Feeding New York in New York

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Abstract

New York City (Steady) State is a project to explore the possibility that the ecological footprint of New York City might become co-terminus with its political boundaries. This research is a thought experiment with a single predicate: the city can become completely self-sufficient. This includes investigation of such areas as water, air and climate, food, energy, building, manufacture, movement, and waste. The study seeks both to prove that self-sufficiency is, at least, a theoretical possibility and – more important - to compile an inventory of strategies and resources that can lead in that direction. It also seeks to suggest an ultimate local means of taking environmental responsibility and of asserting the critical importance of cities to authentic democracy in the burgeoning multinational economy. A portion of the study focusing on morphological transformations will be presented in Mexico.

We have been investigating the possibility for New York City to provide all of its food supply within the boundaries of the five boroughs. At first blush, this seems improbable. How to supply nutrition to eight million people on a site which is substantially built and in which virtually all open spaces are already devoted to other uses? And, how to do this in a responsible, sustainable fashion that respects the earth, addresses the toxic cruelties of the factory farm system, and provides both sound nutrition and ample choice to eaters?

Big changes in our thinking and habits will be required. Current standards and practices are problematic on several counts. To begin, the industrialized, fast-food regime is dangerous at both ends of the chain. The non-organic basis of this system – with its heavy dependence on mono-cultural industrialized agriculture, fertilizer inputs, pesticides, fossil fuels, standardization, corn and soy hegemony, drastic packaging, long-distance transport, labor exploitation, and other much-criticized elements – must be revised. The logic of "organic" agriculture is that its farms be small, diverse, and near. But bringing food production home to New York will demand solutions other than the return of the well-managed, organically-driven, family farm (like the famous Polyface Farms described so persuasively in The Omnivore's Dilemma). This is not to say that much farming cannot remain both organic and small-scale, conducted in back-yards, balconies, stairways, and elsewhere. New methods, however, will be essential as will great diversity.

We are also habituated to a cornucopia of "fresh" foods in all seasons – kiwis from New Zealand, asparagus from Argentina, strawberries from Mexico, tomatoes from the Netherlands – that are incredibly energy intensive and that are bred to exclude many qualities of nutrition and flavor that a more organic process would provide. This is, in its way, as unsustainable as the vile product of the fast-food empire, itself corrupt at every link of the chain, from farm to consumer. It's nonetheless also true that the reduction of our agricultural insanity to a matter of "food miles" is – like most reductive analyses – not as shiningly obvious as it appears at first blush. The economic rationale requires extensive attention to such externalities as labor-exploitation and the loss of the kind of autonomy that a proposal predicated on the idea of self-sufficiency is devoted to. From the standpoint of energy inputs, moving a cargo ship of apples from the Antipodes can be far more efficient than bringing a few dozen bushels in the back of a pick-up from an orchard upstate. Even more fundamentally, a simple check-list mentality (like the LEED system) which simply inventories individual inputs – energy, water, fertilizer, resource depletion, climate change – has a tendency to abstract and de-individualize responsibility and to de-politicize the problem.

This proposition offers its possibilities by degrees. Clearly, the idea that the New York City food shed would be completely co-terminus with its political boundaries is at the most radical end of a larger set of possibilities. Indeed, the practicalities of a regional approach have been argued by many and the dramatic rise in the local and slow food movements, the growth of many sites of urban agriculture, the proliferation of farmer's markets, and so on represent a burgeoning "movement." Indeed, even an extreme approach to self-provisioning might

allow for the barter of local foods with more distant markets that were able to produce foodstuffs that are particularly unsusceptible to home growth. Coffee, a narcotic few New Yorkers can survive without, is something that will be far more difficult to produce than chicken or apples and only under a regime of the most fantastical completeness is it possible to imagine the architectural and agricultural technologies that would enable its local production. And let's not get started on chocolate!

It is clear, in any case, that a self-sufficient diet will demand substantial changes in our daily habits and styles of consumption – most of which are of very recent origin. Any plan for this will require not simply attention to the content of the New York diet but to the question of balancing nutrition and coercion. In our polyglot metropolis we support the cuisines of many cultures and depend on the networks of globalization to enable this. A self-sufficient process will, necessarily, result in a certain localization of dietary components and, potentially, a limitation in choices. However, this dependency on the seasons and on local capacities was characteristic of human dietary habits for millennia and, although we seek to design the most variegated system we're able to, we are also in sympathy with a more general impetus to think locally. Indeed, this inquiry is an extreme instance of such thinking: we wish to bring every New Yorker closer to what is on her plate.

We believe that this approach can be enormously stimulating to creativity: New York is a global hub of imaginative and multicultural thinking and has the potential to reinvent food culture and the meanings of diversity at many levels. We will not consider this problem "solved" if the outcome fails to provide the equivalent of the satisfactions of variety and choice New Yorkers currently enjoy. As we intensify local and smaller scale styles, introduce new modes of production like aeroponics and hydroponics, we will perforce intensify more local and smaller scale styles that will be dramatically juxtaposed spatially. The fact that spatial specialization – thousands of square miles isolated for beef, thousands for corn, thousands for wheat – will disappear suggests not simply the logical synergies of rotation but will conduce new culinary synergies and complexities as well. We believe implicitly that proximity and engagement with the sources of food are essential to cultivating progressive environmental consciousness.

However, in providing a system of self-sufficiency for eight million people on a territory that – even if entirely devoted to traditional agriculture – would only support an order of magnitude of a million, (modern agriculture supports around 1000 people per km2 of arable land) we beg the question of novel means of production. To begin, such a system must engage a range of technologies and media that are disengaged from the surface of the earth. Whether in the verticalization of farming via stacks of growing areas or the use of walls for farming, the use of hydroponic and green-house techniques, or even the use of "test-tube" technologies for growing "meat" without animals, providing enough food for New York's population will oblige the employment of techniques that bear little resemblance to the arcadian image of the family farm.

On the other hand, the need for such demanding ingenuities need not necessarily conduct the complete industrialization of our agriculture. The panoply of small-scale techniques of the urban farmer will be indispensable. Every available space must be engaged, ranging from the retrieval of the surfaces beneath the streets, the use of roof-tops, the grafting of window-scaled greenhouses to existing buildings, the conversion of yards to gardens, the use of cellars and basements, even the dedication of a portion of every apartment for aeroponic cultivation. Our parks must support agricultural productivity as must our waterways. And, we envision dramatic morphological shifts in the figuration of the city as a whole. There is also ample precedent for this, ranging from the small-scale intensification of urban agriculture in war-time to the recent - and similarly shortage driven – proliferation of agricultural production in Havana. In all of these cases, dramatic increases in output have been achieved within the context of fixed basic urban morphologies.

One more transformational prospect for New York is the possible consolidation of the least dense areas of the city into far more compact forms of settlement which will free-up large portions of the "outer" boroughs for farming. Likewise, we imagine that in a self-contained system such as we propose, the nature of the figure-ground relationship – the area of buildings in relationship to the area of streets and open spaces – can be dramatically transformed. As the city disengages from the automotive system in favor of walking, biking, and public transport, the area of street space required for mobility will contract substantially. We imagine that in many parts of the city, this space can be occupied by building and that buildings themselves will grow narrower to better conduce cross ventilation and solar access. This will mean that the area at the interior of our blocks – and we do propose to retain the block organization that is native to our urban culture – will be

substantially greater, yielding a much increased area for agrarian activity. Among other solutions, we imagine the possibility of a complete "figure-ground switch" in some parts of the city. Here, building will occupy the area now given over to roadways, leaving the present entirety of the blocks they define available for green uses.

Any serious attempt to build agricultural self-sufficiency within New York City will seriously compromise – for both good and ill – the traditional relationship of city and country with its commingled suspicion, reverence, dependency, and symbiosis. Raymond Williams has been one of the most lucid in investigating the cultural polarities of country and city that have developed over time. "On the country has gathered the idea of a natural way of life: of peace, innocence, and simple virtue. On the city has gathered the idea of an achieved centre: of learning, communication, light. Powerful hostile associations have also developed: on the city as a place of noise, worldliness and ambition; on the country as a place of backwardness, ignorance, limitation." Marx, of course, wrote famously not simply about the alienation of the city but about the "idiocy of rural life." A transformation of New York City into a newly "rurban" condition will clearly beg not simply technical and organizational questions but consequential social and ethical issues as well.

We locate the ethical vector in this investigation neither in questions of cultural difference nor in questions of cruelty (not to slight their importance) but in the ethics of distribution. Above all, this work is predicated on the practices of acting locally on behalf of global thinking: we seek to show the pathways of responsibility, to set a radical precedent, to raise expectations, and to goad dramatic invention. Scarcity is not an absolute but is defined in the relationship between available resources and the demand for them. But this relationship is not entirely straightforward. Availability is very different for a millionaire in Manhattan and a subsistence farmer in Botswana. And, demand is itself a cultural construct, something very different than the idea of need. Thinking globally conduces a more egalitarian ethic, a recognition that, as far as food supply is concerned, the game really has a zero sum. In the larger scheme of things, my gluttony – and my access to the concept and the possibility of achieving it – do diminish the prospects of my sisters and brothers in Botswana. The ethics of this proposition are therefore very much lodged in the idea of a just median. If we take care of ourselves without imposing demands on others, we begin to address these problems. But we must also be aware that if the system produces surpluses beyond some rational mean, we are confronted with another ethical dilemma in deciding about whether they should be distributed to those on the down side of the curve or whether they should contribute to the satisfactions of our own enlargeable personal desires.

This study approaches the question of distributive justice and inequality via the idea of bearing capacity. Part of the reason that our agriculture is so widely distributed springs from the uneven global distribution of soils, water, climate, and species. The soils of New England support a population of grazers. The Midwest is suited to its role as granary. The slopes of Tanzania are superb for coffee. But cultivation is not "natural" in the sense that it is the automatic result of the convergence of climate, culture, and necessity. Cultivation is always formalization, management, distortion. In the end, it is more important to shorten the chain and reduce inputs than to preserve some fantasy of the "natural" that can only be sustained with air-freight and petro-chemistry.

Finally – and non-trivially - the future of agriculture will doubtless struggle between a rising sense of the capacity and consciousness of animals with our evolutionary need to find more efficient means of delivering nutrition to ourselves. This study isn't predicated on the Peter Singer, animal consciousness, argument but perhaps on something more Rawlsian, a position more focused on equality of interests rather than characteristics.
Either way, this is to assert another dimension of the ethical and political investigation that triggers this research in the first place.

As any move to a more autarkic economy, self-sufficiency in food requires substantial transformations on both the demand and the supply sides of the food equation. To begin, the average American simply wastes close to a third of a pound of food per day. Not all of this is recoverable but even were one to hypothesize a rate of recovery of 5% - a tiny number - close to 150.000 New Yorkers might be fed on what is currently abandoned. Moreover, food waste – most of which winds up in landfills – is an enormous producer of methane, a greenhouse gas 23 time more potent than carbon dioxide. However, methane is a useful source of energy and its recapture has the potential to close yet another loop in the city's respiratory systems. The ultimate point, of course, is to eliminate the concept of waste.

Food waste is also water waste (and land waste, and energy waste, and….) and this occurs at virtually every stage of the process, from growing to processing to transporting, all of which are profligate users of water. Embodied water is also a crucial measure of the efficiency of any food system. For example, the amount of water embedded in the daily consumption of a typical American meat-eater is approximately 4000 gallons. A vegetarian requires about 300 gallons. Making the footprint more literal, an acre of land is required to produce 165 pounds of beef. The same area can be used to grow 20,000 pounds of potatoes. As scarcity becomes more and more of an issue, these divergences become more and more ethical.

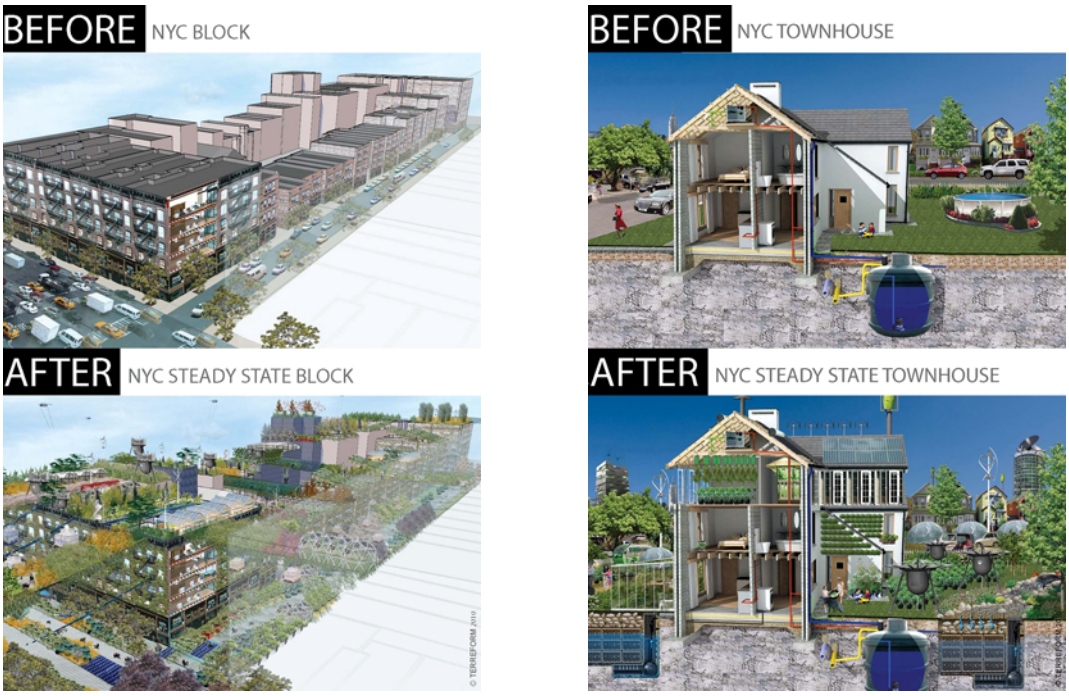
At current rates of consumption and with contemporary eating habits, the food footprint of New York City is around 7.1 million acres, about 36.4 times the area of the city as a whole. We consume (or waste) around 38.2 million pounds of food every day and only a near negligible quantity of this is produced in the city. Of course, not all imports are created equal. A kiwi from New Zealand travels 14,000 miles by air, has a water footprint of five gallons per fruit, and accounts for approximately .85 pounds of CO2, something like seven times the weight of the fruit itself. It takes about 295 joules of ecological energy to produce one joule of edible energy in shrimp. Clearly, a demand side consideration of the problem of feeding of New York is obliged to make distinctions among foodstuffs, based on embodied energy and water, on carbon and other emissions, on up and downstream contaminants, on embodied injustice in production, on nutritive value, on public health considerations, and on suitability for local production.

As an initial benchmark for measuring the city's nutritional requirements, we assume the U.S. Department of Health and Human Services standard of 2000 daily calories of food, distributed according to its current intake pyramid. New Yorkers currently eat an *average* diet of 2681 calories per day (those extra 681 us and, due to wastage this, requires an actual per capita input of about 3900 calories. A quick look at these numbers suggests that if we were to eliminate waste and reduce our caloric intake to the national standard, approximately HALF of New York's aggregated demand for food could be eliminated. The food footprint of 36 New York's could be immediately reduced to 20! This does not assume any transformation in agricultural methods or any gains that might be made from the extreme localization of production. Indeed, this assumes the continued consumption of dairy, meat, and other "inefficient" systems for the supply of protein and other nutrition.

Our first investigation of a self-sufficient food system proposes precisely this, a 2000 calorie diet based on current styles of consumption but with necessarily reduced quantities and 10% wastage, a fairly dramatic, but plausible, reduction. We have examined a number of ways to skin this cat. One possibility is the widespread utilization of vertical farming in any of a number of configurations currently proposed. According to widely-publicized research done by Gerard Despommier at Columbia University, a vertical farm of approximately thirty stories with and area of approximately one city block and utilizing intensive hydroponics, aquaponics, and animal husbandry, would have the ability to produce food for around 50,000 people. Such installations would have additional benefits in the production of energy, the recycling of water, the recovery of wastes, the elimination of run-off, etc.

A solution based purely on such a solution would require 183 such farms, distributed through the city, an area equivalent to that of Manhattan north of the George Washington Bridge. Alternatively, the number of vertical farms might be cut in half with the systematic conversion of currently vacant land and buildings, the utilization of green roofs, the elimination of parking lots, the recovery of 50% of existing street space (essentially the area currently given over to parking), and the utilization of a very large number standard barges for agricultural use. This adds up to about something on the order of 150,000 acres of space at grade. This does not include private yards and gardens nor does it take any currently occupied built space out of its current use.

Successive dietary transformations would progressively reduce the demand for space, technology, and radical morphological transformation. A 2200 calorie vegetarian diet, including eggs and dairy but eliminating meat could be provided by 115 vertical farms or 58 vertical farms plus approximately 100,000 acres of other spaces of cultivation, including vertical growing surfaces, fixed to existing structures. A fully vegetarian regimen would offer only a marginal improvement on this and either diet yield a food footprint from New York City of less than one third its current scale.



Vertical agriculture

While vertical farming represents a macro-technology for facilitating urban agriculture, a wide variety of other technical means – deployed at every scale – might be engaged to transform the productive character of the city. Vertical agriculture is, in fact, an elaborate refinement on greenhouse agriculture and the surface area available to enclosure throughout the city – on roof-tops, streets, abandoned rail rights-of-way, barges, park spaces, etc. – is enormous. The multiplier necessary to increase the cultivated area of the city is also susceptible to increase via low-energy artificial lighting, via the use of wall systems and window boxes, via low-input hydroponics, aeroponics, and via intensive aquaculture which can be located in spaces from basements (Japan is the world leader here) to a variety of pens in the city's waterways, and via the even more efficient emergent technology of aquaponics which unites hydroponics and aquaculture to make a more sophisticated and self-sustaining loop. Technical – and scalar - diversity is absolutely crucial to provide system resilience and to protect against the variety of failures that any system is susceptible to.

Although a variety of relatively sophisticated technologies are available for substantial increases in productivity, the example of a number of cities in which the deployment of much simpler means of intensification is tonic. As mentioned earlier, in Havana, the cruelties of shortage have resulted in a system of urban agriculture in which the premium is placed on the utilization of every available area of the city that might be turned to cultivation. A special intensive technique – "organoponicos" - has been employed throughout the city with the result that the city is currently able to provide of tk% of the its food requirements within its borders. This very high rate of internal production is reflected in a number of cities in China as well as the experience of many cities in wartime during which intensive small-scale cultivation has become normalized.

A self-sufficient food system would potentially ramify morphologically at every scale with an influence that could dramatically modify the character of city space in a variety of ways beyond its reconfiguration for intensive agricultural production. There are, for example, approximately three million households with kitchens and this, in aggregate amounts to several hundred million square feet of space. When restaurant and other collective kitchens are added to this as well as spaces devoted to the processing of raw foodstuffs, the aggregate easily surpasses half a billion square feet of space. Additionally, we can speculate about a logical multiplier to account for the current logistical needs of food distribution both within the city – the wholesale markets, supermarkets, and bodegas; the roadway and other transport infrastructure; the waste recovery and removal systems; etc. – that would surely bring the literal area required for food preparation, distribution, and management to an order of magnitude of a billion square feet.

Given the likely demographic shifts that will occur in the next decades – nuclear family living arrangements are already a minority component in household hierarchy in the United States – the re-configurability not simply of residential structures but of a variety of single-use buildings – from offices to factories – harbingers a distinctive new set of formal possibilities for both physical and social architecture. This new urban architecture is likely to be radically mixed in use – at building, block, and neighborhood scales – as well as far more autonomous in its incorporation of the various aspects of urban respiration at the local scale. Our expectation is that these new architectures will not simply embody the production and preparation of food in increasingly collectivized ways but that questions of waste, water, energy, manufacture, building, climate, movement will increasingly become crucial components of urbanism at every scale and always with an eye to closing loops as locally as logical.

Such a system will, we stress once more, engender a fundamental alteration to the fundamentals of our individual relationships to food and its production. Today, we are spectators, whether at the pristine and invisibly prepared product on the supermarket shelves or at restaurants where we get clean, prepared meals which betray nothing of their origin in toil and soil (never mind the tiny logo on the menu identifying some product as local or organic or low-cal). Part of the mission of this "steady-state" research is precisely to build a stronger relationship to food, to enhance both responsibility, self-control, and the power of the collectivity. By moving production and consumption closer together, we hope that many new forms of food-focused conviviality and process can grow.

At the largest scale, the impact of a self-sufficient food regime will dramatically re-weight the distribution of hardscape and landscape in the city. Every apartment will bristle with green. Streets will disappear and be replaced by farms and greenhouses. Rooftops will offer a "second grade" of agricultural, recreational, and other respiratory spaces. Green bridges will link buildings. The waterfront will reawaken as a zone of food and other production. Vast areas of private yards gardens will be remade as small-scale agrarian plots. Parks will become productive. Rail rights-of-way will be utilized as linear farms. Low-density areas of the city will be consolidated to free up surplus territory for agriculture. The newly needless infrastructure of highways will disappear, freeing up hundreds of square miles for new uses. A great green grid will dominate the form of New York and nobody in the city will be out of sight of the place where the next meal is coming from.