grows. Along rivers, grain moves in barges, and along valleys, other food moves on man-made rails and highways. Unable to shorten distance X, farmers lobby barons or politicians to run rails or paving past their farms to lower the transportation rate r.

3.4. Cheap transport

Avenues of cheap transportation relax Von Thunen's rule. Let relative advantage F of proximity be minus $[100\times(\mathrm{d}\Phi\mathrm{d}X)X]$ from EcoCity.

Advantage in percent per km from EcoCity, $F = r/(P-E-rX)$

$$F = \frac{100 \times \text{Transport per km and per kg}}{[\text{Price} - \text{Production expense} - (\text{Transport and deterioration} \times \text{Distance})]}$$

A strong advantage F sharpens Von Thunen's zones and overwhelms environmental factors, such as the suitable soils and climates that lower production expense E. Being a kilometer closer to EcoCity matters most when transport r is costly and the distance X to town is short. In the opposite way, a high price P lowers the advantage of proximity. Inexpensive production E of a product that travels well also weakens the advantage of proximity. Von Thunen understood that the value of a commodity like spices in the Middle Ages or whiskey in Pennsylvania in 1800 overcame distance.

What he could not foresee was the extraordinary cheapening of transport that weakens the advantage of proximity to nearby cities by both cutting the transport rate in the numerator of the ratio for F and raising the net of price, production, and transport in its divisor. First roads, then canals then railroads and finally interstate highways cheapened transport. During the 77 years before 1966 transport workers multiplied their output 10-fold [9]. During the century after Von Thunen, grain carried on boats and rails, first to Buffalo and then on to and across the Atlantic, flooded Europe with American grain.

Because the cost of transporting a product includes its deterioration, refrigeration also cheapened transport cost. A century ago as Connecticut and New York industrialized and their wheat fields shrank, farmers thought cows and corn would persist because milk would sour

during a slow trip to the city. Refrigeration proved them wrong. Today refrigeration makes Minnesota milk nearly as accessible and sweet for New Haven and New York as milk from their suburbs. The truck gardens near Boston shrank because cheap refrigerated transport delivered lettuce and fruit, year round, from California's warmer climate that irrigation made productive. With snow outside, green peppers from Mexican fields and cucumbers from Dutch greenhouses demonstrate that EcoCitizens can now forage to the ends of the earth. Cheap freight, which includes delivering quality, diffuses Von Thunen's tidy zones.

4. Why bother with EcoCity?

Hard facts answer, "What food will EcoCity need?" And, hard facts force EcoCity to reach outside its own 8500 ha for tons and tons of food. Further, cheap transport and refrigeration diminish the advantage of proximity. Because it cannot sustain its food supply and because proximity to food matters little, why bother about feeding EcoCity? Bother because within its walls, the neighbors of EcoCity have four advantages that my calculations of food and Von Thunen's mapping of zones do not accommodate. It has advantages of ecology, landscape, sidewalks, and fellowship.

4.1. Ecology

A precept of industrial ecology prescribes recycling to close the loop of material that we use and thus minimize waste and pollution. Earlier I reckoned that EcoCity's 550,000 eating the American diet will consume 3500 tons of nitrogen and dispose most of it in wastewater. The 3500 tons could fertilize 18,000 of the 126,000 ha to feed EcoCity. Distaste plus regulation often restricts recycling this waste nitrogen onto cropland. Some wastewater and sewage sludge is nevertheless reclaimed. Although still a pitifully small 1% of the irrigation water that crops consume, the reclamation of wastewater did rise by three-quarters between 1985 and 1995. In Arizona, reclaimed wastewater equaled 4% of irrigation consumption, and in Florida 10% [10]. About a third of US sewage sludge is applied to the land for beneficial purposes [11].

One requisite for recycling is that the land to receive and benefit from waste be far from neighbors who object. EcoCity's small expanse and its sharp boundary between city and unaltered farm and forest provide that requisite separation.

Another precept of industrial ecology, called dematerialization, prescribes more beneficial use of material in the first place [12]. By compressing many people onto each hectare rather than sprawling, EcoCity dematerializes land. An EcoCitizen uses more land than a person in New York City but only 42% as much land as a citizen of New Haven.

4.2. Landscape

EcoCity's isolated state has a distinctive landscape: a landscape one-fifth farms and one-fifteenth cropland surrounds a densely peopled city. People cherish a landscape with church spires, fertile farms and green forests. Paintings generally show what people cherish, and artists frequently paint a scene that is not wholly wilderness, farm or city. Millet's peasants standing in a wheat field near Barbizon listened to the Angelus ringing in a church spire, and Van Gogh, standing in a wheat field near Arles, painted another spire in the distance (Jean François Millet, The Angelus, 1857–59; Vincent Van Gogh, Wheat Stacks with Reaper, 1888).

Connecticut taxpayers have demonstrated that people will pay for a bucolic landscape. They have guaranteed that 12,000 ha will remain in farms [13]. The guaranteed land averages two-thirds prime and important farmland soils, and purchasing the development rights on farmland should not be confused with purchasing open space or forests and parks. The guaranteed land is purchased because it is prime cropland that will likely continue to grow abundant crops and be maintained at no cost to the neighbors. EcoCity's compact settlement and the sharp division of cityscape from Arcadian landscape, provide the cherished backdrop for its citizens' lives.

4.3. Sidewalks

It may be a surprise that cities should be fed because they have sidewalks. Jane Jacobs, however, began "*Death and Life of Great American Cities*" with chapters on sidewalks [14]. She described shoppers and boulevardiers thronging sidewalks. Coffee and children in front of small shops, cafes, and crafts make cities worth bothering about.

In "*Population and technological change*" Ester Boserup argued that urbanization propelled progress [15]. The many in a city could build canals, roads, and irrigation, which would not be feasible for a few. And, the urban population pressed upon local resources and demanded inventions in farming and transportation not required by roaming hunters and fishers. Paving and companions evoke more cleverness and invention than wilderness and solitude, she argued. Even Thoreau did not live in a wilderness. He joined the Transcendentalist movement in Boston and lived in Ralph Waldo Emerson's cabin on Walden Pond, but near the Fitchburg Railroad.

Jane Jacobs began "*The Economy of Cities*" with the provocative chapter "Cities first—rural development later" [16]. She argued against a prevalent theory that assumes cities are built upon a rural economic base. Instead, "If my observations and reasoning are correct," she wrote, "The reverse is true: that is, rural economies, including agricultural work, are directly built upon city economies and city work."

Jacobs cited evidence from New Haven to reason that, beyond being primary organs of cultural development, cities are also primary economic—even agricultural organs.

"Go back to simpler times. Amplify dependence on hinterland. Because we are so used to thinking of farming as a rural activity, we are especially apt to overlook the fact that new kinds of farming come out of cites. The growing of hybrid corn was a revolutionary change in American agriculture; it amounted to a new kind of corn culture. The method was not developed on corn farms by farmers, but by scientists in plant laboratories in New Haven."

Fortunately, the plant scientists in New Haven believed corn would persist in Connecticut. The plant laboratories are The Connecticut Agricultural Experiment Station, America's first experiment station, inspired by Benjamin Silliman of Yale and located a few blocks up the sidewalks from the center of town.

Jacobs' point is that the agricultural invention of hybrid corn along the sidewalks makes—in my words—EcoCity worth bothering about. To quantify what agricultural technology has accomplished since the invention of hybrid corn about 1920, Table 2 concludes with the hectares to feed EcoCity with 1920 yields of corn for feed, soybeans for oil and wheat for flour.

Sustainability is getting what *you* want without compromising your children getting what *they* want. Charted on the sustainability plane, that means sailing eastward to a better income without veering northward to higher environmental impact [17]. Table 2 shows that, while US income multiplied from 1920 to 2003, agricultural technology shrank the cropland to feed 550,000 people. The difference of 369,000 from 495,000 to 126,000 ha that technology spared from the plow approximates two 40×40 km US counties. Agricultural technology made successful

navigation on the sustainability plane possible, reaching higher income with less environmental impact. Jane Jacobs credited part of the success of the navigation to New Haven sidewalks and thus to sidewalks generally, justifying the bother about EcoCity.

4.4. Fellowship

The food on a sidewalk table is the focus of fellowship and another reason to bother with EcoCity. Bread and wine symbolize communion in a church. Businessmen and politicians seal a deal at lunch. Parents and children cement their bonds around the kitchen table.

Gardens of tomatoes also foster fellowship. The American Community Gardening Association "recognizes that community gardening improves the quality of life for people by providing a catalyst for neighborhood and community development, stimulating social interaction, encouraging self-reliance, beautifying neighborhoods, [and] producing nutritious food" [18]. In the *Image of the City*, Kevin Lynch argued for a recognized pattern in the cityscape [19]. The recognized part of North Philadelphia that brightens the view from a train window is a community garden.

Although the scarcity of hectares within EcoCity's walls precludes its feeding itself, parks testify that cities have room for greenery and gardens. Atlanta's parks spread over 1400 ha, Los Angeles's over 6300 ha, and New York's over 13,900 ha (various websites). Often—perhaps typically—community gardens are planted on land cleared of buildings and improved with compost from the city's collection of leaves, an exemplar of industrial ecology. The New Haven Land Trust owns 24 ha; in 2004, 408 individuals gardened individually or in groups on New Haven's 47 community gardens, some on Land Trust and some on city, private and housing authority land. Community gardens are only the tip of the iceberg lettuce. For every gardener in a community garden, many hoe in their own back yard and chat over the fence. EcoCity may not be able to feed itself, but its community and backyard gardens can yield more than 5 kg of tomatoes per square meter plus a bonus of fellowship as EcoCitizens risk frost to compete for the first red fruit.

5. After all

Dismal facts dictate that, left alone within its walls, EcoCity cannot sustain itself. As people's tall profiles cast long shadows at sunset, so EcoCitizens' need for food casts long shadows on the environment. Without bringing in truckloads of food every day, EcoCity would starve. Although cheap transportation and refrigeration weaken the restriction depicted by Von Thunen's zones, ecology, landscape, sidewalks, and fellowship still justify bothering with 550,000 EcoCitizens who cannot feed themselves on 8500 ha.

For recycling waste, EcoCity's small expanse and sharp boundary between city and unaltered farm and forest provide the requisite separation from neighbors. The same small expanse and sharp boundary provide a bucolic landscape for its citizens to enjoy outside the gates. Gardens within EcoCity's limited boundaries can set its tables at only a few mealtimes, but the gardens can yield many tomatoes while engendering warm fellowship.

Technology from city sidewalks, exemplified by hybrid corn from New Haven's experiment station, has raised yields and shrunk the cropland to feed EcoCity by more than a county. Fortunately, technology lightens society's shadow that crop cultivation casts on the environment.

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