The Sustainability and Viability of Marginal Land Agriculture:

Urban and Arid-Land Food Systems

by

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Abstract

This thesis comparatively analyzes urban and arid-land agriculture, looking specifically at the sustainability and viability of these two marginal land food systems. Through analyzing the three pillars of sustainability – environmental, economic, and sociocultural – I explore the potential of improving both systems’ sustainability and viability through synthesizing their practices. I conclude that the development of urban and arid-land food systems is viable – capable of succeeding – only if the environmental, economic, and sociocultural sustainability of the systems are maximized and well balanced. Sustainably developing food systems in agriculturally marginal land areas – the areas of present-day growth and future prosperity – is necessary when considering the realities of urbanization and desertification.
Introduction

“Population growth forced people to adopt intensified means of agricultural production (such as irrigation, double-cropping, or terracing), and to expand farming from the prime lands first chosen onto more marginal land, in order to feed the growing number of hungry mouths. Unsustainable practices led to environmental damage...resulting in agriculturally marginal lands having to be abandoned again.”

– Jared Diamond, Collapse: How Societies Choose to Fail or Succeed

Exponential population growth puts pressure on our life-sustaining natural resources, reduces the percent of arable land available in the world, and subsequently jeopardizes global food production. This human-generated cycle of food production and societal destruction does not have to continue; we have the power, the technology, the resources and the knowledge, to develop a more sustainable food system. While the arable land that once existed no longer does, perhaps there is potential in growing food on more marginal land. Whether in dry desert soil or on buildings’ rooftops, farming on agriculturally marginal land – in areas typically without or presumably unsuitable for agriculture – could be the way to battle the negative effects of population growth, rural to urban migration, and environmental degradation.

Arid-Land and Urban Food Systems Explained

The relationship between urban and arid-land food systems is complicated to
grasp and to some, may even seem nonexistent. I seek to prove that as perplexing as such a comparison may initially seem, there is indeed a compelling connection between the two. Dry-land areas make up 41% of the earth’s land area and are home to more than two billion people, just about 28% of the world’s population (MEA 1). Combine this percentage with the realities of desertification, and suddenly the majority of the world’s land area appears to be turning to desert. Now consider, 53% of the world’s people currently reside in urban areas (World Bank). Like those in deserts, these people need to eat but lack access to agriculturally suitable land. If the majority of people live in agriculturally marginal lands and the majority of land is agriculturally marginal, then we should prioritize learning to grow food in such areas.

Hope for such food systems exists in the development of sustainable agriculture techniques and innovations for agriculturally marginal lands. Overusing land by intensively growing crops has destroyed the biological potential of land and has transformed once healthy and arable land into desert. Excessive dryness, insufficient rainfall in arid areas, and the diminished resource potential of once arable land is detrimental to the future of the world and its people. Sustainable arid-land agriculture techniques focus on innovative soil and water management on land burdened with lack of water, excessive salinity and alkalinity, and seemingly unbearable sun exposure. There is hope in arid-land agriculture.

Such hope also exists in urban agriculture, a system of food production practiced within city boundaries. Agriculture in cities can be broken down into two main categories – intraurban (within) and periurban (on the outskirts) (Mougeot 10). Whether production occurs in the center of a city or on the fringe of the metropolis, urban agriculture can
prove an integral part of society. Urban agriculture compliments outside sources of food supply and acts as an important source of self-provision, strengthening poor urban households’ food security.

Through comparatively analyzing urban and arid-land food systems, I seek to highlight their overlapping sociocultural needs, economic agendas, and environmental struggles. Soil in cities, for instance, is often infertile due to chemical contamination from lead and industry; in deserts, soil is often infertile due to excessive salinity and alkalinity. In both, farmers must grow in inopportune conditions and often must rely on external expertise to reach more food-sovereign futures.

Desertification and urbanization are occurring hand-in-hand, at rapid rates. As these rates continue to rise, arable land will continue to be depleted. If we are to feed the world’s growing population in a manner that will lead to future prosperity, we must address the sustainability of utilizing environmental, economic, and sociocultural resources for agriculture in both arid and urban areas. Through analyzing these three overarching categories of sustainability, we can discern best practices for utilizing resources in each locale and appropriately apply those practices to the other. Integrating best practices of desert and city food systems can improve the sustainability of each system and in turn, increase their viability in their respective locales.

**Sustainability and Viability**

In analyzing best practices relating to the sustainability of these marginal land food systems, we must not confuse *sustainability* and *viability*. Sustainability refers to the
utilization of a resource without completely using it up or destroying it (Merriam-Webster). More specifically, the United Nations defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Benton-Short and Short 439). In a similar vein, viability refers to the capability of something to succeed (Merriam-Webster). But of course such a definition of viability is contingent upon how one defines “success.” For the purposes of this thesis, I define success as sustainability in social, economic, and ecological terms. Therefore, in order for a food system to be viable – capable of growing, developing, and succeeding – social, economic, and ecological resources must be sustained.

Agriculture in marginal land areas must be capable of succeeding without depleting or permanently damaging the resources of an area, for such areas are already too stressed. Farming on agriculturally marginal land might only be viable – capable of succeeding – if the environmental, economic, and sociocultural sustainability of the systems are maximized and well balanced. The ultimate goal of marginal land agriculture should be the viability of the system. Such viability is only possible though, if the sustainability of all aspects of the process are attended to and both the sustainability of the short-term and the long-term are considered. As will become apparent, this is not to say that a system would be completely unable to succeed if the three categories of sustainability are not perfectly balanced or fulfilled. Balance does not refer to perfect equality, but rather to holistic sustainability and viability, which can be accomplished through careful consideration of the trade-offs between the three major pillars of sustainability.
Three Pillars of Sustainability

“The term and concept of sustainability did not simply happen. It is less a linear process, and more a convergence of intellectual perspectives. Gradually, from the 1970s to the 1980s, the idea of ‘sustainability’ coalesced around the three issues of environment, economic development, and advancing social equity.”

- Lisa Benton-Short and John Rennie Short, Cities and Nature

When the United Nations introduced the concept of sustainable development in their 1987 report called Our Common Future, they proposed that sustainability consists of three main pillars: environmental protection, economic development, and social development. These three pillars came to be referred to as the “three Es” – ecology, economy, and equity (Benton-Short and Short 439). I seek to extract best elements from each marginal land food system through exploring practices within each of the “three Es.” Through extracting practices relating to these three pillars, the viability of each system will become more apparent.

Environmental sustainability is a category with a two-fold definition. It refers to the ability to use natural resources without depleting them, and to decisions focused on the preservation of the natural world. While the interconnected nature of agriculture and the environment will be explored in depth in the context of each marginal land food system, I would be remiss to ignore the intersection of modern day agriculture and the environment. After all, sustainable marginal land agriculture systems are in need of development in the first place because of the impacts of conventionalized agriculture
practices.

Industrialized monoculture agriculture operations contribute to deforestation and land degradation. Application of agro-chemicals leads to chemical runoff into water bodies, ultimately decreasing biodiversity. Soil erosion, overexploitation of land by overgrazing, and poor irrigation has degraded land so badly that land once lush, beautiful, and arable, has become biological desert (Hassan, 3). More sustainable agriculture practices that take into account the importance of biodiversity, soil quality, and water resource management could have fewer detrimental impacts on the environment and could be more economically sustainable and viable in the long run.

Adopting sustainable practices for farming on dry, desert land and in chemical-ridden urban soil is easier said than done. While urban and arid agriculture appear different on the surface, some of the environmental challenges and positive and negative impacts of each are the same. For instance, both areas have environmentally unsuitable growing conditions. Besides the challenges associated with infertile soil, farming in deserts and in cities can also negatively impact the environment of their respective locales. The development of agricultural land in deserts could negatively affect an area’s ecosystem, hurt natural wildlife, overuse water, and eventually prove unsustainable for the future. The development of agriculture in cities and the use of agrochemicals in particular, can lead to chemical contamination and related public health concerns.

Like arid-land agriculture, urban farmers must also consider the difficulty of accessing water, which is a particular struggle in impoverished urban neighborhoods – the places where those would benefit most from community gardens. Unlike farmers in the desert, city farmers have the additional struggle of attaining enough space for a
garden and enough sunlight or shade to keep their crops alive. But urban agriculture and desert agriculture, if practiced sustainably and with environmental considerations in mind, can contribute to booming natural ecosystems in places few would think such ecosystems could ever exist.

Sustainably producing enough food for the world’s population is both a struggle and a necessity. To overcome this struggle, we must understand the environmental challenges, impacts, and benefits of developing local food systems and farming on agriculturally marginal lands. Along with the environmental components of urban and arid-land agriculture, the development of marginal land food systems also has significant economic constraints, impacts, and benefits.

**Economic sustainability**, the second pillar of sustainability, refers to “the use of various strategies for employing existing resources optimally so that a responsible and beneficial balance can be achieved over the long term” (Business Dictionary). While striking a long-term balance through optimal use of resources is a component of economic sustainability, of even more importance is to whom and about what that balance refers.

Understanding sustainability as a balance of resources dates back to the very beginnings of the conservation movement when Gifford Pinchot, the first Chief Forester of the United States, introduced the country to his concepts of “sustained yield” and “wise use.” He believed that wisely using resources entails maximizing “benefit for the greatest number of people rather than for the profit of a few.” Like sustainability advocates of today, he “promoted long term interest over short-term concerns” (Benton-Short and Short 437). In order to properly define economic sustainability for the purposes
of my research and in the context of food systems, I believe we must combine the dictionary definition and Pinchot’s pivotal views. Such a combination creates a definition in line with Noah Zerbe’s notion of a “moral economy of provision:” “The success of any alternative food movement depends ultimately on its ability to re-embed food production in the moral economy of provision” (25).

Economic sustainability, or better yet, the moral economy of provision, refers to the use of resources in a manner that ensures long-term success through balancing the needs of producers, distributors, and consumers. An economically sustainable system can therefore prove viable when we responsibly and optimally employ resources so that a balance between affordability and profitability exists and maximizes long-term benefits.

While we might initially perceive urban and arid-land food systems as economically dissimilar, they actually struggle with similar economic constraints. Both areas struggle with the dearth of means to store, transport, and preserve products. They also typically have underdeveloped or nonexistent infrastructure for agriculture and an unreliable market. If marginal land food systems are to be economically sustainable and viable, we must consider the issues from and benefits of developing urban food systems and arid-land food systems.

Like the environment and agriculture, the economy and agriculture are also interconnected – perhaps in an even scarier, more palpable way. The market controls agriculture. Agriculture, or rather the food system as a whole, is a business, one constrained by the concentration of power and players and one with hardly a fair playing field. As Raj Patel so frankly states, “the terrain of the market isn’t so much a playing-field as a razor’s edge” (Patel 13). There is enough food in this world to feed the planet,
yet people cannot afford to purchase food. As businesses strive to become bigger and bigger with the primary goals of reaching economies of scale and increasing shareholder profits, consumers are often left without sufficient resources or wages to consume what they need nutritionally. A marginal land food system with a moral economy of provision must focus on finding a balance between the growth of the food system, the needs of the producers to make a profit they can live with, and the needs of the consumers. Such a system would in turn be considered economically sustainable and viable.

It is extremely necessary to focus on the consumers. How can a food system or a company be successful if it ignores the very people in need of its products? There are very tangible associations between food systems and the environment and economy. Sociocultural realities are more difficult to document, but are nonetheless essential to consider. **Sociocultural sustainability** refers to aspects of a project or system that proves valuable to a society, its people, and their culture. This category of sustainability can also refer to the ability of people within a community to incorporate certain activities into their daily lives that are separate from their work or home lives.

Many people in marginal land areas, urban and arid, typically do not have much agricultural background, leaving an education gap in the development of such production systems. Without much prior information about or knowledge of farming, motivating societal interest could prove rather difficult. In addition, people who are unaccustomed to eating fruits and vegetables could have little interest in growing such food themselves or consuming such products. Sociocultural taste preferences can therefore act as a limiting factor in the success of marginal-land food systems. Sustainably changing the way people live through implementing a new form of labor, lifestyle, or hobby, is easier said than
done. The development of local marginal land food systems, whether in deserts or in cities, without a doubt impacts the communities of the given areas in which the food systems exist.

As will become apparent through my analysis of cases in four locations around the world (including my personal experience in two of those locations – Israel and Queens), and relevant scholarship in journal publications, people seem to benefit from the ability to take part in their food systems. Implementation of agriculture and related programs, regardless of the projects’ size, directly affect communities through creating educational, volunteer, employment, and social opportunities for local residents.

Implementing policies relating to growing food on agriculturally marginal land will contribute to an increase in educational opportunities and job opportunities for populations in both cities and rural desert societies. Marginal land food systems could thus not only benefit the environmental health of the world, but could also contribute to the alleviation of economic and social struggles in such areas. My analysis of the three pillars of sustainability in the context of cities and deserts will further emphasize the necessity of developing sustainable food systems. The success of such food systems relies on their holistic sustainable development and consequent viability.

To examine the above-mentioned criteria of success for marginal land food systems, I will explore and analyze the environmental, economic, and sociocultural sustainability of initiatives in the deserts of Kenya and Israel, and those in Havana, Cuba and New York City.
Marginal Land Food Systems Around the World

I will briefly summarize the two arid and two urban food systems I will be referring to throughout the rest of this thesis.

Turkana, Kenya

Turkana is a semi-arid region in northwestern Kenya on the border of Ethiopia, South Sudan, and Uganda. In much of the region, people live with minimal access to food and water and to this day, rely heavily on their animals for food – milk, meat, and blood. Due to their marginal environment, the Turkana have lived for years as semi-nomadic hunter-gatherers with little to no access to vegetables and agriculture. Over the past few years, climate change has contributed to great suffering in the region through severe and frequent droughts. Living as their ancestors once did has become increasingly difficult for the Turkana and starvation and malnutrition has risen.

Malnutrition and regional political strife are increasing as the Turkana’s traditional means of food provision disappears before their eyes. In order for the Turkana to continue to live in their marginal area of the world, agricultural development must be considered. The Kenya government has encouraged development by cooperative ventures between Furrows in the Desert (FID), an Israeli-run agricultural development project jointly run by the Arava Center for Sustainable Development (ASD, Israel), the Missionary Community of Saint Paul the Apostle (MCSPA, Kenya), Brit Olam (Israel), and local semi-nomadic communities of northern Turkana. FID’s mission is to build local
capacity in sustainable agriculture in order to contribute to greater food security in the area. The program has operated since 2010 with funding from the following entities: Emalaikat Foundation (Spain), New Ways Charity (UK), DKA Austria on behalf of the Catholic Children Movement of Austria, ROTARY International through an initiative of ROTARY Israel, Government of Kenya through the office of the Prime Minister, and the Israeli Foreign Office through MASHAV and the Israeli ambassador to Kenya (FID PowerPoint).

Agriculture can provide the people of Turkana with food and with a way to generate income. The semi-nomadic Turkana live in severe poverty, in distressing environments, and are in need of food and economic independence. Through the implementation of agriculture in northern Turkana, transforming a marginal community into a more food sovereign nation appears to be a more likely reality.
Negev Desert, Israel

Few people can imagine growing their crops on land dominated by a lack of water and abundance of heat and sunlight, but many farmers have taken to arid-land agriculture in deserts across the world, from the dry-lands of the United States to Israel’s Negev desert.

When Israel achieved statehood in 1948, the country’s first Prime Minister, David Ben-Gurion, spoke of ‘making the desert bloom’ even in such an ecologically vulnerable area. From that moment on, Israel began to set the stage for the methods and technologies necessary to farm on dry, agriculturally marginal land. With the development of agriculture research centers, appropriate irrigation technologies, and soil management plans, the Negev became a flourishing agriculture center within a short few years.

At the Arava Institute for Environmental Studies, located on Kibbutz Ketura in the very heart of the hyper-arid region of the southern Negev, researchers, students, professors, and scientists work together to explore and implement ways in which agriculture could be sustainably practiced in the region across religious, cultural, and political boundaries.
Havana, Cuba

Urban agriculture in Havana dates back to 1966 when urban planners incorporated the development of the Havana Belt, a swath of farmland circling the city, into the city structure. Though, it wasn’t until the Soviet Union collapsed that urban residents more fully began to turn their attention towards food self-provision.

Urban agriculture in Havana, Cuba is an example of ground up, self-initiated and rather impromptu agricultural development. Upon the 1989 collapse of the Soviet Union, imports and trade subsidies of which Cuba relied upon, disappeared. So began the Special Period, classified as a period of extreme economic despair in the country when 2.2 million residents found themselves suddenly without access to food imports (Clouse 33). Cuba could no longer access fuel, fertilizers, and pesticides through imports, leaving the country isolated and in need of quick solutions. Fidel and Raul Castro were forced to
innovate, eventually choosing to reject the Green Revolution and the conventional agriculture methods in support of more socially and ecologically focused farming.

With more than 75% of the population living in cities and towns, government supported urban agriculture became the key component to reinforcing food security in the country (Clouse 45). Urban agriculture has continued to play a vital role in Havana to this day. Strikingly, Cuba remains the “only country in the world that has developed an extensive state-supported infrastructure to support urban food production and urban growers” (Short et al. qtd. in Murphy and Gonzalez). Such state support has allowed for thousands of Habaneros to take part in their own food provision. As I will discuss in the chapters ahead, Havana’s urban agriculture takes shape in a variety of ways, all of which make use of organic or permaculture growing techniques: Huertos populares (popular gardens), Autoconsumos (institutional gardens), Organopónicos (cooperative gardens), and Empresas estatales (state enterprises). These systems will be explored in depth in Section 2.2.

Organopónicos, Havana, Cuba. Photograph: James Padgram
Queens, New York

While the centralized state-sponsored urban agriculture in Cuba is exceptional, development of localized urban food systems extends beyond the relatively isolated island. Two initiatives in Queens, NYC, provide us with examples of a move towards more localized urban food systems. One of the most culturally and economically diverse places in the world, Queens is home to a number of impressive, successful, and collaborative urban agriculture initiatives. At the Queens County Farm Museum (QCFM) and the Queens Botanical Garden (QBG), residents of NYC and this diverse borough have the opportunity to reconnect with the land, with farming, and with each other. QCFM is a publicly run farm owned by the NYC Department of Parks and Recreation.

Queens County Farm Museum’s history dates back to 1697; it occupies New York City’s largest remaining tract of undisturbed farmland. The farm encompasses a 47-acre parcel that is the longest continuously farmed site in New York State. This site includes historic farm buildings, a greenhouse complex, livestock, farm vehicles and implements, planting fields, an orchard and herb garden. – Queens County Farm Museum

The Urban Farm Project at the Queens Botanical Garden runs in partnership with the New York City Department of Sanitation Bureau of Waste Prevention, Reuse and Recycling (BWPRR).

The farm was developed to show the link between food waste and food production. Organic debris generated on the farm and at the Garden will be turned into finished compost and used to nurture the soil. Food scraps from QBG and the neighboring community will be incorporated into the composting system to diversify the nutrient content of the finished material and provide residents with an easy food scrap drop-off opportunity at QBG. – QBG Farm
Planting Fields, Queens Farm. Photograph: Queens County Farm Museum

Educational Garden, Queens Botanical Garden. Photograph: QBG Farm
Section 1: Arid-Land Food Systems

“It has been theorized that what triggered the very origin of agriculture on several continents 8,000 to 10,000 years ago was warming and drying trends, which forced the growing human population to innovate in order to achieve greater food security. As we now enter the new normal of even greater climatic uncertainty, we may have to scale up the most promising adaptations that desert dwellers have improvised over the last several centuries to achieve resilience in our food systems as a whole.”

— Gary Nabhan, *Growing Food in a Hotter, Drier Land*
Chapter 1.1  Environmental Sustainability of Arid-Land Agriculture

*Environmental sustainability* is a category with a two-fold definition. It refers to the ability to use natural resources without depleting them, and to decisions focused on the preservation of the natural world.

Picture an arid-land region – the sand, the rocks, and the unbearable heat penetrating the soil. What if, beneath the rocky, sandy, and hot terrain, exists a potential for growth. Can our picture then change from that unbearable nothingness of deserts to regions where water flows and crops grow?

The environmental sustainability of arid-land food systems lies in the development of and implementation of agricultural techniques suitable to combat the many challenges that dry land farmers face. Considering these challenges and the ways in which they can be sustainably mitigated, can give way to the development of a viable food system.

The Challenges of Growing in Stressed Conditions

Access to water is a major concern for arid-land farmers. Water is the foundation and recipe for life, both for people and for our crops. According to a 2007 report on water scarcity, “agriculture accounts for 70% of all water use globally,” and with the rapidly growing industrialized agriculture system, we are using more and more water each day (Coping with Water Scarcity 5). Promoting sustainable arid-land agriculture would not
only impact people’s food consumption, but also invariably the management of water resources.

Little water ever reaches the soil surface in dry areas. The water that does reach the surface is often too minimal to penetrate the soil sufficiently enough to be useful in growing food crops. In dry-land areas, overexploitation and poor management of water resources has contributed to waterlogging, excessive salinity, and erosion. Implementing agriculture in areas already under deeply stressful conditions could lead to further management errors.

In a combined ecosystem of low rainfall and high winds, low vegetative production is commonplace. Farming puts a lot of pressure on the land, which contributes not only to cases of low vegetation, but also to land erosion (Portnov and Safriel 660). The health of soil is reliant on the production of organic material. Low rainfall and reduced plant growth leads to slower production of organic material, and therefore a reduced potential for fertility.

More often than not, soil in arid and semi-arid regions have low holding capacity for moisture, experience widespread surface crusting, and are densely packed. Soils in deserts have reduced rates of infiltration compared to the infiltration abilities of soil in wetter climates. Such low rates of infiltration lead to high run-off and less effective use of rainfall (Portnov and Safriel 665). In addition to the low infiltration rates within the soil, high rates of evaporation also play a role in water storage issues in arid land. Hot dry winds reduce the effectiveness of rainfall by increasing the rate of water evaporation (Cresswell and Martin 3). An increase rate of water evaporation increases moisture stress, which ultimately leads to high evaporation loss of stored waters.
Soil collects minerals from the breakdown of rocks. In a region with normal precipitation, these minerals are leached from the soil on a relatively regular basis. In arid areas where water is drawn from lakes, rivers, or reservoirs, the leaching of minerals does not occur regularly, resulting in soil containing excessive minerals (Creswell and Martin 3). Irrigation in dry lands could very well solve this excessive mineral issue, but could also create a more saline environment, which would support few crops.

The world’s irrigated lands, whether those of the desert or elsewhere, suffer from salinity due to salt accumulation in the soil. Saline water limits crop production. Its existence in irrigated lands draws attention to the difficulty of implementing even the most successful of technologies like drip irrigation. Obtaining water, conserving it, and managing it efficiently without damaging the soil is necessary, but something that is clearly easier said than done.

Like other regions, arid areas are also prone to diseases, pests, and temporal mismatch between crops and pollinators. Such issues are of even greater concern due to climate change and related events. Extreme climate events can put severe pressure on arid areas, ultimately affecting pest population and disease incubation. Like in other areas, in arid areas, high winds, temperature increase, and sporadic but intense rainfall events can impact insects’ dispersal and change the makeup of pest populations (Padgham 134). In regards to temporal mismatch, or what Gary Nabhan describes as an asynchrony, climate change triggers crop plants to break bud and flower in advance of pollinators, which can lead to reduced fruit and starved pollinators. Nabhan explains, “most fruit and vegetable crops require pollination by animal vectors at levels sufficient enough to set seed, ripen fruit, and allow them to mature as fully formed, nutritionally rich foods” (Nabhan 194).
With this reality in mind, he suggests that farmers around the world, whether in arid areas or not, “invest in pollinator-habitat-enhancing practices that offer redundancy through the presence of a diversity of wild and domesticated pollinators” (195). People must adapt to climate change regardless of where they are located. In arid lands, where conditions are already stressed, solving disease, pest, and asynchrony related problems in ecologically sustainable ways is often more challenging than it would be elsewhere and takes more thought and perhaps more innovation than may be initially presumed.

**Addressing the Challenges: Adaptations and Technologies**

Believing that there is a need for arid-land agriculture will not alone lead to the development of a sustainable and viable food system. Dry swaths of land cover our world. Recognizing the need to grow food in these areas is only the first of many steps. We must also recognize the challenges of implementing sustainable dry-land agriculture systems. Once the challenges stated above are recognized, we can address their solutions.

Like the challenges themselves, the solutions are also interlinked. Adapting to changing environmental conditions is not a new concept for farmers, but one that must be emphasized in environmentally stressed areas. The capacity of farmers to adapt to the intense challenges in arid areas is a matter of concern, but given enough attention and care for detail, it does not prove to be impossible. Farmers must adjust planting and harvesting operations to focus more intensely on crop variety, crop heat tolerance, and when certain crops should be planted. Some crops known for their heat tolerance and drought resistance include chilies, sorghum, millet, and cassava. Short-stemmed plants
and crops with limited leaf surfaces minimize transpiration, and quick maturing varieties ensure growth occurs before the hottest and driest parts of the year.

In addition to turning attention towards crop variety, using irrigated agriculture methods is the simplest solution to manage water in areas with a lack of precipitation (Rosenzweig and Tubiello 861). With appropriate water technology, we can grow many food crops in arid areas.

Managing water effectively and efficiently can lead to better soil care and increased crop production potential. Arid-land farmers must prioritize the use of modern irrigation systems if water use is to become more efficient and risks are to be minimized. Utilizing drip irrigation is one way to make arid-land agriculture a more sustainable endeavor.

For example, in Israel’s Negev, farmers have adapted their growing practices to the desert environment and have created a successful industry out of a food system many people once thought never to be possible, and some continue to think is ecologically unreasonable. Doing so has required creative minds, hard workers, and innovative technologies that together prove that farming in arid land can be increasingly environmentally sound and can be a viable practice.

Israel has led the world in drip-irrigation, a system that has quite substantially changed the face of agriculture worldwide. Drip irrigation minimizes water and fertilizer use by allowing water to drip slowly to the plant roots through a network of valves, pipes, tubing, and emitters (Padgham 81). Without drip-irrigation, arid-land farming would be irresponsible, as it would inefficiently use the minimal water that exists in a desert.

Netafim, the Israeli-based company that introduced drip-irrigation, was founded
in 1965. Only a year later, they introduced the world’s first dripper and one year after that, the company supplied drip irrigation equipment to vegetable growers in Israel’s southern Arava, “turning the region into an agricultural powerhouse” (Netafim). Before that point in time, the hostile growing conditions of the desert limited the productivity of agriculture in the area.

With drip irrigation, farmers were able to successfully grow a range of crops. Drip irrigation’s success led the Israeli government, NGOs, the private sector, and regional farmers on a mission to improve the technology and continue to farm in the region. According to information provided on Netafim’s website, the drip irrigation systems increased “crop yields in the region by nearly 70%” and water usage in the area fell by 5%. With technology at work, the twenty agricultural settlements in the southern Arava became known as the center for agriculture innovation and development. The challenges of farming on arid land still existed, but with drip irrigation, desert agriculture became much more environmentally, and economically viable.

Drip irrigation, like other irrigation methods, poses challenges relating to the salinity of soil. Some researchers thereby suggest that dry land farming should not necessarily be considered farming with the use of innovative irrigation systems, but rather, farming with minimal irrigation. Instead of utilizing irrigation systems, arid land farmers can put greater stress on conserving and utilizing rainfall. In order to conserve and utilize rainfall effectively, soil must be able to absorb water and the evapotranspiration rates must be reduced. Evapotranspiration is the process by which water moves into the atmosphere and plants extract water from the soil and release it back into the atmosphere (Creswell and Martin 8). Farmers can reduce
evapotranspiration with various methods.

Such methods include the use of drought tolerant crops and the implementation of windbreaks, or lines of trees planted perpendicular to the direction of the winds. Windbreaks alleviate the wind, reduce evaporation and wind erosion, and provide some shade from the sun for the crops (Creswell and Martin 3). In addition to windbreaks, mulching can also reduce the wind’s effects and reduce soil temperatures.

Since weeds compete for soil nutrients and water, farmers must also pay special attention to controlling weeds in dry-land areas. Planting crops with CAM, crassulacean acid metabolism, is also a common practice. Such plants keep their stomata closed during the day and open at night, thereby reducing water loss (Zelitch 722). Increasing the space between crops allows fewer plants to compete for soil moisture and nutrients. When utilizing windbreaks combined with very particular crop decisions and soil preparation methods, farmers can reduce evapotranspiration rates and can conserve water at a greater rate.

Adapting to an arid-land agriculture environment does not only require the adoption of the aforementioned methods. In order to adapt successfully, one must pay close attention to the slope of the land, the direction of the sun and the wind, and the application of nutrients.

Learning to Adapt to the Arid-Land Environment: A Personal Journey

During a four-month stay in the Arava Valley, in Israel’s Southern Negev, I learned first-hand about the environmental challenges, adaptation strategies and
techniques for growing crops in such a dry environment.

In the spring of 2014, I lived in the heart of Israel’s Negev on Kibbutz Ketura while studying at the Arava Institute for Environmental Studies. The Kibbutz is located about 50 kilometers (31 miles) north of Eilat, Israel’s southernmost city. While studying at the Arava Institute, I took a seminar and field-based class called “Small Scale Farming in Arid-Land.” The class ran in conjunction with Furrows in the Desert, the Israeli based program focused on the development of agriculture in Turkana, Kenya. Learning about Turkana while in Israel called my attention to the analogous conditions of deserts and set me on the path I find myself on today, comparing two desert food systems not only with each other, but also with urban food systems.

As part of the Small Scale Farming course, eight students including myself, engaged in studies and activities pertaining to farming in the desert using Israel as our field and Turkana as our case study. We learned about appropriate technologies for water distribution systems and farming, and about the difficulties of setting up a farm in remote, dry regions. Never had I before been exposed to such harsh agricultural conditions.

Through lectures, I also learned about the people of Turkana, Kenya: about their social structure and their culture. I will discuss these sociocultural aspects more in depth in the following chapter. I will focus here, on the environmental-based adaptations I learned about during our fieldwork in Israel.

Based on Israel’s success in agricultural technology, FID has developed and implemented four agricultural models in Turkana. As part of the course, my class learned about each of these four models and practiced various aspects of each in the field:

- Subsistence to commercial agricultural plots
- Diversion of flood runoff
- Earth Pan System
- Central Farm for dates and fodder on a commercial scale

Each of these models highlights specific aspects and stresses of desert environments. The first model utilizes gravity fed drip irrigation systems (FDS). The second model focuses on the cultivation of crops through utilizing catchments of runoff water along the banks of dry riverbeds. Farmers can only use this model in places where seasonal floodwater can be diverted by canals and retained by low earth dikes. It is an economically viable model that requires relatively small investment in infrastructure and maintenance. However, it is not necessarily environmentally viable in hyper-arid areas or places without much water to divert in the first place. The third model emphasizes the use of short-duration crops. The earth pan, while filled with water, can support adjacent plots and when the water in the earth pan resides, rain-fed crops can be planted inside the earth pan, utilizing the water absorbed by the soil. This model can support vegetables, fruit and grain (i.e. sorghum and millet) for about nine months. The last model is directed specifically at Turkana’s agriculture. It combines the use of the alkali water of Lake Turkana with intercropping, a process in which farmers grow multiple crops together. Intercropping saline and alkaline resistant crops, like dates and pomegranates, could boost the environmental and economic viability of agriculture in arid areas.

My Small Scale Farming class in Israel had neither the time nor the resources to practice all four of these methods. We did, however, experiment with some basic techniques based on these methods on our very own small-scale agriculture plot.
I had prepared a seedbed once before, but never in the dry soil of the desert. When we walked out of the gate of our Kibbutz and across the street to the fallow land we would soon call our farm, I don’t think I fully grasped what was ahead of me. Once across the street but before deciding on a plot of land, our teacher instructed us to examine the field for slope and the direction of the wind and sun. In order to set up a drip irrigation system successfully and for the water to flow to the crops, the land must not slope too much in any particular direction. If it does slope, the water could pool in one area or flow the wrong direction, preventing crops from receiving their much-needed water supply and ultimately contributing to waterlogging issues.

Considering both the wind direction and the sun is vital in determining the direction of the seedbed. In sandy soil of the desert, it also isn’t uncommon to come across rocks. Before digging everything up, we were instructed to remove all stones, crop residue, and anything that might get in the way of our crops’ growth. With these guidelines in mind, we set out to prepare the land. We made sure to check if the soil was loose (it wasn’t) and that it was smooth without lumps (which it wasn’t). In order to work in such arid and inhospitable conditions, our teacher instructed us to think about the various ways we could increase soil fertility - soil cover (mulch), crop rotation, and compost. Nothing had ever been planted in this particular location in the past, so we decided to focus most on compost. Compost takes about 4-6 months of measuring, layering, and turning before it is ready for use. Luckily, the Kibbutz had already had a compost pile ready for us.

Compost is by far the agro-ecological practice most emphasized for small scale farming in dry areas. It is a collection of materials combining carbon from organic
materials and nitrogen from animals. A 2:1 ratio of carbon to nitrogen is a primary component of a successful farming system. It is essential to measure, layer, and turn the compost before using it to cover the beds. Once the compost is ready, farmers can double dig the land and fill the beds, which will further prepare the seedbed for success. In addition to compost, tilling the soil is also beneficial preparation as it prevents crusting, allows air and water to penetrate the soil, removes weeds, and breaks up the soil, which helps plants grow. The timing of tillage is sensitive so farmers must be aware of when it is appropriate to plow. Farmers should not till when the soil is wet and they should plant immediately after tilling. Utilizing compost, combined with the implementation of water irrigation methods, crop rotation, proper tillage, and mulching with straw, leaves, and waste, can increase yields in dry areas despite the marginal water supply.

When it came time for my Small Scale Farming class to actually begin digging the beds, we realized what we had assumed would be the most straightforward of tasks was actually one of the most difficult. When we dug up the ground, the sand immediately fell back into place. How could anyone work with such soil? It takes time, energy, and a whole lot of dedication. We learned to laugh about it despite the hot desert sun and the exhaustive nature of the manual labor in which we were participating. It was frustrating and challenging nonetheless, and it took hours upon hours to complete.

When the beds were finally complete, the compost tucked rather haphazardly inside each bed and beneath the top layer of soil, it was time to set up the drip irrigation system. Although we determined that drip irrigation would be the most efficient irrigation method to use in this area, our teacher also instructed us on its downfalls. It could create a more saline and alkaline environment and could lead to waterlogging. Nonetheless, it has
90% efficiency, unlike flood irrigation (30%) or sprinkler irrigation (70%). Drip irrigation is so efficient because unlike the other methods, it delivers water at the very top of the soil, which allows the water to reach the roots of the plant without the wind interfering. It therefore creates optimal moisture in the root zone and reduces overall water losses.

By the time we had set up the beds and the drip irrigation system, a week or so had passed and the summer heat of the desert proved too difficult to work with. The environmental challenges of the region were simply overbearing, and we were unable to continue to work the land. Our small-scale desert project proved to be a failure before we even planted a single seed.

We had fortunately planted seeds earlier on in the semester at a smaller experimental garden located on the Kibbutz. In preparation, our teacher had double-dug the soil, used compost, mulch, and drip irrigation on this site as well, providing it with similar care to the plot we had attempted to create together. I planted sugar snap peas on this smaller plot, which sprouted and grew to fruiting age. They lasted all of a week before withering away from dehydration and the heat of the sun. They needed more water than the drip provided and more shade than the desert allowed.
Arid-Land Agriculture’s Environmental Impact: Can it be Sustainable?

If my personal journey of living and farming in the desert for four-months taught me anything, it is that my perception of the desert has always been correct. It is filled with sand, it’s too hot to function, and it sure as hell is inhospitable. The environmental challenges in deserts are great. Perhaps focusing on composting, mulching, intercropping, and irrigation are not alone ways in which we can sustainably and viably combat arid-land farming challenges. We may need to turn our attention more towards the development of even more innovative technologies like utilizing seawater and solar powered greenhouse technologies. I will explore the economic sustainability of such technologies more in depth in the following chapter. Growing in technologically based greenhouses in deserts might be more sustainable and subsequently more viable than solely utilizing agro-ecological methods. But before I jump ahead of myself, allow me to backtrack.
At the beginning of this section, I had you picture the desert. Now, I want you to picture the rainforest – lush, green, and incredibly diverse. People have for years, regarded the rainforest as an endangered ecosystem. “Save the rainforest” is an environmental catchphrase at the heart of the environmental movement. Whether or not the existence of such a slogan has contributed to successful ecological developments in the rainforest is not of focus here. My focus is on the reason the rainforest needs to be saved. It is at least in part, due to deforestation from the development of monoculture plantations to grow our food. These monoculture plantations are biological deserts. Once land turns to desert, it might appear as though it will forever remain fallow.

The production of food crops in land that was once so very biologically diverse has contributed to environmental distress, climate change, and the growing need to develop innovative agricultural methods for growing food in deserts. Perhaps preventing biological deserts by reducing monoculture operations and increasing the process of reforestation can be considered hand in hand with the development of arid-land agriculture projects. After all, the development of agriculture in arid areas could reduce the creation of biological deserts and incentivize people to move away from growing in cherished biologically diverse regions.

From issues of extreme dryness to the high potential for erosion, deserts are practically the most inhospitable of ecosystems for people to grow their food. Yet, while the environmental challenges of farming in deserts is quite clearly great, the implementation of such practices is possible and is not overly harmful to an area’s ecology. Or at least, an area’s perceived ecology. In general, transformation of land into agriculture fields, as can be seen in areas once fully occupied by rainforest, is a major
factor in habitat destruction (Shanas et al. 292). However, according to a study regarding ecosystem services in the region, “compared to other global ecosystems, desert regions have relatively low priority with regard to biodiversity” (Sagie et al. 39). Considering there isn’t much land less desirable than desert, turning such dry inhospitable areas into places to grow food would be considerably less harmful than transforming rainforests and other natural lands’ ecosystems into biological deserts.

Regardless of locale and perceived hospitality, it is important to recognize that agriculture plays a role in land degradation no matter what. In deserts, that degradation occurs through improper tillage and overgrazing (Tal 40). Agricultural development in ecosystems – whether they are areas characterized by great biodiversity like rainforests, or areas characterized by fallow lands like deserts – impact the species of the given area. Even if we perceive a desert to be lacking in significant ecological importance, developing agriculture in the desert is at the cost of losing and changing some of the diversity of a given region (Shanas et al. 285). Agriculture in arid areas, especially overgrazing, and improper tillage, can very well lead to further land degradation and desertification (Tal 40). Even low intensity farming practices can have effects on the biodiversity of the desert ecosystems. And while already dry and presumably fallow land does not attract the same attention from environmentalists, it should be recognized that agriculture plays a role in the destruction of natural ecosystems and is a major source of greenhouse gases.

Thus, implementing a sustainable agriculture system in the desert is not without its challenges. Arid-land farmers can, however, sustainably combat challenges through proper crop planning and crop rotation, certain irrigation systems, composting, and very
specific land preparation techniques. These adaptations, mitigation methods and technologies are not necessarily the be-all and end-all to creating a sustainable and subsequently viable food system in arid areas. If anything goes wrong along the way, whether in the form of water loss or improper composting, or if the environmental challenges of the area prove to be too difficult to manage, a seemingly environmentally sustainable system can become unsustainable, which could diminish the system’s ecological viability completely.
Chapter 1.2 Economic Sustainability of Arid-Land Food Systems

Economic Sustainability (The Moral Economy of Provision) – refers to the use of resources in a manner that ensures long-term success through balancing the needs of producers, distributors, and consumers. An economically sustainable system can therefore prove viable when we responsibly and optimally employ resources so that a balance between affordability and profitability exists and long-term benefits are maximized.

It is expensive to develop, implement, and monitor agriculture technologies like drip irrigation systems, radio-control crop monitoring systems, and greenhouses. They cost a significant amount of money to purchase, require labor to set-up, and necessitate constant maintenance. In an arid-land region, it is necessary to efficiently employ resources if agriculture is to be economically sustainable. Doing so though, could be quite challenging. Food insecurity, the lack of access to enough food for an active healthy lifestyle, is a huge trial for people in both the developing and developed world. I seek to explore the potential to alleviate this challenge, as well as its underlying cause – poverty – through the development of food systems in agriculturally marginal land areas. Since the majority of the world’s poor live in such areas, developing local food systems in agriculturally marginal areas seems like an appropriate and valuable endeavor.

The economic sustainability of agriculture relies on finding the balance between affordability and profitability, and optimally employing resources. Determining the costs necessary to begin a project, how many people will take part in the production aspect of
the system, how much money constitutes a living wage for the workers, and how many people the food system needs to feed, directly correlates with the economic sustainability of the system. The community’s financial and physical accessibility to the food system relates to both economic and sociocultural sustainability. I speak more about the importance of accessibility in both the following chapter and Chapter 2.3. Small-scale farming could boost local desert economies by providing people in deserts with jobs and much needed sustenance. As demonstrated by the Turkana project, the goal of small-scale arid-land agriculture projects is not necessarily to put products on the market for external use, but rather, to provide the given population of an arid region with food.

**The Challenges: Balancing Affordability and Profitability**

People tend to focus on the short-term, especially when food and money are involved. Growing food is challenging economically because it is almost impossible for farmers to reap immediate benefits. There is a process to follow and a calendar to go by. In order to make the most of a season and to reap the greatest yields from a particular plot of land, farmers must plan rather extensively. In arid areas, planning is even more necessary.

In order to successfully draft crop plans, farmers need the knowledge and education to do so. Much of the arid world is home to the world’s poor and people who suffer from poverty are more likely to lack access to the necessary education and know-how to plan the most economically effective agricultural systems. This lack of know-how relates to economic sustainability, as it can have a direct affect on yields and a farmer’s
ability to purchase, set-up, and operate certain technologies. It also relates to sociocultural sustainability, which I will explore in the following chapter.

Even more pertinent to economic viability is accessibility of start-up funds and necessary tools. People may recognize the benefits of certain technological advancements, but such costly innovations may be economically out of reach. The cost of modern technology alone could prevent people in deserts from implementing their own local food systems. In such cases, projects could prove entirely economically unsustainable before they even begin. In addition, when considering the economic viability of arid-land food systems, it is important to address the potential for the development of a sustainable customer-base. Depending on location and demographics of an area, developing a market could be a trying task. Ensuring the sustainability of that market could be even more difficult.

**Addressing the Challenges: Pursuing Economic Viability**

Arid land agriculture must rely at least to an extent on technology. While much can be done outside in the field, utilizing a greenhouse to create more ideal growing conditions in certain areas might prove more holistically sustainable than farming solely outside. The Seawater Greenhouse, a low-cost technological solution developed in 1991 in the United Kingdom, enables crop production in hot arid regions. The technology is most beneficial in areas in close proximity to the sea, where water can be drawn towards the greenhouse with pipes. Through the utilization of seawater and sunlight, this technology enables dry land regions to grow crops regardless of weather and climate
conditions. According to their website, the Seawater Greenhouse is indeed economically sustainable and viable. When compared to conventional modern greenhouses, these greenhouses are slightly better off. Their operating costs are 10 – 25% less, fixed costs are 10-15% less, and returns on invested capital are 15-35% greater (Seawater Greenhouse). Additionally, the Seawater Greenhouse reduces the need for costly desalination.

The Seawater Greenhouse is economically sustainable because it utilizes free water, has no exposure to fossil fuel inputs, and has reduced pesticide costs. The fixed costs are economically sustainable because there is no need for cooling, heating, CO2 enrichment, or additional desalination equipment. Neither the farmers I observed in Israel, nor those I learned about who are farming in Kenya utilize seawater greenhouses as of yet. Not all areas of Israel would benefit from this technology, but in the hyper-arid region of the southern Negev, located only 50km north of the Red Sea, this technology could perhaps prove economically viable.

Diagram: Seawater Greenhouse
For now, farmers in Israel and Turkana focus instead on drip irrigation, which has cheaper initial costs and has already proven economically viable. The list price for Netafim’s 1000ft drip techline is just $511.00 (Professional Lawn Sprinkler). Along with the techline, farmers must purchase all the other necessary components including valves, emitters, and tubing. No matter the extra costs to purchase the parts, utilizing drip irrigation appears to be cheaper than using other technologies. In arid regions, sprinkler systems and hoses are usually unavailable, so gravity drip irrigation systems are highly recommended. Gravity fed irrigation requires the use of a water tank, which collects water and feeds it through the drip irrigation system. Once purchased and set up, a gravity drip irrigation system can go a long way and prove an economically sustainable asset.

Up until the development of drip irrigation, arid-land agriculture in Israel was not as economically viable of a system as it is today. Regardless of whether farming in deserts is environmentally sound, new innovations have created a market for Israeli crops and technologies, both of which bring valuable economic resources to the country. Before the establishment of new technologies, Israel’s agriculture saw hardly any substantial yields. Alon Tal, a leading environmental activist in the Middle East and cofounder of the Arava Institute of Environmental Studies, expresses in “Shifting Sands: Land Management in the Middle East” that while the environmental sustainability of Israel’s agriculture practices is questionable, it is undoubtedly apparent that the country has done remarkably well economically in arid-land farming (41). Agriculture in Israel’s Negev has been profitable and therefore in the minds of many, economically sustainable.

He notes that since agriculture in the Arava region began, the crop yields have
“increased eighteen-fold.” He goes on to explain that Israel “consistently produces more ‘crop to the drop,’” which can be seen in the numbers (38). He states, “in the early 1950s, a full-time agricultural worker supplied food for seventeen people; by 2010, that figure had risen to 113” (38). From a purely economic standpoint, agriculture in the Negev continues to substantially contribute to Israel’s economy. Applying Israel’s technologies and innovations elsewhere might prove beneficial for countries facing food insecurity around the world.

While studying abroad in Israel, I learned about how drip irrigation and agro-ecological growing practices are currently being implemented in Turkana, an arid region of Kenya with high rates of food insecurity. Teams of Israelis who have experience in arid-land farming in Israel’s Arava region have introduced villagers in Turkana, Kenya, to the world of agriculture – both subsistence and cash-crop systems. According to Moti Harari, the founder of FID, agriculture can bring the Turkana economic benefits, which they are completely unfamiliar with - ones that will undoubtedly increase their wellbeing. With the development of marketing, the Turkana will be given the “wheel to continue” (Lecture 7 May 2014).

**Pursuing Economic Viability: The Case of Turkana**

Of course, we must consider the present economic situation in a given area before we implement local desert food systems in the developing world. It is important to first determine if a society will benefit from farming or if they will instead find themselves further impoverished. In the developing arid region of Turkana, it wasn’t until the Kenya
government invited Israeli agricultural developers to introduce farming and agriculture innovations into the traditional hunter-gatherer communities, that the doors to jobs within the agriculture sector opened for the Turkana.

1 Kenyan Shilling (Ksh) = 0.011 US Dollar ($)

Products produced on the farm are consumed locally. The surplus is sold to the missions and at the local markets in Lokitaung and Kaikor (FID PowerPoint Presentation).

Poor farmers across the world, especially those in deserts, lack the financial resources necessary to purchase technologies. While Israel’s arid-land agriculture benefited from the implementation of drip irrigation, most developing countries have less developed infrastructure and little means of purchasing and implementing such systems. Instead, people must rely on donations from international NGOs, the government, or agriculture extension services. With the help of Israel, Turkana farmers in particular are beating the odds and bringing fresh produce to their region.

An FID produced PowerPoint presentation on the future of their program suggests that a total of $3.59M would be necessary for three years of program implementation (FID PowerPoint). This funding would go towards infrastructure like farming kits, solar
water pumping units, tractors, vehicles, and living facilities. It would also go towards maintenance, hiring a team of experienced trainers, future support of trainees and graduates, and administrative costs. If such programs are to prove economically viable, FID must find donors for their initiative. The Red Cross in Kenya, for instance, has a history of donating greenhouses and water pumps to various regions in Kenya, in order to increase food security in the country (Olielo 4). Given that people in Kenya, both in Turkana and elsewhere, lack much opportunity to learn about how to utilize these resources sustainably and effectively, success of agriculture initiatives is not a guarantee.

As farmers and food system workers pursue economic sustainability, it is possible for them to degrade the other kinds of sustainability. For instance, in both the Negev and Turkana, farmers use chemicals to increase their yields, prioritizing economic sustainability over environmental sustainability. Such prioritization and reduction in other components of sustainability, does not make the food system completely unviable. In desert communities, such practices could actually be rather necessary in order to make local food and farming better equipped to exist for the long run and accessible to a greater number of people. In such situations, it is even more essential for people to consider the holistic sustainability of their initiatives and attempt to strike the proper balance between the “three Es” – ecology, economy, and equity.

Gary Nabhan, an ethnobotanist who focuses his research primarily on desert plants and cultures, suggests in his book “Growing Food in a Hotter, Drier Land” that desert communities can increase their sustainability through focusing on land health, human health, and economic health (Nabhan 210). A well-balanced system is one that takes into account all three categories of health, which for all intents and purposes
overlap with the three pillars of sustainability. Based on the criteria listed in the below chart, economic health refers to systems that are sustainable and viable. Nabhan suggests that the steps towards economic health, combined with steps for human health and land health, are part of a pathway to restoration that will enhance our land’s food producing capability while simultaneously creating less waste and redirecting community economies. As can be seen in the chart below, I have adapted Nabhan’s list from Economic Health of desert communities in general to the Economic Health of desert communities in Turkana, Kenya.

<table>
<thead>
<tr>
<th>Economic Health of Desert Communities</th>
<th>Economic Health of Desert Communities in Turkana</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Criteria as suggested by Nabhan</strong></td>
<td><strong>Nabhan’s general criteria adapted to Turkana</strong></td>
</tr>
<tr>
<td>(210)</td>
<td></td>
</tr>
<tr>
<td>Resurgence in the use of locally available capital (for equity and loans) upon which community economic health depends.</td>
<td>Development of local capital to ensure market capabilities and economic viability.</td>
</tr>
<tr>
<td>Region-wide coordination of investors willing to help jump-start and sustain farming, food, and health micro-enterprises.</td>
<td>International and regional cooperation and collaboration, with the ultimate goal of sustaining small-scale enterprises among the Turkana.</td>
</tr>
<tr>
<td>Minimizing dependence upon multinational banking institutions and governments for loans and equity shareholders.</td>
<td>Minimizing dependence on outside food aid through increasing investment in innovations and outside technological</td>
</tr>
<tr>
<td>Nurturing a high diversity of local participants in micro-enterprises and models for innovation/demonstration.</td>
<td>Fostering farming knowledge amongst a diverse group of local participants, who ultimately will run their own small-scale agriculture businesses.</td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td>Rescuing and renewing traditional knowledge about local trading of work and materials, bartering and sharing tool and seed libraries.</td>
<td>Utilizing traditional knowledge about local trading and bartering to inform newly introduced economic endeavors.</td>
</tr>
</tbody>
</table>

The economic health of FID’s agriculture program in Turkana appears to match Gary Nabhan’s more general measures of economic health in deserts. Successfully addressing these five overarching aspects of economic health, as the Turkana Project strives to do, is not to say that the sustainability of FID is completely without challenges. Based on Nabhan’s criteria of economic health, Turkana’s food system is economically sustainable, and is on its way to becoming socially and culturally sustainable as well.

Once people implement arid-land farming into a community, it can offer the community a number of economic benefits. It can provide more jobs for the poor and more food for all of society. If provided with the tools, technology, fertilizers, seeds, and infrastructure necessary to farm in the dry soil of the desert, arid-land agriculture could very well be a viable way for communities throughout the world to decrease the gap between rich and poor and reach food security. While the projects might appear economically sustainable and viable on paper, we must also address the sociocultural
impacts of farming in the desert, especially the impacts on people like those in Turkana, who have traditionally led hunter-gatherer lifestyles and lived without any exposure to agriculture.
Chapter 1.3  Sociocultural Sustainability of Arid-Land Food Systems

*Sociocultural sustainability* refers to aspects of a project or system that proves valuable to a society, its people, and their culture. This category of sustainability can also refer to the ability of people within a community to incorporate certain activities into their daily lives that are separate from their work or home lives.

“For me, the idea is to go somewhere into the desert [to find a place to share with others—one severely degraded over time by neglect, depletion of water and perhaps climate change]. We’ll proclaim that yes, this place has been desertified, but now we’re going to make it into a living oasis, one where we will respect and nurture a diversity of life.”

– Gary Nabhan, *Growing Food in a Hotter Drier Land*

Agriculture development in arid regions increases the value of the given area and the health and wellbeing of the people in that area. By utilizing environmentally sustainable methods and implementing economically sustainable practices, desert farming could very well prove socially and culturally viable as well. Exploring the ways in which such creative practices and innovative development affects the people and culture of a given area, could determine the sociocultural sustainability and viability of desert farming systems.
Challenges and Impacts of Desert Agriculture: The Israeli-Turkana Partnership

Turkana is the largest and least developed district in all of Kenya. The Turkana are resilient and know well how to adapt to harsh desert conditions. Traditionally, those in Turkana have relied solely on their livestock for food. They are semi-nomadic pastoralists who still live to this day like their ancestors once did. Unfortunately, droughts and increased geopolitical stress in the region have decreased their ability to continue to rely solely on the meat, milk, and blood of their livestock. The largely youth-populated society has experienced an increase in starvation and malnutrition, which has contributed to rural to urban migration and their dependency on international food aid (FID PowerPoint).

Food aid can only go so far. As of 2013, Oxfam’s food distribution program of corn, peas, flour and oil, was unable to keep up with the population’s growing need for sustenance (Oxfam International). Oxfam was only able to reach the most vulnerable of families. As food aid proved increasingly insubstantial, the Turkana found themselves without much needed sustenance. They were forced to act in their own self-interest and began to raid neighboring tribes for livestock. These raids increased already existing geopolitical stresses. Climate related realities combined with the lack of agricultural know-how and insufficient food aid, has led the Turkana into a precarious situation. Without outside help, the Turkana lack the agricultural background necessary to implement widespread and successful farming systems in the area.

Israeli-run agricultural development project, Furrows in the Desert, aims to supply the Turkana with an alternative way of life that can greatly reduce the geopolitical stress
in the region and act as a means of increasing food security. FID began after the Turkana-based Missionary Community of Saint Paul the Apostle (MCSPA) partnered with Israeli organizations Brit Olam and the Arava Center for Sustainable Development (ACSD) in 2010 to conduct a need-assessment study with local communities in Turkana (FID PowerPoint). In partnership with the ACSD, MCSPA invited Israeli volunteers and agricultural experts to Turkana in order to share their expertise and implement farming practices similar to those used in Israel’s desert. FID’s goal is to slowly but surely increase the potential for the Turkana to reach food security and self-sufficiency.

Those who developed the FID program see the implementation of agriculture as the solution to combat environmental, economic, and political struggles. Its implementation is also intended to be socially and culturally beneficial, but reshaping a society is not without difficulty or controversy.

Given the harsh desert conditions, it is difficult to bring in outside experts for long term stays. Without consistent educator presences or educational opportunities, the development of a socially and culturally sustainable agriculture system is ever the more difficult. In addition, the cultural gap between the traditional herding lifestyle and the farming way of life can also prove to be a challenge. Even when outside experts and volunteers do agree to stay and teach in Turkana, who’s to say that locals will accept and respect them? Convincing people that they must adapt a completely new way of life – a new schedule, diet, and market system to better their livelihoods, is western elitist and seemingly implausible. As will be explored in Chapter 2.3, elitism across demographics in urban areas can also prove to be a challenge.

FID believes agriculture is a necessity and sustainably implementing agriculture
in Turkana is indeed a reasonable possibility. Agriculture in Turkana seeks to increase the Turkana’s food security and health, and ultimately their survival. While introducing cash crops, market-systems, and farming education programs will undeniably change the culture of Turkana, such changes might be the only way to combat food insecurity and economic, environmental, and social uncertainty in the region. As people are driven away from their roots of trading livestock and more towards a westernized, materialistic culture, a different question arises. Food insecurity has contributed to a rise in geopolitical concerns, but so too can materialism contribute to conflict and violence. So the question then is, can the materialism associated with agriculturist societies actually sustain food security?

Perhaps only time will tell.

**Addressing the Challenges: Are Arid-Land Food Systems Socially and Culturally Sustainable?**

At first look, Israel’s agricultural development in the desert seems like an extremely socially and culturally sustainable project. In Israel, arid-land farming has created a community in the desert, one that consists of people who find agriculture to be spiritually, ideologically, and aesthetically important to their lives. Perhaps such a connection to the land can be instilled in the minds of those in Turkana as well. Slowly but surely, they too can become as enthusiastic about greening the desert as Israelis in the Negev.

In 2013, in partnership with the Arava Institute for Environmental Studies,
researchers set out to explore how people in the Arava feel about their surroundings through the context of ecosystem services. As the researchers explain, ecosystem services pertain to the value and benefits people receive from an area. While many people are quick to perceive deserts as lacking in ecosystem services, residents of the Arava Valley think otherwise. A number of kibbutz members in Israel beautifully express their perspectives on desert agriculture. One man believes that the “fact that [Israel] managed to do agriculture in the Arava is one of the main reasons that [people] are able to survive [in the Negev]” (Sagie et al., 5). A large portion of the respondents actually attribute their mental well being to the aesthetic value of the green provided by the agriculture in the area. For people in the Arava Valley of the Negev, agriculture is what holds the communities together and ties them to the land. With the ideology of kibbutz members in mind, the sociocultural impacts of arid-land food systems seem nothing but positive and very much so socially and culturally sustainable.

As amazing as many kibbutz members feel regarding Israel’s agricultural pursuits in the Negev, making the desert bloom has not been without negative social and cultural impacts too, particularly on the Bedouin population of the country. Since the 1948 war and subsequent administrative resettlement plans, Bedouin tribes have found themselves fragmented and landless. Israel’s move to relocate Bedouins in concentrated settlements is “closely connected with the annexation of Arab lands to facilitate the establishment of Jewish settlements and for national development objectives” (Falah 40). In other words, Israel’s development objective of greening the desert, and therefore expanding their agricultural pursuits in the Negev, has put Israelis in conflict with the Bedouin who are “being forced to protect their two most important means of survival: lands used for both
pasture and agriculture, and livestock.” Depriving the Bedouin of this land, specifically agricultural land, highlights the overpowering nature of economic and political pursuits. As agriculture took shape as an economic powerhouse in Israel, the social and cultural sustainability of the food system was reduced. In order to strike the appropriate balance between the three pillars of sustainability, we must bare in mind “the amount of human suffering caused by cutting the nomads off from their own culture and environment” and the reality that “the sad state of the demoralized Bedouin community is a consequence of the loss of a unique human culture” (Falah 50). With the existence of documented sociocultural stress of Bedouins, it is of even greater importance for volunteers with FID to pay heed to the social and cultural needs and desires of those in Turkana. Having based my research of FID’s sustainability on materials solely written or spoken about by Israelis, my informed discussion is admittedly one-sided. Even so, both Kenyan and foreign entities support FID, showing perhaps that the program itself is not only a foreign initiated development.

Continued agriculture development in Israel has also reduced the number of Israelis actually farming the land. While Israelis do claim to feel connected to the agriculture in the desert, few Israelis actually call themselves farmers in the Negev today. The labor force is instead made up of foreign workers, in large part from Thailand. By 1993, Israel had begun to rely heavily on foreign labor due to political strife and economic realities. According to Israel’s government officials, Israel was no longer able to rely on Palestinian workers due to border closures and fear of terrorist strikes (Bartram 305). In addition, the small immigrant country had developed a lot during its short statehood, and like other developed countries, they too simply needed to begin to rely on
outside labor (Bartram 305). In spite of high unemployment rates among Israelis in the mid-1990s, foreign agriculture workers from Thailand flowed into the country (Bartram 318). As the agriculture sector grew and the desert continued to bloom, fewer and fewer native workers stayed out in the fields.

The acceptance of foreign labor has begun to change the social and cultural makeup of Israel, as workers send for their families and more and more foreigners settle in the land. But perhaps the use of foreign labor is indeed economically sustainable for the agriculture system, as few Israelis are willing to accept the low wage positions in the agriculture sector. The use of foreign labor highlights the tradeoff between economic and sociocultural sustainability that is necessary in a constantly developing industry. Even with the growing rate of foreign labor, and the realization that few Israelis directly participate in agriculture, the Israelis who do live in the desert feel nonetheless connected to the land, as we heard above.

It is therefore unsurprising that Moti Harari, an Israeli and the founder of Furrows in the Desert, believes that agriculture development and related innovations in Turkana will allow the region to change for the better. (Lecture, 7 May 2014). As FID suggests in their project presentation, “droughts perhaps cannot be prevented, but famine is preventable.” FID thereby sees agriculture implementation as the solution to the growing trend of food deprivation. Due to the relatively short existence of agricultural development in Turkana, it remains to be determined whether or not the people of the region agree with Harari. In order for agriculture development to become fully viable in their communities, those in Turkana must too recognize its sustainability.

In order to prove viable, the FID program focuses in large part on innovative
methods of sustainability, including but not limited to those of sociocultural focus. In 2013, FID volunteers established the training farm, which has been used since to train men and women in North Turkana during five to six month periods. In a region prone to a rising frequency of droughts, subsequent loss of livestock, and related geopolitical and health concerns, the economic and social benefits of agriculture alone have acted as incentive enough for groups of locals to jump at the opportunity to participate in the government supported, expert-run FID program.

Furrows in the Desert educates and trains locals so that one day the trainees can manage their own agriculture projects. If all goes well and people in Turkana truly want to adopt farming into their lives, then FID and farming in the arid region will prove both sustainable and viable. For FID’s volunteers, gaining short-term local interest in their project is therefore great, but not as necessary as ensuring the long-term holistic sustainability of the initiative.

To do so, an Israeli agronomist lives on site in Turkana and acts as Farm Manager, while Israeli trainers with agricultural backgrounds stay in the region for at least one full training period of five to six months. By running the program over the course of roughly two or three plant cycles, trainees come away from the experience having learned all aspects of the agricultural cycle more than once. When the training period ends, the assistance and education does not. For one year after graduation, FID supports the graduates’ income and supplies them with a Farmer’s Kit with all the necessary tools to start small-scale projects in their own villages. In order to ensure that the benefits of the program are far reaching, and that the trainees receive appropriate support and the most relevant education, FID volunteers also visit graduates’ new farms.
during that first year to provide in-person guidance.

By the end of 2016, FID intends to develop a credit system for graduates to access chemical inputs for their own local farms. By the same year, FID intends to facilitate local farming agreements to form coops or clusters in order to increase capacity to maintain a centralized water distribution system. Outside support will soon after be reduced and the training farm will be handed over to local management and local agriculture trainers.

Those involved in Furrows in the Desert believe that agriculture can be the catalyst for change in Turkana. Through the development of agriculture and the various innovations needed for its holistic sustainability, the people of Turkana will become self-sufficient in not only food production, but also education and healthcare.

While the Bedouin would likely disagree with Moti Harari’s assertion that implementing agriculture in Turkana is fully sustainable, FID is conceivably different. If Israel’s relationship with the Bedouin of the Negev teaches us anything, it is that FID volunteers must respect the social and cultural makeup of the Turkana and only act if it is truly in the best interest of these nomadic people. Since its inception, just over two years ago, “FID has established an agricultural training farm…has trained 59 farmers and 120 farmer’s assistants, educated four graduates to be agricultural trainers at the farm, and helped to establish 57 agricultural plots within 31 villages in the region.” In addition, FID graduates have established the first ever Turkana local farmers association (Furrows in the Desert AIES). Without actually speaking with those in Turkana, it is difficult to ascertain the sociocultural sustainability of FID. Perhaps though, taking the initiative to establish their own farmers association can in and of itself imply that the Turkana feel
positively towards agriculture development in their region.

FID not only gained the approval of the Kenyan government early on but since its inception, it has also successfully collaborated with The Missionary Community of Saint Paul the Apostle, which has for years been working in Turkana. Such collaboration has allowed the program to thrive among the Turkana. Increasing collaboration and ensuring that locals are part of the planning and implementation of the project, can ensure a sociocultural sustainable and viable agricultural society.
Section 1 Conclusion

“The important point here is not that all desert adaptations will work in other landscapes, but that they can serve as inspirations for local adaptations that do.”

– Gary Nabhan, Growing Food in a Hotter, Drier Land

Whether developing a farming system in the desert of Israel or in the desert of Kenya, environmental, economic, and sociocultural challenges abound. This is not to say that the challenges are exactly the same in these different locales. They absolutely are not. Israel is a world leader in arid-land agriculture. Those in Turkana, Kenya are only just shifting to an agricultural food system from their traditional hunter-gathering system that has become increasingly less viable. Nevertheless, people who practice agriculture in both regions must address the viability of their agriculture systems through exploring their environmental, economic, and sociocultural sustainability.

Next Steps: Collaboration and Policy

By looking at two very different desert communities and their experiences with agriculture, the benefits of sharing and adapting innovations to use in similar, yet different regions, becomes apparent. As Gary Nabhan suggests, traditional agro-ecological desert adaptations can inspire new technologies and new adaptations that take into account the landscapes and biodiversity in other locations. Exploring the benefits of technologies across boundaries, in two different deserts and very different communities,
stresses the positive and negative realities of those technologies. Drip irrigation is one such technology that has wide-scale applicability regardless of locale. It was developed in Israel but is utilized not only there, but also around the world and now in Turkana. By collaborating with environmental scientists, researchers, economists, anthropologists, and sociologists, farmers would be better able to determine the applicability of, sustainability of, and viability of certain practices.

If farming in the desert is to be holistically sustainable, it cannot just develop in the blink of an eye. It takes careful planning and consideration of time, place, and people. Communities without traditional knowledge of agriculture are most at risk for food insecurity and famine. Based on lack of background knowledge and resources, they are also the least capable of sustainably and viably running their own farming projects. On the ground support combined with government and policy incentives could be key in providing people with appropriate access to resources and education.

**The Viability of Arid-Land Food Systems**

Analyzing the environmental, economic, and sociocultural sustainability of desert farming is indeed one way of determining the viability of such systems. Yet, I do not conclude this chapter with a definitive decision regarding arid-land food system’s viability. As discussed in the introduction, the three pillars of sustainability, particularly as they relate to our marginal-land food systems, all go hand-in-hand. If one aspect of the system proves overly unsustainable, the system will eventually breakdown and prove unviable.
This section addressed the three overarching categories of sustainability in order
to determine the viability of farming in desert regions. We have seen that these categories
of sustainability are sometimes at odds with each other, which necessitates making
tradeoffs between the pillars. A food system employing socio-culturally and
economically sustainable practices, might also utilize environmentally unsustainable
practices, or vice versa. But as we addressed early on, determining the viability of such a
system is less about complete sustainability of each category and more about finding a
sustainable balance. Further, determining viability must take into account our global
economy and the potential for cross-boundary applicability of technologies, practices,
and resources. Perhaps a proper balance of sustainability combined with cross boundary
teamwork would lead to the most viable marginal land food systems. The potential in
such collaboration will be further explored through analyzing food systems in urban
areas. Cities, after all, are at the forefront of the modern day marginal-land food
revolution.
Section 2: Urban Food Systems

"Urban agriculture is not new to cities: it can be traced back to the earliest cities; even medieval cities in Europe grew crops within the walls. But it has been ‘rediscovered.’ Today, local supplies of fruit and vegetables are part of sustainability."

- Lisa Benton-Short and John Rennie Short, Cities and Nature
Chapter 2.1 Environmental Sustainability of Urban Agriculture

*Environmental sustainability* is a category with a two-fold definition. It refers to the ability to use natural resources without depleting them, and to decisions focused on the preservation of the natural world.

People in cities are beginning to pay more attention to our world’s vital natural resources and to the importance of preserving such resources. In addition, as an increased number of people seek greater connection to their food, the production, distribution, and consumption of food in cities is becoming more localized. Urban agriculture has begun to complement food “imported” to urban areas.

There are vast environmental benefits to a more localized food system, but there are also environmental challenges to growing food within cities. The environmental sustainability of urban agriculture therefore lies in the development and implementation of agro-ecological techniques and innovative technologies that do not exhaust or compromise urban natural resources like soil and water. Sustainable innovations must effectively mitigate or combat the challenges of creating a more localized urban food system. Considering positive impacts of urban agriculture alongside the ways in which challenges can be sustainably mitigated, can lead to the development of a viable food system in urban areas.
The Challenges of Growing in Concrete Jungles

Water is the foundation and recipe for life, both for people and for our crops. This reality is true across ecosystems and across cultures. Urban farmers face two overarching challenges related to water. On one hand, nearby industry can greatly contaminate water sources, thereby making it difficult for city farmers to access clean, uncontaminated water for their crops. On the other hand, applying chemicals to enhance the growth of plants in city gardens can greatly contaminate the water table and put the environmental health of a densely populated area in danger.

Existence of nearby industry can contribute to toxic chemical contamination. For instance, airborne lead, heavy metals, and toxic organic industrial wastes can contaminate the water and seep into the soil. Crops and the soil in which they grow, would then contain dangerous chemicals. Soil is vital to the growth and wellbeing of crops. In the United States, federal policy has mandated that lead-free automobile gas be used in order to decrease the rate of lead contamination in the soil (Brown and Jameton 31). Unfortunately, this mandate does not take into account brownfields, or already contaminated properties. Manufacturing residues and automobile exhaust can very well contaminate gardens and soil located downstream or downwind from industrial sites, or former industrial sites. When plants absorb these chemicals, and people eat the plants, peoples’ health is compromised (Brown and Jameton 31).

In addition, farmers in urban areas might utilize agrochemicals, like fertilizers, pesticides, and herbicides. Doing so could be incredibly harmful to their crops, their neighbors, and to their city’s water source. In research focused on urban agriculture’s
public health implications, Kate Brown and Andrew Jameton explain, “carried by the wind, sprays of these chemicals can easily overshoot a garden’s boundaries and contaminate the surrounding neighborhood. Similarly, run-off from rain and a garden’s irrigation system can carry these chemicals into storm drains to contaminate the city’s sewage system or pollute rivers and the water table” (31). As will be discussed more in depth in the following two chapters, a premium market for vegetables grown without the use of chemicals can contribute to a decrease in their use and subsequent environmental sustainability of urban agriculture practices. Agriculture projects in cities clearly must not only take into account the challenges they face due to their location, but also the impacts of their practices on their given location.

The contamination of water and soil by industry or by farmers themselves are not the only challenges urban farmers face. The presence of excessive heat in warmer months combined with a lack of shade is difficult too. Intertwined with soil and water pollutant problems, the conditions of cities seem terribly unsuitable for agriculture.

Those with the means to do so in New York City, tend to escape the hustle and bustle of the five boroughs during the summer months. In a concrete jungle like New York, walking around in the summer heat is practically unbearable. Because of the Urban Heat Island Effect (UHI), farming in such locations is even worse. To pursue agriculture in a city, farmers must take into account the UHI, a heat and shade related challenge that not only makes the city unbearable for people in the heat, but can also stress food crops and animals raised within city limits.

A UHI develops when permeable surfaces are replaced by non-reflective and impervious surfaces, like concrete. The effect is intensified in areas where little shade
exists. According to a temperature map of NYC created by NASA Landsat and the Department of Geography and Hunter College in August of 2002, the UHI effect increases the city’s temperature by an average of 3.6 to 7.2 degrees Fahrenheit over the course of the year compared to its surrounding suburban and rural areas (Ackerman 67).

Rooftops provide a great amount of space for gardens to grow within city limits, but they also face incredible difficulty in regards to shade acquisition and the UHI effect. Rooftops are home to dark impermeable concrete and little, if any, shade. Rooftop surfaces, and other similar concrete surfaces absorb a high percentage of incoming solar radiation, which leads to elevated temperature. In cities, where much of the land is covered in such surfaces, the UHI effect is exacerbated, making it ever the more challenging to grow crops. It is worthwhile to note that not only does the UHI effect contribute to challenging agricultural conditions, but it also leads to negative environmental and health conditions like increased use of air conditioning, and elevated incidence of asthma and heat stroke.

Nevertheless, the world’s cities have potential, not only for growth of industry and business, but also for the growth of food. Such growth would provide for the growing number of people within city limits. Urban farmers must be willing to take the necessary steps to combat the various challenges with which they are presented. Only then, will greening a city with agriculture prove environmentally sustainable and viable. Utilizing environmentally sustainable growing practices, while adapting to the various challenges, is necessary if agriculture is to be viable in urban areas.
Addressing the Challenges: Adaptations and Technologies

The challenges of growing within cities are vast. Sustainably addressing the challenges is essential if urban agriculture is to prove a viable system.

There are a few simple ways to manage water effectively and reduce the possibility for its contamination. If farmers or gardeners manage water ineffectively, not only will the water become contaminated, but also the soil, crops, and surrounding water and plant ecosystems will suffer damage. The habitual use of agrochemicals is first and foremost a recipe for incorrectly managing water. In small-scale agriculture projects in urban areas, Integrated Pest Management, a practice that encourages consideration of natural pest control mechanisms and the application of chemicals on an as-needed basis, can prove effective in managing an agriculture system. The use of other specific crop management techniques like crop rotation and intercropping can also reduce pests and prevent the need for agrochemicals. Combine such techniques with case-by-case consideration of pests and diseases, and the occasional application of chemicals, can ensure both economic viability and environmental sustainability.

The environmental sustainability of urban agriculture lies in the development of farming methods that safeguard soil and crops from chemicals already in the soil, but also from future pollution and erosion. Preventing further contamination and working with previously contaminated land, or brownfields, is therefore an essential component of a sustainable urban agriculture system. As defined by the Environmental Protection Agency, brownfields “are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance,
pollutant, or contaminant. Cleaning up and reinvesting in these properties protects the environment, reduces blight, and takes development pressures off greenspaces and working lands” (EPA.gov).

There are a few tried and true ways to grow food sustainably in chemically ridden soil. Brown and Jameton suggest the process of phytoremediation. Phytoremediation involves planting crops whose specific purpose is to take up contaminants in the soil (31). Although such methods might be slightly time intensive, practicing such a bioremediation method can prepare the soil effectively for future gardening endeavors. An alternative to phytoremediation is replacing the soil of a given area altogether with clean fill (32). Doing so though is only possible with financial resources and legal support.

Compost can also be a means of bioremediation, in that it too can diminish the likelihood that plants take up contaminants from the soil. As discussed in Chapter 1.1, compost is a vital component of any agriculture system, especially those in marginal land soils. Composting is an aerobic, or oxygenated, process that involves the biological decomposition of organic wastes (Brown and Jameton 32). Compost is filled with bacteria and microorganisms that help break down chemicals in the soil. When sufficiently hot, it can actually sterilize infectious bacteria and help to immobilize heavy metals in the soil.

Utilizing compost not only reduces possibilities of chemical contamination from nearby industry, but the biological activity within the compost also reduces the need to use chemicals on crops. If compost is to be utilized effectively and sustainably in urban gardens, urban agriculture practitioners must pay heed to proper composting methods. It is necessary to properly balance carbon and nitrogen and to consistently monitor the
compost’s use (Brown and Jameton, 32). Composting acts as a means of reducing waste, it suppresses pests and diseases, reduces the need to utilize agrochemicals, and increases yields. As explored in a study supported by the Earth Institute at Columbia University, compost can amend contaminated soil, like those found in cities and can also amend compacted soil, often found in deserts (Ackerman 71). Small-scale urban agriculture provides an opportunity to create a closed loop system where food waste from within city limits becomes compost and is recycled back into the soil. Not only does doing so decrease the need to transport waste materials outside of the city, but it also enhances nutrient-poor and potentially contaminated soil.

Even if soil contamination is successfully remediated or compensated for through the use of raised beds, urban farmers must still deal with the Urban Heat Island Effect. The growing trend in urban areas towards farming indoors has the potential to alleviate the environmental challenges associated with growing food within cities. I will discuss such innovations in the following chapter, for such systems have significant economic aspects to consider. In addition to these innovative systems, adapting dry-land farming practices, like greenhouse technologies and drip irrigation, could make growing in cities and on rooftops in particular, more sustainable.

Climate controlled greenhouse technology is particularly useful in cities where shade is at a minimum and the UHI effect proves to be a difficulty. Once more green spaces in cities exist, they would actually act as carbon sinks and mitigate the UHI effect. Greening rooftops can also reduce the amount of energy necessary to heat and cool a building. Soil and vegetation on roofs allow heat to permeate through the surface, which means they retain more heat than conventional rooftops. Vegetation itself provides
shading to reduce outside heating and can reduce fossil fuel consumption, greenhouse gas emissions, and energy usage. According to the Earth Institute’s report on urban agriculture in NYC, “green roofs reduce temperatures inside a building by an average of 2 degrees C (4 degrees F) during the day and raise them by an average of .3 degrees C (.5 degrees F) at night” (Ackerman 68). Rooftop agriculture is therefore a natural heating and cooling system.

Rooftop greenhouses in particular, allow for even more flexibility and productivity on city’s buildings. Like green roof projects in general, they too can insulate buildings and contribute to energy savings. Greenhouse technology can also be integrated directly into a building’s heating and air conditioning system, thereby allowing for direct ventilation and evaporative cooling methods. Utilizing evaporative cooling systems, in which high temperature and low humidity air enters evaporative pads on the greenhouse wall from outside, is necessary in order to maintain optimal growth. When the air passes through the wall, it becomes cool and saturated with water. The air then moves through the greenhouse, as the sun raises its temperatures and lowers the humidity. Fans and natural circulation patterns can then lead that air into the HVAC system of the building (Ackerman 68).

Greenhouse technology can also prove environmentally sustainable and viable in the winter, as it allows for buildings to utilize solar rays to heat the building. Implementation of greenhouses and utilization of greenhouses in the winter are not without costs. Regardless of the economic costs associated with building greenhouses, it is without a doubt that greenhouses and green roofs in general, simultaneously reduce the Urban Heat Island Effect and lower the energy cost to cool and heat a building. When the
innovative methods discussed here are used, the development of agriculture in urban areas could prove quite environmentally sustainable and viable.

**Urban Agriculture’s Environmental Potential**

Soil erosion, destruction of vegetation, depletion of water bodies and pollution of resources like soil, air, and water, are all negative impacts and realities of urban areas. Greening urban areas can change these realities. Policies must be put in place to reduce the ability of farmers to utilize toxic chemicals in urban agriculture. In densely populated cities, utilizing such chemicals can put a large number of people in danger. As long as farmers refrain from overusing agrochemicals in cities, their practices can very well prove environmentally sustainable.

Farming in cities improves the microclimate, conserves biodiversity, and increases the oxygen-carbon dioxide balance. Conserving biodiversity through garden development can reduce CO₂ emissions and thereby contribute to the reduction of negative climate change effects. Similarly, producing more food in areas where people actually live, contributes to a more localized food system, which also reduces CO₂ emissions (Ackerman 66). Urban water can be better managed with gardens, for gardens increase the permeable land surfaces within cities and allow for rainwater and runoff to drain through the soil, which would decrease the risk of floods and landslides. Garden vegetation can help to increase humidity and lower temperature. Gardens can help break wind and intercept solar radiation, which creates shade and more protected areas. Few such areas of greenery and shade exist in cities.
Urban agriculture has incredible potential. Feeding an entire city with produce produced in that city is not necessarily the goal of urban agriculture. Rather, the goal is to increase the holistic sustainability of urban areas through supporting a more localized food system. The utilization of compost, phytoremediation methods, and greenhouse technologies in environmentally sustainable manners could imply that an urban agriculture system is perfectly viable. Though without the tools, resources, and knowledge to implement such practices, such a system would fall short of its fullest potential for sustainability.
Chapter 2.2 Economic Sustainability of Urban Food Systems

Economic Sustainability (The Moral Economy of Provision) – refers to the use of resources in a manner that ensures long-term success through balancing the needs of producers, distributors, and consumers. An economically sustainable system can therefore prove viable when we responsibly and optimally employ resources so that a balance between affordability and profitability exists and long-term benefits are maximized.

“A sustainable food system is one in which people participate directly in the operation and governance of multiple components of the food system in ways that are more complex and influential than simple market transactions.”

– Noah Zerbe, Moving From Bread and Water to Milk and Honey

Cities, and the people who live within them, are driven by efficiency. Constant movement and productivity is the norm. Economic efficiency though is not synonymous with economic sustainability. While agriculture in its traditional form is hardly a quick process, people have begun to refocus their energy towards the garden in order to combat urban food access disparities. As pertinent agricultural technologies and adaptations continue to develop, urban dwellers are finding themselves closer and closer to their food sources.

A growing number of people no longer visualize cities solely as areas of densely packed streets, tall buildings, and an abundance of people. Within that hustle and bustle,
they now see green. There are gardens on empty plots of land, crops growing on balconies, and farms on rooftops. Urban agriculture has begun to thrive across the United States and around the world. With urban agriculture’s rise, there exists the possibility for an even greener and more innovative image of cities to appear.

According to Noah Zerbe, urban agriculture systems in and of themselves are sustainable for the very reason that they require people to take ownership of their food. Based on my definition of economic sustainability, an innovative urban food system will be economically sustainable not only when people take ownership of their food, but also when the system as a whole fulfills the moral economy of provision by striking a balance between affordability for the consumer and profitability for the producer.

Small-scale community based agriculture combined with technologically innovative urban farming movements, like rooftop gardening and vertical farming, could strike that balance and provide a greater number of people in cities with jobs, food security, and a viable local-food system.

**The Challenges: Balancing Affordability and Profitability**

Similarly to what I discussed in the context of desert food systems, the economic sustainability and viability of urban agriculture also relies on finding the most successful balance between affordability and profitability, and optimally employing resources. Doing so is difficult when small-scale initiatives have little financial support and developing, implementing, and monitoring technologies for larger-scale production can be quite costly.
Urban agriculture could boost the economies of cities through providing people with jobs and much needed sustenance. Ensuring a project or business stays afloat while satisfying the needs of producers and consumers, the labor force, the market, and the ultimate goal of producing at scale is not an easy feat. If people have little interest or background in agriculture, it could be difficult to find people to fulfill the labor force requirements. If little interest exists in local food production, developing high market demand amongst consumers could also prove challenging. If the market demand is high, that too could be an issue. Producers then would have to ensure that they could produce at the scale necessary to feed that high demand. In order to satisfy all of these factors, people must not only continue to develop community gardens, but urban agriculture must also reach new heights.

Establishing community gardens on empty urban land is not without risk. Gardeners are rarely granted permanent ownership of city land, and instead often must rely on loaned space. When a city decides it is time to build more housing or to develop business on that land, the community garden finds itself in harm’s way. Without legal possession of the land, the government can use their power of eminent domain and make community gardens disappear before they even reach their greatest potential.

In January of 1999, New York City residents and activists found themselves at the center of a community uprising regarding the termination of their community gardens. Rudy Giuliani, the mayor at the time, called for terminating a vast number of community gardens in order to implement his redevelopment strategy. He ran on the platform that developing land for housing would combat crime and homelessness. Because community gardens would not alleviate the growing housing crisis in the city, Giuliani and the
government saw the land as developable.

Facing imminent loss of their land, grassroots organizations, guerilla gardeners, and community groups fought for their gardens. Of the 114 gardens intended to go up for public auction in 1999, citizens managed to save 69 of them. Those dedicated to this cause believed that the city’s gardens could continue to exist alongside the increase in the development of housing (Smith and Kurtz 201). The housing developments simply did not have to occur in areas where gardens were already growing, as there was plenty of other open space to develop.

Even after the success of the 1999 auction, people in New York City and across the United States continued to have issues with accessing land. In fact, a high-publicity community agriculture case appeared just a few years later on the opposite side of the country. Between 1994 and 2006, the South Central Farm in Los Angeles, California, became known as one of the largest, most successful urban agriculture projects in the United States. Like the community gardens in New York City, this garden occupied land on loan. Despite its success and the many positive impacts it brought the community, the government eventually decided to end this project in favor of developing a soccer field on the property. Like the plots in New York, the South Central Farm was not “considered the ‘highest and best’ use of urban land” (Lawson 91). A sports field, they believed, would have a greater impact on a greater number of people than would the community garden.

The government acquired the land through eminent domain, the law which states that they have power to take private property for public use. Due to years of economic and political strife between the community, the landowners, and the government, the plot
of land that was once so beautifully established as a garden in South LA, remains empty to this day. As will be explored more in depth in the following chapter, urban agriculture has continued to thrive in New York City and despite continued land access issues, the government has become more receptive to such initiatives. Nevertheless, people across the country continue to face trouble in securing long-term land use, limiting the development of community gardens in cities.

In addition to land access issues, urban farmers and gardeners must consider the challenges associated with growing marketable products. In order to distribute products at low prices, benefit a great number of people, and decrease food access disparities, products must be produced not only locally, but also at scale. Economies of scale refers to the microeconomics phenomenon where cost per unit of output decreases with increasing scale (Bluestone et al. 69). Community gardens are unable to reach the same cost advantages as larger production practices, and can therefore only survive by increasing the market value of their products. While some people might be willing to pay a premium for locally produced, high-end, sustainable products, many people in urban areas have neither the economic means nor the taste preferences to support such decisions. As urban agriculture initiatives grow, it is necessary to develop projects that not only function as alternative food movements for the upper class, but also for the rest of the population.

Collaboration between small-scale community garden initiatives and larger-scale and high-tech urban agriculture projects could lead to more sustainable provision of food in urban areas. Without collaboration between community garden initiatives and larger projects, cities have little chance to produce valued products at scale. Yet, it would be
careless to ignore the reality that small-scale agriculture can truly have a great impact, as the case of Havana, Cuba will show. As I will discuss, the existence and success of urban agriculture in Havana demonstrates the ability of small-scale farming to feed a population. Such a decentralized system may not work everywhere, but Cuba’s success is worthy to note.

**Addressing the Challenges of Economic Viability: The Case of Havana**

Cuba has successfully incorporated urban agriculture into Havana’s development plans. In doing so, the country has proven that urban agriculture projects have most potential at becoming economically viable endeavors if they are considered alongside other urban developments. Urban agriculture initiatives must not be considered an afterthought, but rather as essential components of housing projects, businesses, and recreational spaces. By incorporating the development of gardens into general city planning, community gardens would no longer be at such high risk of losing their land and people would be less inclined to consider alternative functions for their particular plots.

The value of small-scale, community-based practices can be best seen in Cuba, where widespread, organized, and subsidized agriculture practices brought the country out of deep food insecurity. At the start of the Special Period and the food crisis in 1989, Cuba’s government immediately prioritized urban farming initiatives. New land regulations transferred management of the land from state farms to cooperatives. While these new regulations only allowed government owned property to be used as gardens,
they still provided people with access to space to cultivate and grow their crops of choice. The socialist agenda lived on, as urban farms took over parks and public open spaces (Clouse 55). Without urban agriculture, the food rationing system of Cuba’s socialist regime would prevent most of the population from obtaining their basic nutritional requirements.

Havana, Cuba is a model example of urban agriculture development, as Habaneros have truly re-embedded urban agriculture into their societal procurement of food. Through providing a way out for people to access desired food, urban agriculture has given Cuba greater food sovereignty.

As I discussed briefly on page 19 of the introduction, Havana’s urban agriculture can be broken down into numerous categories. Havana’s most significant urban agriculture initiatives are *organopónicos*, which have high yields and take up 2,500 to 20,000 square meters (Clouse 82). These state-sponsored urban farms sell their produce to the public and tend to be located on the outskirts of the city where they can afford access to larger swaths of land. They became the Castro brothers’ model garden for signifying self-sufficiency under their socialist regime.

In addition to *organopónicos*, Havana is known for its small-scale projects like *patios* (yards) and *parcelas* (lots), both of which act as extensions of family homes and play a role in community engagement. The government-sponsored *parcelas* are urban lots that take up no more than 1,000 meters squared and fit within the category of *huertos populares* (popular gardens) (Premat 15). Together with *patios*, they are the most common form of Cuba’s urban farming today (Clouse 78). While *parcelas* are ultimately dependent on the state for their creation and continuity, government oversight through the
Cuban Ministry of Agriculture actually proves rather beneficial. By fulfilling expectations outlined by the government, those with parcelas can access government funds, educational resources, and agriculture extension services crucial to their success. By 1998, there were more than 30,000 people producing close to half of the country’s vegetable intake on 8,000 urban farms in Havana (Clouse 43). Agriculture endeavors, as supported by the government, have brought Habaneros out of food insecurity and into more sustainable times.

Clearly given the necessary tools, knowledge, and land space, small-scale urban agriculture has the potential to significantly alleviate food insecurity by contributing to employment opportunities, income, health benefits, and food provision. As Cuba’s government demonstrates, local governments are “best equipped to educate the public, promote sustainable decision making to individuals and respond to concerns of their citizenry” (Benton-Short and Short 457). While Cuba remains the only country with a wholly state-supported urban food system, interest in urban agriculture is growing around the world.

**Addressing the Challenges of Economic Viability: Cuba and Beyond**

Urban agriculture, as practiced on terraces, in backyard gardens, or in community plots, can offer low-income families access to otherwise unaffordable self-produced and nutritious food. By 2000 in the United States, urban agriculture had produced about $38 million worth of food annually (Brown and Jameton 21). According to a recent report by the National Gardening Association, “35% of all US households (42 million) participated
in food gardening in 2013 – an overall increase of 17% in only 5 years” (5). Like in Cuba, where close to 100% of leafy greens consumed in Havana are produced within city limits, it is looking more likely that healthy food supplied through urban self-provision could also replace or supplement typically purchased items (Clouse 173). With money saved on food, the cities’ poor would be able to afford other fees like those for school, transportation, and household appliances.

Community gardens are fantastic ways to bring food education and agricultural activities to urban communities. But creating a holistically sustainable and viable food system can only happen if the environment, society, and the economy are all taken into account. Community gardens prove environmentally and socially sustainable, in that they provide recreational and educational opportunities for urban residents. To some extent, as can be seen in Cuba, if widely practiced, community gardens can prove economically viable as well.

More focus has been turned towards programs that have the potential to produce enough produce to mirror the yields of industrialized agriculture. For instance, the Queens County Farm Museum focuses on educational programs, but even more so on production. While the farm is determined to integrate community engagement into their mission, they especially emphasize their dedication to agricultural productivity and their pursuit of economic sustainability. By focusing more heavily on production, they are able to contribute a greater amount of produce to those within city limits. Through its production intensive focus, Queens Farm is paving the way for more widespread adoption of local food consumption within cities. The Queens Farm is unique in that it occupies a large swath of land within an urban area. Such areas do not exist in great
numbers in cities, so further innovation is necessary if urban agriculture is to truly satisfy production needs.

Utilizing artificial growing technologies and innovations could produce much-needed food at faster and more reliable rates than community gardens. While high start-up costs for such technologically based farming methods could prevent these projects from ever getting off the ground, the promise to produce at scale can garner government support and subsidies. If the projects are subsidized by the government and practiced alongside other community-based initiatives, the long-term economic sustainability and viability of food provision within urban areas could very well increase.

More holistic sustainability and efficiency can be seen in the newfound vertical farming movement. Vertical Farming promises to produce food for cities at scale and within city limits. They can do so while using less water, less fertilizer, less land, and fewer agrochemicals than conventionalized agriculture. Utilizing hydroponic growing methods takes soil out of the equation. Growing with artificial light and within a controlled climate, takes away weather- and climate-related agriculture challenges. In such controlled conditions, there is a reduced need for agrochemical application. In addition, the food travels fewer miles, ultimately reducing both fossil fuel emissions and the costs of transporting food (Ehrenberg 19). By hiring people from within city limits to manage the operation, and providing tours, educational opportunities, and on-site farmers’ markets, vertical farms can become the cultural center of cities. While vertical farms might eventually provide under-fed populations with more food by bringing the production and distribution closer to the people, a great amount of financial resources must go towards the start of such development. Convincing people of the long-term
sustainability and viability of such a technologically dependent system could be quite difficult.

Nevertheless, vertical farming is an innovative urban agriculture system that seeks to combat the negative environmental, economic, and social impacts of our industrialized food system through re-embedding agriculture into our cities. It has the potential to do so in a way unfounded. Unlike one-story greenhouses, neighborhood gardens, or even rooftop farms, vertical farming has the ability to provide for the masses.

**Economic Accessibility: A Look at New York City’s Food Deserts**

If local urban food systems truly intend to provide for the masses, then they must turn their focus towards increasing the accessibility of their products for those who reside in food deserts. People who live in food deserts have no access to healthy food within walking distance of their homes and consequently suffer from high rates of diet related diseases.

People in food deserts and those of lower socioeconomic backgrounds in general often have difficulty accessing farmers’ markets due to unreliable public transportation. In addition, produce tends to be sold at higher prices at farmers’ markets than at bodegas, gas stations, or fast food restaurants. Physical and financial inaccessibility to these healthy, local goods leaves those who fall within lower-income brackets without the means to purchase them.

In “Expanding Access and Alternatives: Building Farmers’ Markets in Low-Income Communities,” Lisa Markowitz discusses the success of a farmers’ market in a
low-income community in Louisville, Kentucky. Because of the farmers’ market’s location in a poor neighborhood surrounded by affluent ones, the market attracts a diverse demographic group of people, allowing it to fair well economically and act as a viable option for both low-income and more affluent individuals. If this market is located in an area that attracts a diverse demographic, it can prove economically viable. Careful consideration of a market’s location can open doors to low-income communities while simultaneously providing for local farmers and more affluent individuals.

In reality though, people will only benefit from farmers’ markets and community gardens if they actually have interest in the projects. Gaining that interest can have rather challenging sociocultural implications.

The economics of food is therefore strongly associated with the social and cultural aspects of communities. Societal and community desires and needs play a role in the success of the market. If people realize that producing, distributing, and consuming locally grown food is beneficial to their economic wellbeing as well as their overall health, urban agriculture could very well prove economically sustainable and viable. In order for a project to be sustainable though, it must also take into account sociocultural needs, for all three categories of sustainability are interconnected.
Chapter 2.3  Sociocultural Sustainability of Urban Food Systems

*Sociocultural sustainability* refers to aspects of a project or system that proves valuable to a society, its people, and their culture. This category of sustainability can also refer to the ability of people within a community to incorporate certain activities into their daily lives that are separate from their work or home lives.

“I see young people and they want to work, but they’re in this thing where they’re caught up – I see kids of color and they’re just on this track that’s designed for them, that leads them to nowhere. So with gardening, I see an opportunity where we can train these kids to take over their communities, to have a sustainable life. And when we do this, who knows? We might produce the next George Washington Carver. But if we don’t change the composition of the soil, we will never do this.”

- Ron Finley, *TED 2013*

Ron Finley is a guerilla gardener and community food leader from South Los Angeles. He grew up in a food desert of LA without access to healthy, real food. With the realization that gardening can increase food security, decrease diet-related diseases, and get kids off the streets, Finley began to grow food right outside his front door. He seeks to “flip the script on what a gangsta is,” and show all those who experience poverty and live in low-income neighborhoods and food deserts that gardening is gangsta (Finley). Through community urban agriculture initiatives, Finley is leading a gardening revolution. He believes food deserts will become food forests where people will live happier, healthier, and more productive lives.
Urban agriculture strives to focus on just that – a commitment to the people and their quality of life. Focusing on sociocultural sustainability highlights a much-needed change in today’s food system. The present day food system revolves around large corporations and monoculture operations. This conventional system incorporates few individual citizens and focuses instead, solely on economic efficiency. Decentralized urban agriculture and food-related programs in cities can promote local food procurement and decrease peoples’ reliance on agribusinesses. Urban agriculture can also alleviate socioeconomic issues and public health concerns of low-income city residents. In order for urban agriculture to prove successful, people must first have both the desire and the resources necessary to take part in the alternative food movements.

Urban agriculture projects can engage citizens in activities that are sure to enhance their quality of life through increasing their community engagement, time spent outdoors, and access to healthful food. Such projects can therefore provide for individuals and for families in ways the present-day conventional food system is unable to do. Urban agriculture’s commitment to revitalizing communities has surely contributed to the movement’s momentum. As Ron Finley passionately suggests, this momentum has the potential to grow even more.

Implementing urban agriculture projects is not an effortless undertaking. Despite the fact that there are vast benefits to local food production and consumption, these benefits will only be realized if people are willing to try new foods and adapt to new lifestyles. Such willingness to adapt can only occur if people understand the reasons for why they should adapt. Due to overarching challenges related to geographic proximity, inaccessibility to transportation, premium pricing, and market distribution, urban
agriculture remains physically and financially inaccessible to many low-income urban residents. In addition, such food systems remain socially and culturally inaccessible as well. Exploring the ways in which people perceive urban agriculture and the ways in which urban agriculture affects the people and culture of a given area, could determine the sociocultural sustainability and viability of urban food systems.

**The Challenge of Widespread Applicability: The Farmers’ Market and Community Garden**

As I discussed in the previous chapter, food deserts are areas in which residents do not have access to healthy food. Such areas are simultaneously most in need of urban agriculture, and at the same time least equipped to take on urban agriculture projects. Even in areas where stores or markets do offer some healthy food, people are often ill equipped with the necessary knowledge and income to purchase such food, let alone produce it themselves. Instead, people rely on the cheaper fast food and packaged high-calorie foods, offered at conveniently located fast food chain restaurants and bodegas (Segal, 1). While urban agriculture programs could promote the accessibility of healthful food, successfully implementing such programs in food deserts is not without difficulty.

If all people are to live happy, healthy, and sustainable lives, urban agriculture programs must pay heed to the needs of those in food deserts. Farmers’ markets and community gardens are two major urban agriculture programs with similar goals. They seek to connect people to the food they eat and to the people who grow it. While farmers’ markets and community gardens seek to enhance local food production and consumption
by supporting local farmers and individual citizens’ desires for local food, they are often only accessible to those of the upper-middle class.

If locally produced food is to become accessible to the great majority of urban residents, then people must address the existing disconnect between affordability and accessibility in localized urban food systems. If this necessity for balance rings a bell, it’s because of how similar it is to my discussion of economic sustainability in the previous chapter. Yet here, instead of focusing on profitability for the producers, I focus more completely on the needs and desires of the consumer.

As I noted in the previous chapter, Louisville Kentucky has introduced an economically sustainable farmers’ market model where the market is located on the border of a low-income area and more affluent area. This allows greater physical accessibility for low-income residents, while still providing vendors with the ability to sell to more affluent customers. While the Louisville market focuses on the importance of increasing low-income residents’ physical access to local, organic, and sustainably grown food, the market doesn’t address the difficulties associated with increasing social and cultural access to, or rather, interest in, such products.

The Food and Environment Reporting Network recently published an article considering this very issue. Using the example of the first Whole Food’s store in Detroit, the author asserts that for Whole Foods to truly reach all Detroiter – “whether for idealistic reasons of equity, or savvy ones of expanding its customer base – [they] needed to do more than just turn a profit. It needed to persuade a new kind of customer that what it sold – local, organic, and sustainable – was worth seeking out. It needed, in other words, to change the food culture among the poor (or at least poorer), just as it has done
among the affluent” (McMillan). In a similar vein, urban agriculture initiatives – whether they take shape as farmers’ markets, community gardens, or rooftop or vertical farms – must strike the appropriate balance between accessibility and affordability and they too, must work towards changing the food culture of lower-income urban residents if they are to truly benefit the greatest number of people.

Access to resources and food- and nutrition-education is where the sociocultural sustainability of urban food systems comes into play. Implementation of urban agriculture, whether in the form of community gardens, farmers’ markets or innovative farms, can only be sustainable if people understand their importance and feel the need to partake in the system. People won’t simply adopt new lifestyles and food habits at the drop of a coin. If urban agriculture truly exists to increase all peoples’ ability to access fresh, healthy food on a local level, then we must carefully consider the ways in which we implement these programs.

**Increasing Sociocultural Applicability: Affordability and Accessibility**

Alternative food movements attract the upper-middle class, people who typically believe they are well-informed about nutrition and have the financial means to purchase healthy food. People who have never experienced poverty shouldn’t dictate what other people should eat and how they should procure their food (A. Conroy and J. Conroy 516). Expanding local food systems’ accessibility is necessary. Determining ways in which to enhance food education and leadership initiatives among those within the low-income bracket could alleviate reliance on those from the outside and contribute to greater long-
term sustainability.

Preventing discriminatory behavior in urban agriculture is therefore a must if the widespread beneficial impacts of urban food programs are to be realized. Localized and community-oriented food production can benefit people in countless ways. Instead of the timeless and distant cuisine of industrialized systems, urban agriculture and other alternative food systems seek to re-embed “people in time and place through linking them to a specific piece of land and awareness of the seasons” (Zerbe 20). Creating such a connection between people and food can foster happier individuals and more sustainable communities. Working with each other in a neighborhood garden or with local farmers on a small-scale farm fosters a sense of responsibility and enjoyment within and across communities. Increasing the accessibility of alternative food sources is necessary if urban agriculture is to prove worthwhile for all urban citizens, especially those most in need. Only then will urban agriculture prove socially and culturally sustainable.

As exhibited by East New York Farms, an urban agriculture organization based in Brooklyn, NY, the programs that may have the greatest potential at increasing that accessibility and long-term sociocultural sustainability are those that are directed towards society’s youth. Nutrition education programs for school-aged children, farm-to-school initiatives, and internship and leadership opportunities, provide students with the tools and the resources to learn about their food and make real, ground up, change in their communities.

East New York Farms believes that youth play a big role in community development. By hiring youth and engaging them in their local food system through work in gardens and at farmers’ markets in the area, East New York Farms is creating a more
accessible alternative food movement. The young interns, as well as their families, are grateful for the program. Interning with East New York Farms provides youth with a safe, calm space to take on responsibility and demonstrate maturity. Acquiring and developing valuable knowledge and skills, material compensation, and being a part of a safe space are all documented benefits of the program (Hung 71). Such a program highlights the importance of working with youth in order to nurture interpersonal relationships, cultivate future leaders, and identify needs of the community.

Careful consideration regarding the location of farmers’ markets, a move towards accepting food stamps at farmers’ markets, and the development of youth programs and community gardens in low-income neighborhoods by the people for the people, can engage diversity in urban areas.

Engaging diversity can only occur sustainably if people build a shared, or collective identity around the local food movement and urban agriculture initiatives. New York City’s 1999 reaction to the auction of community gardens, introduced in the last chapter, highlights the ability of a collective identity to foster passion and inclusion around a shared interest. The garden auction spurred citywide protest among people who had invested time and effort into their gardens. Non-profit organizations and activists came together to protest the auction for they believed that “the city would lose ecologically and socially valuable green space when publicly owned and leased garden lots were sold to private developers” (Smith and Kurtz 200). By banding together to save their community gardens, people formed their collective identity and ultimately prevented a number of gardens from vanishing.

Urban agriculture is proven to alleviate stress, fear, and anger among community
members. Urban agriculture projects offer opportunities for people to take on leadership and community organizing roles, which ultimately contribute to greater social capital and wellbeing. Engaging with one another in caring for a collective property can contribute to healthier interactions with each other outside of the garden. Not all urban residents have the opportunity to partake in official internships like those at East New York Farms, but increasing food awareness is possible even in the short term. During a two-month internship at the Queens County Farm Museum in New York City, I experienced and witnessed sociocultural sustainability and the benefits of urban agriculture firsthand.

**Volunteering on an Urban Farm: An Inside Perspective**

When considering the development of urban agriculture projects, careful consideration of how, when, and what is implemented can greatly benefit a community. Sometimes, the most successful or the most sustainable of programs are those that leave their doors open. The Queens County Farm Museum is the oldest continuously farmed plot of land in all of New York State. Located on the border of Queens and Long Island, the farm is an incredible green oasis on the outskirts of an urban concrete jungle with open gates year-round.

As a summer intern at the Queens Farm, I broadened my perspective on the impacts of the American food system and explored the need for urban small-scale agriculture by actually participating in the system. I spent my days working in the greenhouses and planting fields. Through interning on the farm, I was able to help implement the Queens Farm’s mission of preserving, restoring, and interpreting the
history of the site, while learning about and following a range of sustainable agriculture practices, like crop rotation, timed planting, companion planting, and cover cropping. Interning on the farm allowed me to step away from our fast-paced, technologically dependent society, and reconnect with farming culture, the land, and the people around me.

The people around me, specifically the children, caught my attention. Inner-city children walked through the farm, on tiptoes, awestricken, having never seen farmers or food growing in the ground. Some children called out to me, getting my attention with a wave or a “hey farmer!” I was all too eager to engage with them. Spending just one day on the farm can provide children with all the happy experiences necessary to push them to seek out more food-related opportunities. I know this, because I was one of those kids.

I first visited the Queens Farm when I was in kindergarten and to this day, I can still remember the visit. After checking in with a number of my friends from kindergarten and learning that they too remember our farm visit fondly, I realize how important and special these experiences can truly be for city kids. I’m not saying that every child who walks through the gates of the Queens Farm will become a foodie, a food justice advocate, a farmer, or an activist. What my experience does show is that exposing city children to farms can provide lifelong memories and can influence people for years. If that doesn’t represent a component of social and cultural sustainability, I don’t know what does.

At the Queens Farm, I connected not only to children during their farm visits, but also to the greater New York Community through participating in weekly volunteer days, and working at their farm-stand. Perhaps the most meaningful moments during my internship were those when I engaged with volunteers. Each and every volunteer had a story and a
passion, and a reason for seeking out the Queens Farm. Some had experienced diet-related diseases and were interested in learning more about vegetables and healthier food options. Others were high school students interested in spending time outdoors to fulfill their required volunteer hours. They expressed their enthusiasm for working with their hands, being outside, and volunteering alongside others. Perhaps their understanding of farming was sometimes idealistic, but perhaps it is that naivety of farming’s complexity that could lead these young members of society towards future food related work. At least, that’s what the Queens Farm did for me.

Whether I was engaging with older volunteers who were looking to refocus their lifestyles or high school students trying to fulfill volunteer hours, I saw people coming together and forming a community of more knowledgeable citizens and more educated eaters. The volunteer program at the Queens Farm engages people that otherwise may never connect to the food they eat or to the people who grow their food. The Queens County Farm Museum opens its doors to thousands of people each year and exposes them to the world of sustainable alternative food movements.

**Are Urban Agriculture Initiatives Socially and Culturally Sustainable?**

Despite the challenges associated with urban agriculture’s development, sociocultural sustainability and urban agriculture are for the most part, positively intertwined. Increasing educational opportunities amongst youth, access to farmers’ markets, and the ability of all people to start their own initiatives, will change the face of urban agriculture for the better. Across the board, we must continue to raise awareness
about urban agriculture in order to encourage the government to implement necessary policy changes and for people to gain more access to agriculture education, resources, and financial support. To combat diet-related disease and further environmental degradation, New York City has begun to take a few steps in the right direction. The city has demonstrated an increased focus on nutrition education, expansion of the Greenmarket to low-income neighborhoods, and developing more community gardens and related initiatives.

Food Bank for New York City aims to end hunger in New York City. They conduct free workshops that emphasize education on smart purchasing decisions and healthful cooking throughout the city. Just Food, a non-profit organization in NY focuses on connecting communities and local farms with the resources necessary to make fresh and locally grown food available to all New Yorkers. They promote community leadership by training “volunteers to teach their neighbors how to select, store and preserve fresh produce, all in order to live healthier lives and support sustainable food systems” (Segal, 7). Unlike other organizations, Just Food focuses on advocating for change from within – a practice that more should adopt.

Along with the non-profit organizations’ work to positively impact underprivileged New Yorkers’ health and wellbeing, the NYC Department of Health has also taken a few steps in the right direction. Greenmarket, the country’s largest consortium of farmers markets in the county, accepts food stamps at most of their stands throughout their 46 locations in the city. Additionally the NYC DOH implemented a coupon system for food stamps, called Health Bucks – for every five dollars spent with food stamps, low-income residents can receive a two-dollar coupon to buy fruits and
vegetables at the farmers’ market (Segal, 8). Unfortunately, while the government seems to take into account the issue of food access for many New Yorkers, many residents of food deserts continue to lack convenient access to farmers’ markets and supermarkets. For the negative affects of food deserts to subside, access to farmers’ markets and larger supermarkets must increase.

With inconveniently located supermarkets and limited access to farmer’s markets, residents of food deserts have no other choice but to continue to shop at bodegas and other small convenience stores. Working with these realities, the Department of Health and Mental Hygiene (DOHMH) developed an ad campaign in 2006 to promote healthy food choices on both the distributor and consumer sides (Segal, 8). The Healthy Bodegas Initiative focused on increasing availability of healthier foods in stores in low-income areas by working with neighborhood bodegas as well as communities. Since its inception, the program has implemented two programs targeting bodegas in low-income communities of New York City. The programs are the Moooove to 1% Milk campaign and Move to Fruits and Vegetables Pilot (Healthy Bodega Initiative). This initiative only works if storeowners are willing to restock their shelves and community members are interested in purchasing the products. Without the demand, storeowners would have to accept the risk of losing revenue in the process.

In addition to education initiatives and food access reform, former Mayor of NYC, Michael Bloomberg, made public health a focal point of his administration. In 2006, restaurants were banned from preparing foods with trans-fat, an unhealthy fat that raises cholesterol. That same year, New York City passed a law requiring restaurants to post calorie counts for their food items to motivate New Yorkers to develop healthier
purchasing habits. In 2009, Bloomberg tackled the issue of excessive salt consumption in America when he launched a National Salt Reduction Initiative, encouraging producers to sign on to reduce levels of sodium in their products by 2012 and 2014 (Kliff). These programs would prove most successful if the government and those of upper class communities worked alongside the lower-income population to tackle low demand, high prices, and poor quality infrastructure. Not only is it important to focus on seeking out additional funds for resources, but is also essential to consider ways in which to increase demand and reshape the food culture and taste preferences of low-income residents.

As can be seen through the success of East New York Farms and the Queens County Farm Museum, educational opportunities could be one such way to increase social and cultural accessibility of alternative food movements in low-income areas.

Yet another urban agriculture initiative has begun to thrive at the Queens Botanical Garden. This program is focused entirely on educational opportunities and the importance of providing educational resources and experiences for community members. It is a rather new program with limited funding, but one that benefits directly from city taxpayers. This project focuses specifically on compost in order to demonstrate the cyclic nature of the food system and to contribute to more widespread adoption of composting. By focusing on compost, the farmers seek to express to the community that farming is a circle of life of which we are all a part. While there is definitely some focus on production, there is more emphasis on farm-based education. If people develop more programs like those at East New York Farms, the Queens County Farm Museum and Queens Botanical Garden, more urban dwellers will be exposed to a crucial component of society. In doing so, they will be able to take matters into their own hands, to form
relationships with people they might otherwise never engage with, and become ever more a part of their communities.

As citizens and the government focus more on diet-related health concerns, we can hope that economic disparities and sociocultural inequalities will soon no longer be as widespread as they are today. Programs focused on nutrition education, greenmarket expansion, government health reforms, and initiatives like those at East New York Farms and in Queens, New York City appear to be working hard to combat the health concerns of today’s citizens, while contributing to a more food-educated society. With continued commitment to public health, it is reasonable to believe that access to healthy food through alternative food movements will become a right, and not a privilege, for all.
Section 2  Conclusion

As I said throughout this section, there are challenges associated with growing food in urban areas and effectively combatting these challenges is not without difficulty. Whether the challenges come from the environment, the economy, or the social and cultural realities of the community, there is room for improvement in the development of sustainable urban food systems.

Adopting sustainable practices based on successful urban agriculture initiatives, whether those in Cuba, New York City, or elsewhere around the world, could contribute to more widespread acceptance and success of urban agriculture initiatives in the future. As we continue to develop urban agriculture programs in cities, we must prioritize the pursuit of holistic sustainability and viability.

Next Steps: Collaboration and Policy

By looking specifically at community agriculture initiatives in Cuba alongside projects in the United States, I highlighted the potential challenges and impacts of small-scale initiatives. Through my incorporation of research on more innovative technologies that focus on larger-scale production, I stress the importance of producing at scale and in a way that can benefit the greatest number of people.

Sharing ideas, collaborating on projects, and incorporating the successes of small-scale initiatives into the large-scale programs could prove viable. None of this collaboration can happen immediately. In order for community gardens to prove more
sustainable and actually act as viable food alternatives, people must first gain access to land, resources, and support. The work urban agriculturalists do is integral to the development of their urban communities and their cities’ environmental, economic, and social sustainability. Not only are they community members, gardeners, or farmers, but they are also educators, advocates and activists. They must seek out educational opportunities to develop their skills and knowledge base not only on farming or gardening techniques, but also on advocacy and politics.

Governments and their policies play a role in the viability of urban agriculture. As it stands, there remains a disconnect between the positive components of farming in cities and existing policies. Land access issues, for instance, remain a problem. Gardening advocates suggest though that people can protect their gardens by privately purchasing land or developing non-profit land trusts to protect the gardens (Lawson 92). As seen in Cuba, enforcing a garden’s role in the community beyond the individual growers could validate the purpose of the garden and prove an effective way to alleviate some tension. In order to increase the viability of gardens as recreational spaces, they can be included within public parks or developed within new parks. Such an urban agriculture project has actually already proven successful in Cuba. The Parque Metropolitano de la Habana is a 700-hectare food park within Havana that consists of a botanical garden, a zoo, and a variety of recreational areas. More notably, farmers came together at the onset of the Special Period to form a sustainable, agro-ecological, urban food cooperative within the park. Of the ninety-six growers, some are salaried workers and others are community members. Together, they work in the park to cultivate 78.5 hectares of land (Clouse 83).

The Queens County Farm Museum in New York City is somewhat similar to the
Parque Metropolitano de la Habana, in that it exists on a relatively large swath of land owned by the Parks Department. While the Queens Farm relies only on a small team of farmers to tend to the land, it also acts a park and natural space for the greater urban community. Perhaps such successful programs can convince more public officials that community gardens and production centered urban farms can be sustainably and positively incorporated into city parks.

City planners must also think sustainably and must ban the use of chemicals to prevent urban gardeners from utilizing potentially harmful products. On the economic level, policies need to be developed that relate to crop insurance, loans must be offered at the onset of projects, and public and private funds must be made available. In addition, cities should focus on incorporating the use of food stamps and vouchers at farmers’ markets, but also directly on site at gardens and farms. Increasing access to kitchens, serving healthier food at restaurants, and introducing new recipes to educate those who are unfamiliar with cooking healthier food is also a must that can have great sociocultural impacts (Brown and Jameton, 27). Policies can change the way cities obtain their food and can allow for more holistic sustainability.

The Viability of Urban Food Systems

Implementing environmentally sustainable practices in cities is the key to developing economic and sociocultural sustainable programs. If people approach urban projects with little consideration of any of the three major categories of sustainability, creating a viable project would be near impossible.
For a project to be viable, it must also be sustainable. While it is essential for us to consider the environmental components of projects in urban areas, as well as the economic components, it has become ever the more apparent that pursuing sociocultural sustainability in urban food systems is perhaps the most vital, yet most challenging factor of all.
Conclusion

“Hope is not what we find in evidence, it is what we become in action together.”

- Francis Moore Lappé

Comparing urban and arid-land food systems might be to some like comparing apples and oranges. At first consideration, urban and arid areas are exactly the opposites most imagine them to be. Urban areas are cities where people live and businesses thrive. They’re places with tall buildings and a lot of stores. Arid areas are deserts where little really happens. A few shrubs here and there, and practically no water. Comparing the two may seem futile at best. But here’s where it gets exciting. There is one overarching similarity between urban areas and arid-land areas that ties the two together: the challenge of growing food. Exploring urban areas and arid areas within the context that they are both agriculturally marginal lands can prove that comparing the two is not in vein. Such a comparison could enhance the world’s agricultural pursuits and could perhaps even lead to a newfound holistically sustainable food revolution.

Overlapping Practices: What Can Cities Learn From Deserts?

People have been growing food in arid areas since the very beginnings of agriculture. As we learned in Section 1, utilizing traditional practices and knowledge alongside innovative solutions can very well lead to a sustainable growing system in arid regions. Traditionally, agriculture was practiced without dramatic modern technological innovations. People had to work the land with their hands. They had to innovate, not with
modern technology, but with agro-ecological practices. To maximize yields and to contribute to one’s household, people used methods like composting, cover cropping, inter-cropping, and windbreaks. These agro-ecological practices have proven valuable in deserts as ways to alleviate the negative effects of such inhospitable growing conditions. These methods, which combine traditional practices and ecological sensitivity, may also prove to be effective in urban areas. Indeed, in some instances I discussed, they already have.

Agro-ecological growing practices have proven effective across the board, regardless of locale. For the purposes of this comparison between urban and arid-land areas, it is therefore even more imperative to look at the innovative modern-day technological developments and their cross-geographical applicability. Drip irrigation technology for instance, was originally developed to conserve water in arid areas. Cities though can also benefit from drip technology, regardless of where they are located, whether in arid- or water-secure regions. Drip irrigation conserves water, requires little maintenance, and given the desire and the need, can even be controlled remotely. Drip irrigation is a conservation-oriented irrigation system. Not only does it allow for crops to grow successfully in dry regions, but it can also maximize an urban area’s water use and thereby allow growers to manage water more sustainably.

Drip irrigation is just one desert technology with widespread applicability. As discussed in Chapter 1.2, innovative solutions utilizing seawater and sunlight have also been successfully developed in dry-land regions. By utilizing a combination of greenhouse technology, natural renewable resources, indoor growing methods, and innovative technology for controlling those resources, agriculture in deserts can reach
greater scales. As has been determined in arid areas, agriculture systems must be able to produce at scale if they are to truly feed the world’s population. Utilizing such artificial growing technologies could also benefit urban areas. With such technologies that utilize artificial growing conditions or indoor space, urban agriculture could increase its yield. People would therefore be able to more consistently purchase and consume food grown within their own city. Innovative modern technologies would thereby eliminate the harmful environmental and economic impacts of conventional agriculture’s long supply chain.

If people are to grow on agriculturally marginal land, regardless of locale, paying heed to sociocultural sustainability and tradition, while also incorporating the use of innovative technologies is necessary if the practices are to prove holistically sustainable and viable. Just as cities can learn from the traditional growing practices and innovative technologies of arid-land regions, deserts can learn valuable food-system practices from cities.

**Overlapping Practices: What Can Deserts Learn From Cities?**

People in urban areas are increasingly interested in learning about where their food comes from, how it is produced, and how they might produce it themselves. Community gardens and small-scale farms within cities provide people with the opportunity to experience their food system first-hand. In doing so, small-scale projects reduce people’s reliance on conventional agriculture practices. The conventional system has failed to provide food for the world’s population. Given the desire, resources, and
support, people in cities can change the way the food system runs. In the grand scheme of
the world’s history, cities are relatively new yet are home to the majority of the world’s
population. As the world continues to face climate change, land degradation, and the
people of our cities increasingly face economic, social, and cultural struggles, it is now
time to search for our long lost agricultural pasts and utilize these pasts to benefit the
future. Reacquainting people with agriculture has the potential to not only benefit the
world around them, but also the people themselves. Reconnecting with the land and
increasing social and cultural benefits of city life provides the foundation for community-
based food initiatives in urban areas.

Similar socially focused and community-based initiatives could exist in arid-land
regions as well. If such movements became more prevalent in deserts, as they have for
years in the Negev, arid areas could become hot spots (if you will) for people, businesses,
and most of all, local food. Adopting urban agriculture’s focus on community
development through food provision could create a flourishing desert and could
ultimately alleviate the younger generations’ desire to leave their desert homes for cities.
Agriculture could become accessible, not only to big corporations, but also to ordinary
citizens.

The Big Picture: Urbanization and Desertification

We must develop sustainable and viable food systems in both urban and arid
areas. No matter where food grows, it should be produced, distributed, and consumed
sustainably. Comparing these two locales in particular is significant, not only because of
their applicability to each other, but also because they draw attention towards the present
day phenomena of urbanization and desertification.

Urbanization, the process by which people move to cities and leave their farming
lives behind, continues to take place around the world. This phenomenon plays a role in
rising unemployment rates, overcrowding conditions, and income disparities in cities.
When land in the United States was converted to urban areas and jobs subsequently
moved from the country to the city, people followed. This population shift contributed to
a decline in subsistence farming and a rise in commercial agriculture (Winfield 67). The
entire culture of the United States had begun to shift.

While commercial agriculture produces food in an economically efficient manner,
I argue that it is not enough for an agriculture system to just be efficient. It must be
holistically sustainable, with a focus on the environmental and sociocultural sustainability
in addition to the economic sustainability. The industrialized agriculture system
combined with land utilization transitions and population shift from rural to urban areas
has significantly affected the sustainability of our food system.

If urbanization is to continue, developing agriculture practices rooted in
traditional agro-ecological methods is necessary. If the negative affects of urbanization
are to be alleviated, encouraging a new shift back to rural areas and even perhaps to
deserts could also be helpful. If deserts can provide for people just as cities could, then
people could spread out and could pursue more small-scale and locally based agriculture.

The problem of desertification goes hand in hand with urbanization, as it too is a
global phenomenon that is interconnected with the conventional agriculture system. The
concept itself was only brought to international attention in the late 1900s after a drought
and famine in the Sahel region of Africa. At the time, the international community was without a clear-cut definition or understanding of desertification, but the dire need for both was all too clear. Representatives from all across the world joined together in September of 1977 in Nairobi, Kenya to begin the global conversation at the United Nations Conference on Desertification (Hassan 3). The UNCOD was the first convention of its kind, and brought together hundreds of people from around the globe. The definition ultimately agreed upon is “that desertification is the destruction of the biological potential of the land that can lead ultimately to desert like conditions” (Rechkemmer 55). Alongside this definition, people also define desertification as degradation of land in arid, semiarid, and dry sub-humid lands (MEA 1). Land degradation is a concept often used interchangeably with desertification and refers not only to land turning into desert, but rather specifically to erosion and the reduction in vegetation and in biodiversity – all concepts relating to and implying a diminished resource potential of a particular land.

There is a cyclic relationship between desertification and urbanization. The world’s monoculture agriculture system has contributed to widespread land degradation and subsequent desertification. As more and more land is used for such operations, more and more of that land is turned to biological desert. This food system and process of land degradation has also contributed to a growing desire among people to move away to cities. As more and more people move to cities, the fewer people there are to farm the land. Once privately farmed land then becomes a part of the industrialized system, ultimately facing abuse, destruction, and desertification. The people who live in cities must learn to provide for themselves, but just as importantly, people must begin to
develop ways to utilize the land that has already been destroyed.

Innovations in arid regions could be adopted and used in areas that undergo desertification in the name of conventional agriculture. Not only can innovations allow for productivity on land that might otherwise prove unviable but they can open up doors for success in other regions as well. The adoption and application of such innovations would then contribute to lower population density in cities. Development of community-oriented and locally based growing systems in cities could contribute to healthier and more sustainable city life for an even greater number of people.

Realizing the impacts of urbanization and desertification highlights the importance of my comparison between urban areas and deserts, and points to the cyclic connection between the two food systems. Urbanization and desertification go hand in hand. As urbanization and desertification continue, learning from each other across boundaries becomes all the more necessary. As world population rapidly increases and far more land is degraded by unsustainable agricultural practices, city and desert cultivation is where agriculture’s future lies. It is a future founded in humanity’s commitment to our food system’s holistic sustainability.

Tying the Two Systems Together

Not all agricultural practices in urban areas can be applied to food systems in arid areas. Similarly, not all practices meant for arid areas can be applied to urban areas. My research shows that urban areas focus more greatly on the sociocultural sustainability of their projects than do arid areas. Considering the fact that cities tend to be more populated
than most arid-land areas of the world, it makes sense that they focus on the people and the community. Arid areas on the other hand, depending on size, focus a lot on the environmental and economic sustainability of their practices. In such dry areas, growing food could be impossible without consideration of the area’s ecology, the market, and the advantages and disadvantages of certain practices. In both areas, pursuing economic sustainability is important. Whether people are growing in greenhouses in the desert, purchasing drip irrigation technologies for arid areas, or growing in vertical farms in cities, or in empty plots of land between buildings, the financial components of each project plays a role in the system’s ability to survive.

Accomplishing 100% sustainability in all three pillars of sustainability, may not be possible. But that shouldn’t be the goal. By considering another locale with similar challenges, urban areas and arid areas could each enhance their efforts towards holistic sustainability and viability. As economist Joseph Schumpeter’s founding idea of creative destruction suggests, innovations involve destruction of already existing structures (Fayolle 101). For the purposes of this thesis, Schumpeter’s idea highlights the reality that in order to create the most holistically viable system, we must make tradeoffs between the three pillars of sustainability when pursuing innovative food system initiatives. The best practices of urban and arid-land food systems, especially those that have consciously considered these tradeoffs, can be applied in some capacity from one to the other to enhance their pursuits of environmental, economic, and sociocultural sustainability.

Deserts could reach greater sociocultural sustainability if they are to adapt best community-oriented practices of cities. Urban areas could reach greater economic
sustainability if they are to consider the potential for introducing more innovative
technologies. Granted each has the financial support and technological know-how, both
can benefit from applying aspects of each other’s artificial and climate controlled
growing innovations. Deserts can learn from cities, and cities can learn from deserts.
Together, they can create a future of food in this world that relies a little less on
chemicals and big business and more on real food and self-sustaining communities.
Works Cited


“Queens County Farm Museum.” Queens County Farm Museum. Queens County Farm Museum, n.d. Web. 19 Apr. 2015.


