

Urban Agriculture on the Rooftop

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The Rossetties liked to cultivate pharmaceutical plants up on the roof, a few of them hardy enough to survive fogs and frosts, but most returning as fragments of peculiar alkaloids, to rooftop earth, along with manure from a trio of prize Wessex Saddleback sows quartered there by Throp's successor, and dead leaves off many decorative trees transplanted to the roof by later tenants, and the odd un stomachable meal thrown or vomited there by this or that sensitive epicurean – all got scumbled together, eventually, by the knives of the seasons, to an impasto, feet thick, of unbelievable black topsoil in which anything could grow, not the least being bananas. Pirate, driven to despair by the wartime banana shortage, decided to build a glass hothouse on the roof, and persuade a friend who flew the Rio-to-Ascension-to-Fort-Lamy run to pinch him a sapling banana tree or two, in exchange for a German camera, should Pirate happen across one on his next mission by parachute.

Gravity's Rainbow (5). Thomas Pynchon 1973.

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Introduction

Rooftops are places of fantasy and imagination – places that sit above the din and chaos of the city, engaged with and yet apart from the city’s motion. Rooftops yearn for the sky and yet are grounded to the city through the buildings which they top. What better place could there be for a garden? Or even better, a garden and a source of food? In this thesis, I will explore the topic of rooftop agriculture, one that has little comprehensive literature written about it. I will examine case studies and the potential for the expansion of roof gardens, as well as barriers to their successful implementation.

Cities have effectively driven out agriculture from their boundaries. Food systems today seem more and more nonsensical – the number of farmers is in constant decline, as large agribusinesses win the majority of government subsidies and increasingly learn ways to combine petroleum (or mechanization) and grossly underpaid migrant labor into food. Food arrives in the city from hundreds of miles away. It is often neither fresh nor good. Pesticides and preservatives may also diminish the health value of produce.

There is an urgent need for more sensible food systems. A countervailing movement in organic and local produce branches from the dominant agricultural trend. This movement is closely linked to the idea of food security, a term established at the 1996 World Food Summit, referring to the availability of "safe, nutritious, personally acceptable and culturally appropriate foods, produced in ways that are environmentally sound and socially just."¹ The United States Department of Agriculture (USDA) published a report in 2000 stating that a total of 31 million Americans were food-insecure

¹ Rabinowicz, 2002. See bibliography throughout for more detailed citations.

in 1999, including 12 million children.² According to Nobel Prize-winning economist A.K. Sen, famine is not typically a product of inadequate food supplies; rather, it is more a consequence of the avoidable economic and political factors that lead to poverty and inequality.³

One of the most vital components of this movement towards increased food security is a system of grassroots urban agriculture, grounded in community and school gardens. While urban agriculture cannot be relied upon alone to reduce hunger, it should be an important component of a comprehensive system of food security. Individual urban food production rarely confers self-sufficiency; more often it is a means to supplement one's diet with safe and adequate food. Through urban agriculture, city residents can learn to sustain themselves with food that they have produced with their own hands, but if urban food production is to reduce hunger and poverty, then it must also be part of a broader strategy.

Ultimately, urban agriculture should be coupled with other reforms aimed at reversing the concentration of agricultural production into fewer and fewer hands. This means supporting not only initiatives for urban agriculture, but also supporting small local farms and working to transform an unjust agricultural system in which large agribusinesses are subsidized at the expense of small farmers in and outside of the United States, and in which fossil fuel use and mechanization are overused, at the expense of global environmental and social health, in part because of perverse taxes and subsidies. Agricultural mechanization was widely implemented throughout the world during the "Green Revolution" of the 1960s and 70s, when the creation of improved wheat, rice, and

² Ibid.

³ Sen, 1981.

corn that were more responsive to controlled irrigation and petrochemical fertilizers allowed for more efficient conversion of industrial inputs into food.⁴ As a result of the new seed varieties of the Green Revolution, agriculture globally produces tens of millions of extra tons of grain a year.⁵

Some celebrate the Green Revolution for having saved millions of lives from starvation by increasing agricultural productivity, and others lament it for having reduced agricultural sustainability and global environmental health. The issue is indeed complex: agricultural mechanization seems an inevitable product and continuation of the Industrial Revolution, and the reasons for its development are both good and bad. But we need to be aware of its dominance and effects, both direct and indirect. According to World Bank and Business Week analyses cited by Food First, global hunger has actually increased since the Green Revolution, proving that the increased outputs made possible by agricultural industrialization do not seem to solve problems of world hunger, as inequality and poverty prevent an appropriate distribution of food.⁶ Wealthier farmers gain control of agriculture when the viability to succeed competitively depends upon purchasing expensive inputs. Not only does this harm small-scale, local agriculture and waste fossil fuels, it also seems to adversely affect health and food security. In North America, the average food product in the supermarket has traveled 1400 miles before ending up on the shelf.⁷

Urban gardens can provide a forum for community connections in addition to the produce that they can provide. Urban gardens often serve as purveyors of tradition for

⁴ Collins et al., 2000.

⁵ Ibid.

⁶ Ibid.

⁷ Rabinowicz et al., 2002.

immigrant communities, for instance when immigrants are eager to continue agricultural traditions that they left behind in their native countries. Community gardens may offer immigrants the opportunity to grow food that they are otherwise unable to access in North America. Urban gardens can serve as urban oases -- as vital green spaces that offer city residents a respite from the concrete along with opportunities to connect with the dynamic lifecycles of a garden.

Rooftops are often places of privilege; top floors of buildings often turn into penthouse apartments for the rich. The heights of buildings are frequently rarified spaces. This distinction follows a classical notion of hierarchy, illustrated by a pyramid – the peak can be an untouchable, extraordinary space that floats above the masses. This makes sense. Height means distance from the masses of the city. Height for skyscrapers confers prestige on a business that calls the building its own. Height is distinction. Height is fresh air and escape. Rooftops can flatten the hierarchy when they are accessible to all and particularly when they hold community gardens.

Rooftop gardens, as a specific urban agriculture niche set within a broader system of city gardens, enjoy their own set of distinctive benefits. Rooftops are underutilized and rarely-considered urban spaces with great potential for creative development. There are essentially three options for rooftop gardens. The first is container gardening, a less formal, cheaper form of roof gardening. In container gardening, few to no modifications are made to the existing roof structure; containers – anything from plastic swimming pools to recycled-wood planters – are placed on a rooftop and filled with soil and plants. The second type of roof garden, in which the rooftop actually becomes the planting medium, involves more intensive investments, but comes with its own set of advantages,

including greater storm-water retention, building insulation, and the formation of patchwork urban “stepping stone” ecosystems, which work to reverse the fragmentation of ecosystems that follows urbanization by offering temporary habitats to fauna such as birds and butterflies during their long migrations. The third rooftop garden possibility is rooftop hydroponics, in which plants are grown in a soilless medium and fed a special nutrient solution. Rooftop hydroponics can be the lightest of the three options and may offer the possibility for faster plant growth and increased productivity.

Overview of the Literature

In my review of the literature, I found websites such as www.greenroofs.com and journals such as The Green Roof Infrastructure Monitor devoted entirely to the subject of green roofs. English language forums for green roof research and discussion have expanded at an incredible rate since the development of a green roof industry in North America beginning largely in the 1990s. I also found websites such as www.hydrogarden.com and books such as Howard Resh’s 1995 Hydroponic Food Production that are devoted to hydroponics, as the subject also enjoys a structure of industry support, although in this case the subject has been studied and developed in English since the 1940s. Many books are also devoted to container gardening, including Anthony Atha’s 2000 Container Kitchen Garden. Topics in international urban agriculture are examined in forums such as Urban Agriculture Magazine and by scores of local and national organizations, including Food First and FoodShare Toronto.

To the best of my knowledge, however, there is no thorough, comparative literature about rooftop food gardens. The topic is explored here and there, for example,

in articles published in The Green Roof Infrastructure Monitor, posted on the website of City Farmer, Canada's Office of Urban Agriculture, or written for Urban Agriculture Magazine. These articles are mostly of two types: some general and speculative, citing the possibilities for rooftop agriculture, while others are specific and locally focused, examining the development and practices of one rooftop agriculture project. I will discuss many of these projects later, in my case studies section. I found two notable exceptions, student projects distinct from the other literature because they are research projects that attempt to evaluate the broad potential for rooftop agriculture. Robin Kortright at Trent University developed and tested an agricultural plot on a green roof at Trent in 2001, while Joseph St. Lawrence at York University created a partially hydroponic container garden on the roof of a Toronto warehouse, while marketing the lettuce he grew to test the viability of the project as a business venture. York and Trent are both Canadian universities.

Joseph St. Lawrence's project was part of his requirements of the Masters Degree of Environmental Studies that he completed in 1996.⁸ Mr. St. Lawrence began a lettuce growing business on the roof of the Field to Table warehouse in Toronto. In 1997, his project turned into a business called Annex Organics, which successfully produced and



Field to Table Roof Photo Courtesy Laura Berman

marketed organic heirloom tomatoes until the company was absorbed by Field to Table, which merged with FoodShare Toronto. For a few seasons, FoodShare used the rooftop produce for its Good

⁸ St. Lawrence, 1996.

Food Box program, a marketing and distribution system for fresh, local, and affordable agricultural products, but inadequate load requirements of the roof meant that the garden had to be disassembled every fall and reassembled every spring. Because the work was colossal, FoodShare workers were happy to receive a parcel of land that could serve for growing their Good Food Box in place of the warehouse rooftop, although the roof still holds a small greenhouse that FoodShare uses for seeding.⁹ Mr. St. Lawrence concluded that although rooftop agriculture has potential for restaurants or catering companies that might grow specialized produce on their own rooftops, roof gardens that must be moved during winter are not viable, since they require too much work and too few returns.

Robin Kortright, as an undergraduate in Trent University's Environmental Studies program, established an experimental vegetable garden on the green roof of the Trent University Environmental Sciences building.¹⁰ She monitored soil temperature and moisture, as well as crop health, quality, and productivity, planted a 7.5 by 30 meter plot of radishes, beets, lettuce, carrots, onions, corn, beans, potatoes, cucumbers, and squash, and donated her produce to the local YWCA for distribution to food banks, missions, and halfway houses. Ms. Kortright also conducted taste tests with her roof produce, but with only nine participants, her results were not conclusive. To gauge productivity, Ms. Kortright compared the productivity of her plot with data on provincial yields from the Ontario Ministry of Agriculture, Food and Rural Affairs, although admitting that the Ontario figures may not be appropriate comparisons, as they are those of experienced farmers who have worked for years to maximize productivity. Some of her crops yielded more per square meter than ministry totals, but overall, the rooftop yielded only 26.7

⁹ Berman, 2003.

¹⁰ Kortright, 2001.

percent of commercial production standards. Ms. Kortright concluded that although rooftop food production may not yet be viable in a broad commercial sense, it may be viable with the incorporation of green roofs into a greater portion of the urban landscape.

Overview of Roof Garden Benefits and Challenges

Cities give off heat. Rooftop plantings can interact with the heat produced by the city in a couple of ways – plantings can work to cool buildings by insulating and shading them; the heat produced by buildings can also work to extend the garden’s growing season. Rooftops plantings can reduce the money spent on heating and cooling buildings, as well as improving urban air quality. Reduced energy usage also reduces greenhouse gas emissions. According to the Canada Mortgage and Housing Corporation’s *Greenbacks from Green Roofs: Forging a New Industry in Canada*,¹¹ plantings on roofs and surrounding buildings can reduce heating in winter by 25 percent by protecting buildings from the wind, and they can cut air conditioning in the summer by 50 to 75 percent.

The urban heat island effect explains the six to eight degree heat increase in cities as compared to the surrounding countryside. The heat island effect is a product of cities’ hard, mostly absorbent, brick, stone, and blacktop surfaces, which absorb and retain heat. Studies have shown that white or lighter color rooftops make a remarkable difference in terms of mitigating the heat island effect because they reflect rather than absorb heat;¹² the evapo-transpiring surfaces of green roofs do an even better job because they replace a

¹¹ Peck, Steven, et al. 1999

¹² Goldsmith, 2003.

city's hard surfaces with living, breathing surfaces that effectively process and diffuse heat rather than reflecting or absorbing it.¹³

According to their proponents, green roofs also have a remarkable ability to retain and utilize rainwater. While urban runoff typically works to (harmfully) dilute and transport urban pollutants into the watershed's streams, lakes, and soil, that runoff is diminished by rooftop gardens, which retain 70 to 100 percent of the precipitation that falls on them in the summer and half that much in the winter.¹⁴ This may decrease a city's wastewater infrastructure costs. Plants also work as an effective pollution filter, effectively removing, according to *Greenbacks From Green Roofs*, as much as 95 percent of heavy metals such as cadmium, copper, and lead from runoff.¹⁵ Urban plantings additionally improve urban air quality by trapping and absorbing nitrous oxides, volatile organic compounds, and airborne particulate matter.¹⁶

Rooftop gardens overcome the problem of restrictive land costs and the pressure that many urban gardens face from competing land uses like housing developments. It takes a mental tweak to imagine, but cities can be seen as expanding land surface rather than destroying it – not only do buildings have flat roofs, but they also typically have four other surfaces that can serve as growing space for vining plants.

In Switzerland and parts of Germany, this kind of mental shift – resulting in imagining buildings as displacing and not destroying land surface – has become federal law: developers must either improve the biodiversity of existing land, or transfer the

¹³ Cheney, 2003.

¹⁴ Peck et al., 1999.

¹⁵ Ibid.

¹⁶ Ibid.

green space that they displace to their rooftop or other building surface.¹⁷ Even old buildings are required to transfer one-fourth of the land they have displaced to their roofs.¹⁸ In 1989, Stuttgart, Germany passed a municipal by-law requiring all flat-roofed industrial buildings to install green roofs, and Mannheim has passed a similar by-law.¹⁹ Germany's green roof industry has expanded an average of 15 to 20 percent annually since the 1980s; by 1989, 1 million square meters of roofs had been greened, and by 1996, the number had grown to 10 million square meters.²⁰ In total, over 80 German cities offer incentives to builders for green roof construction.²¹ Because of federal and municipal incentives like these, green roofs have become a multi-million dollar industry.

The impetus for growing food on rooftops also derives from the scarcity of urban land, as well as tremendous pressure for the development of urban lots. Where community gardens have succeeded, garden plots are often disappointingly small. Even these overwhelmed community garden spaces are subject to pressure for other land uses, particularly housing and commercial developments. Rooftops never face this pressure – as long as a building stands, its rooftop is available. And once a rooftop has been developed for gardening, it remains that way, as long as the garden is designed in a fashion that does not require deconstruction if the roof needs to be repaired. Community gardens are also not always in convenient locations; gardeners may have to drive to reach their garden plot. Roofs of course are – they top every building, and can therefore be closer to places of residence. Rooftop accessibility, though, is a major concern, because most existing rooftops are not meant to accommodate visitors with the exception of

¹⁷ Green Roof Industry Support, 2004.

¹⁸ Peck et al., 1999.

¹⁹ *ibid.*

²⁰ *ibid.*

²¹ Green Roof Industry Support, 2004.

occasional servicing. For rooftops to be accessible to elderly and handicapped individuals, provisions have to be made for elevator service and roof railings.

Roofs are also free from the threat of ground-level pests and vandals, major concerns to any traditional gardener. Community gardens in cities, particularly, often cite vandalism and theft as one of their major problems, and are ultimately forced to fence and padlock their gardens. Community gardeners can deal with theft creatively, for example, in Toronto, by growing an extra patch of food for those who might need it, with a sign saying, “Take food from this patch only if you need it.”²² But roof gardens can provide relief from the pain and extra work caused by garden vandalism, since vandalism is one thing roof gardeners rarely need worry about.

The extent to which green roofs can absorb rainwater is directly correlated to the amount of surface area that they cover, and to their soil depth. Since, according to Colin Cheney of the Earth Pledge Foundation, most rainstorms are less than one inch of rainfall, even shallow green roofs can usually effectively absorb rainwater.²³ Other systems, both on rooftops and at grade-level, can also absorb urban rainwater, and might confer similar savings to the city in terms of the reduced need for storm water infrastructure. These include “wet roofs,” which like green roofs are rooftops made to hold water, and parking lots as well as parks which are built to retain storm water.²⁴ Still, none of these other methods have the additional benefits that green roofs do -- namely in aesthetics, urban heat island mitigation, air quality improvement, providing wildlife habitat, enhanced roof membrane life, and the removal of pollutants from storm water.

²² Berman, Laura et al.

²³ Cheney, 2003.

²⁴ Spirn, 1984.

Rooftop greening also has aesthetic appeal, and offers the potential for health and horticultural therapy, particularly for hotels, hospitals, and prisons. Access to and even views of green roofs can increase property values, as well as increasing worker productivity and creativity. Le Corbusier and Frank Lloyd Wright, both icons of modern architecture, used roof gardens in their work; Le Corbusier in fact advocated roof gardens as one of the five points of his new architecture, both because they restore green space lost by building construction and because they offer a private natural haven for residents.

Many of these green roof benefits are, of course public, i.e. they are positive externalities; as a result there is a problem of encouraging public and private building owners to pay for their costs. This means that green roofs will likely become widespread only when there are public incentives for their installation. These might include subsidies and grants, or allowances for builders to construct extra stories in exchange for including a green roof in the building plan.

Methods

In this section I will give a brief overview of the methods I used for research; in the following sections I go into more detail, first with the three different types of roof gardens and then with specific case studies, some of which I have seen first hand, and others about which I gained knowledge through reading. My varying knowledge of the case studies is apparent from what I list as sources: for the gardens which I have seen first-hand, my information largely comes from personal interviews and observation. For those sites which I have not seen, my sources are articles and web materials.

During fall of 2003, I sought to find examples of rooftop agriculture in the United States and Canada to visit and to study in more depth than reading articles and conducting telephone interviews would allow. Because of location and specific leads that I was given after contacting a number of organizations and searching the internet, I decided to visit Toronto and New York City, the city governments of which are both moving towards developing green roof policies and which boast some of the only examples of rooftop agriculture in the U.S. and Canada. In Toronto, I set up meetings with Jane Welsh, a city planner who works on green roof policy, Wayne Roberts, a staff member at the Toronto Food Policy Council who has written about green roofs in addition to food policy, and Laura Berman, community garden coordinator for FoodShare and one of the founders of the now-defunct Rooftop Gardens Resource Group. I chose to contact these specific people based on suggestions from Mike Levenston of City Farmer, Canada's Office of Urban Agriculture, and from Ireen Wieditz and Angela Loder of Canada's Green Roofs for Healthy Cities Coalition.

With Laura Berman, I visited the 401 Richmond roof garden, a well-known and successful Toronto roof garden that includes an agricultural aspect which produces herbs and vegetables for the building's café. Ms. Berman also showed me FoodShare's small



Laura Berman in the FoodShare Roof Greenhouse

rooftop greenhouse, which is the only surviving aspect of a larger rooftop agricultural project that ended when FoodShare was given a piece of land on which to raise their produce. In addition, upon the

suggestion of Jane Welsh, I met with Peter Carr-Locke, a manager at the Mountain

Equipment Coop, who gave me a tour of the store's green roof. I hoped to see the roof at the Royal York Fairmount Hotel, where the hotel's chefs grow herbs and claim to save about \$20,000 Canadian every year in costs. Unfortunately, I could not get permission to go onto the roof, because the woman who could have granted the permission was out the day that I visited. Because I visited on the weekend, I also missed weekday visiting hours at the Toronto City Hall green roof, but I spoke with Laura Berman and Wayne Roberts about the project.

In New York City I met with Colin Cheney, Green Roofs Initiative Director at the Earth Pledge Foundation, who talked with me about Earth Pledge's campaign to transform New York's rooftops and showed me the organization's small green roof and kitchen garden. Earth Pledge is at the forefront of efforts to green the city's roofs, and has one of the city's only rooftop agriculture projects. I also went to Eli's at the Vinegar Factory, an Upper East Side Manhattan Deli and Grocery Store with a major rooftop greenhouse, which is visible from the street and produces tomatoes, herbs, and salad



Eli's at the Vinegar Factory

greens year round for sale in the grocery store. I had learned about the Eli's greenhouse first from a New York Times article detailing creative uses of New York's rooftops.²⁵ Unfortunately the man who cares for the greenhouse, the only person who could have given me permission to go onto the roof, was out of work for weeks, and I was not able access the greenhouse. The store manager gave me the contact information for the

woman responsible for ordering from the rooftop greenhouse. When I called the woman

²⁵ Brick, 2003.

with my questions, she asked me to email her instead. Although I emailed her repeatedly with my questions, she never responded.

My efforts to see and study actual roof gardens, and to speak with roof gardeners, were met mostly with incredible generosity – most of the people I contacted for information were helpful and enthusiastic about the project, while only a few neglected to return emails or phone calls. My visiting schedule, of course, was far from ideal in relation to the work week; I was limited by my class schedule, which left only weekends open. Additionally, I saw the gardens in October, rather than during the peak of the growing season, and I was only able to make one visit each to Toronto and New York.

For the international case studies, I chose to examine the most interesting and innovative rooftop agriculture projects that I came upon in my research. The information for most of these – Australia, Senegal, Russia, and India, came from articles in Urban Agriculture Magazine. Information about Montreal came from web articles, mainly one posted on the International Development Research Center website. I examined the case of Italy while studying with the Cornell-in-Rome Program during spring of 2004, learning about renaissance villa gardens and Roman monuments during classes and field trips and speaking with Barbara Saura of Arte Continua about Marjetica Potrc's roof garden project in Siena, although I was not allowed to access the garden itself.

In the fall of 2003, I began having conversations with Erica LaFountain, a friend of mine majoring in Natural Resources at Cornell, about our mutual interest in roof gardens. Erica decided to do an independent study on roof gardens during the spring of 2004. Erica and I realized that we could combine our knowledge and efforts to build a roof garden in Ithaca. Although I would be studying in Rome during the spring semester,

Erica and I wanted to work together to plan the roof garden, and to find a roof for it. We wanted the roof garden in Ithaca to serve the ends which we were passionate about – creating a more sustainable food system based on organic, local agriculture, opening an underutilized urban space to the community, and bringing environmental and particularly agricultural processes, directly into the community where food is bought and consumed. Our hope was that Erica would go on to build and establish the roof garden in the springtime, and I would continue my research in Rome and Europe.

I learned from Professor George Frantz that Cornell's new west campus plan included green roofs atop the dining halls. After meeting with Andrew Magre, project architect for Cornell's new west campus construction, I realized that the planned dining hall green roofs could not serve for our rooftop agriculture endeavor as I had hoped, and that we would instead have to continue to look for another roof space. We decided to pursue a roof garden project at Ithaca's Greenstar Cooperative grocery store. After months of hard work trying to begin the project, Erica found an engineer to appraise Greenstar's roof structure. Unfortunately, the project was halted when the engineer found that the roof, which was constructed before Ithaca's increased snow load requirements were enacted, could not support the weight of a garden. Realizing that more research must be done if roof gardens are to become more widely applied, Erica instead decided to conduct roof garden research on the roof of Seeley-Mudd Hall at Cornell, a space which is available for plant experiments. Although we were disappointed that we were not able to realize our plan, we have learned a great deal, and our work has been a fascinating, very personal study of the barriers to roof gardens.

Container Gardens

Many people already garden in containers on porches, balconies, fire escapes, rooftops, and window boxes – whatever outdoor space that they have available.

Ornamental container gardens are common on hotel and restaurant rooftops. Roof container gardens hold any number of ornamental plants; they can also hold almost any kind of food plant given large enough containers. Container gardening has many uses; it is a highly flexible form of gardening that is especially effective for urban settings, because it avoids problems of inaccessible or questionable soil. While the soil of some empty lots may contain toxic chemicals, and the spaces are thus unsuitable for growing food, the soil in container gardens can come from an area known to have healthy soil, and this can be supplemented with compost produced from the garden's organic wastes as well as additional organic wastes produced within the building.

With containers, plants can be grown anywhere. These nontraditional gardens do not require access to the ground; they only need a vacant space, on any kind of surface, such as a concrete sidewalk or gravel rooftop. Containers can be made with the kinds of materials that are available anywhere – like plastic buckets, scraps of wood, old shipping crates, or large sacks. Container gardens are also mobile, so when they are placed on a roof, the original roof surface is easily accessible if any maintenance or repairs need to be made. And most any modern roof, especially those in temperate climates, is required to be able to support a snow load that is comparable to the weight of a roof garden.

Even if roofs are not built to hold gardens, then, they typically can, at least during the growing season, without the added weight of snow. The support capacity of existing buildings, of course, should be verified by an architect or structural engineer before a

rooftop garden is built. With rooftops of questionable strength, container gardens can also be removed during the snowy season, therefore avoiding the combined load of containers as well as snow. For unimproved rooftops, the heaviest containers can be put at the edge of the roof, near columns which are meant to support much of the structure's weight. Moving heavy containers at the beginning and end of each winter can be a great deal of work, especially with large gardens. Perceived limits of roof loading are still the main barriers to roof gardens – there is understandably caution for using rooftops because of fear of building and roof damage.

But container gardening, if allowed, is an excellent option for many non-commercial urban rooftop gardens, particularly for people who lack the means or the will to make changes to the actual structure of the roof. Containers also have the advantage of providing large space (depth-wise) for soil and roots, which is difficult to obtain with extensive green roof systems.

One of the most significant challenges of container gardening, according to Laura Berman, the community gardens director of FoodShare Toronto,²⁶ is that containers freeze and thaw relatively easily. Ms. Berman has had many gardens, but because she has always lived in the city, her gardens have always been in containers and on balconies or rooftops. The garden of her last apartment was on a 50 by 20-foot rooftop. During the growing season, she was able to grow more than enough produce for herself and her husband.

According to Ms. Berman, the soil in rooftop containers might thaw on a warm winter day, when the strong rooftop sun effectively tricks perennials into germinating as if it were spring even though the winter is not yet over. The plants, then, begin to grow

²⁶ Berman, 2003.

but die when they cannot yet survive the cold nights. Rooftop gardeners, additionally, must choose containers that can survive harsh winters. Although gardeners might prefer terracotta pots to plastic, metal, or wood, for example, terracotta often cracks during the freeze and thaw cycles of winter, and needs to be brought inside if it is to be protected. Because terracotta is porous, terracotta pots also lose moisture too easily, which is a problem on rooftops, where the harsh environment dictates that gardeners use containers which hold moisture. Wood, plastic, or metal containers generally survive the winter better, and hold soil moisture quite well. The constant freezing and thawing of the soil can also be mitigated by insulating containers with a material such as Styrofoam sheets.

Extreme rooftop temperatures and the smaller soil volume of containers, as compared to the ground, also mean that roof container gardens dry out quickly and often require daily watering. A mulch cover such as straw, wood chips or even a sub-soil layer of newspapers and compost can help to prevent the rapid drying of container soil by slowing evaporation and shading the soil. Containers without drainage holes obviously hold water better than those with drainage, but gardeners must also be careful of rotting.

Green Roofs

Green roofs are an entirely different subject than container gardens; they form the basis of an entire, up-and-coming industry of architects, designers, builders, and manufacturers who advocate – and make their work out of – green roofs. Green roofs are the fancier, more expensive cousin to rooftop container gardens. While normal roofs cost about ten to fifteen dollars a square foot, green roofs cost roughly fifteen to thirty-five dollars per square foot, which doesn't include the cost of structural renovation sometimes

necessary for roof greening projects.²⁷ Prices vary according to the type of system used as well as the choice of union or non-union labor. All green roofs have an impressive set of benefits in common, but vary in their other attributes. Many green roofs are built to be inaccessible, and to require very little or no maintenance. Green roofs are constructed using a special root and water-proof membrane for the base layer, then a root barrier, a retention/drainage layer, plus the soil layer, and finally the plants.

Alpine plants or desert succulents are often used for green roofs, as they are adapted for the thin, rocky soil of mountains or deserts and can withstand the sometimes-harsh rooftop conditions like wind, erosion, and extreme temperature. Native plants are also used for rooftop plantings, because they are adapted to the specific area, and should not require extensive watering or maintenance. Ecologists, furthermore, encourage the use of native plants because they are ecologically sound, conserve the native habitat and counter the invasion of harmful non-native plant species. But, judging from the failure of Toronto City Hall's Black Oak Savannah roof garden plot,²⁸ some native plants are not appropriate for certain types of roof gardens.

The only maintenance that many of these green roofs need is to have tree seedlings pulled out periodically. The green roof industry has effectively solved one of the major challenges of green roofs – during the initial phases of the green roof industry, there was concern that green roofs made access for roof infrastructure maintenance too difficult and expensive. In response, the industry created a modular green roof system, which makes roof infrastructure access much easier because parts of the roof can be moved independently. Contrary to popular belief, any kind of rooftop planting, if done

²⁷ Cheney, 2003.

²⁸ Wilson and Pelletier, 2003.

appropriately, can work to protect the actual roof surface by keeping it unexposed to the elements, thus extending roof life. According to a green roof article in “Environmental Building News,” typical membrane roofs in a temperate climate need to be replaced every ten to twelve years because of membrane wear and damage from extreme temperatures, ultraviolet light, hail, and other natural forces, green roof component manufacturers claim that green roof membranes last two to three times as long.²⁹ The European green roof experience supports these claims, but because green roofs are a recent phenomenon in North America, more time is needed before the claims can be verified. Of course, while green roof membranes should last longer, fixing them is more expensive, even with a modular system.³⁰

Because rooftop environments are far from uniform, although certain principles are universal, more information is needed about specific North American rooftop conditions for green roofs to become widely implemented. Research so far has clarified and quantified green roof benefits, giving municipalities more reasons to draft green roof policy incentives and giving a handful of developers reasons to pay the high overhead for including green roofs in their building plans. Here I will highlight just some of the research being conducted on green roofs in North America, with attention to the variety of roof garden benefits being monitored and stressed. Although the history of green roofs in North America is brief, green roof research has undergone a drastic increase since the start of the 21st century.

At Pennsylvania State University, Dr. David Beattie has developed a Center for Green Roof Research to “demonstrate and promote green roof research, education, and

²⁹ Ibid.

³⁰ *ibid.*

technology transfer in the Northeastern US.”³¹ The research facility is made up of a series of six small shed-type buildings, three of which have green roofs. The buildings are fitted with temperature sensors and are monitored for heat flux, storm water runoff, and nutrient filtration. Research projects at the center include the development of computer aided storm water management design tools and testing protocols for North American roof systems and conditions.

In New York City, beginning in spring 2004, the New York Ecological Infrastructure Study will investigate the stormwater benefits of green roofs in New York; the study aims to develop integrated stormwater models for lower Manhattan.³² The models will be based on the development of a 40,000 square foot green roof at Pace University. The roof will be used for recreation and research and will be the city’s largest green roof. The world’s largest green roof, in comparison, is the 12-acre green roof that tops the Ford Motor Company’s Rouge Complex plant in Dearborn, Michigan, a project that was designed by architect William McDonough and Partners.

The city hall green roofs in Atlanta, Chicago, and Toronto were all built in part as research projects for monitoring. Atlanta’s City Hall rooftop, built in 2003, is monitored for temperature reduction, energy efficiency, stormwater retention, and membrane life. Chicago City Hall’s semi-extensive green roof was completed in 2001 as part of the EPA Heat Island Initiative; as a result its monitoring focuses on temperature differences between the green roof and hard roof surfaces. At Toronto City Hall and the associated project at Toronto’s Eastview Community Center, temperature, heat flow, and soil moisture content are monitored as part of Environment Canada’s urban heat island study.

³¹ About the Center, 2004.

³² Cheney, 2004.

That these municipalities have developed green roof research programs to suit specific local concerns is encouraging, as it is a move towards developing a comprehensive set of policy incentives that might serve to encourage the expansion of green roofs.

Hydroponics

Hydroponics is a means of growing plants with a substrate other than soil – possibilities include peat, sand, gravel, old rubber tires, rockwool, perlite or vermiculite. A nutrient solution is used to water the plants. While purists argue³³ that hydroponics by definition uses only inert growing media, such as those already mentioned, simplified hydroponics systems, like those advocated by the Institute for Simplified Hydroponics, may use compost instead, which is nutrient-rich, and, in soil-based agriculture, is used as a soil amendment. The purest form of hydroponics is water culture, in which a plant's crown is supported by a thin layer of substrate, while its roots are immersed in a nutrient solution.³⁴ Although it is a system often overlooked in discussions of roof gardens, Hydroponics is a method well-suited to rooftops, since the containers used in hydroponics can be lighter-weight than soil-filled containers, and since hydroponics systems can be quite mobile.

Plants require light, food (nutrients), carbon dioxide, water, heat, and fresh air. Soil typically provides plants with their necessary nutrients. As every gardener knows, potassium, nitrogen, and phosphorous (NPK) are the main limiting factors for plant growth. Although soil-based nutrients are often not in forms that are usable to plants,

³³ All traditional hydroponics organizations, for example the American Institute of Hydroponics, use this definition.

³⁴ Hydroponics, 2004.

they are made available by the processes of microorganisms, as well as any fertilizers that might be used. Deficiencies in the soil, of course, are why fertilizers are used in most kinds of agriculture. In the case of hydroponics, the growing medium is inert, that is, without nutrient value; its purpose is simply to support the plant and its root system, and to hold some moisture around the roots.

Using a growing medium with some nutrients, such as compost, allows for a more simplified hydroponics because it makes the nutrient solution slightly less essential. While commercial hydroponics systems require careful calculations to formulate nutrient solutions, in simplified systems for popular use, such exact calculations should not be necessary. In any case, a nutrient solution made directly and readily available to roots partly or entirely takes the place of nutrients in the soil. The nutrient solution is cycled through the growing medium.

Commercial and popular hydroponic systems vary a great deal in their costs and requirements. Commercial hydroponics is considered a specialized science, while simplified hydroponics is practicable by anyone. Commercial hydroponics is often resource and capital-intensive, while simplified hydroponics is cheap and straightforward. Hydroponic systems can be divided generally into two groups – passive and active systems. Passive systems are the most simple, and the cheapest, requiring only a container with drainage, a tray that holds liquid, and a growing medium. Plants are hand watered with the nutrient solution and soak up the solution via capillary action. Active systems include “ebb and flow” or “flood and drain,” in which a pump regularly floods the plant tray with nutrient solution, which then drains back into a holding tank. Various other systems require different growing media and methods of irrigation, but all

need to be monitored for pH and nutrient solution strength, since plants have different nutrient requirements during different stages of their growth.

The benefits of growing hydroponically are many. Plants may grow faster (up to two to four times³⁵) because they have ready access to nutrients and water, and put their energy into growing leaves, fruits, and stems, instead of roots. Many hydroponic systems are automated and don't require labor, and pesticides are rarely necessary because plants start out on a medium that is disease-free.³⁶ Plants can be grown in smaller containers because they will not become root bound, and more densely because they aren't competing for nutrients. Hydroponics can be practiced anywhere, even indoors, with the help of artificial lighting, and no digging or weeding is generally required. Growing conditions are highly controlled, so plants can be provided with the best possible conditions, resulting in better quality, disease-resistant plants with higher yields – commercial tomato growers have reported yields up to 40 times higher per hectare than soil-grown plants.³⁷ Almost any kind of plant can be grown hydroponically – tomatoes, peppers, rhubarb, cucumbers, squash, snow peas, beans, spinach, lettuce, strawberries, chard, and broccoli are just some examples.

Modern hydroponics is derived from ancient tradition throughout the world. The hanging gardens of Babylon, the floating gardens of the Aztecs, called *chinampas*, in Mexico, and the floating gardens of the Chinese are all examples of ancient hydroponics.³⁸ The hanging gardens of Babylon, of course, are also cited as one of the precursors to modern roof gardens. Ancient Egyptian hieroglyphic records also describe

³⁵ Frequently Asked Questions, 2004.

³⁶ Hydroponics Questions and Answers, 2004.

³⁷ Frequently Asked Questions, 2004.

³⁸ Ibid.

the growth of plants in water. Hydroponics was used to feed troops on the Pacific Islands in World War II, and will be used by NASA on long space flights to provide astronauts with fresh vegetables.³⁹

Commercial hydroponics systems, which include a reservoir to hold the nutrient solution, a pump to circulate the nutrient, and growing trays and pots, cost from under \$100 to several thousand dollars.⁴⁰ Home-made hydroponics systems, in which plants are hand-watered, can be virtually free, particularly when constructed of recycled materials.

Good growing media are ones that maintain enough air in the root zone while also holding nutrient solution. Rockwool is a widely-used growing medium made of basalt rocks and chalk which are heated to 1600° C, creating a lava-like liquid, which is blown into fibers using a spinning chamber. The fibers are cut into mats, and subsequently into blocks, slabs, or cubes. It is made almost entirely of recycled materials – mostly slag from pre-consumer iron-based metal products, one cubic yard of which becomes 37 cubic yards of rockwool.⁴¹ Rockwool is biodegradable, and can be reused once or twice.

Expanded clay pellets are also widely used. They can be used for many seasons without degrading and provide excellent root aeration, although they hold little water. Perlite is the term for a naturally-occurring siliceous rock that is heated quickly to above 1600°F, which pops the crude rock into light, porous pieces. Vermiculite can absorb three or four times its volume in water and attracts nutrients such as calcium, magnesium, potassium, and phosphorous. It is a volcanic silicate mineral, mined in Australia, China, Kenya, South Africa, and the U.S. Vermiculite has a spongy consistency. Perlite and vermiculite make a good combination for a growing medium, since perlite is hard and

³⁹ Frequently Asked Questions, 2004.

⁴⁰ Growing Media, 2004.

⁴¹ Ibid.

brittle and vermiculite is soft and spongy. Because the medium both holds water and drains well, it can be used for hand watering systems.

Toronto Case Study: Mountain Equipment Cooperative's Green Roof

Mountain Equipment Cooperative (MEC), a Canadian not-for-profit, seeks to increase its environmental building standards with each new store that the cooperative opens. I visited MEC-Toronto in October of 2003, and spoke with Peter Carr-Locke, MEC-Toronto's Sales Manager, who took me to see the MEC green roof and answered



Peter Carr-Locke and the MEC-Toronto Green Roof

my questions about its development. The Toronto MEC was the first store that MEC actually built, instead of occupying an already existing building. The company has grown at an incredible rate ever since its founding by five University of

Vancouver students in the 1970s who sought better deals on outdoor gear. Mountain Equipment now has nine stores throughout Canada: in Vancouver, Montreal, Toronto, Montreal, Ottawa, Calgary, Winnipeg, Edmonton, and Halifax. The Toronto store is the only one that was built from scratch; as a result it is the only site with a roof garden, although MEC plans to install a new one atop its Winnipeg branch. In constructing the green roof that their informational pamphlet describes the garden as a “native prairie meadow,” MEC hoped to improve insulation and drainage, improve urban air quality, and set a powerful example for the kind of environmental leadership that retail outfits can demonstrate. Contrasted with the gravel roof on the neighboring building, MEC's green

roof, which is visible from surrounding buildings like the Holiday Inn Tower, considerably improves the aesthetic quality of the city's roovescape.

MEC's rooftop is accessible for those willing to sign a waiver form (there are no railings), meet with a store representative, and to climb a short, fixed ladder in back of a store room.⁴² MEC's green roof is particularly unusual because it tops a retail space; most green roofs in North America are parts of public projects -- for example the Toronto and Chicago City Hall green roofs -- or on residential buildings.

According to Peter Carr-Locke, MEC's green roof has been met with an overwhelmingly positive response. Mr. Carr-Locke told me that MEC welcomes visitors from all over the world who come to see the green roof, and that the roof has received a great amount of press in local newspapers and other media outlets.

The roof has been low-maintenance since its inception, except for the occasional weeding to prevent large woody plants from taking root. The roof has been planted in flowers, including, initially, a spread of sunflowers planted in the form of MEC's initials. Mr. Carr-Locke has also planted herbs on the roof, but stopped because of the maintenance that the herbs required. The roof plants were growing into a kind of alpine carpet when I visited in October 2003. MEC-Toronto is an example of exemplary environmental building standards in other ways as well -- the store is made of mostly recycled materials, including recycled concrete, metal railings, and lumber salvaged from the St. Lawrence River. The MEC building also makes use of natural lighting and has a solar-powered sign as well as high, thermostat-regulated windows for temperature regulation.

⁴² Carr-Locke, 2003.

Toronto Case Study: City Hall

Toronto's City Hall has eight roof garden plots covering 3,200 square feet on a third floor podium roof. Although my Toronto visit did not coincide with the City Hall green roof visiting hours, I read about the project, as well as discussing it with Laura Berman of FoodShare and Wayne Roberts of the Toronto Food Policy Council. Each of the plots tests a different style of construction and maintenance, and the roof was built by companies associated with the Green Roofs for Healthy Cities coalition, for a case study by the Institute for Research in Construction, a branch of the Ottawa-based National Research Council. Some of the City Hall roof plots are extensive, with shallow soil profiles, low weight, and relatively low cost, while others are intensive, allowing a greater range of plant diversity because of their deeper soil profiles, but requiring larger initial investments. The City Hall demonstration project was launched in November 2000.

The project actually involves two distinct components, the publicly-accessible podium roof on the City Hall, and the inaccessible Eastview Neighborhood Community Centre site in East Toronto, which covers 5,000 square feet. The goals of the project are to “gain a better understanding of the technical performance of green roofs in the Toronto climate and to raise awareness and quantify the private and public benefits green roofs can bring to the City in order to create a green roof industry.”⁴³ The project is a public-private partnership involving the member companies of Green Roofs for Healthy Cities, the City of Toronto, the Toronto Atmospheric Fund, and the Canadian Federal

⁴³ Green Roofs for Healthy Cities.

Government.⁴⁴ The green roof infrastructure was manufactured by Garland Canada and Soprema Canada with plants supplied by Sheridan Nurseries.

The City Hall Plots are as follows:⁴⁵ (1) Extensive Plots featuring low and hardy alpine, dryland, or indigenous *sedum*, *thrift*, *armeria*, and *phlox*; (2) Semi-Extensive Plots combining intensive and extensive green roof systems and featuring plants such as *iris*, *day lilies*, *Echinacea purple coneflower*, and *coreopsis*; (3) Black Oak Savannah, a native prairie ecosystem now endangered in North America, including *big blue stem*, *heath aster*, *little blue stem*, and *greenheaded cone flower*; (4) Bird and Butterfly Meadow, designed to attract birds and butterflies and to illustrate the potential to create new habitat with green roofs, including the species *eastern columbine*, *bottlebrush grass*, *grey headed coneflower*, *New Jersey tea*, and *winecup*; (5) the Kitchen Garden, demonstrating the potential for rooftop urban agriculture to produce food within the city while generating employment, featuring perennials and vegetables such as *pepper*, *tomatoes*, *sage*, and



City Hall Roof Photo Courtesy Laura Berman

chives; (6) and the Permaculture plot, another food plot which utilizes innovative design techniques, like a space-efficient spiral herb garden, keyhole pathways, which provide improved access for plant tending, and three sisters planting

-- *corn*, *beans*, and *squash* grown together -- in the traditional Native American way, in which the beans fix nitrogen for the squash and the corn serves as a trellis for the beans.

⁴⁴ Ibid.

⁴⁵ Ibid.

Because of a lack of coordination in caretaking, some of the City Hall plots have failed or had mixed results, among them the Black Oak Savannah. Laura Berman expressed concern about the thin soil profile of the Kitchen Garden, which was cared for and planted in part by FoodShare.⁴⁶ Some of FoodShare's members, skeptical about the design and maintenance of the Kitchen and Permaculture Gardens, were surprised that City Hall's food plots had any success whatsoever.⁴⁷

The initial ambition of the diverse City Hall Project made its success more difficult, particularly because each of the plot types requires different expertise, making consulting a formidable task. Green roof professionals clearly had different ideas about what would constitute a successful food plot than did those involved with urban agriculture.⁴⁸ The discrepancies are to be expected, since each group comes from a different professional arena. If rooftop agriculture is to become more widespread, however, these kinds of discrepancies must be worked out, and a comprehensive set of guidelines for soil type and depth for each kind of green roof must be developed.

Toronto Case Study: 401 Richmond

The building at 401 Richmond is a unique complex of office and gallery spaces, converted from a 19th century warehouse initially occupied by the Macdonald Manufacturing Company, the first tin lithographers in Canada. Today, the building's tenants are mainly organizations and entrepreneurs promoting social justice, arts, and the environment; the building also houses a daycare center. The roof garden started when

⁴⁶ Berman, 2003.

⁴⁷ Ibid.

⁴⁸ Ibid and Green Roofs for Healthy Cities.

one the building manager, Mike Moody, started growing flowers on the roof in his spare time. Margi Zeidler, who owns the building and is the daughter of one of Canada's foremost architects, discovered Mr. Moody's small roof garden,⁴⁹ encouraged Mr. Moody's roof gardening by giving him a budget to expand the garden, build a roof deck, trellises, and containers, and to buy chairs and tables for the deck. The roof is heavily used, particularly during the lunch hour. The roof deck construction also includes a guard fence around the roof edge, in order to bring the rooftop into compliance with Toronto law for roofs and decks – 42 inches of unclimbable vertical pickets or solid material from the base of the roof.⁵⁰ Mr. Moody's garden includes ornamental annuals like chrysanthemums and ornamental kale as well as some perennials like shrubs, which require containers with larger soil capacities.⁵¹

Ms. Zeidler also hired Beth Ann Curry to establish a small greenhouse and food garden on the gravel portion of the roof. Ms. Curry grows eggplants, peppers,



Beth Ann Curry's Recycled Planter Boxes

and tomatoes, as well as many herbs.⁵² She uses integrated pest management techniques such as companion planting of marigolds to deter insects. The food she grows supplies the building's restaurant, the Loftus Lloyd Cafe. During the peak of the growing season, Ms. Curry's garden supplies the café with several kilograms of vegetables and herbs

⁴⁹ Berman, 2003.

⁵⁰ Ibid.

⁵¹ Ibid.

⁵² Ibid, Curry, 2003.

daily, which adds up to about \$500 worth throughout the season.⁵³ Many of the building's tenants have also purchased produce from the rooftop garden, and produce is given away to distinguished visitors to the building such as Jane Jacobs. Ms. Curry also composts on the roof, next to her food garden, with food scraps collected from the building, mainly from the cafe. She uses a three-step system, beginning with an aerial turning-bin, and ending with a vermicompost system.⁵⁴



Beth Ann Curry's Rooftop Compost Bins

In 2004, a green roof will be installed on the 401 Richmond rooftop.

The deck area of the roof garden will be maintained, while Ms. Curry's section of the roof – her container vegetable and herb garden on top of a gravel-covered roof surface -- will be replaced with the green roof. Food production on the roof will be limited in 2004, but will be made a priority again after the green roof system is established.⁵⁵

New York City Case Study: Earth Pledge Foundation

New York City's Earth Pledge Foundation was founded in 1992 by notable author and labor negotiator Theodore W. Kheel to promote the principles of the Earth Summit in Rio de Janeiro. Earth Pledge is located in a five-story, 1902 town house on 122 East 38th Street, on an old residential Manhattan street in Murray Hill. I visited the Earth Pledge building in October of 2003, and met with Colin Cheney, Green Roofs Initiative Director,

⁵³ Curry, 2003

⁵⁴ Ibid.

⁵⁵ Ibid.

who also took me to see the building's green roof/kitchen garden. When Earth Pledge acquired the building, it was promising but in need of repair. The top floors of the building are still under renovation, with the help of the many, varied materials donated to the Foundation. There are plans to turn some of the upper-floor space into an apartment, perhaps for use of visitors from UN organizations with whom Earth Pledge is affiliated.⁵⁶ Another room has donated fiber optics poking through its ceiling. The ceiling's pattern will ultimately mimic a starry sky.

In 1999, the staff was confronted with the project of renovating the building's kitchen for the Foundation's Sustainable Cuisine cooking courses, staff gatherings, and videotaped cooking demonstrations. Many of the old components of the kitchen were salvaged, including the original brick walls and chestnut doors.⁵⁷ Much of the kitchen hardware came from European companies, attractive because of their strict environmental standards, including those regarding toxins reductions.⁵⁸ The Terra Green Ceramics flooring has a recycled-glass content of 60 percent and a high thermal capacity, and the lighting is comprised of low-voltage halogens and energy-efficient fluorescent spot lots.⁵⁹ The Franke sink is made of recycled chrome and nickel steel and includes a water filtration system that eliminates lead and chlorine.⁶⁰

With a budget of just over a million dollars, Earth Pledge strives to address sustainability at the local level – its programs include the Green Roof Initiative, which encourages initiatives to green New York City's rooftops, and the Waste=Fuel program, which aims to facilitate an industrial infrastructure for turning food waste into fuel,

⁵⁶ Cheney, 2003.

⁵⁷ Fox, 2002.

⁵⁸ Ibid.

⁵⁹ Ibid.

⁶⁰ Ibid.

enabling the city to generate electricity, heat, and steam. Earth Pledge has published the Sustainable Architecture White Papers, which includes essays from green architects, planners, and educators such as William McDonough, Samuel Mockbee, and James Wines. Earth Pledge's Sustainable Cuisine White Papers, similarly, is a collection of 39 essays linking environmental and food issues. Earth Pledge's Farm to Table campaign seeks to promote sustainable and local agriculture through FarmToTable.org, where New York consumers are linked with local farms, restaurants, stores, educational workshops, and research on topics including compost tea, greenhouse technologies, micorrhizae, and vermicomposting.

Earth Pledge's Green Roof Initiative, formed about two and a half years ago, faces many challenges, but has been met with much enthusiasm, amongst both the public and city administrators.⁶¹ Colin Cheney, a Brown University graduate who majored in environmental policy, directs the Green Roofs Initiative at Earth Pledge. According to



Colin Cheney and the Earth Pledge Green Roof

Mr. Cheney, 29% of Manhattan's rooftops are flat, offering prime opportunities for green roof installation, but the older buildings especially will require hyper-lightweight green roof systems.

Successful systems will also minimize the need for irrigation, since New York City has suffered from recent summer droughts.

The Earth Pledge building has a small green roof of 700 square feet which is accessible by stairs, partly ornamental and partly to serve the building's kitchen. The roof is surrounded by a barrier and lightweight aluminum planters filled with herbs. The

⁶¹ Cheney, 2003.

roof also accommodates a table and chairs for rooftop lunches. The green roof's soil is a lightweight mixture of expanded slate and volcanic ash, mixed with 15 percent compost and 30 percent sand. The roof supports plants such as, in the decorative portion, alpines like sedums, and in the small "kitchen garden," herbs, tomatoes, and peppers. A drip irrigation system supports the watering needs of the plants when rain is scarce. Earth Pledge has also grown arugula, zucchinis, yellow squash, basil, sage, lavender, tarragon, verbena, bee balm, catmint, and day lilies.



Earth Pledge's Lightweight Aluminum Planters

Colin Cheney believes that a highly visible green roof will propel green roofs into the city's public eye, and envisions a green roof atop the old Domino Sugar factory, a site visible from the Brooklyn Bridge. A project like this, he believes, would be great for the green roof cause, because it would increase green roof visibility and interest. The Greening Gotham vision statement, according to Mr. Cheney, has been signed by New York's Department of Environmental Protection Commissioner, the Commissioner of Planning, and the mayor, as well as actor Edward Norton and a number of New York City's fashion models. The city has also established a green roof task force, which is exploring direct government support of green roofs, including tax credits and other incentives. The initiative has garnered a great deal of interest from many different territories. Mr. Cheney considers the two most important types of green roof projects to

be those that are monitored for performance and those which are publicly accessible and visible.

The Viridian Project, part of the Earth Pledge's Green Roof Initiative, seeks to provide low-income communities with green roofs. Part of the project includes green roof plans for a building in the Bronx meant for grandparents who raise their grandchildren. The building is slated to open in 2005 with a community vegetable green roof. Earth Pledge will also be publishing a book, due out in fall of 2004, entitled Green Roofs: Ecological Design and Construction. The book is a collection of case studies, solicited by Earth Pledge from around the world and highlighting various green roofs and roof gardens and their environmental, community, and food security benefits.

Rooftop Agriculture Throughout the World: The Case of Brisbane, Australia

As outlined by an article in a 2002 issue of "Urban Agriculture Magazine,"⁶² a proposed project in suburban Brisbane's Mt Gravatt Central will test organic rooftop hydroponics and aquaculture, and offer local restaurants a range of organic produce. The organic "rooftop microfarm" utilizes light, portable, oval-pipe hydroponics systems with worm "liquor" as a nutrient solution. The proposed project involves the collection of wastes from nearby restaurants and hospitals, the processing of the food waste through vermiculture, the production of salad vegetables and herbs, and the sale of these salad vegetables and herbs back to the restaurants and hospitals which provide the microfarm with compostable food waste. The project aims to produce food ecologically by using minimal space, to provide employment opportunities for people who are disadvantaged in

⁶² Wilson, 2002.

the labor market, and to sustain itself economically through the profitable sale of produce. Integrated Skills Consulting, which tested the feasibility of the microfarm concept, found that with a total funding of A\$212,455, the Mount Gravatt rooftop farm could be profitable after 17 months of operation, and then provide a return of roughly 20% a year on invested capital. The farm, additionally, could provide three to four new jobs, possibly suited to people with a disability.⁶³

When potential customers were interviewed, they claimed that they would be willing to pay about 10% more for organically grown local produce that was harvested for same day sale.⁶⁴ The study also identified the by-products of vermiculture as a potentially important component of the product mix sold by the microfarm. Worm castings, for instance, could be used for rooftop container gardens, or sold as a valuable soil additive for local home gardeners.

The proposed layout for the hydroponics system occupies 450 of the roof's 600 square meters, with six rows of eight 3x2 meter structures, all covered with insect-proof netting and hail mesh. The aquaculture component of the project could supply mature fish or crustaceans to local restaurants. Silver Perch, an Australian native freshwater fish, might be a good choice for the project, since it is ideal for the restaurant and retail markets.

Rooftop Agriculture Throughout the World: the Case of Senegal

Senegal has undergone rapid urbanization in recent years, coupled with a diminishing availability of land for urban agriculture, as urban land is under intense

⁶³ Ibid.

⁶⁴ Ibid.

pressure for development.⁶⁵ Senegal does have, however, many houses with flat concrete roofs, and a year-round growing season, in an arid, semi-desert climate. By 2002, according to an article by Saydee and Ujereh, the Rooftop Gardening Program of the United Methodist Church had trained over 100 people (99 of whom were women) in Dakar and Thies. Although there are other institutions working on roof gardening in Senegal, their concern is not popular education and training -- their methods, including hydroponic gardens which require daily applications of fertilizers, have proven both too expensive and too complex for many Senegalese.

The program uses brick and wooden box beds. Bricks are laid to create a bed roughly 80 cm wide and 10 cm high, in which plastic sheeting is laid before compost-based soil. Gardeners generally use the brick edges of beds as their walkways. The program promotes the use of compost made of organic garden and household waste over expensive and potentially dangerous fertilizers and pesticides. During the rainy season, roof gardeners create a trough for drainage in the middle of the bed; the plastic sheeting is moved underneath the bottom brick layer. Soil is kept inside of the beds, while water can drain out. And because nutrients drain out of the soil along with the water, gardeners use compost tea – prepared by soaking a sack of compost in water for 14 days – to water the plants.

For wooden box beds, used packing crates, particularly those for packaging tiles, are made into beds roughly 10 to 15 cm deep, 80 cm wide, and 120 cm long. The wooden bed is, as with the brick bed, covered with plastic sheeting, and a draining tube is fitted and glued into a hole drilled into a side of the box. During the rainy season,

⁶⁵ Saydee and Ujereh, 2002.

gardeners create a channel between the soil and all four side of the box, allowing water to flow easily through the drainage tube.

The United Methodist Church Program recommends mainly crops with smaller, fibrous root systems, since the shallow soil profile of the boxes (10-15 cm) can support only these types of crops. For crops with larger roots, such as cassava and potatoes, the depth of the beds must be increased, which can be done, for example, by turning the bricks on their upright sides.

When the church began its rooftop gardening program in late 1999, it struggled to attract interest because many people believed that rooftop gardens would damage roofs and the buildings below them, leading to rooftop collapse or leakage. The program overcame the problem by setting up a demonstration garden which emphasized lightweight compost as soil and lightweight wooden beds. Mainly because of the demonstration garden, many women became interested in the methods and sought training with the program. The major problems that the rooftop gardeners now face are initial funds for the project, as well as bird and insect damage. For birds and insects, gardeners are trained to use bird screens and natural pest management.

Through roof gardening, many Senegalese women have found a method of self-employment in a time of high unemployment, while others have been able to diversify or increase their incomes. The roof garden projects have also increased food security, at a time when the price of fresh vegetables is high, and availability is low. Now, poor families are able to produce fresh vegetables, which they certainly consume themselves, and sometimes sell to others, typically from their homes, to neighborhood buyers.

Rooftop Agriculture Throughout the World: St. Petersburg, Russia

In 1999, according to Price's 2003 article in "Urban Agriculture Magazine," St. Petersburg's urban farmers produced more than all rural farms in the Leningrad region; their produce included: 23 million cut flowers, 15,800 tons of potatoes, 47,400 tons of apples, pears, and plums, 7,900 tons of strawberries, and 38,500 tons of vegetables.⁶⁶ The gardeners of St. Petersburg are mostly above 35; younger generations are uninterested or busy with other work. St. Petersburg mainly became urbanized during the Soviet period, when one story houses with small gardens and animals were destroyed to make room for multi-story apartment buildings and urban infrastructure. Soviet authorities discouraged agricultural activity in the city, which was allowed only for the retired and the handicapped. Urban subsistence-level food production was limited by the high land tax.⁶⁷

Today, several forms of urban agriculture are thriving, partly due to the changing policies towards urban agriculture –one clause of the Russian law now states that authorities are obliged to help gardening associations with roads construction and repair, as well as water drainage and supply.⁶⁸ Types of urban agriculture include the *sadovodstvo*, which is a large community garden of hundreds of plots with related buildings and infrastructure and located outside of the city, **factory gardens and greenhouses**, which originated during the communist period, when nearly all factories grew food in gardens and greenhouses to feed their employees in their cafeterias, and

⁶⁶ Price, 2003.

⁶⁷ Moldakov, 2000.

⁶⁸ *ibid.*

buildings in which **basements** are used to grow mushrooms and **rooftops and balconies** are used for fruit and vegetable production.

The St. Petersburg Downtown Gardening Club began a Rooftop Gardening Program in 1993 which planned to use rooftop gardening techniques developed by Dr. Martin Price of ECHO, Education Concerns for Hunger Organizations. Rooftop gardens were seen as a means by which people could produce substantial amounts of produce, utilize household waste through vermicomposting in empty basements, garden very close to where they live, especially valuable for women who needed to look after children at home, improve urban ecology by growing plants which produce oxygen, and bring nature back to the city.⁶⁹ In addition to its roof garden initiatives, the club also began a garden for prisoners at a city prison, developed a model apartment building called the Eco-House, began a garden for therapy at a prosthesis institute, and helped with school gardening projects.⁷⁰

The roof garden projects are meant to act as a closed, circular system of production, consumption, and processing.⁷¹ The roof, of course, is where production occurs, while kitchen waste is processed into vermicompost in the cellar. When vermicomposting systems are properly aerated, and therefore aerobic rather than anaerobic, they produce very little odor, and worm manure produces a compost which is rich in nutrients and lightweight. Composting, additionally, is lower in heavy metals than urban soils, which have for decades been subject to pollution and acid rain. And according to Dr. Martin Price, although many people are concerned about the contamination of fruits and vegetables grown in the city, when rooftop-produced

⁶⁹ Martin, 2003.

⁷⁰ *ibid.*

⁷¹ *ibid.*

vegetables have been tested for heavy metals, they have been found typically to have a lower heavy metal content than vegetables produced in the countryside.⁷²

Rooftop Agriculture Throughout the World: India

Dr. Padmashri R.T. Doshi has developed a system for urban roof and balcony and roof gardens in India that makes use of cheap, readily available local materials.⁷³ Dr. Doshi describes his system in detail in a 2003 article of “Urban Agriculture Magazine.” As in all successful community gardening initiatives, this kind of innovative adaptation to local circumstances is essential to any successful community gardening initiative. His innovations are efforts to reduce the costs and labor of farming.

Dr. Doshi’s method uses high-density polyethylene bags, the kind used for 50kg of cement or fertilizers. The bags have a diameter and length of 22.5cm. For crops like sugarcane, Dr. Doshi recommends bags of at least 35 cm, and for fruit trees like fig, guava, and mango, a bag with a 45 to 51.5cm diameter.⁷⁴ The bag is first cut open along the bottom. The bottom half of the bag is then tightly packed with biomass, which serves as a kind of plug that prevents soil from falling out of the bottom of the container. Dr. Doshi generally uses sugarcane stalks, collected from sugarcane juice vendors outside of his house, who are glad to get rid of the waste. The biomass is lightweight, allows water drainage, and keeps soil in the bag.

The quarter of the bag above the biomass is filled is compost. The “International Institute of City Farming,” an organization set up by Dr. Doshi and headed by Vandana

⁷² Ibid.

⁷³ Doshi, R.T., et al. 2003.

⁷⁴ Ibid.

Shah and Sunil Doshi, produces composts from cow dung, organic waste, and water, which are left to mature in polyethylene bags for six weeks. The institute prefers this method of composting because the sealed bags prevent vermin and because it requires so little labor. The upper quarter of the bag is filled with regular soil. Instead of planting seeds all at once for a mass harvest, the Institute advocates what they call “chain-planting,” in which plants are grown at staggered time intervals.⁷⁵ The Institute argues that the “Doshi System” requires less water than conventional farm, since little evaporation takes place from the sealed, cylindrical polyethylene bags. Their claim counters Laura Berman’s argument that rooftop gardens require increased watering because evaporation occurs more rapidly from rooftop containers; perhaps the system is a solution to the problem of watering. The system, additionally, can be used in any type of open space, and on any scale. Urban agriculture, the Institute believes, should be supported by government policies and can reduce food prices and ease food scarcities.⁷⁶

The Mumbai Port Trust is one of the organizations to develop an organic rooftop farm after a training program given by the International Institute of City Farming. The organic farm sits atop the Port Trust’s central kitchen, an area of about 279 square meters. In addition to preparing food, kitchen staff members tend the garden’s 275 plants. The garden uses compost produced in the kitchen and produces fruits such as pomegranate, guava, and sugarcane, and vegetables like tomatoes and radishes. The roof garden has attracted positive attention, including a 2nd prize award from the National Council of Friends of Trees during their annual show. Many visitors also come regularly to see the roof garden.

⁷⁵ Ibid.

⁷⁶ *ibid.*

Rooftop Agriculture Throughout the World: Montreal, Quebec

Montreal has a shortage of urban garden space; waiting lists for community gardens are prohibitively long. Combined with a problem of poverty – the city has the largest proportion of low-income residents of any Canadian city, with one-quarter of its 1.7 million residents classified as poor and ten percent considered “very poor” -- and a scarcity of fresh produce, simple roof gardens are an appropriate solution. According to a 2004 article published by the International Development Research Center, Alternatives, the Action and Communication Network for International Development, is working on developing site-appropriate roof garden technologies for Montreal. Alternatives is currently experimenting with simplified hydroponics.⁷⁷ Simplified hydroponics, in contrast with commercial hydroponics, uses straightforward technology, with minimal startup and maintenance costs.⁷⁸

Karen Templeton, a researcher at Alternatives, has worked with the University of Casablanca in Morocco and the Institute for Simplified Hydroponics in Mexico. From these examples in the developing world, Ms. Templeton has learned about innovative but simple urban gardening techniques that are practical for individuals in any strata of society, in any part of the world. She has also discovered that hydroponics can reduce the water needed for a garden by 90 percent.⁷⁹

In 2002, when she returned to Montreal, Ms. Templeton started researching appropriate growing media and recycled materials for developing roof gardening projects in Montreal. Alternatives first converted plastic 50-gallon olive barrels into containers by

⁷⁷ Logan and Foss, 2004.

⁷⁸ Ibid.

⁷⁹ Ibid.

cutting them in half, cutting drainage holes into the upper barrel, stacking them, and putting a smaller olive barrel, containing the nutrient solution, inside of each lower barrel. Every three days, the nutrient solution from the lower barrel was poured into the upper section, or the growing bed, which was dammed for 30 minutes, and then allowed to drain back into the lower section. Researchers found that plants did best in a soil-replacement mixture that included perlite and compost.

During the next summer, the summer of 2003, growers experimented with a wider variety of plants, including tomatoes and ground cherries. They adapted drip irrigation systems to balconies, walls, and spiral staircases, as well as successfully testing a floating bed/solid substrate wick system. Alternatives also began working with members of the Jeanne Mance collective garden in Montreal, who participated enthusiastically in a test garden after overcoming their initial skepticism. Alternatives also now works with Engineers Without Borders (EWB) at Concordia University, an international volunteer organization that does local and international community development work, and Santropol Roulant, a volunteer organization that delivers meals to disadvantaged citizens. A co-op student from EWB has worked on rooftop hydroponics systems design, while Santropol Rouland has been cooking and delivering the project's harvest, and will be producing vermicompost from their organic waste, and using it for the nutrient solution.

Tèlè-université Québec (TèIUQ) has agreed to let Alternatives use it rooftop space for a project in summer of 2004, in addition to getting TèIUQ researchers involved with the project.

Rooftop Agriculture Throughout the World: Italy

Most Italian rooftops are accessible, and apartments often have terraces or balconies. Tenants of apartment buildings are each given a key to the door leading to the rooftop. Rooftops are built for use; they are the place where people hang their clothes to dry and grow plants, which are mostly ornamental. The tradition of Italian rooftop gardens likely comes from the ornate and complex terraced roof gardens of Italian villas during the Renaissance.

Great country gardens for wealthy Romans, while not generally on top of roofs, were often built on constructed flat areas above staircases or walls with niches and artificial caves. Terrace gardens also often had subterranean passageways beneath them, for service or escape in case of siege. These terraces, far from grade level, mimicked rooftops. The elevation, in addition to acting as a fortress, was clearly a function of a families' perception of their own importance, that is, their distance from common people. Terrace gardens also provided wealthy families with physical separation, and therefore respite from, the reality at grade level. Villas were the arena in which the wealthy and the powerful could create their separate realities, based on landscapes and architecture designed exactly to their specifications. These gardens were incredibly diverse and luxurious, including not only ornamental plants sculptures, theaters, and fountains, but also fruit trees and vines such as orange, lemon, pomegranate, pear, plum, fig, grape, peach, apple, and olive, as well as nuts, such as pine and chestnut.⁸⁰

But the history of Italian roof gardens goes back even further, to ancient Rome. Plants were often used on the rooftops of great Roman monuments. The mausoleums of

⁸⁰ Lazzaro, 1990.

Emperors Augustus and Hadrian, for example, both incorporated trees and plants into their rooftop plans.

In 2003, the Slovenian artist Marjetica Potrc created a roof garden in Siena, a medieval Tuscan city, as an example of future urban agricultural experiments. Ms. Potrc's work in Siena was in collaboration with Associazione Arte Continua, a Siena-based art and architecture organization made up of international artists and architects who work on a wide range of projects.⁸¹ When I spoke with Arte Continua's Barbara Saura via email and telephone about the possibility of seeing the roof garden and talking about it with someone from the organization, she told me that the project was impermanent, and that it would like be removed before long. By May of 2004, the garden was closed, the project visible only from the street. The project had no plans for long-term care and sustenance, rather it was part of a temporary set of art and architecture-related installments in and around Siena. The idea was demonstration rather than long-term impact.

Ms. Potrc's roof garden uses hydroponics, and is built with structures made to collect and recycle rainwater. The materials are all locally-available, either recycled or purchased. In addition to the rainwater collection system, the garden's structures also include horizontal and vertical screens that can protect the garden in extreme conditions, either in the summer or the winter.

Ms. Potrc has traveled extensively in Africa and South America, where she has become familiar with the ways in which urban agriculture can ease social crises such as increasing urban poverty, as well as ecological crises.⁸² While spending time in Siena,

⁸¹ Potrc, 2003.

⁸² Ibid.

Ms. Potrc felt that the city was weighed down by its history; in her project she wanted to focus on contemporary urban issues and needs, and to introduce methods of innovative agriculture practiced from the developing world into the developed world.⁸³ The manual Ms. Potrc used to build her garden is from Cuba, a country that has become famous for its local, low-input urban agriculture, albeit forced by the country's poverty and the economic isolation imposed by the U.S. embargo. Ms. Potrc's project is both a means to bring contact with nature back into the city and to conserve and utilize water as a resource.

Ithaca Case Study: Cornell West Campus Construction

After visiting a number of roof gardens in Toronto and New York City and researching others throughout the world, I hoped to apply what I had learned by beginning a rooftop agriculture project in Ithaca. When I learned from a class with Professor George Frantz that Cornell's west campus construction included plans for green roofs, I thought that integrating agriculture into at least one of the rooftops might be a possibility. I discussed my ideas with project architect Andrew Magre. Although he told me that agriculture could not be integrated into the green roof project, I learned about the history of and plans for the west campus green roofs, and these make an interesting case study in and of themselves.

Cornell's west campus construction project aims to create a set of "residential communities," with five small dining halls and long, tall dormitory wings that expand lengthwise down the hillside. Five low-roofed dining halls lie parallel to, and connect,

⁸³ Ibid.

the long residential wings. One of the plan's main foci is to open up the view shed of the region from higher points on campus, creating a series of uninterrupted green swaths that extend towards Cayuga Lake,⁸⁴ particularly improving the built landscape of the site where Noyes Community Center now stands. The existing class halls extend horizontally, that is, parallel to the lake, while the new dormitories will be oriented in the opposite direction, a change that will have a significant effect on the environmental impact of the residential community. Each wing of the new residence halls is also slated to have a professor-in-residence, as well as a graduate student-in-residence. According to Andrew Magre, project architect,⁸⁵ Residential Life will not give the buildings themes, as they fear that doing so might prove divisive and coercive, but hopes that certain, smaller communities will evolve naturally. The buildings will be LEED certified. LEED is an acronym for Leadership in Energy and Environmental Design, and works as a voluntary national ratings system for sustainability in buildings design.⁸⁶ Andrew Magre believes that minimum environmental standards are the least that the university can do, and that Cornell must have certain environmental responsibilities for its construction projects.

The dining halls will be equipped with green roofs, mainly for aesthetic purposes. The green roofs will be extensive, with an eight inch soil profile, and planted with sedums and grasses. Project architect Kieran Timberlake designed the project and conceived of the green roof idea. Landscape architects Trowbridge and Wolf are involved with phase II of the green roof project; Andrew Rogan worked on phase I. In addition to being the only buildings running perpendicular to the residence halls, the dining halls also have the plan's only low, flat roofs. Green roofs contribute LEED

⁸⁴ Frantz, 2003.

⁸⁵ Magre, 2003.

⁸⁶ Leadership in Environmental Energy and Design, 2003.

points for building projects if they cover at least 40% of the built roof area, but because the dining hall roofs are not 40% of the new project roof space, the buildings earn no LEED credit for their roofs. The green roof aspect has also had a tenuous beginning, mainly because they are considered an expensive, risky endeavor.

When estimates for building costs came in high, architects nearly removed the green roofs from the plan; however, the trustees supported the design strongly enough that it remained unchanged. The dining hall green roofs will be punctuated by long skylights that run parallel to the residential halls. The dining hall green roofs will all have limited accessibility. Some of the rooftops will be accessible only from the ground via a ladder, while others will be accessed through a door. These differences are a product of the variance in dining hall height – shorter buildings are easily accessed via a ladder while taller buildings require an additional rooftop entrance. According to Andrew Magre, the architects considered making the green roofs accessible to students and others, but decided against public accessibility because of the additional costs that it would require. Mr. Magre expressed concern about the damage that use might incur on the green roof membrane, stating that the membrane cannot support much activity, and that increasing roof accessibility would also mean additional reinforcement of the roof structure.⁸⁷

When I asked Mr. Magre about the possibility of growing vegetables or herbs on the dining hall green roofs, I realized immediately from his responses that it was not a possibility. Such a project, it seems, must be the intention from the beginning of the planning process if it is to be integrated into a green roof. For a green roof system to effectively produce food, it might need to sustain a thicker soil depth, depending on the

⁸⁷ Magre, 2003.

kind of produce grown. Herbs thrive even in shallow soils, while root or fruiting crops do better with a thicker soil profile. Maximum food production would likely require an intensive green roof system, which can support up to several feet of soil, as well as shrubs and even small trees. Different soil mixes are also appropriate for different green roof plants, as vegetable crops demand higher quality and more nutrient-rich soils than do alpine plants.

It is unfortunate that the west campus green roofs will not be places that students can enjoy directly – the roofs might have been great for gardening, views, and human and natural contact. They might have played a small role in narrowing of the gap that has grown between our food production and consumption at Cornell. The project, of course, is still impressive, and it is admirable that Cornell is participating in such a worthy movement. The macro effects that green roofs might have on the environment will only occur if green roofs become widespread, likely if incentives for green roofs are enacted through federal, state, and municipal policy. Although the motivation for the West Campus green roofs is more aesthetic than environmental, the buildings will still set an example for green building design.

According to Mr. Magre, the West Campus plan does improve site drainage, not so much as a result of the green roofs, which will have a porous soil mixture not intended to hold water, but because the plan relocates the current asphalt parking lot.⁸⁸ He did not mention possibly damaging drainage implications of the proposed parking lot, however, which calls for the destruction of the “Redbud Woods,” a site which, though now overgrown with invasive species, is the historic gardens of the A.D. White family, who played vital roles in Cornell’s founding.

⁸⁸ *ibid.*

According to Andrew Magre,⁸⁹ one green roof will initially have an irrigation system, but the system will be removed as the plants become established. LEED standards do not allow any kind of permanent irrigation system. The project designers hope that the green roofs will become no-maintenance; indeed, plants have been selected for this purpose – they are hardy perennials, often succulents or mosses that stay green in both drought and rainy conditions.

Mr. Magre told me that Cornell dining chefs had been interested in herb or vegetable production on the dining hall rooftops,⁹⁰ but that in light of cost and structural constraints, incorporating dining hall gardens into the actual landscape seemed to make more sense. Cornell does have the space and the ability to embark on such a project, especially because Cornell has ample open green space, no issue of land tenure, and they hope, no soil contamination. Dining hall rooftop food production would have been great because of the project's visibility, its special nature amongst universities, its potential to offer opportunities for research, demonstration, and experimentation, and because of the conceptual space that the food production might occupy, as produce cycled down into the building and back up to the rooftop as compostable organic matter. It also would have been immune to ground-level pests and vandalism. Edible landscaping near the dining hall(s) might serve much the same purpose, but the project will not have the advantage of being so visually striking, nor would the project be exceptional for a university.

⁸⁹ Ibid.

⁹⁰ Ibid.

Possibilities for Ithaca, New York

Although Ithaca is more rural than sites typically considered for roof food gardens, an Ithaca roof garden could still make good sense. Roof gardens are elegant systems in which the cycles of food production and consumption are distilled into simple, clear elements – the system is compressed in space, the need for transportation from production to consumption site is removed. Rooftop agriculture is local agriculture extreme.

When the Cornell dining hall possibility failed, Erica LaFountain and I considered the Dewitt Mall and Greenstar as likely options for roof garden development possibilities. The Dewitt Mall is a centrally-located converted primary school; it now houses restaurants and stores on its lower level, offices on its first floor, and apartments throughout the rest of the four-story building. Greenstar Cooperative Market is a member-owned cooperative grocery with an emphasis on local and organic foods. Greenstar is located not in Ithaca's center but between one of Ithaca's major thoroughfares, Route 13, and Taughannock Creek.

In late November of 2003, we first approached the Moosewood Restaurant at the Dewitt Mall, with the idea that Moosewood's emphasis on fresh, seasonal, local and organic produce might compel the restaurant to accept our proposal. We learned from Moosewood's manager that the building and the rooftop have been owned for the past 30 years by William Downing, the architect with the original vision for turning the school into a residential and commercial mall. The manager claimed that the restaurant has a less than ideal relationship with Mr. Downing. He agreed to support the project if we were successful, but told us that Moosewood could not promise us any money or labor.

We continued to Mr. Downing's office on the Mall's top floor, and although he was gone, his receptionist, Alison Van Dyck was very helpful -- she walked with us out onto the roof, which had recently been replaced, but said that Mr. Downing would be resistant to any kind of plan regarding it, because when she had talked with him about the possibility of installing solar panels on the roof, he had not been receptive to the idea. Ms. Van Dyck also suggested that it might be possible to build a garden on the lower roof terrace that is currently rented by apartment tenants, is accessible from a public indoor stair, and is meant for a use as a garden or picnic area. The space seemed ideal, especially because the Campbells, who rent the apartment, leave Ithaca for the late spring, summer, and early fall, except, as we noticed, the roof is shaded for most of the day by the higher part of the building.

We also spoke with a worker at Oasis Grocery to gauge his interest in the project. The worker was hesitant: he told us that Oasis would buy produce that we grew, but that he couldn't make any long-term commitment because the future ownership of the grocery was in question. In fact, by the spring, we learned that Greenstar Cooperative had bought the space to open a smaller branch store. We realized then that the Dewitt Mall idea posed significant challenges -- of who would continue caring for the garden after Erica and I left the area, of the intended market for the produce, and of the building owner's probable resistance to the project. The project still seemed attractive, though, because of the mall's central location, the accessibility and large area of both the lower and upper roofs (via door), and the proximity of three businesses as potential markets -- Oasis Natural Grocery (now Greenstar), Moosewood Restaurant, and the Dewitt Cafe, which are all inside Dewitt Mall.

At the end of November 2003, we also visited Greenstar Cooperative Market informally, to ask if they might be interested in having a roof garden. We learned that their roof, like the roof of the Dewitt Mall, had recently been replaced. Greenstar also rents rather than owns their building, and their gravel rooftop is only mildly accessible, via ladders through the storeroom. When Greenstar moved to its current location, the council actually discussed transform the roof to a usable space: a patio, or public space were some ideas. Greenstar's rooftop is somewhat more attractive than that of the Dewitt Mall, because the matter of continued care for the roof garden is less tricky -- Greenstar could easily charge member-workers with watering and caring for the garden after Erica and I are gone. The member-worker program at Greenstar allows member-owners (called this because Greenstar is a member-owned cooperative) to sign up for regular or temporary two-hour weekly or biweekly shifts in exchange for a discount on their purchases in the store.

The workers with whom we talked were enthusiastic about the idea, and suggested that we draft a project proposal addressed to the store's general manager, Patrice Jennings. We did so, and brought the proposal⁹¹ to the store just before Thanksgiving. Ms. Jennings contacted both of us via email by mid-December, and spoke with Erica on the telephone about her concerns: membrane roof structure and load, continuation of the project after Erica and I left in fall 2004, and finding and paying for an architectural consultant to assess the roof. These were exactly the issues that we had been the most concerned about, but we hoped that we could find our way past them.

When Erica returned to Cornell in the January, she set up her roof garden independent study project, with Professor Rob Young, who teaches a course entitled

⁹¹ For the proposal, see the appendix.

“Green Cities,” as her advisor. She continued contact with Ms. Jennings, but was mainly exchanging ideas with Pam Williams, an architect on Greenstar’s staff, who Ms. Jennings had asked to be the contact person for the initial phase of the project. Erica began to look for a structural engineer who could assess the roof without charge, wrote a blurb about the project for “Greenleaf,” Greenstar’s newsletter, and prepared to present the project at a Greenstar Council meeting. Erica and I were both very hopeful and optimistic that we would be caring for the roof garden during the summer after our graduation. Friends of ours who were spending the summer in Ithaca were also excited to help with the project.

We had, however, underestimated the challenge of finding a suitable structural engineer for the project. Because she was having some trouble concerning the roof assessment, Erica began to think instead of finding a rooftop at Cornell on which she could do experiments to help fill the rooftop vegetable garden design vacuum. She began to look for potential rooftop spaces for experimentation on campus, and spoke with many people about lending her support and roof or lab access. In February, Erica called the Ithaca City Building Department, and found out 1) that building codes are either state or local; the state codes apply to state-funded Cornell buildings while city building codes apply in the city of Ithaca, and can be accessed on the internet at www.cityofithaca.org; 2) that roofs must have a railing if occupied; 3) that the Ithaca snow load requirement is 45lb/sq ft., which is adequate to hold a seasonal roof garden; 4) that plans for all buildings in Ithaca should theoretically be held at City Hall, but there are none on file for the Greenstar building; and 5) that insurance would likely increase if the public is allowed on the roof.

By April, Erica had found a graduate student in Cornell's engineering department, Amanda Stanko, to do preliminary assessments of the Greenstar roof, and began conducting experiments to find an optimum soil mix for a rooftop container garden, considering both soil fertility and dry as well as wet weight. Ms. Stanko calculated that the Greenstar roof can hold 20-35lbs/sq ft., a disappointing result. Because the Greenstar building had been built before Ithaca increased its snow load requirements, the Greenstar rooftop seemed inadequate to hold a garden. Meanwhile, however, Erica had discovered that Seeley Mudd Hall rents rooftop research space, and she submitted a space request for 20 sq ft. at three dollars a month, which was immediately accepted. Erica ultimately wrote her independent study paper on the need for more rooftop research space if these projects are ever to become common.

Conclusions and Implications

Despite having many benefits, roof gardens face clear challenges to their widespread application, in all of their forms – container gardens, green roofs, and hydroponic gardens. The most significant are issues of access and roof load capacity. These barriers are especially problematic in liability-obsessed countries like the United States, although concerns for safety and building protection are certainly valid. Lack of knowledge or incentives, funding, water supply, safety, and the harshness of rooftop environments are also major barriers. Still, rooftop agriculture is slowly becoming more common, particularly in the developing world, where rooftop food production may have a significant impact on food security and income, solutions are creative and site-specific, and roofs are often built of different materials than those in the developed world. The

green roof industry is quickly gaining visibility and respect in North America, and a few cities, including Portland (Oregon), Toronto, Chicago, and New York, are beginning to create incentives for green roof construction. Still, we are a long way from the kind of progress that has been made in Switzerland and Germany.

It is unfortunate that so many green roofs are not built for accessibility, because inaccessibility prevents the realization of a great deal of rooftop potential. Without accessibility, green roofs serve many impressive environmental functions, yet additional community or food security benefits are lost. The inaccessibility of green roofs, of course, makes sense in light of cost constraints and liability concerns. The most ideal form of rooftop agriculture, in terms of its potential to maximize ecological, agricultural, and community benefits all at once, is in fact green roof agriculture. With the rapid expansion of the North American green roof industry, expansions for green roof agriculture might also expand. Of course, green roofs are also the most expensive of the three types of roof gardens, and, for that reason, are not a possibility for many sites. Nor do they make sense in all situations – where people have created a rooftop garden system that they can build out of local materials and repair and maintain themselves, as in Senegal, India, and St. Petersburg, they use their intimate knowledge of local conditions and available materials to design elegant, simple systems that increase their self-reliance. But one would hope that as municipalities, states, and nations learn the advantages of creating incentives for green roofs, even now-unlikely green roof projects will become possible. Along this vein, affordable housing organizations are working with Earth Pledge Foundation’s Viridian Project to bring green roofs to underserved housing

communities in Chelsea, Harlem, and Brooklyn, all of which are to be completed by the summer of 2004.⁹²

Rooftop food gardens work best atop buildings where food is consumed or processed – at 401 Richmond, for example, on an office building which houses a café, near restaurants in Brisbane, Australia, and atop houses or apartment buildings in Senegal, India, Italy, Montreal, and St. Petersburg. When land at grade-level becomes available, food is not consumed close to the roof garden, or garden care has not been well coordinated, rooftop agriculture has been less successful, for instance at Toronto City Hall’s permaculture and kitchen garden green roof plots, on the Field to Table/FoodShare warehouse in Toronto, or with the brief herb plantings that Peter Carr-Locke did on MEC-Toronto’s green roof. In countries like the United States, where food costs for many people are only a small part of income and most don’t feel threatened about their food supply or safety, few people will take the initiative to begin rooftop agriculture projects. But those that do will create projects, whether short or long-lived, that spread a bit of the enthusiasm for the potential that roof gardens can have – and, just as urban community gardening has grown tremendously within the past decade, into a real, vibrant movement -- so might rooftop agriculture. Erica and I, regardless, will continue to look hard for a roof on which to try out our ideas.

⁹² Cheney, 2004.

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Appendix: Selections From Erica LaFountain's Roof Garden Journal

11/7/03: Our first roof garden quest: Dewitt Mall and Greenstar Co-op

11/23/03: Memorandum

The following is a memorandum Michelle and I wrote and submitted to the general manager of Greenstar Co-op.

Memorandum

To: Patrice Jennings

Submitted by: Michelle Nowak and Erica LaFountain, co-op members and Cornell students

Date: November 23, 2003

Re: Proposal for Greenstar Cooperative Roof Garden / Green Roof

Proposal

We propose an herb and vegetable garden on Greenstar's roof. We will design and construct the roof garden in winter 2003. We will plant the garden in containers built from salvaged materials in early spring 2004, with the help of any willing community members. The garden will include a rooftop composting system, utilizing food scraps from the store. The vegetables and herbs produced on the rooftop will be sold within the market.

A structural engineer or architect will also need to verify the structural capacity of the building's roof. The project will require further rooftop accessibility. We suggest a simple, external staircase, though more options are available.

Our work on the Greenstar roof garden design and implementation will be part of our coursework at Cornell: Michelle is currently writing her senior honors' thesis on rooftop agriculture, and Erica has organized an independent study in the spring on the same topic. Member-workers will care for the garden after our graduation from Cornell in May 2004.

If this project is successful (i.e. financially and socially sustainable), we hope that Greenstar might be interested in installing a green roof on its new building. The rooftop of a green roof actually becomes the growing medium, distinguishing it from a container garden, in which planters are placed atop the roof. Green roofs yield additional environmental, structural, and food security benefits by virtue of their greater surface area.

Benefits and motivation

The roof garden...

- ❖ can fill some of the demand for local, organic produce that is not currently being met by the Cooperative.
- ❖ can be part of a dynamic, sensible local food system.
- ❖ is a creative use of otherwise wasted urban space.
- ❖ can extend the life of Greenstar's new roof.
- ❖ is an elegant model, both practically and conceptually, of the connection between food growth and consumption.
- ❖ can hold stormwater runoff, improve air quality, and decrease heating and cooling costs by insulating the building.
- ❖ will attract positive attention to the Cooperative.

Precedent

- ❖ 401 Richmond in Toronto is a vibrant urban complex. The building's café uses produce from its roof garden. Website: 401richmond.net
- ❖ Toronto City Hall has a green roof with six experimental plots, including a kitchen garden. Website: www.greenroofs.ca/grhcc/demopics.htm
- ❖ Earth Pledge Foundation, which is working to green New York City's rooftops, has its own rooftop kitchen garden. Website: www.greeninggotham.org
- ❖ Eli's grocery store in New York City has a full-rooftop greenhouse; the store sells fresh, local produce year-round. Website: www.elizabar.com/vinegar.html
- ❖ Rooftop agriculture projects in Senegal and St. Petersburg have allowed city residents to grow and sell their produce.
- ❖ Greenstar can set another example for a sustainable and cost-effective rooftop garden project!

Please contact us soon via e-mail; we would like to meet with you regarding this proposal.

Michelle Nowak: MEN25@cornell.edu, Erica LaFountain: ENL2@cornell.edu

12/12/03: Advice from Gary

During my work shift at the Durland Alternatives Library I brought up the proposal Michelle and I had written and submitted to Greenstar. I brought it up because Gary Fine, assistant director of the library, was once the general manager of Greenstar himself when the co-op relocated to the current location after a fire. In fact, he was chair of the "personnel committee" that hired Patrice Jennings. Gary had many suggestions and lots of information. He told me that when Greenstar originally moved to its current location the council discussed many options for the use of the building's roof: a patio, a public space, even a hot-tub (a joke I assume). He's pretty sure Greenstar will approve of the project as long as I can organize a way for the project to continue after I leave (training a super-worker?) and if I can organize public access to the roof. He suggested a group called the Black Locust Initiative, which apparently promotes the use of non-rotting wood for outdoor construction. Greenstar has purchased a bench from them

already, which sits outside the store. Gary and I also discussed Greenstar's plans to expand, possibly opening a second store closer to downtown. I told him Michelle and I brought this plan up in the proposal we submitted. He said, "no one will verify this, but I think Greenstar is looking to take over Oasis." Now that was a surprise. This just happens to be the other site where we proposed a roof garden! And that roof, I must say, was ideal, besides the small hindrance that it is leased, by the building owner, along with the adjacent private apartment. Still, I think this is good news, if true.

12/13/03: Phone call

After phoning early in the morning on Saturday and leaving a message on Patrice' answering machine, Patrice called. She had read over the proposal and had a few concerns:

- Roof structure and load
- Take-over following Michelle and my departure from Ithaca
- Membrane roof
- Architectural consulting / budgeting

12/15/03: At Greenstar again

Today I went to Greenstar to inquire about the building plans, which I hope to show to an architect at Cornell to find out what the building can support on its roof. Patrice wasn't there and neither was Pam Williams, an architect on their staff who Patrice thought might be willing to bring me up on the roof. No matter; there is a foot of snow up there anyway. I left a message on Pam's voice mail before I left, addressing my desire to see the roof before I leave in two day, and asking whether I could borrow a copy of the building plans to show to an architect regarding weight. I alluded that perhaps she would be willing to take a look, as she is trained as an architect (though her position at Greenstar is listed as "education outreach."

12/17/03: Some leads

On this day, I got a ride home to Potsdam with a friend, Cam. We always talk about our plans and about what projects we're working on and so roof gardening came up. He had lots of questions, and as we pulled into downtown Potsdam, we turned at a busy corner, at which point Cam remarked "I don't know if you know Steve Yianoukos, but he owns that building and I'm sure he'd let you start a roof garden on it as long as you don't damage the roof." Now this is interesting. I doubt I could ask for him to fund the project, but the roof alone would be quite a contribution. That's a lead I suppose I'll follow if the Greenstar project fails.

12/23/03: Call to Pam

I just called Pam. She remembered me and has come up with a whole list of questions but she doesn't have them with her. She'll be out of town for a while, but wants to meet at Greenstar when we're both back in Ithaca. I asked her about the building plans. She has them. And I asked about having an architect look at them She says that's not something she can do and that it's more of a structural engineer's job. Perhaps she can give me some names from Cornell. They charge by the hour, she says. I hope there's some way around that cause I don't have a budget yet. She says it sounds like a great project, very multidisciplinary, which is something I was more than a little afraid of, though it sounds like an interesting challenge. She has all the information about the roof installation company and a phone number and website for information on membrane roofs. I'll try to do a little research on my own regarding that. I told her that Michelle will be gone in Rome next semester and that I'll be the only one working on the project until I can do some recruiting. I told her I've set up a sort of "half-year thesis" since I didn't have time to start last semester with a full and difficult course load. Next semester I'll have only two classes and this independent study. I feel lucky that the growing season starts so late, leaving me plenty of time for research and other preparations.

I hope to have Rob Young as an unofficial advisor, perhaps working officially through Joe Yavitt, my faculty advisor, who has said he's be "willing to sign off on it." Rob has experience with cultivating, but more importantly Rob is a doer, he's persistent, and he's dealt with local politics and multidisciplinary approaches. And last but not least, Rob is very involved in Greenstar, perhaps on the council. I hope more than anything to depend on Rob for new ideas when I hit dead ends, and for inspiration if the project becomes too demanding.

I'm not sure what a budget would look like for this project. It would need to include seeds, and containers unless I could scrounge some for free. I hope to protect the roof from feet with some discarded palettes from the multiple construction sites on and around campus. I still haven't thought of where I could get the soil, but maybe the community gardens would be interested in donating some compost from the many bins. I'll also need a watering can. I hadn't even thought of how to get water up there. I know there's roof access, though it probably won't serve as the main access, that I could thread a hose through from a faucet downstairs. I'll need a hose for that. The main expenses I see are the structural engineer consultation and constructing a public access route. An outdoor staircase would be the most expensive option, and ladder would probably be the least.

1/15/04

Spoke on the phone to Rob Young today. He had responded to an email I sent him asking if he could spare some time each week to advise me in an independent study. He was very receptive, even offering to provide me with soil and containers. Rob is both familiar with the workings of Greenstar as well as with container gardening, which he has personally done when he lived in Brooklyn. His advice: 1) Water the plants more than one would normally water them, 2) be persistent with Greenstar, following through with all of their questions and concerns. I asked about credit. He seems to be willing to grant me however much credit I work for, as long as he can justify this with the products of the study. I feel lucky and confident to have Rob on board such a project.

1/24/04

Wrote the following email to Pam Williams:

I'm back in Ithaca and ready to work on the roof garden project. I've found an advisor, Rob Young, who I'm guessing you know already. He has experience with Greenstar and with container roof-gardening. My first order of business is to find a structural engineer to look at the plans. When I find one, I'll let you know. If you would like to meet sometime to discuss the project/proposal just let me know. Also, I'll hope for a nice day in the near future when I can finally check out the roof myself. Hope you had a nice vacation. Keep in touch if you have any questions or answers.

Erica

1/29/04

Wrote the following email to Pam Williams:

hi, pam

I got a few names, from the architecture department, of staff members capable of a structural assessment. Before I meet with any of them, I would like to know what you will require for your approval of the project. Must I get an official stamp of approval, or something more informal. Do I need to find out how much the roof can hold, or just whether it will hold the weight of my project (this will require less intense calculations I assume)? Is the first step for me to estimate the weight of the container garden or to go to the engineers? By the way, could you send me the names of the engineers you had in mind. One that knows you may be more likely to help me out. Also, once I have the engineering thing over with, I would like to present the idea more widely to the Greenstar community, whether to the council, or in the newsletter, to get some feedback and determine what kind of support and help I should expect. Do you agree?

thank you for your time.
p.s. could you give me Patrice Jennings' email address?

erica

Mock speech to the Greenstar Council at next meeting: 2/10/04:

"To prove how psyched I am about this project, I've abandoned my fear of public speaking just for the occasion. I'm Erica LaFountain. I'm a senior Cornell student in the natural resources major. I've focussed on environmental studies and city and regional planning, and I've taken both of Rob Young's classes. In fact, Rob has volunteered to be the advisor of the independent study that I'm taking and that I'm about to explain to you. First, I'll contextualize the project a little. I grew up on a large ex-farm in Potsdam, NY about 200 miles due north of here. My parents have always had a large food, herb and flower garden, which has expanded recently, now occupying about an acre. The past few years I've helped my parents increase production of rhubarb, cilantro, kale, and Swiss chard to sell to our local food co-op where we are co-workers. It was in Rob's class, Greencities, that I first heard of roof-top gardening. Two years later, when choosing a thesis topic, a friend and I independently both decided on roof gardening. It no coincidence that we had taken Greencities together. While she got started researching aesthetic and philosophical reasons for roof gardens, as well as visiting and reporting on a few case studies, I decided to wait with the topic until the spring semester and make it an independent study, rather than a thesis. Nonetheless, Michelle and I got out to a few locations in town last fall to discuss the option of a roof garden, the most promising of which was Greenstar. And so in November last year Michelle and I submitted a proposal to Greenstar. Since then, I've received positive reactions from Rob as well as Patrice Jennings and Pam Williams, as well as a few questions from each of them. These questions regarded structural support, funding, and the fate of the project when I leave. Since then, I have consulted a structural engineer to peruse the building plans and verify the ability of the roof to bear the load of a garden; I've also assured Greenstar that I won't rely on the co-op for any funding, though I would like to organize a drive for seed, container, and soil donations through the co-op; and I have given my word that I will not leave the project unless I have found sufficient help to continue it in my absence. I have done all I was asked to do in preparation for this exciting project that will bring herbs and vegetables as well as educational opportunities to Greenstar. I hope you agree that I deserve a chance to carry out this project. Thank you." [hand out copies of Michelle's thesis and of our proposal]

2/03/04 12:50pm

email from Pam:

Hi, Erica, I would like to talk with you about your roof garden proposal. Let's set up a time to meet at GreenStar. Please call me at GreenStar 273-9392 (Tu., Th. 9 AM- 1 PM) or at my home # 277-7061. Thanks. -Pam Williams, Store Designer at GreenStar

1:48pm

Hi, Erica, For this project to go ahead, we will need approval from Patrice Jennings and GreenStar Council. In order to give that approval, Patrice will need to know project cost (to GreenStar) and answers to questions about ongoing care (Patrice doesn't think it will work to have member-workers care for the garden after you leave). I would think a structural assessment would have to be done on site. If the structural engineer comes to GreenStar, I would like to be at that meeting. The structural engineer needs to determine how much the roof can hold. The roof will need to hold the weight of the containers, and the weight of people walking on the roof. The engineer can determine if the roof structure will fail or deform because of increased foot traffic, or water retention in the containers after a heavy rain. The first step for you is to set up a meeting with the engineer to come to GreenStar. It would help if you gave him the size of the containers that will be used. The engineers I had in mind would charge \$80 - 100/hour. Do you still want their names? Why not just use the Cornell engineering students or staff? Yes, you will need to present the project to the Greenstar Council, and Patrice. An article in the Greenleaf is a good idea. Patrice Jennings' email address is patrice@greenstarcoop., but she asked me to be the contact person in the beginning stages. We should set up a meeting time (with the engineer?). How about next week? I have a list of concerns that we should address. --Pam

2/05/04 12:09pm

I emailed two structural engineers: Jonathan Ochsorn (jo24) and Mark Cruvellier (mrc14), whose names I got from the secretary at the architecture department office:

Hello. I am a Cornell student and I'm working on a large independent study, the goal of which is to organize and plant a rooftop garden on a building in town: Greenstar Food Co-op. Naturally, the staff of Greenstar have asked that I verify, with a structural engineer, that the building can hold the weight of the garden plus human traffic. I have access to the plans and a flexible schedule. I am asking that you help me determine the potential load of the building, or at least refer me to someone who can. It is a novel and exciting project; I hope you can help. Please respond as soon as possible. Thank you. Erica LaFountain

1:31pm

I emailed Rob about the independent study:

hi, rob.

so I've signed up for the independent study. It's pass/fail and you'll have to let Joe Yavitt know how I do so that he can officially report it. If you want a copy of the independent study form, including a description of my plans, I have one. So far I've been continuing internet research and reading a book called A Patch of Eden for inspiration. It's a series of case studies of urban gardening in the US. My short term plans are to get a structural engineer, get a blurb in Greenleaf, and present the project to the council. I need the council and Patrice's go ahead. Can we set up a time to meet on campus or elsewhere and talk for a half hour or so weekly? Since you're seldom on campus, just name a couple of times you have available. Thought of any structural engineers yet? Know any graduate engineering students? erica

2:31pm

I emailed Michelle:

this is a little pertinent research I did and a blurb I want put in the newsletter at greenstar (at the bottom of the document). I have a request, michelle: could you send me a copy of your thesis. I think I'll have to present the project to the council and I want to bring a copy of your paper along for anyone who wants a well-written account of why rooftop gardens rule, by the co-proposer of the project. it's looking good. I'm having trouble finding a structural engineer, but I seem surprisingly excited about presenting the project to people. I even wrote out a mock speech to the council the other day. I think it's going to happen. also, Heather Irvine said that if I decide to leave after graduation, she'll continue the project at least through the end of the growing season. love, erica

For Greenleaf:

There are exciting plans in store for the roof of Greenstar. Ordinarily an unused space, the roof may house a productive and beautiful garden in the coming spring. In mid-November of 2003, two local college students submitted a roof garden proposal to Greenstar Co-op. The garden, to be built by Erica LaFountain and any volunteers, will produce flowers, herbs, and even vegetables in the coming growing season.

The many benefits of rooftop gardens, as laid out in the proposal include food production, creative use of otherwise wasted urban space, extension of the life of Greenstar's new membrane roof, and attraction of positive attention to Greenstar, among others.

The main preparatory concern now facing the project is the weight capacity of the roof, which will soon be determined by a structural engineer. Still in it's beginning stages, Erica is taking any feedback or suggestions. Write to ENL2@cornell.edu with any suggestions, or feedback, or request a copy of the proposal. Donations of seeds, soil, and containers will be gladly accepted.

2:48pm

I emailed Pam:

hi, pam I called you today at the store and left a message around 12:30. I wrote to two structural engineers from the architecture department but haven't hear back yet. Until then, I'm researching ways to decrease the weight of a container roof-garden. For example, i've read that "Most roofs are designed with an average loading strength of 40 lbs. per cubic foot. Wet soil weighs on average 100 lbs. per cubic foot." "In order to reduce the soil weight, lighter soil varieties should be used such as perlite, vermiculite, peat moss and coconut husk fibre" "Find out where the building's structural columns are located, as they are able to support greater loads than other areas. Place the largest planters and containers at these locations and spread the smaller, lighter ones about equally." "Since different plants require different soil depths depending on their root structure, find out how much soil each plant requires. Plants with shallow, spreading roots can grow in less soil depth than plants with longer (tap) roots. Do not use more soil than you need." I'm also learning more about drainage, container types, and appropriate plants to use for sch a project. I'm willing to present to the council. The next meeting is very soon and I probably couldn't squeeze into the agenda anyway, so I guess I'll shoot for next month. Meanwhile, could I get a blurb in Greenleaf. I already wrote one, so just say the word. Here's what I wrote: [above] I'd like to meet next week. If tuesday and thursdays are the only times available to you, thursday is better for me. If other times are available, let me know. I will keep trying to line up a structural engineer before then. Thank you. Keep in touch, erica

2/06/04

Jonathan Ochshorn, one of the architects I wrote to wrote this:

Erica, Because this needs to be verified by a structural engineer, I would suggest that you contact a practicing structural engineer. Academic independent study projects are useful for speculation and general research, but an actual proposal for altering a building, either in terms of its occupancy or loading, requires the services of a professional engineer (or architect), working in that capacity (rather than in the capacity of an academic advisor). Too many technical, legal, and life-safety issues are at stake to treat this as an "academic" exercise. Engineers (or architects) who sign off on such projects accept a considerable amount of risk as part of their professional obligations; this is not something that can easily be taken on through normal academic channels. On the other hand, if you are just doing preliminary research about rooftop garden loading, there is an existing literature that deals precisely with such questions: I advise you to do a book and periodical search, asking reference librarians at either Carpenter or Sibley for help. Speaking of speculation: I suspect that the existing structural frame would not be able to accommodate the increased loads of a rooftop garden, and would require substantial reinforcement. Good luck. Jonathan

2/09/04

Pam wrote this email in response:

Hi, Erica, Sorry I missed your call last Thurs.; I was at the store, and don't know why I didn't get the call. Anyway, sounds like you're doing some good initial research. For the GreenLeaf, I was thinking you might do an informational article about the project, once we're sure it's feasible i.e. after the engineer's assessment. I can meet with you this Thursday. What time? Perhaps it would be good for us to meet even without the engineer, just to cover some basics. Look forward to hearing from you. --Pam

2/10/04

I called Pam and set up a meeting at Greenstar on Wednesday, 2/11/04 at 9pm

2/11/04

I called Rob Young and set up a meeting at his office in Fernow on Monday at 3:30pm. He says there are only 2 certified structural engineers in town. I'm guessing these are the two Pam referred to, who charge \$80-100/hour.

2/23/04

Met with Rob:

Discussed, research, Dead end phone call, conversation with Tyler, and possibility of roof garden in Potsdam and soil experimentation in Ithaca. Rob suggested filling "a design vacuum" that exists in roof gardening. This can be done by experimenting with the objective of supplying information that can change or supplement building codes in the city (or beyond).

Experiment: Create several soil mixes, test for bulk density (saturation capacity) by weighing when completely dry and weighing when fully saturated. Plant in soil (controlled). Find the lightest mix that is still suitable for plant growth. Also experiment with methods of replenishing soil while minimizing inconvenience of hauling around.

*Perform a literature survey to find what has been studied in this area already.

*Contact Tom Leyden regarding ideas for thermal mats that spread weight / mitigate impact as well as insulate.

*pick up buckets from Rob's house

*Look up "Integral urban home"

*Brainstorm / research possible materials

Email from Rob to Tom Leyden:

Dear Tom,

You may get an email from a student (and all around great woman) named Erica LaFountain. She is working on the topic of large-scale, applied rooftop vegetable gardens. During our meeting today she brought up the idea of adding the thermal insulation component to gardens to spread out the per square inch impact of the planters as well as to add value through the energy conservation aspect of the design. She recalled your system (PV plus rooftop insulation) and so may get in touch to discuss your thoughts on materials etc.

Hope all is going well at your end. All is more than fine here except one of my solar panels broke at both ends just beyond the support rails. I can't figure out what would have caused it short of some very large condor landing with both feet at once on my roof!

Be good,
Rob

Email from Rob:

Dear Erica,

One: Don't let small minded folks who don't ask real questions deter you from what you are doing.

Two: I think while you are here (Cornell) you want to look into the structural engineering aspects of this. Learn what part of the town government keeps such information on buildings and what department (most likely a different one) has information on the regulations for structural requirements for buildings. Also, take advantage of Cornell's labs to do the weight measurement/different soil mix/pallets or thermal mats thing. There must be somewhere that you could weigh matting and pots filled with water drenched soil, etc. In addition, scan your readings for such information.

Three: Stay in touch.

Four: I think you have something here.

Best regards,
Rob

2/25/04

Sent emails to Amanda Stanko, Allison Hornor, and Henry Crans:

Hi, Henry.

My name is Erica. I'm a friend of Jerry Carter's. He recommended contacting you about a project I'm doing currently. I'm really interested in urban gardening techniques, the most interesting of which is roof gardening. My project involves putting a roof garden on a building by this summer. I'll be testing weights of various soils, planting in them, then putting them on a roof. The garden will be temporary, disassembled by fall.

I'm running into some municipal barriers with the building I chose downtown, so I thought I'd try my luck on campus. Please help me out with any of the following information if you can...

- 1) Do you know of some campus roofs that are suitable for this project (can easily hold at least 40lb per square foot, are flat, have easy access, and are generally safe)
- 2) Do you know what kind of barriers I might face from the university?
- 3) Do you think the university will support such a project?
- 4) Do you know who is in charge of the Ag. quad building (Jerry said you're in charge of the arts buildings)?
- 5) Can I get access to some roofs to check them out?

Any information is very helpful. If you'd like to meet, just let me know.
Thank you.

2/26/04

Called the Ithaca City Building Department: Tom Nix:

-**Codes** that apply are either state or local. The local codes apply in the city of Ithaca, whereas the state codes apply to state buildings (including state-funded Cornell buildings) and out of city areas. The local codes can be accessed on the internet at www.cityofithaca.org, "code", search function.

-**Restrictions:** must have railing if occupied, no furniture, structural requirements (unnecessary if container garden, removed by winter)

-Snow load in Ithaca is ~45 lb/sq ft.

-A container garden is a point load, so heavy impact would require structural certification ex) raised beds, or large planters

- Although, in theory, the plans of all the buildings in Ithaca are catalogued at City Hall, this is not exactly reality. No plans for Greenstar on file. Perhaps from original architect or current owner, but doubtful.
- My results could be used to compile a pamphlet to provide in the building department office or to disseminate to architects, engineers and interested community members.
- Insurance** would likely increase if the public is allowed on the roof.
- Cornell**: state code applies to state-funded buildings, "responsibility for enforcement varies." The state does its own inspections. Call Mike N. for more information on Cornell.

Email from Henry Crans:

Most of the lab buildings have flat roofs but lots of chemical fumes coming out of the air handling systems. Risk Management may have some problems with students on the roofs. Most parapet walls are not high enough to keep people from falling off. I think the university will support your project if it is class related. Tell me more about your plan. Call me on my cell phone 227-5815.

Checked out roof of Emerson Hall with Rob. Has railed access, and morning sunlight which will increase to summer. Roof is covered with round rocks which probably weigh a great deal and can be removed to add plants.

Wrote a note to Allison Hornor in 706 Bradfield asking if she can pose as a project partner since she's in the soils department, a graduate student, and knows how to access the soil labs.

Building maintenance:

Spoke with Ron Clayton (wrc1), who said "This might be one of those things where it's easier to get forgiveness than permission." He said he would tell anyone and I could claim ignorance later, but that getting permission would likely be difficult. When the weather gets warmer, he said, people will start putting lawn chairs out there and everything and it'll be ok. He also suggested a small interior "roof" in the plant science building that I may be able to use as backup. It has door access and cold frames planted.

Email from Jeff Lallas: jnl3@cornell.edu, 241 Roberts Hall, 227-1082, 254-8219

Erica, this sounds like a great project. have you looked around the campus? have you a few buildings that you consider prime for the project? I am not sure that I am in the best position to help you in my current job, but I am copying two people that may be able to help out. I think the hurdles you will have may be similar to the ones you had downtown, but I think the University will be more sympathetic to research. There would be advantages if you get the right people involved. I assume you are doing it through the LA department (?) but it could have support from a few other departments in CALS. Anyway, as a facilities manager, I would have a few concerns. Some of these are heavily dependent on how ambitious a garden you are planning. I think something small will take less investigation and review compared to a larger garden. Here are my thoughts.

- 1) safety -- roofs, even flat roofs, are dangerous sites, and there will be concerns with the safety of those people on the roof working or whatever they will do (setting it up and on going service)
- 2) access (traffic through the building) -- not all roofs are readily accessible, and depending on the activity, may create some unwelcome traffic through a building
- 3) material transporting -- crane? wheel barrel?
- 4) roof membrane protection -- not only during the installation (having some sort of barrier) but it'll be important that soil not be left on the roof when the project is done
- 5) roof structure protection -- a roof that can carry the load of wet soil and plants for the summer may not be able to handle the weight of that plus snow -- people will probably need assurance the set-up is removed well in advance of winter weather
- 6) how much area will you need?

It sounds like a lot of fun. Good luck, Erica! -Jeff

Email from Ch'aska:

In regards to determining total nitrogen content in a soil sample, I read that you can use dry combustion of dry, ground samples of soil with a gas analyzer. This will give you total organic carbon, too. just a thought...

Organic waste emerges in to dumpster to the side of Bradfield / plant science...looks like potting soil.

Email to Tom Leyden:

Hello Mr Leyden.

I am a student and friend of Rob Young. Remembering the PV system you constructed for the public library, which I glimpsed in Rob's Green Cities class, I thought you might have a couple of ideas for a project I'm currently working on. The project involves brainstorming and testing various soils, containers, and roof covers to maximize the utility and production of a rooftop garden system while minimizing the additional weight. The garden I have in mind includes clusters of containers placed above the strongest areas of the roof. The containers will contain lightweight soil no more than a foot deep. Rob and I have discussed using construction pallets to distribute the weight, however we would prefer a more elegant solution such as an insulating mat that distributes weight while lowering energy costs for the building. Please send me some ideas if you come up with anything.

Thank you.
erica laFountain

2/26 Email response from Allison Hornor

Hi Erica,

Sorry to have missed you today, I was working at home on a presentation. I'm so glad you're inspired to work with soil :-). If you'll be around next fall...CSS 260 Intro Soils is a great class and offers an excellent background on the properties of soil. Unfortunately potting mixes are really not my specialty. I think Emily Vollmer is in Marguerite's class with you. She did an independent project with potting mixes and organic amendments last year that was really well put together. She would know much more than I do about different mixtures, so I recommend you ask her. All I know is that

10-20% vermicompost is an excellent amendment for increased plant growth. :-). Who's your advisor on the independent project? If it's someone in Horticulture, you should probably use their facilities and testing equipment...departmental politics around here can get pretty tricky. I know that Dilmun Hill has some greenhouse space...that would be a good bet for supplies, potting containers, peat moss, vermiculite etc. The roof of Emerson is for maintenance access only...I'm trying to think of another place on campus with a flat roof that wouldn't mind an experiment set-up...that's a tough one. You'd probably have better luck setting up in a house or apartment building. One of the co-ops around town might be interested. Or you could test the mixes outside at Dilmun Hill (I don't know much about roof top gardening so I don't know how different the conditions would be). Sorry I couldn't be of more help...I'll bet Mann Library has some excellent general resources on potting mixes...I've found lots of great stuff there. Take care, Allison

2/27/04 Tom Leyden responded in email:

Hi Erica - lots of work has been done on green roofs which I assume you can find on the web. The roof tile that PowerGuard is modeled on is made by T-Clear. Take a look at this to see if it helps. <http://www.finpan.com/> Best of luck. Tom

2/28/04 I wrote this email to Theodore Eisenman after having spoken to him briefly on the phone at Rob's house. He will be writing an article on rooftop gardening in a landscape architecture magazine. He did the graduate LA program here at Cornell and was a TA for Green Cities. Theodore Eisenman, Project Manager, University Design Exhibit, USDA Living Memorials T: 267-481-3453

Hi, teddy. Just to remind you, I'm a friend and student and advisee of Rob young. I'm doing an independent study on rooftop container gardens and I'd like to read your article when it's out. Also, if you run in to some neat roof gardening organizations/companies, please send them my way...I just can't get enough of them, plus I'm looking for career opportunities and experience in the area. Are you a writer or a roof greener or both? just curious. Thanks. erica lafountain

3/1/04 Teddy Eisenman responded in email:

Erica, Nice talking to you too. I'm doing a range of work, including writing . . . but i have not personally built any green roofs. Aside from greenroof.com, check out GreeningGotham in NYC, and DC Greenworks. Look forward to staying in touch. -t

I responded to Jeff Lallas' email:

To answer your questions...

Q: have you looked around the campus?

A: Yes, actually I walk around with me eyes fixed on the roofs of the buildings around me.

Q: have you a few buildings that you consider prime for the project?

A: Yes, I'm thinking about the roof of Emerson because it has guardrails and because the membrane is covered, however there are access problems that I hoped you could help me overcome.

Q: I assume you are doing it through the LA department (?)

A: Actually, I'm in the Natural Resources department.

Q: 1) safety -- roofs, even flat roofs, are dangerous sites, and there will be concerns with the safety of those people on the roof working or whatever they will do (setting it up and on going service)

A: I'm the only one who needs to be up there. This is why I hoped to find a building with higher parapet walls or guardrails.

Q: 3) material transporting -- crane? wheel barrel?

A: By foot. hopefully by elevator

Q: 4) roof membrane protection -- not only during the installation (having some sort of barrier) but it'll be important that soil not be left on the roof when the project is done.

A: This will be a container garden and will leave no soil behind. The drainage holes in the containers will be screened well.

Q: 5) roof structure protection -- a roof that can carry the load of wet soil and plants for the summer may not be able to handle the weight of that plus snow -- people will probably need assurance the set-up is removed well in advance of winter weather

A: With a container garden, the plants can easily be removed at the end of the growing season to replenish the soil and to remove the weight from the roof structure.

Q: 6) how much area will you need?

A: Not much. a 10x10 ft area could be sufficient, however if I was granted more space I would be eager to use it.

Could I set up a brief meeting with you for sometime this week? half an hour would be great. How about on wednesday after 3p or thursday between 11:30am and 5pm? Thank you. erica lafountain

3/2/04 Jeff Lallas responded by email:

Erica -- thanks for the response. The two people I copied on the e-mails, who will be helping you on this, are John Ullberg (University planning department and university landscape architect) and Jim Constantin (was the associate university architect and now is managing property for the university out of facilities management. Both are great guys and would be happy to work with you. John is familiar with landscape issues and knows about research being done in the LA department with roof gardens. Jim would be the one ultimately allowing you access. He has already been wondering about water access and other practical issues -- and asked me if you had considered the differences between a test site a roof verses on the ground (like in a parking lot). He was thinking that a parking lot might be easy to set up, maintain, and monitor -- and a lot safer! But you should talk with them. Good luck! -Jeff

4/4/04

Amanda calculated that the main roof can hold 20 lbs at worst, 35 at best (in addition to a person). I find this discouraging. I don't think I'll be able to go through with a garden unless I can find a lightweight soil mix that I can afford and that can support plant life well on a roof. I'm currently doing some experiments to that goal. thank you for the time you've committed. erica LaFountain

3/3/04 I wrote an email to Jim Constantin: jic37@cornell.edu and John Ullberg: jl2@cornell.edu

Jeff Lallas recommended contacting you about the independent research I'm doing on container rooftop gardening techniques.

I like your suggestion about the parking lot. I had not thought of that. It would take some testing to determine whether the conditions are similar enough. The main requirements are direct sunlight, a little extra wind, and increased temperature. I would be using only a small portion of a roof for some experiments with different soils and will remove all that I take up (this is easy with container gardens). I am the only person who would need access for these experiments.

I would like to meet with you briefly in the near future to discuss rooftop gardens on the Cornell campus. I am hoping I can at least take a look at some of the roofs with your permission or even your company. I am available after 3pm on Monday and Wednesday, and after 11:30am on Thursday (but not tomorrow). Thank you. Erica

Jim Constantin responded:

Erica: I am available for discussion on Monday 8 March 2004 at 3:30 if that works for you. I am located at Room 116 Humphreys Service Building. Thank You, Jim

John Ullberg responded:

Hello Erica-I just picked up on the fact that you are interested in rooftop CONTAINER gardens. That's a little different from what we have been exploring lately which is green roofs.

I am by no means an expert on green roofs or container gardens but I can let you know that Cornell has a number of underground buildings and experience with them and that the new West Campus residence hall dining rooms will have green roofs. The landscape architects supervising that work are Trowbridge and Wolf. Katherine Wolf has done a number of presentations sharing the knowledge that she has picked up on the subject and I'm sure that you can tap into that via Peter in the Landscape Architecture Department.

The groundbreaking work (no pun intended) in green roof technology is being done in Germany and Canada. But green roof design has a different objective and a different plant vocabulary than container gardening.

I'm not sure what help I can be to you, am willing to chat, but suggest that you explore some of these other resources first. John Ullberg

3/9/04 Amanda emailed me with some questions about the building:

Erica, I need to know more information about the building. Maybe you could ask Pam or the current owner of the building. Do you know when the building was built? Also, on the roof, do you know what is under the white vinyl roofing? Does it cover an old roofing system, or was the old one removed? Also, has the roof ever had any trouble? Did the roof ever need repair, or sag during the winter under a lot of snow? Is there a phone number I can reach you at during the day? I am in and out of class all day, but you can try me on the office phone: 255-6155 Hope to hear from you soon, Amanda

I emailed Pam Williams about Amanda Stanko's questions

3/10/04 Pam Responded:

Hi, Erica,

As far as I know, the building was built in the 1960's. Before the new roof went on last year, there were leaks throughout the building whenever it rained. I think they applied the new roof right over the existing, but can you ask the roofer? Thanks. --Pam

4/5/04 I wrote up the experiment I did on 3/30/04 and another that I hope to do on a roof on campus.

4/9/04 I went to Seeley Mudd hall and surveyed the rooftop and greenhouses. I also spoke briefly to Paul Cooper, principal grower at the Seeley-Mudd greenhouses. He emailed me a space request which I filled out immediately for 20 square feet of rooftop: \$3/month.

4/13/04 Pam Williams wrote back:

Hi, Erica,

Do you mean 20 to 35 pounds per square foot? -Pam

I sent this email to Paul Cooper:

Hi Paul,

I don't know if I fully explained that I'm doing an independent study on rooftop container gardens. After spending a great deal of time looking and asking for access to roofs on campus and in town, I was relieved and excited about the access at Seeley Mudd. What's particularly interesting to me is that you are able to generate revenue (albeit small) while providing research space. As far as I know this is the only opportunity of its kind in Ithaca, though rooftop gardening is a subject that could use much more research. I've been thinking about this little venture and would like your permission to write a paper on the program you have set up. Would you be able to provide some information about how much revenue is generated, who uses the space, for what purposes, what amenities are provided, etc.? If so, I can come in to talk to you sometime this week. thank you. erica lafountain

p.s. I filled out the form online.

4/16/04 My space request was processed and accepted.

