PRODUCTIVE URBAN LANDSCAPES:
THE RELATIONSHIP BETWEEN URBAN AGRICULTURE AND PROPERTY VALUES IN MINNEAPOLIS, MINNESOTA

by

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Masters of Architecture (Professional), University of Pretoria, 2010

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Environmental Design and Planning
College of Architecture, Planning and Design

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2015

Abstract

Urban agriculture and urban food-systems are locally productive landscapes and their supporting programs and networks. Urban agriculture is now valued and actively promoted by many urban communities. Having numerous community benefits, UA is often considered to have desirable neighborhood amenities and is assumed to have effects on nearby property prices. However, very little is known about the primary or secondary economic contribution of these productive landscapes to urban environments, particularly in regards to how urban agriculture relates to property values in a neighborhood. Because urban agriculture sites are often overpowered by increasing exchange-values of surrounding properties, the original values (economic and non-economic) to the neighborhood or community may be lost as urban agricultural sites are transformed by "higher return" development schemes. Since urban agriculture can disappear or fail without effective financing and adequate policy and planning support, it is imperative to the longevity of such programs to understand how important land-use and economic variables interrelate. This study examines the spatial-temporal magnitude and economic relationship between urban agriculture parcels and property values. The study uses the hedonic method employing the Spatial-Durbin modeling approach. Findings expand the theoretical and policy discourse on how investment of public resources aids neighborhood development through low exchange-value programs such as urban agriculture. In understanding the advantages of local food systems to urban form, context-specific neighborhood strategies developed in tandem with targeted community development and comprehensive plans can improve urban revitalization and (re)development within a larger resilient city planning framework. The key findings from the study illustrate that there is great value in understanding the most appropriate design approach and features of urban agriculture for different neighborhoods and market groups. Important design considerations include scale, design aesthetic, abundance and quality of urban agriculture sites within different market groups and neighborhoods.

Keywords: urban agriculture, urban food systems, spatial econometrics, environmental economics, productive urban landscapes, community development, comprehensive planning, land-use planning, local economic development, environmental economics.

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Table of Contents

List of Figures

List of Tables

Acknowledgements

A great thanks to all my friends at Kansas State University and my family supporting me through this period. A special thanks to professors Huston Gibson and Lee R. Skabelund for their continuous encouragement and dedication. My gratitude to professors Jason Brody, Michael Babcock, John Harrington Jr., and Mark Burkey, who provided helpful and constructive commentary at critical times. My gratitude to Mr. Mark Campbell, who was a very gracious host during my visits to Minneapolis. Finally, thanks to Katie Burke, Theo Heyns, Alejandro Gonzalez, and Meg Atteberry for their enduring friendship and cheer throughout.

Preface

This document discusses research on productive urban landscapes as it relates to urban and community development, comprehensive planning, and growth management. This research explores how the value of urban agriculture trades in the urban environment by studying the relationship between urban agriculture and property values.

This document has five sections. Chapter One provides the background and frames the research problem. This introductory chapter includes a discussion of the key concepts of continuous productive urban landscapes, urban agriculture and local food systems, the challenges and core issues related to urban agriculture, the significance of the study, and the research question. Chapter Two discusses the literature pertaining to the empirical evidence related to the value of urban agriculture and other comparable land-use types. Chapter Three explains the research design, study area (Minneapolis, Minnesota), the data collection and analysis methods and techniques, the formation of proxies and variables, and the purpose and form of the models used in this research. Chapter Four extrapolates the results and explains the findings of the study. Chapter Five concludes with a discussion on the role and future of productive landscapes in cities, notes related policy issues, and offers recommendations for planners, designers, policy-makers, and urban land-use researchers.

Chapter One - Research Framework

Prologue

This chapter provides the background and frames the research problem. This includes a discussion of the key concepts of continuous productive urban landscapes, urban agriculture, and local food systems. The challenges and core issues related to urban agriculture, the significance of the study, and the research question are also discussed.

Introduction

In the last decade North American cities have seen a surge of interest and promotion of urban agriculture and local food systems. North American cities are increasingly — and in many instances progressively — including urban agriculture and local food systems into city planning, design and policy frameworks. Many of these cities are among the most populous urban environments in the United States. Urban agriculture and local food systems are promoted as complimentary strategies for creating healthy, sustainable communities and resilient urban life (Goldstein, 2011; Mees & Stone, 2012; Mendes, Balmer, Kaethler, & Rhoads, 2008; Mukherji & Morales, 2013). In the global north there is growing interest in including urban agriculture and local food systems into city planning, policy, zoning, urban development, and redevelopment plans — not only within the city, but also at fringes of the city (RUAF, 2014). As such, urban agriculture and local food systems form part of a design narrative of continuous productive urban landscapes and urban green infrastructure in support of urban resiliency (Viljoen, Bohn, & Howe, 2005; Viljoen & Bohn, 2011).

Figure 1. A Minneapolis resident gleaning produce from his local urban agriculture site.

Key Concepts

There are a number of key concepts related to growing food and other crops in the city. These concepts are briefly discussed in the next few pages.

Local food or local food system

The United States Department of Agriculture (USDA) describes local and regional food systems as:

"…place-specific clusters of agricultural producers of all kinds — farmers, ranchers, fishers — along with consumers and institutions engaged in producing, processing, distributing, and selling foods."

United States Department of Agriculture, 2015

The USDA reports that since 2007, number of farmers markets has grown over 150%, regional food hubs 300% and farm-to-school programs over 400% (United States Department of Agriculture, 2015). This is a significant increase in local food production and local availability. Yet, compared to organic food and food products, there is no legal or universal consensus on the definition of "local food." The concept of local food is a grey area, as individuals and communities have a range of interpretations about what a local food source truly is. Local food is a generally used in a geographical manner. In most interpretations, local food is related to the distance between food producers and consumers. Yet this does not capture a variety of other interpretations on what local food could be. For example, there are some disputes on what is considered a reasonable local food distance band. Some people would consider local food as accessible food within walking distance, while others would consider local food as the point of origin of the source, such as within particular state. Furthermore, a predetermined distance band does not always describe the local foods market. For example, a product may be grown in one state, but sent away to be packaged in another state, only to return again for retail in a third state (Martinez et al, 2010). This further skews the general understanding of what the concept of local food truly is, or ought to be. Therefore, a second interpretation of local food is defined in terms of the market, which includes aspects such as supply chain characteristics, or type of local ownership of farms (Martinez et al., 2010). In this interpretation, local food is the direct-to-consumer market, and not the geographic distance. Finally, some consumers are motivated to purchase only organic food products, or support sustainable farming practices specifically. These motivations may result in purchases far outside of a predetermined local food distance band, but still be understood by the consumer as related to the local food concept.

Urban agriculture

For the purposes of this study, the definition of urban agriculture is as follows:

> *Urban agriculture "is an industry located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis, which grows or raises, [then] processes and distributes a diversity of food and non-food products, (re-)using largely human and material resources [and] products and services found in and around that urban area [—] in turn supplying human and material resources, products and services largely to that urban area."*
>
> *Mougeot, 1999, p.10*

Urban agriculture and local food systems include support systems such as farmers markets, schools and restaurants, input suppliers, local processing and distribution networks, and related sub-industries. Urban agriculture is seen as an economically viable industry (Smit, 2001) with strong existing and emerging research in ecological, environmental, and socio-cultural areas (Condon, Mullinix, Fallick, & Harcourt, 2010; De Zeeuw, Van Veenhuizen, & Dubbling, 2011; Despommier, 2010; Drescher, 2001; Goldstein, 2011; Gorgolewski, Komisar, & Nasr, 2011; Hodgson, Campbell, & Bailkey, 2011; Mougeot, 2006; Viljoen et al., 2005). Urban agricultural producers range from individuals and smaller scale community initiatives to large, fully-operating for-profit urban farms. However, there are barriers and constraints on the implementation mechanisms for urban agriculture and city planning goals (Gorgolewski et al., 2011; Smit, 2001). These important issues will be discussed in the section "Barriers and Constraints in Policy and Planning."

Continuous productive urban landscapes

Viljoen and Bohn (2005) developed a design concept for a new kind of landscape layer for cities — a "continuous productive urban landscape" or CPUL. The CPUL is an active, productive, coherently planned and designed open urban landscape network that is integrated with a metropolitan scale sustainable landscape strategy. The CPUL is envisioned as a city-wide continuous open space network, which includes spaces for agriculture and ecologically functional landscapes. The CPUL was originally an inter-urban design concept, but it is not limited to city boundary. The landscape system can extend beyond the urban core to facilitate the urban fringe and boundary landscapes (Viljoen et al., 2005).

The CPUL links productive gardens to outdoor leisure and recreation, natural habitats, ecological corridors, and circulation routes for non-vehicular pedestrian traffic. With this concept, the urban agriculture component refers mainly to fruit, vegetable, and herb production, typically at a much smaller scale than most modern productive agricultural systems (Viljoen & Bohn, 2011). The CPUL aims to operate economically (food or crop production), activate positive socio-cultural behavior (quality of life), support environmental processes including carbon dioxide and emission reduction, improve biodiversity and air quality, capture and re-use of stormwater, and provide urban heat island sinks to help cool nearby neighborhoods and the larger city (Viljoen et al., 2005; Viljoen & Bohn, 2011).

Urban Agriculture Types

Urban agriculture includes a range individual small-scale producers or larger for-profit farms, but also farming activities that are removed from the larger rural landscape or from the limitation of soil all together (Bruinsma & Hertog, 2002; Martinez et al., 2010; Philips, 2013; Smit, 2001). This can include non-traditional agricultural formats such as factory farms[1] and rooftop farming or more sophisticated technological methods such as hydroponic production, agricultural intensification, or other technical conditions. In theory, much agricultural production could be removed from the land that it occupies as land and soil are no longer prerequisites for successful and productive crop production or animal husbandry. Even though agricultural production can be removed from land to some extent, a major critique is that urban agriculture could never entirely replace larger-scale organic farming, nor is it likely to replace the present dominant industrialized agriculture system (Sharzer, 2012). Thus, the primary agenda for urban agriculture cannot be to promote agricultural production alone, but instead, to use urban agriculture and local food systems in a facilitating a supportive role in urban development. It is within this framework that urban agriculture and local food system agendas can be connected to a continuous productive urban landscape strategy for sustainable and resilient urban settlements.

There is a long history of different types of urban agriculture and food systems within cities, but at times, key terms have been used in different ways, or are interpreted differently. It is only with the separation of food production and city life over the last century that urban agriculture became a recognized phenomenon in its own right.[2] Distinct kinds of urban food production or urban agriculture types have been widely discussed in the literature (Bruinsma & Hertog, 2002; Goldstein, 2011; Herod, 2012; Karanja & Njenga, 2011; Mees & Stone, 2012; Mukherji & Morales, 2013; RUAF, 2014; Smit, 2001; Philips, 2013).

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[1] *Factory farms are typically thought of as intensive industrial operations that raise large numbers of animals for food — or farms where large numbers of livestock are raised indoors in conditions intended to minimize costs and maximize profits.*

[2] *Please refer to the next section "Emergence of Urban Agriculture and Local Food Systems in the Modern Planning Arena."*

For clarity and consistency, as the study area for this research is Minneapolis, Minnesota, this research uses as a foundation the definitions set out in the Minneapolis Urban Agriculture Policy Plan (Minneapolis, 2012). The Minneapolis plan organizes types of urban agriculture into subcategories. Key definitions are provided and discussed in the excerpts below.

Community garden

"A community garden is generally considered any space where plants are grown and maintained by a non-profit organization or group of individuals to meet the needs of that community… [and] is generally understood as a plot of ground managed and maintained by a group of individuals where herbs, fruits, flowers, or vegetables are cultivated, for personal or group use."

Minneapolis, 2012, p.13

The community garden generates food for immediate or individual consumption (see Figures 1,2, 3, 17, and 18). A community garden is not producing fruits, vegetables, herbs, and flowers a priori for market purposes. The concept of a community garden is not restricted by participant numbers nor the output of a certain amount of produce, rather by the type of activity. Community gardens are not limited to food production. Some gardens are meant for beautification and/or non-food related products. The variety of organizations or gardeners who own and manage community gardens often focus on the teaching of skills or other knowledge. These spaces are often leased by an organization from the governing body (for example, Minneapolis). Community gardens are allowed in most zoning districts in Minneapolis, including residential areas. However, the "community garden" is not formally defined in the Minneapolis Zoning code at this point.

Urban farm

"An urban farm is a commercial growing operation that is generally larger in scale than a community garden… An urban farm is generally considered a commercial operation with a greater intensity of use than a community garden and may not be an appropriate land-use in all zoning districts."

Minneapolis, 2012, p.13

The urban farm is a typology that has gained momentum in some cities, especially cities dealing with high vacancy rates and land appropriation issues (see Figure 4 and 22). Such farms would likely be managed more intensively, perhaps by also using small tractors or machinery, incorporating hoop houses or greenhouses, and other more extensive agrarian technologies to sustain year-round growth. One such an example of appropriating vacant lands for agriculture can be found in Detroit, Michigan. A major property sale occurred in Detroit in 2012-2013. The buyers, Hantz Farms, proposed to developed over

10,000 acres of vacant private and/or city-owned property in Detroit, and turn it into the world's largest for-profit urban farm (Dolan, 2012; Nettler, 2012; Prado, 2012). The initial plan was to convert only 200 acres for productive purposes, but the proposal was dramatically expanded. New proposals sought to purchase over 2,300 parcels of public and private land for forestry, orchids, and hydroponic vegetables (Dolan, 2012).

Other private developers are also incorporating productive landscapes on roofscapes and courtyard spaces as part of new development schemes. In 2015, the Arnold Development Group proposed to develop a fully functioning rooftop urban farm for a new multi-family residence in Kansas City. Here the rooftop farm concept is incorporated into the multi-family development scheme as part of an integrated strategy to reduce household expenditures (such as utilities, transit and food supply). A secondary stratagem is to make sure that every inch of the site be useful and profitable — including rooftops and landscapes.[3]

Yet, in the case of Detroit, some urban agricultural practitioners voiced concerns that larger scale, profit-driven urban agriculture undervalues the influence of the original urban agriculture concept, namely, to advance community-building, secure local food, and provide for actively used green spaces within cities (Dolan, 2012). Hantz Farms has been showered with support and criticism. While some citizens support the promise of change and development for Detroit's vacant lots, others have expressed concern that this proposal is primarily a land-grab (Nettler, 2012). The scale and management intensity of urban farms is thus seen an important issue to be considered and debated within urban communities.

Market garden

"'Commercial garden' or 'market gardens' are the terms sometimes used to describe smaller operations, similar in scale and intensity to a community garden, that sell commercially."

Minneapolis, 2012, p.13

Minneapolis's Urban Agriculture Policy Plan notes that there is not yet a specific threshold that distinguishes a market garden from an urban farm. However, the plan aims to provide recommendations in the near future to make the distinction clearer. The bottom-line is that market gardens are intended to be smaller, less-intensively managed areas — perhaps the size of a quarter-acre parcel up to one block, or a series of small, contiguous sites. As a result, less farm-like machinery would be needed. In the study area for this research, very few sites within Minneapolis identified themselves as market gardens

[3] *Personal communication during employment at Arnold Development Group, Kansas City, Missouri, 2015.*

specifically. Sites that did identify as market gardens (or explicitly for-profit agriculture) were grouped under the urban farms category.

Community supported agriculture (CSA)

"Community Supported Agriculture consists of a community of individuals who pledge support to a farm operation with the growers and consumers providing mutual support and sharing the risks and benefits of food production."

Minneapolis, 2012, p.13

This kind of initiative supports local farmers/growers. There is a trade relationship between the farm/garden owner (or grower) and the shareholders (or consumers) of a particular farm or garden. The shareholders normally pledge in advance to help pay for anticipated farm operation and labor costs. In return, the shareholders receive shares in the farm's produce throughout the growing season (typically at a very reasonable price). The CSA receives capital benefits from shareholders, and through direct sales to community members. In this way, farmers and workers can have better financial security and are relieved from extensive marketing burdens, where the community receives better prices for local produce. CSA's may be more or less linked to agricultural land within a city since farmers and growers may live within or outside of municipal boundaries.

Local food system (Minneapolis)

As discussed earlier, the definition for a "local food" system can vary across regions. For Minneapolis, the adopted definition is as follows:

"... local (food) can relate to a specific geography like a tri-state area or a set radius like a 100-mile radius from where the food is sold."

Minneapolis, 2012, p.14

As a local food system is highly contextual to each city environment, the Urban Agriculture Policy Plan prepared for Minneapolis is only targeted at land-use policy and related issues associated with local food within the city boundaries. The plan does not focus on areas outside the city limits. Defining what the local food system means for a particular city or region can provide clarity for both growers and consumers.

Emergence of Urban Agriculture and Local Food Systems in the Modern Planning Arena

Today, there is a distinct geographic divide between the origin of food sources and the consumption of food sources. Yet historically, this has not always been the case.

A brief history of food and the city

For thousands of years, cities and agriculture coexisted — a central concern to human settlement development is the need to easily, safely, and continuously access food sources. There is a long-held popular narrative that the great cities were born when humanity first mastered large scale agriculture. Although agriculture is instrumental in bringing about the first wave in the development of human civilizations (Toffler, 1980) agriculture is often also described as the absolute origin of cities — without stabilizing agricultural endeavors, cities as would not be formed at all. This idea can be referred to as "the dogma of agricultural primacy" (Jacobs, 1968, p.41), or the idea that agriculture is the fundamental origin of all urban development. However, in her classic book, *The Economy of Cities*, Jane Jacob challenges the assumption of the myth of agricultural primacy and the idea that the rural environment is responsible for the urban environment.

> *"Both in the past and today, the separation commonly made, dividing city commerce and industry from rural agriculture, is artificial and imaginary. The two do not come down through two lines of descent. Rural work — whether that work is manufacturing brassieres or growing food — is city work transplanted."*
>
> *Jane Jacobs, the Economy of Cities, 1968, p.18*

Jacob's premise is that cities do not develop from the rural, nor from the expansion of small towns (Jacobs, 1969, p.129), nor from a pre-formed agricultural heritage (Jacobs, 1969, p.3-48). Instead, cities are fundamentally "great" because of two other principal conditions — the inherent forces of urbanization and density. Jacobs argues that instead of agriculture as primer, the conditions of urbanization (reduction in time and expense in commuting, employment opportunities, education, and housing) are the primary forces for the development of a great city, and these conditions are economic in nature. Agriculture merely supports this intensifying growth; it does not generate it (Jacobs, 1968). Jacob's second premise is that industry originates from the city — a place of density — and that a creative local economy drives the development of cities. Agriculture cannot provide this density; therefore agriculture cannot provide a creative local economy. The city is the primary function, and agriculture secondary function, and not the other way around.[4] Primary functions attract secondary functions: the urban as a primary use attracts the "non-urban" as a supportive, secondary use. In this way, the agricultural environment cannot be the foundations of a great city, but will always be in a symbiotic service relationship with the city. Jacobs also explains that rapid urban growth is cyclic — swelling and subsiding periodically. Cities that undergo very rapid growth soon replace previously imported products and services with local production and services, and so spur the internal engine of local urban growth (Jacobs, 1968, p.165). Following this line of thought, one could theorize that highly localized food production may be one of the representations of a greater wave of import-replacement for many urban areas.

Agriculture and the city have a long interdependent history. Yet, only during the last century has food production been separated from urban living to such an extreme degree. Before the Industrial Age, the lack of a sophisticated transportation and refrigeration technology compelled people to live and farm in very close proximity. However, since the 19th Century, the surge of technological innovations dramatically changed the relationship of food and the city. The increase in technology and production capabilities and the ease at which perishable, out-of-season produce and tonnage of livestock could be transported across great distances by rail, sea or even air not only changed the physical relationship between cities and agriculture profoundly but spearheaded the development of the urban-rural divide (Jacobs, 1968; Mumford, 1961). Fewer farmers were needed outside cities, and more laborers were needed in factories. The Industrial Revolution led to regional agricultural specialization, and the striking concentration and control over large agricultural resources (Dimitri, Effland, & Conklin, 2005). Technology allowed a dramatic increase in the scale of agricultural production areas, and fewer farmers were needed to manage greater expanses of cropland. Finally, with this surge in urbanization there were simply fewer spaces either inside or near cities left that could be compete with these new kinds of farmers, their technologies and their enormous agricultural lands outside the city.[5]

The exodus of agriculture from cities was further driven by the advent of urban and rural zoning, the principles of "nuisance" or "nuisance laws," and the principle of highest and best use of urban lands.

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[4] *This echoes Jacobs' ideas in The Death and Life of Great American Cities, where she explains how the mix of different urban uses is essential in creating vibrant and diverse city life (Jacobs, 1961).*

[5] *During the early 1900's, 41% of workforce was employed in agriculture, whereas in 2000, only 1.9% of the workforce is in agriculture. Since 1900, the number of farms has fallen by 63%, while the average farm size has risen 67% (Dimitri et al., 2005).*

"There is perhaps no more impenetrable jungle in the entire law than that which surrounds the word 'nuisance.' It has meant all things to all people, and has been applied indiscriminately to everything from an alarming advertisement to a cockroach baked in a pie. There is general agreement that it is incapable of any exact or comprehensive definition."

Prosser et al., 1984

During the 19th and early 20th century, the density and close proximity of competing urban land-uses brought about numerous squabbles among the citizenry, who felt that the "nuisances" of incompatible land-uses became unbearable. Urban dwellers were often offended by the presence and (intentional or unintentional) effects of nearby industrial or agricultural wastes and litigation costs escalated quickly (Geier, 1980; Lapping & Leutwiler, 1987). However, valuable farmland could not be given over to the whim of every citizen's claim on nearby nuisances, and cities became aware of the need to control the use of precious urban land as well as valuable cropland. Over time, to address incompatible land-uses in cities, urban zoning was developed, predominantly structured around the utility of the land, its perceived value, and mitigation of externalities (Fischel, 1978; 2001; Nijkamp et al., 2002). One way to argue for the value and use of the land is to determine the "highest and best use." The most equitable way to settle squabbles of the value of the land is to measure it against a monetary value. Economic return was (and still is) the model that determines the highest and best use of lands (Lennhoff & Parli, 2004; Nijkamp, Rodenburg, & Wagtendonk, 2002). In the case of farmland, the major measurement of value is the fertility of the soil, whereas in the case of urban lands other economic returns (such as rent and appreciation) is the measurement for the value of the land. In the early 20th Century, urban areas were increasingly planned to optimize space for the highest and best use of land. At the time the increase in scale and capacity of industrialized agriculture practices, together with the advent of nuisance laws and "highest and best use" principles, meant that it was more often the case that the "best use" of an urban lot is no longer for an agricultural purpose (Geier, 1980; Lapping & Leutwiler, 1987). Agriculture was finally pushed out of the city to the "rural community" as we understand it today. The contemporary distinctive separation of "urban" and "rural" was definitely established (Hirschman & Mogford, 2009; Jacobs, 1968; Lapping & Leutwiler, 1987).

Over the last 150 years, agriculture became completely orphaned from the city and almost exclusively non-urban. This had a radical effect on how communities structured themselves, especially in the new "rural" landscapes. Conversely, some believed that the city was orphaned from agriculture (Mumford, 1961; Wright, 1932). The alienation between city and country quickly spurred a counter-revolution amongst urban thinkers and planners. Fronted by a handful of prominent individuals, a desire developed to balance the urban-rural phenomenon. An early prominent advocate for the reintegration of city and country was the architect Frank Lloyd Wright, who viewed modern industrious urban life age as a "…parasite of the spirit…" (Wright, 1932). Although Wright meant this in terms of the pace of life and general health that the country lifestyle bring, many believed then, and even more believe so today, that humanity's estrangement from the source of production and consumption of food resources are factors that contribute to several environmental, economic, public health, and social issues (C. Carlson, 2008; De Zeeuw et al., 2011; Despommier, 2010; Hodgson et al., 2011; Mougeot, 1999; Mumford, 1961; RUAF, 2014; Smit, 2001; Viljoen et al., 2005; Viljoen & Bohn, 2011). [6]

Yet, not all forms of agriculture have been expelled from the modern city. Urban agriculture has existed as long as there were cities and continues to do so to this day. The modern global north has a substantial history of urban food production, particularly in dire economic times (A. Carlson, 2008; McClintock, 2010; RUAF, 2014; Smit, 2001). The 19th Century "Marais System" concept in France, the global colonial allotment gardens, anti-war, and war-relief gardens of WWI and WWII (including "Victory Gardens" and "Depression Relief Gardens") are all reactions to conditions where access to food was limited or under strain. Haeg (2010) states that by the end of World War II over 80% of households were growing some of their own food in the US alone (Haeg, Allen, & Balmori, 2010). Internationally, countries that had more extensive urban agriculture practices were usually under considerable stress. In the mid-to-late 20th Century, urban agriculture was a means to relieve pressures of imposed sanctions (Cuba), or fight famine (Uganda), and provide other hunger relief programs (Bruinsma & Hertog, 2002; RUAF, 2014; Smit, 2001).[7]

Yet, even during less dire times, there were some that raised concerns for the highly centralized urban model of the developed world, and in particular, the separation of city and country. During the 1920's and 1930's, several alternative models of urban reinvention were proposed to counteract the centralized urban morphologies brought by the Industrial Age across Europe and the United States. Most notable of these were Howard's Garden Cities (1903-1904) in the UK, Mumfords' urban greenbelt design experiments with the Regional Planning Association (1920's), Le Corbusier's vertical Garden City (1932) and probably the most extreme decentralized model, Wrights' Broadacre City (1932) (as per Jacobs, 1961

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[6] *The RUAF network represents one of the many organizations whose efforts are directed to counter the increasing urbanization of poverty. Some of their goals include countering urban food insecurity, which is an interplay between urban-rural migration, lack of formal employment, rising food prices, growing dependence on food imports, increasing dominance of supermarkets and fast food chains, and several other challenges posed by climate change (RUAF, 2014).*

[7] *A recent survey indicated that 15 -20% of the world's agriculture practices today are urban (Karanja & Njenga, 2011). However, it is hard to compare apples to apples so to speak, as measurements vary quite a bit, and there are differences within these surveys as to what is considered "urban" and what is considered "non-urban" agricultural production.*

and Mumford, 1961). Each of these models incorporated agriculture as an integral part of the development scheme, although very few have been constructed to completion or are operating to their initial design ideologies. During the 1960's and 1970's, a similar wave of interest in urban food production swept across the US and UK due to rising fuel prices. This time, a number of urban agriculture proposals were vertical. Steel and concrete high-rise and super high-rise structures brought about a new kind of vision to integrate agriculture within cities. The idea of the vertical farm became more popular in the late 20th century. In vertical agriculture models, agriculture is proposed to integrate into the building or structure itself — as part of self-sustaining living community models (Koolhaas, 1994). The most recent adaptation of the vertical farm idea is proposed by Despommier from Columbia University. Despommier proposed that we should develop not only mixed-use high rise projects that are integrated with agriculture, but have buildings that contain fully productive and competitive urban farms. Through the use of modern hydroponics and other technologies, this model is conceptualized as fully productive vertical agricultural operation, with the aim of feeding hundreds or thousands of citizens from one such farm (Despommier, 2010).[8]

Over the past century the urban agriculture focus shifted from a mostly utilitarian outlook to a public health outlook, particularly for populations with limited access to fresh fruits and vegetables. Until very recently most efforts for urban agriculture in modern cities were narrowly focused on sustenance or fighting famine and hunger. However, today the perspective is focused not only on food access, but also on creating healthy and resilient neighborhoods, social justice and equity and a broad range of other related social-economic issues (RUAF, 2014). Throughout the last two decades urban agriculture saw renewed interest in the United States. This interest was especially driven by the emergence of the environmental movement, and augmented during energy crisis period of the mid-1970's (Creasy, 1982; RUAF, 2014). Until very recently, urban agriculture and local food efforts in the US were seen as a mostly marginal activity, narrowly focused on combatting food shortages and hunger rather than building food security or public health (Bruinsma & Hertog, 2002; Gorgolewski et al., 2011; Smit, 2001). Within the last decade urban agriculture has become a frequently discussed subject in planning and design

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[8] A popular, but contested, argument in favor of integrating industrious urban agriculture into cities is to decrease the transportation required in the food network. By extension, more frequent localized food access points will also counter the emergence of "food deserts "phenomenon. One measure to illustrate the impact of getting food to people is to measure the number of food miles travelled. The average food mile in the USA has been increasing steadily since the mid-20th century, and is currently considered roughly between 1,300 and 1,500 miles per food item (Hill, 2008; Pirog, Van Pelt, Enshayan, & Cook, 2001). Although the accuracy and validity of food miles is a somewhat contested topic (McKie, 2008) the issue raises serious questions about the impact of food, transit, and energy costs.

spheres.[9] Today, the advocacy for urban agriculture as a sustainable and resilient answer to current urban dilemmas is echoed by writers globally (Condon et al., 2010; De Zeeuw et al., 2011; Despommier, 2010; Drescher, 2001; Goldstein, 2011; Gorgolewski et al., 2011; Hodgson et al., 2011; Mougeot, 2006; Viljoen et al., 2005). These advocates claim that successful urban agriculture and local food systems do (or can) contribute significantly to neighborhood and sustainable community development in a variety of different ways. However, most advocacy for urban agriculture today has occurred within the fields of social sciences, social justice, and food security, with more pronounced interest by planners and designers happening during the past ten years (Condon et al., 2010; Gorgolewski et al., 2011; Philips, 2013).

In his substantial work for the United Nations Development Program, Jac Smit proposed that urban agriculture is "…a prerequisite to both sustainable urbanization and sustainable agriculture" (Smit, 2001, p.22). Although Smit is more focused on the production of urban agriculture specifically, one cannot help but hear echoes of Jacob's thesis. Agriculture was, and always will be, an integral urban service within cities. To sever the program of urban agriculture from our cities, to compartmentalize it as an external, exiled activity would be quite alien to the history of the development of human settlements (Jacobs, 1968).

It would seem that both historically and for the future of healthy city life, we cannot seem to ignore the value of agricultural production within our metropolises. The recent surge of urban agriculture in the global north has been perceived as a "new" phenomenon, which is driven primarily by grassroots reactions to urban environmental ills such as blight and land vacancy, or alternatively, conditions associated with health, lifestyle or community capacity building. However, urban agriculture was the norm of human settlement for centuries. In fact, it is the farm-less human settlements of today that is the radical new turn in the history of cities.

Benefits of urban agriculture

Urban agriculture contributes in building local social-economic capital and helping cities progress and achieve sustainability and resilience goals.[10] Besides the grassroots surge of local urban agriculture and escalation of farmers markets in the last decade (Goldstein, 2011; Martinez et al., 2010; United States

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[9] In the United States alone, studies show that 30% of agricultural products are produced within metropolitan areas (Smit, 2001). In addition, within the last 10 years, consumers have seen an increase in opportunities to purchase food directly from producers as the number of operating farmers' markets rose 180% between 2006 and 2014 (United States Department of Agriculture, 2015).

[10] For in-depth discussions and detailed benefits of urban agriculture within communities, refer to RUAF (2014), Mukherji & Morales (2013), Philips (2013), Goldstein (2011), Viljoen et al., (2005), and Smit (2001).

Department of Agriculture, 2015) the more formal emergence of urban agriculture as strategy in the planning arena of the United States may be attributed to achieving two main goals: (1) to improve community development and public health, and (2) to help conserve resources and create more sustainable cities and regions. More recent planning strategies now include urban agriculture as part of spatial-economic components of urban planning and policy-making to fight social injustice (Schmelzkopf, 2002). Urban agriculture is also employed as a medium for urban space appropriation, namely by securing rights to use vacant, underutilized land. Cities such as Detroit (2012), Cleveland (2009), and Philadelphia (2013), are actively developing urban frameworks, policies, and strategies to incorporate and promote urban agriculture as a means to secure vacant, underutilized urban land in order to reduce urban blight while increasing the livability and economic utility of these places.

Urban agriculture is seen by some as a vital component of community development and public health improvement efforts. Accessibility to healthy, local food is a major concern for the US Department of Agriculture and many other parties (Coleman-Jensen, Gregory, & Singh, 2014; Walker, Keane, & Burke, 2010). This issue is prevalent in urban settings where residents have difficulty in accessing basic fresh foods at reasonable prices. Many urban communities are isolated from food sources, and some areas within US cities have great difficulty in accessing local healthy food sources at all. Lack of access to fresh food in parts of large urban areas has been especially prominent in a number of low income communities and high-density neighborhoods in the United States (Walker et al., 2010). This situation is particularly difficult when public transport or other transit means to grocery stores or other outlets are not readily available. Urban agriculture is advocated as component to solving the "food desert" and other food accessibility problems for cities of various scales around the world (Mukherji & Morales, 2013).

Urban agriculture, especially if supported in planning and policy, results in a gain in local social capital (Mendes et al., 2008). Urban agriculture is seen as one of the tools of building resilient urban communities (Condon et al., 2010; Goldstein, 2011; Gorgolewski et al., 2011; Hodgson et al., 2011; Mees & Stone, 2012; Mukherji & Morales, 2013; Pratt, 2013; Smit, 2001). Studies have also claimed links between urban gardening and the reduction of local crime (Herod, 2012). Urban agriculture is further employed as a medium for urban space appropriation where there is undesired levels of vacancy or blight as part of underutilized land management strategies.[11] The community benefits of urban agriculture are often argued as an activity or practice that contributes to public health through increased physical activity and healthy foods, and also contributes to the local spatial-economic strategy (Cleveland & Chattanooga, 2009; Detroit, 2012a; Philadelphia, 2013; Schilling & Logan, 2008).

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[11] *The cities of Detroit (2012), Cleveland (2009, and Philadelphia (2013) are actively developing their urban frameworks, policies, and strategies to incorporate and promote urban agriculture.*

Urban agriculture is posited as one of the ways to promote sustainable and resilient urban ecological development (Condon et al., 2010; Mok et al., 2013; Smit, 2001; Thibert, 2012). Urban agriculture can also contribute positively to urban processes such as stormwater management (Philips, 2013), and aid in other urban ecological services including urban carbon sequestration (Kulack & Vasquez, 2012). Cities and planners are rethinking green infrastructure and the role of productive landscapes in (re)development, spearheaded by advocates such as Viljoen, or non-profit groups such as RUAF (Mougeot, 2006; RUAF, 2014; Smit, 2001; Viljoen & Bohn, 2011).

To summarize, urban agriculture contributes in building local social-economic capital and helping cities progress to achieve sustainability and resilience goals. Urban agriculture contributes to feed the immediate population and also a greater population of the city or region through distribution. Local practices contribute to the continuity of the food supply and the price of food — especially in culture-specific produce.[12] Urban agriculture also contributes to employment in the local population, whether through direct employment by the agriculture practices or affiliated groups such as the local restaurant or catering industry. The income distribution contributes to local economic development and poverty alleviation. Urban agriculture sites often form part of fund-raising initiatives, local community events, or other social or leisure activities. Urban agriculture is said to have secondary economic benefits, which includes the contributions to urban greening initiatives, urban stormwater management, and other ecological contributions. Finally, urban agriculture contributes to social inclusion, leisure, and recreational services. This in turn contributes to the reduction in health and environmental costs of the city by enhancing access to nutritious food and recycling of urban wastes.

The literature on urban agriculture illustrates that it has an important use-value to individuals, neighborhoods, and communities.[13] This particular view on the benefits of urban agriculture to community development has contributed to the increase and support for urban agriculture practices and production, and subsequently introduction into planning and policy in the United States. However, there are several barriers to overcome within the planning field, some of which can derail well-intended urban agriculture efforts (Kaufman & Bailkey, 2000; Smit, 2001).[14] Because urban agriculture sites are most

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[12] *In Minneapolis there is a strong Hmong community of local farmers with small scale operations. During my visits and casual conversations with some of the local growers, many emphasized that they cannot find culturally specific fresh foods within the city, and when they do, they have to pay significantly for those items. For them it is highly practical to grow and sell their own food among the community and the local restaurant industry in this way. I had similar conversations with practitioners in the Kansas City farmers markets and elsewhere.*

[13] *Please refer to Endnote 1 for a discussion of use-values and exchange-values.*

[14] *These risks are also heightened by other factors, which are discussed in the next section.*

often situated on underused or vacant land parcels, one of the major barriers to urban agriculture is tenure of land. As a counterpoint to this concern, advocates claim that urban agriculture can increase the value of the land parcels and contribute to greater stability within the neighborhood, and therefore urban agriculture programs should be expanded to occupy as many vacant lands as possible. However, this improvement creates the potential for neighborhood gentrification. The argument could be made that as urban agriculture contributes to positive neighborhood development, consequently, one can expect that the desirability of the neighborhood may increase. As a result, urban agriculture components may be replaced with more competitive businesses or other urban programs deemed to be of higher value or better use of the urban lands, eliminating the original value of the urban agriculture and rendering its social, ecological, and potential advocacy role useless (LaCroix, 2010; Schmelzkopf, 2002).

Barriers and Constraints in Policy and Planning

"If [key] constraints can be removed, urban farming will become more competitive and efficient, and participation by new practitioners in additional locations becomes possible."

Smit, J. (2001), Chapter 9, p.1.

To maintain a continuing and successful urban agriculture and local food system strategy, several planning and policy challenges have to be met. The barriers can be grouped into five overarching categories: (1) socio-cultural preconceptions and institutional constraints; (2) formalization constraints; (3) mitigating health risks; (4) organizational and resource support constraints; and (5) economic obstacles and tracing economic benefits. [15]

1) Socio-cultural preconceptions and institutional constraints

Urban agriculture faces many of the same barriers such as parks and green spaces. These include the possibility of nuisance, noise, untidiness, privatization, and limited levels of accessibility (Voicu & Been, 2008). Some people may associate urban agriculture with other negative attributes, such as odors or visual unattractiveness. If urban agriculture areas are perceived as disturbing nearby residential or commercial land-use areas, this could turn the program into a disamenity [16] with urban garden/farm sites

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[15] *Many of these issues resonated with urban agriculture practitioners and representatives of organizations, and were brought up in discussions during my site visits to Minneapolis, Minnesota in 2014.*

[16] *Where an amenity is considered a contributing feature or service within a neighborhood, a disamenity can be understood as a disruptive feature or service, or even seen as a liability within the neighborhood.*

seen as signals of distressed environments (Herod, 2012). However, the reverse is also true. One researcher found that to many neighborhood residents, community gardens were seen as a sign of community vitality (Francis, 1987). These spaces indicated that residents valued their leisure time and signaled positive community engagement. In many ways, Francis argues, urban agriculture connotes active recreation and engagement within an urban green space, as opposed to some parks and urban open spaces, which may be perceived as providing only passive forms of recreation such as resting/sitting (Francis, 1987).

When planners, economists, and city managers regard urban agriculture as a marginal activity of the informal sector, the view tends to spread to market and credit agents, legislators, and the general population as well. As a result, the perception of urban agriculture as non-contributive to the urban environment and the lack of understanding regarding its actual and potential benefits may continually misunderstood by residents, community leaders, and decision-makers (Schmelzkopf, 1995; Smit, 2001).

2) Formalization constraints

The formalization and sustainability of a city-wide urban agriculture system is bound by land-use practices, zoning policies and land tenure structures (Goldstein, 2011; Guitart et al., 2012; Herod, 2012; Mukherji & Morales, 2013). The majority of urban agriculture within the United States exists on public lands, which means that there is some consistent level of civic interaction with the local governing body (Guitart et al., 2012). For gardens and farms on private property, obtaining a lease or permit for the activity is sometimes the hardest part of the whole enterprise — unless the city explicitly supports the endeavor through zoning, policy, and planning. City zoning has been a primary tool to regulate and implement appropriate and complementing uses of a municipality’s land. Zoning is a particularly relevant issue to urban agriculture (Mukherji & Morales, 2013) and overly-restrictive zoning codes can make it problematic for residents to engage in urban farming.

Urban agriculture practices are often found in highly contextualized conditions — every city has different approaches, environmental settings, socio-economic drivers, and/or support systems (Bruinsma & Hertog, 2002; Goldstein, 2011; Herod, 2012; Mees & Stone, 2012). Furthermore, urban agricultural types and scales vary across different cities, counties, states, and climates (Goldstein, 2011; Mukherji & Morales, 2013). Local definitions of urban agriculture components are frequently conceived in different ways. Variations between agricultural activities, city policies, ordinances, by-laws, zoning codes, and the socio-cultural and geographical context make it difficult to generalize about common impediments that zoning regulations and associated land-use policies place on urban agriculture and local food systems (Mees & Stone, 2012; Voigt, 2011). Nevertheless, in order for community stakeholders to effectively incorporate urban agriculture and local food systems into city networks, there are two overarching zoning and regulatory general restrictions that must be addressed: restrictions on the types and scale of agricultural activities permitted in a zoning district; and restrictions on the scope of business or commercial activity permitted in a zoning district. Fundamental zoning and regulatory issues that frequently act as barriers to urban agriculture and local food systems include the following:

a) Concerns: urban livestock, animals and wildlife in (sub)urban settings.

There are health and aesthetic concerns about keeping farm animals. Even small animals (for example bees, chickens or rabbits raised for a variety of commercial purposes) are not specifically allowed for in most city codes or ordinances. Although accommodation of chickens and other small animals has become more common in urban settings the regulations and conditions for raising larger livestock in cities are generally very limiting (Mees & Stone, 2012; Voigt, 2011). In addition, some residents may raise concerns about inviting wildlife nuisance or pests into urban areas.[17]

b) Concerns: agriculture as a primary use.

Even though cities allow residents to grow their own basic produce, some localities limit residents from using adjacent or entire plots of land for agricultural purposes (Mees & Stone, 2012; Mukherji & Morales, 2013; Voigt, 2011). Furthermore, even though codes make it clear that a single site can have multiple primary uses, frequently there are complications with urban agriculture activities in areas with multi-dwelling or multi-family housing (Voigt, 2011).

c) Concerns: location of sale, home income, and occupation

Some locations within the city, for example multi-family residential or transportation districts, prohibit agricultural activities, especially agriculture for profit or as a primary use. This is a frustration to small commercial enterprises, such as restaurants and stores, which might make use of vacant land and then use or sell the produce grown at local shops or restaurants (Voigt, 2011). The reverse is also true, as community gardens may only be allowed to sell on their own premises, but not anywhere else (Mees & Stone, 2012). Raising animals and managing plant nurseries are activities commonly associated with

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[17] One example can be found in the south of England, where urban beekeepers are blamed for causing swarms as large as 10,000 bees at a time to form in the urban areas. The swarms are publically perceived as a health risk, although the British Beekeeper's Association said that such swarms are not dangerous, and swarms are a positive indicator that the bee community is healthy. Experienced farmers are able to handle the situation, but many novice farmers seem unprepared for swarming (Rudgard, 2015).

urban agriculture, but many of these more intensive farming activities may be viewed as incompatible with residential developments. Local regulations may also prohibit urban agriculture as a home occupation (Voigt, 2011). In addition, where codes do allow agriculture activities, operating standards may require that businesses are not visible from neighboring properties, adjacent streets, or to the public. Other details, such as permissible composting or storage, may also be a limitation in many cities (Voigt, 2011). As urban agriculture is often practiced by lower-income community groups, and, as this group more than often uses urban agriculture as a form of income generation, such limitations can be very restricting and affect access to healthy food by lower-income residents.

Across much of the US, zoning laws and other ordinances may be outdated (overly restrictive and inflexible) in regards to urban agriculture and local food systems; they may intentionally or unintentionally prohibit residents from growing crops and raising animals for personal or commercial production (Mees & Stone, 2012; Voigt, 2011). The majority of US cities that accept urban agriculture within their contemporary zoning and ordinances often classify urban agriculture as "community gardens" only, which greatly underrepresents the spectrum of opportunities urban agriculture can bring to cities (Philips, 2013). On the other hand, too strict definitions within codes or ordinances may also be very limiting. If hard-and-fast rules are applied to urban agriculture sites or practices, the harder it may become for the general public or practitioners to participate in this land-use type or program.

3) Health risks

There are certainly some risks of farming in the city (Bruinsma & Hertog, 2002; Drescher, 2001; Hodgson et al., 2011; RUAF, 2014; Smit, 2001). These risks are primarily related to soil or water contamination and public health concerns (Smit, 2001). Other health risks include the handling and management of composts, with particular concerns in the case of raising livestock and animals (RUAF, 2014). Health risk concerns lend support to the idea that urban agriculture should be formally recognized and supported by a local authority (Bruinsma & Hertog, 2002; Drescher, 2001; Hodgson et al., 2011; RUAF, 2014; Smit, 2001).[18]

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[18] *As with any industry, it would benefit urban agriculture practitioners and interested residents to take basic training courses. Cities could provide this public service and/or require that more specific in-depth education for higher-risk activities be available to minimize risks to human health and environments. Refer to the recommendations section in Chapter 5.*

4) Organizational and resource support constraints

Urban agriculture practitioners often have limited or constrained access to resources, inputs, services, and post-production development activities, particularly related to processing and marketing (Smit, 2001). Another major constraint is limited access to groundwater, reclaimed wastewater and/or surface water. Using wastewater (especially greywater) to irrigate has the added advantage of providing nutrients to crops; however, urban wastewater is seldom available to urban farmers because sewage systems are commonly designed to quickly remove sewage from buildings and neighborhoods, rather than treating and then reusing wastewater locally (Gorgolewski et al., 2011; Smit, 2001). Likewise, many cities do not make provisions for reuse of surface water for applications such as farming. The lack of access to alternative irrigation compels urban farmers to use piped (potable) water. Without subsidy this can become quite expensive for urban farmers and some farmers obtain irrigation with difficulty, or illegally (Smit, 2001). In some instances collection of nearby rooftop water in cisterns or the use of grey-water systems can provide access to irrigation water. However, these systems often require adequate financial aid and regular management, and in some locations, local codes and state/regional water laws may limit rainwater harvesting and/or wastewater (including grey-water) re-use for sellable food production.

5) Barriers and tracing economic benefits

"Urban farmers would like government to take an active, positive role in promoting their industry. They believe that government can help them expand and modernize their farming activities by facilitating credit, easing access to tools and seeds, paying agricultural extension agents, and improving access to land for agricultural use."

Smit, J., 2001, Chp. 9, p.5

A number of issues arise in regards to creating supportive economic conditions for urban agriculture and local food systems. Two issues seem to be central.

First, there is frequently insufficient local data for managing and regulating urban agriculture and local food systems within cities (Smit, 2001). This is partially caused by urban agriculture's general exclusion from urban land and program management. The legal constraints through zoning and regulation (Voigt, 2011) and land tenure (LaCroix, 2010) can make it difficult for practitioners and communities to realize their larger economic goals and reap long-term monetary, environmental, or health benefits. Furthermore, local urban food systems may have very complex commodity chains (Sharzer, 2012) making it difficult to fully understand the secondary economic benefits of a local urban agriculture industry.

Second, urban agriculture can be seen as both a productive use of land and also an amenity that forms part of a city's green infrastructure (Viljoen et al., 2005). Assuming the use of water- and habitat-sensitive farming and gardening practices, urban agriculture can support urban environmental and ecological efforts in significant ways. Potential environmental services include reducing and mitigating the impacts of rapid or polluted stormwater runoff, reducing and mitigating the loss of biological diversity (especially be creating pollinator and other vital habitats for birds, butterflies or other wildlife), reducing and mitigating air pollution and high temperatures, and positive contributions to urban green systems that promote active living and improved health. Even if there are not intentional ecological improvement efforts by practitioners, nearly all urban agriculture produces useful local effects (or positive externalities) within the environment and remains a public and environmental good. One such an example is urban agriculture's contribution urban carbon sequestration (Kulack & Vasquez, 2012; Kulak, Graves, & Chatterton, 2013), which is external or secondary to its primary products (fruits, vegetables, herbs, and associated goods) and planned activities (frequently focused on community or neighborhood involvement and learning). Each of these environmental services has economic value. However, these monetary benefits are rarely explicitly accounted for by cities and their economic development experts.

Opportunities for ongoing research and outreach related to these two central issues are tremendous and should not be overlooked in regards to developing and managing local food systems in cities and regions. A clear understanding of both costs and benefits is vital to the long-term success of urban agriculture.

Figure 2. One example of the "Youth Farms" across Minneapolis, Minnesota.

Theoretical Construct and Problem Framework

It is well understood that urban agriculture and local food systems can aid in planning for environmentally sustainable, healthy and resilient cities (Goldstein, 2011; Pratt, 2013; Wachter, Scruggs, Voith, & Huang, 2010). However, this subject area lacks quantitative data regarding the specific influence that urban agriculture and local food systems have on the built environment (LaCroix, 2010; Sharzer, 2012; Voicu & Been, 2008). For example, very little is known about the economic impact of urban agriculture on neighborhood property values in different cities across the United States. Besides the commodities and employment it can provide, there are several other justifications frequently posited for urban agriculture as an urban land-use.

1) Impacts on land

Urban agriculture and local food systems are beneficial to neighborhoods and therefore assumed to have positive impacts on urban development. One such assumption is that urban agriculture and neighborhood food systems have positive relationships on property values (C. Carlson, 2008; Guitart et al., 2012; LaCroix, 2010; Sharzer, 2012; Tranel & Handlin, 2006; Voicu & Been, 2008). Only two studies have found that urban agriculture can increase neighborhood property values in the US urban context (Tranel & Handlin, 2006; Voicu & Been, 2008). If found to be true that urban agriculture generally has a positive influence on property prices in urban areas, the desirability of associated neighborhoods may increase with the presence of well-managed urban agriculture sites. However, we need several more studies across a greater variety of cities and climates to come to generalizable conclusions regarding this claim.

Competition for land and public resources within cities favor those mechanisms that promise higher exchange-values of land for the foreseeable future (LaCroix, 2010; Molotch, 1976; Wachter & Gillen, 2006). However, this market behavior creates pressures for systems that identify themselves as possessing relatively low exchange-values. Urban agriculture and neighborhood food systems researchers claim that these systems provide important use-values to communities (Guitart et al., 2012). This suggests that urban agriculture may distribute benefits in a neighborhood or city, but that an urban agriculture site and program may have a much lower direct exchange-value compared to other urban programs. These pressures threaten to undermine the existing and potential benefits urban agriculture and local food systems can bring to neighborhoods. As soon as a site succumbs to market pressures the utility of urban agriculture may be lost completely, as would its latent open space and related structural and functional benefits to communities and urban development. For example, some argue that as the value of the land it occupies becomes higher, an urban agriculture parcel will likely be supplanted by another “higher” or more economically-favorable use (Guitart et al., 2012; LaCroix, 2010; Wachter et al., 2010). This market-centric gentrification process could threaten the existence of many urban agriculture parcels and also threaten the positive impact of the larger local urban agriculture and local foods systems network (Condon et al., 2010; Schmelzkopf, 1995; Wachter et al., 2010).

Additionally, although urban agriculture may have many benefits to communities in need, if there is a negative relationship in regards to perceived neighborhood desirability, urban agriculture properties may be seen as signals of areas in distress. Regardless of the direction of the relationship, when property values change, urban agriculture and its associated activities could be under threat (Guitart et al., 2012) — unless this land-use is explicitly protected by both locally-approved plans and legally-binding policy (Barrios, 2004; Philadelphia, 2013; LaCroix, 2010; Voicu & Been, 2008).

2) Justification: open spaces and parks versus development

It is generally deemed important to local governments that urban land be developed at its highest and best use. From and economic vantage-point, the highest and best use of land achieves greater property tax revenues for the city. Property tax revenues in turn represent a significant portion of funding for other essential public goods such as schools. However, local governments must remain aware that not all urban land can nor should be developed, especially given the desire to integrate parks and open space into the overall city structure (Wachter et al., 2010).

New development projects can cost communities more than effective open space management does (Crompton, 2007). Through the provision of additional services and infrastructure, new or expanding residential development costs may outweigh the revenue generated (Auger, 1996; Crompton, 2007). Crompton argues that parks may actually be more economically beneficial to municipalities than many residential developments. Although residential development may add to the tax base, it also produces greater demand for infrastructure and services. This can ultimately result in even higher costs for the city. The management of open space, such as parks or agricultural land, can provide a more cost-effective solution — in some cases 35 cents for every dollar in revenue (Auger, 1996). Researchers have found that open space and agricultural land paid significantly more in taxes than it required in servicing from local governments (Auger, 1996; Crompton, 2001; Crompton, 2007). The cost of maintaining underused and expansive infrastructure is also a major concern for the phenomenon of “shrinking cities” such as Detroit (Detroit, 2012a; Watrik, 2013). Parks, unlike many residential and commercial developments, urban agriculture can increase property tax revenues while only marginally increasing service costs — assuming that cities account for initial procurement, continuing maintenance demands, and as-needed improvement costs for each land-use type (Crompton, 2004). Similarly, as an active green space, urban agriculture should provide comparable contributions.

There is overwhelming evidence for the economic benefits of park and open space management to improve property values and increase a city’s tax base (Crompton, 2004). Parks and open spaces are often seen as having high use-value, and provide measurable contributions to urban development through environmental utility. Like parks and green spaces, urban agriculture finds itself squarely footed in social, environmental, ecological, and economic dimensions simultaneously. However, research on urban agriculture and its economic impact on urban property values is lacking.

3) Justification: productive use of land

Cities may desire urban agriculture and neighborhood food system strategies for community planning, (re)development, or urban growth management. As a land-use, both profit-driven and non-profit urban agriculture may be justified based purely on the output capacity and productive use of the land (LaCroix, 2010). However, urban agriculture and neighborhood food systems can also be justified for indirect financial effects reasons. For example, urban agriculture generates positive environmental externalities that are often comparable to parks, green, and open space areas. Parks generate external benefits for non-users, such as providing scenery, open space, and attractive landscaping which can be enjoyed without entering the actual park area (Weigher & Zerbst, 1973). Studies in New York City show that the secondary benefits of parks and green spaces on residential property is substantial, where parks and green spaces influence decisions to purchase or invest in properties adjacent to a green space and generate higher rents in both office and residential spaces (Ernst & Young, 2003). This “curb appeal” effect and other similar environmental externalities are expected from urban agriculture parcels as well.

Urban agriculture can also be justified for non-financial reasons, even on high-value urban parcels. Such sites may be warranted on higher exchange-value lands if the social or environmental benefits are deemed sufficient to *not* develop these sites for other land-uses (LaCroix, 2010; Wachter et al., 2010). For example, urban agriculture may be deemed a particularly attractive way for cities and affiliated organizations to pursue complimentary goals related to stormwater and environmental management, open space provision, hunger relief, and socio-economically advantageous community development. Furthermore, urban agriculture can serve as an economically and socially viable type of open space by serving as a transitional and productive solution for low income areas, vacant urban landscapes, or blighted neighborhoods for the purpose of redevelopment and improvement (Detroit, 2012a; Wachter et al., 2010). Urban agriculture can do so by providing access to land that encourages active-living (regular physical exercise), healthy eating (fresh fruits and vegetables), and visual and psychological enjoyment.

4) Contribution to social justice and public health

Justifications for urban agriculture as a land-use can be found in local social-economic capital building and community cohesion (Butler & Moronek, 2002; Glover, Parry, & Shinew, 2005; Guitart et al., 2012; Hovorka, de Zeeuw, & Njenga, 2009; Okvat & Zautra, 2011; Philips, 2013; Vazquez & Anderson, 2001). Studies have also claimed links between urban agriculture and the reduction of local crime (Garrett & Leeds, 2014; Herod, 2012). Besides ecological benefits (Kulack & Vasquez, 2012; Kulak et al., 2013) another externality of urban agriculture is public health. Urban agriculture can contribute to an increase in physical activity and other associated physical and mental health benefits. Such benefits are comparable to those provided by parks and other open spaces. For example, an attractive open space has been shown to increase the physical activity of nearby residents. As a particularly active type of open space (frequently requiring digging, weeding, hauling, harvesting, etc.), urban agriculture can positively contribute to public health. Gardening is known to be a very good form of physical and mental exercise (Sugiyama, Francis, Middleton, Owen, & Giles-Corti, 2010).

It is within these larger frameworks that urban agriculture can be seen as a highly valuable and justifiable land-use. Land-use planning should take such considerations into account. If cities actively incorporate urban agriculture and local food planning into their comprehensive plans, open space strategies, and land-use ordinances and policies, multiple benefits could be gained. This raises a question for further study: how much should local governments invest, maintain, promote, or support urban agriculture as a core land-use type and community policy?

Significance of the Study

Urban agriculture has started to form an important part of city planning and urban policy narratives. The high costs associated with establishing and maintaining mono-function green open space and solid waste management programs could be alleviated if planners and authorities think of multi-function opportunities such as urban agriculture instead. As a multi-function green space, urban agriculture sites could potentially offset some latent economic, health, environmental and social costs associated with several independent or disparate projects. Cities are often challenged to provide more green space, more active or a higher abundance of public spaces, provide solutions to vacant land or blight conditions, provide access to healthy food, and sustain an economically vibrant urban ecosystem. As many of these projects operate independently, costs to cities can escalate. Yet, many of these issues can be addressed in a successful public urban agricultural program. Therefore, since urban support structures, such as policy-making, rezoning, and related planning processes are time-consuming and costly, it is rational to assume that the economic relationship of urban agriculture and local food systems to urban form is important. On the other hand, some advocates for urban agriculture claim that the costs of not formulating and implementing the land-use policies can be higher (Drescher, 2001).

Without evidence as expressed in monetary terms, cities may find it challenging to allocate resources to such public programs (Voicu & Been, 2008). There is a need to understand how much urban agriculture contributes economically to the local neighborhood, and if this information can aid in making better and adequate land-use, planning, and policy decisions. City-wide urban agriculture systems may be weakened or fail if they are not adequately supported in policy and planning (Barrios, 2004; Philadelphia, 2013; Hodgson et al., 2011; LaCroix, 2010; Mukherji & Morales, 2013; Smit, 2001; Voicu & Been, 2008; Voigt, 2011). To match investments in public infrastructure (for example affordable housing, schools, small parks, or sports facilities) urban agriculture and local food systems must be proven as a complementing and appropriate program (economically, socio-culturally, and ecologically) in sustainable urban development. The problem corresponds to the following core issues and questions:

Economically-viable and socially-optimal use of urban lands:

- Do urban agriculture and local food systems contribute to neighborhood desirability, as seen through property price changes?
- Is there a case for urban agriculture and local food systems to become a socially optimal use of urban lands?
- Under what conditions and at what point in time are urban agriculture and local food systems considered a viable land-use? In other words, is it valuable for cities to invest in new sites, or should they support existing sites instead, and for how long?

1) Land-use maximization:
    - Can we draw generalizations as to how US cities can maximize urban agriculture as a land-use type and its appropriate spatial-temporal place in urban design and environmental planning?
2) Actions and policies:
    - How can local urban authorities take action to support and develop a viable urban agriculture land-use and urban program, to what set of stakeholder expectations, and to what extent?

This research evaluates the role and future of urban agriculture and local food systems in the built environment through an empiric economic lens focused on a specific urban setting (Minneapolis, Minnesota). As previously discussed, there are gaps in the literature on urban agriculture as a land-use and its economic effects on local urban environments, particularly as to how these sites related to residential property prices. This research provides an approach to evaluation, a model, and a method which collectively speak to important questions of on how urban agriculture can contribute to improve land-use, local food systems, local economic development, growth management, neighborhood (re)development, and environmental and sustainability efforts. As such, this targeted urban agriculture research is expected to help address important questions for both established and transitioning urban areas.

Research Question

To respond to the core issues, the central research question this project addresses is:

Is there an identifiable relationship between urban agriculture and property values?

And if so:

What is the direction, magnitude and significance of the effect of urban agriculture on property values?

The null hypothesis is that there is no significant relationship between urban agriculture and property values. The alternative hypothesis is that there is a significant relationship between urban agriculture and property values. Findings from this research are expected to demonstrate the direction and magnitude of the particular relationship and its components. The discussion of findings will address the core issues of the problem framework and lead to an important policy-related sub-question: should local governments invest, maintain and promote urban agriculture as a core land-use type and community policy, and, if so, to what degree?

This research expands on ongoing theoretical and policy discourse (Beilin & Hunter, 2011; Condon et al., 2010; Mougeot, 2006; Sharzer, 2012; Thibert, 2012; Turok, 2009; Viljoen et al., 2005; Wachter & Gillen, 2006; Wachter & Wong, 2008; Wachter et al., 2010) revealing how investment of public resources and appropriate policy ordinances might aid urban development efforts via productive landscapes. By means of urban agriculture and other productive landscapes, it is hoped that cities can develop healthy, enjoyable, diverse and resilient urban landscapes in which to live and work. The implication is that if city planners and administrators better understand the impact of low-exchange value systems as part of their integrated urban design or city renewal efforts, more efficient and effective planning for neighborhoods and urban edges will greatly aid the processes of urban revitalization — thus strengthening neighborhood development and supporting sustainable growth policies.

Chapter Two – Comparable Literature Analysis

Prologue

This chapter discusses literature regarding the empirical evidence of municipal parks and similar public green spaces comparable to urban agriculture, and how these spaces relate to home sales prices. The dominant methodology used throughout this body of literature is the hedonic method. The literature discusses hedonic studies of urban agriculture, peri-urban agriculture, green amenities, and green infrastructure, examining the related economic effects on nearby land or property values.

Introduction

To date, urban agriculture research is strongly rooted in the qualitative literature. There is very limited quantitative research available. Without measurable results from rigorous research, it may make it difficult to provide evidence for and support urban agriculture in urban policy and planning (Garrett & Leeds, 2014; Tranel & Handlin, 2006; Voicu & Been, 2008). There is a gap in the empiric literature on how urban agriculture sites influence their immediate urban environments, particularly unknown and likely urban economic effects. One such urban economic effect is the economic or monetary influence that urban agriculture sites may have on the desirability of neighborhoods. As we know that parks and other active or passive green spaces have measurable economic impacts (described in this chapter), it is reasonable to assume that other active and passive green spaces, such as urban agriculture have comparable economic effects on their surroundings. Therefore, there is a need to include the urban economic effects of urban agriculture in the greater body of literature, and to understand how urban agriculture sites may behave differently as compared to the green spaces, parks, and comparable urban amenity counterparts.

Methods used to Determine Land-Use Values

Economists, social scientists, planners, and city authorities seek to understand the values, preferences, and actual behaviors of individuals and groups (Freeman, 2003). However, some forms of value cannot be directly measured, or are difficult to determine without a comprehensive understanding of the many factors involved. In the urban environment for example, one can measure air quality fairly simply. It is much harder to determine the quality of life of a neighborhood without an aggregate understanding of all the factors involved, which would include clean air. To make responsible decisions for managing urban environments, planners, and policy-makers need to build useful environmental information bases, which must include economic trade-offs and preferences within the environment.

One such urban economic trade-off is the willingness-to-pay for convenience and amenities. Other things being equal, most people are willing to pay more for a home closer to a good park or amenity, and adversely, an amenity with negative qualities may diminish home prices (Crompton & Decker, 1990; Crompton et al., 1997; Li, 2010; Nicholls & Crompton, 2005; Sherer, 2006). A primary measurement of the desire to be in a particular urban area is housing sales prices. Neighborhood property prices are indicators of socio-economic attributes, features, and trends. Since housing sale prices are indicative of how much people are willing to pay to live within certain neighborhoods (and the associated desirable amenities provided in these areas), property values can also be seen as indicators of neighborhood desirability. Housing sales prices, therefore, can be used as proxies for neighborhood desirability. One of the influences associated with housing prices (besides the size and quality of homes and yards) is commonly thought to be proximity to amenities and green space access. The higher values of homes that are closer to good parks or green spaces means that their owners pay higher properties taxes. This is what Crompton calls the capitalization of parkland, which explains the general increase values of all the properties within the proximate area close to a park (Crompton, 2001; 2004). The difference between the value of the home itself, the value of its proximity to amenities, and the utility of neighboring environmental features, is called its "hedonic value." To understand the relationship between environmental amenities and their economic effects on a specific location, property, and neighborhood, researchers often turn to hedonic modeling or methods.

Rosen's hedonic method is described as a holistic approach to understand the implicit monetary values of amenities or utilities that are difficult to trade on the open market, including utility derived from the environment (for example, clean air or open space) (Giannias, 1988; Rosen, 1974). Although the hedonic method has seen various iterations and criticism through its application to different fields during the past forty years, the basic theory remains relatively unchallenged. A model, developed using the hedonic methodology, can determine if property values increase for properties close to the amenity in response to the treatment (Rosen, 1974). This method sheds light on those variables that have effects on sales prices and if there are any significant relationships for further study.

The derived results from hedonic modeling provide researchers, planners, and local governments with two valuable monetary gauges: (1) direct income or loss from the amenity, and (2) collective wealth contribution. Collective wealth is understood as direct savings or benefits to individuals who have the free use of the amenity, and also through environmental savings and/or benefits. The hedonic method has been employed for many decades to explain statistically significant relationships between a range of environmental factors and property prices (Kolstad, 2011), including green and open spaces (Bolitzer &

Netusil, 2000; Crompton, 2001; Nicholls & Crompton, 2005; Prilliad & Van Rensburg, 2012), schools (Gibson, 2009), and vineyards (Prilliad & Van Rensburg, 2012), to name but a few. These studies provide measureable findings, and guide general planning and design efforts for particular topics. Hedonic evidence is used, for example, to support environmental management or explain effects of certain features on general housing market trends (Heckert, 2012; Wachter & Gillen, 2006; Wachter & Wong, 2008).

Limitations to the method

There are limits to what the hedonic method can achieve. Although the model has proven to provide valuable insights and is reliable, a hedonic regression analysis cannot extrapolate beyond the range contained within the dataset (Miller, 2001). The valuation, as estimated through hedonic modelling, is restricted to the designated utilitarian values of the environmental goods (Li, 2010). In addition, not every contributing or disturbing aspect can be reasonably quantified. For example, it is hard to proxy the contribution of parks or forests to mental health (Harnik & Welle, 2009) — even though this may be a primary reason that park or green environments are more attractive to buyers.

Researchers do not decide on a sample size in advance but instead include all sales that satisfy certain criteria (Miller, 2001; Tranel & Handlin, 2006; Voicu & Been, 2008). These criteria for hedonic analysis are usually for property sales that occurred in a particular geographic area and/or are property sales that occurred within a specified time frame. This explains why there are somewhat mixed results in the literature for comparable studies, and why thoroughly explained methods and interpretations of results are important.

A further impediment to this method is that it is very difficult to analyze business and commercial property changes for several reasons. Business or commercial properties tend to have lower turn-over rates than residential properties (Nicholls & Crompton, 2005). Business properties are often not entered into the real estate listing services that are used as the secondary data sources. Furthermore, business owners and homeowners have differences in their choice of location between and within cities. This explains why most studies rely on residential sales transactions only.

There is also a limit to setting the unit of analysis to property sales price because sales price will not necessarily directly reflect the choices of a rental market. Rental data and rental changes can and have been used in some analyses, but generally this data is very hard to come by, is under privacy protection, and may not be reliable (as it often does not reflect the real rental price). For instance, Butler and Donovan (2011) did not have access to the secondary data on rental prices. They resorted to the already collected data on the rental price of households from the listing websites such as Craigslist. Eventually the researchers excluded apartments, condominiums, row houses, and duplexes because of the complexity in accumulating true (or reliable) data, and were left with rental information for single-family houses

(Donovan & Butry, 2011). By using only single-family homes, these studies limit themselves in applicability for use in different contexts, such as rental preferences associated with housing. Nevertheless, it can be argued that persons who rent a home may reflect relatively similar interests and choice of location as those persons who purchase a home, especially if factors such as median income or other socio-demographics are controlled for.[19] Furthermore, households derive inherent services from the housing stock in which they belong to. In exchange for services, households pay an explicit rent. In the case of homeownership, households pay an implicit rent (Crone et al., 2004; Smith et al., 1988). Therefore, the case can be made that in hedonic analysis, a homeowners' market reflects the general behavior of a rental market (Crone et al., 2004; Donovan & Butry, 2011; Smith et al., 1988).

Another inherent limitation is that variables are interdependent. In many cases the variables are linked and thus behave together and in parallel. This can lead to understating the significance of particular variables in the analysis. Therefore, different functional forms of the model, variation in specifications of analysis, and auxiliary tests must be considered and form part of the research design. There are also limitations in data gathering, especially with the field of green amenity measurements and property prices. Unlike schools or other built public infrastructure, green amenities or green cover can take a long time to mature, and sometimes mature irregularly. Lastly, direct comparison between studies can be slightly problematic due to the variations in context and research design. This is why, for example, it is important to understand and express the full context of the particular urban agriculture site or property, as it effects may vary seasonally.

Relevance of this method

This method is a relevant method for studying the relationship between urban agriculture and property prices for several reasons. First, there is insufficient empiric economic data and evidence for understanding, managing, and regulating an urban agriculture system in a citywide context (Smit, 2001; Tranel & Handlin, 2006). There is very little empiric meta-data for urban agriculture in general (Heckert, 2012; Sharzer, 2012). Second, if urban agencies want to maximize the benefits of urban agriculture on a

[19] In speaking to several other students and researchers regarding the true rental data or reliable sources for rental data versus home sales data, some suggested to build automated computer applications that can collect rental data from online sources such as Zillow, ApartmentFinder and others. However, even if the necessary information could be obtained in this way, there is still a lot of room for misinterpretation as many agencies list available units as a means to attract clients, or do not accurately track the availability of the units as reflected on these sites. Those sites with sophisticated online advertising mechanisms (such as ApartmentFinder) usually serve a higher income group, and will not reflect the entire rental market fairly. For the purposes of this study, home sales price was deemed an effective unit of analysis, as discussed in Chapter Three.

citywide scale, then this local food production system needs to form part of an integrated, continuous productive urban landscape framework. Understanding the economic contribution and urban effects are very relevant to the discussion. This is incredibly helpful to policy makers in deciding how investment of public resources should be distributed and associated urban policies should be supported. The implication is that if we better understand the economic relationship of productive landscapes systems such as urban agriculture, then context-specific strategies can be planned and designed to improve urban revitalization and development in larger open space urban frameworks.

Empirical Studies Part I

Urban agriculture and property values

The following review examines relevant empirical studies that are focused on the effects of urban agriculture within cities. Generally, these studies capture any site or feature described as a "community garden" within cities or urban areas. The first two studies focus specifically on urban agriculture and property values. The remaining studies focus on urban agriculture and environmental or socio-economic effects within the urban environment. Table 1 summarizes the empirical findings.

Relatively few studies have specifically researched the monetary relationship and impact that urban agriculture has on surrounding properties in the United States. At this point, only two studies have examined this particular link (Tranel & Handlin, 2006; Voicu & Been, 2008). The Tranel and Handlin study is comparative, while only Voicu and Been used the hedonic method explicitly. These two studies are useful because they consider two different urban densities and neighborhood characteristics — a higher density environment of the Bronx, New York, and a lower density environment of St. Louis, Missouri. These two studies provide evidence that allowed the researchers to make certain generalizations, but are limited to their particular study areas. As such, these studies do not fully capture conditions elsewhere across the United States, indicating that more evidence from different urban contexts is needed.

Table 1. Empirical literature on urban agriculture	
Hedonic Regression (HR); Single-Family Housing (SFH)	
Source	**Title, method and summary**
Tranel & Handlin (2006)	*Metromorphosis: documenting change*
	Difference-in-differences of neighborhood unit and block groups of community gardens (53) in St. Louis, Missouri (1990-2000).
	"Garden Impact Area" approach showed that indicators such as resident quality-of-life and neighborhood conditions are impacted in the following ways: for owner-occupied housing, median rent, median housing costs, and homeownership rate increases or decreases in the immediate vicinity of gardens relative to surrounding census tracts following garden opening.
Been & Voicu (2008)	*The effect of community gardens on neighboring property values*
	HR of apartment buildings (condominium type apartments) and SFH (517,791 property sales, 1,799 census tracts) of community gardens (86) in Bronx Borough, New York (1974–2003).
	Opening of a community garden has a statistically significant positive impact on the sales prices of properties within 1,000 feet of the garden.
Wachter, Scruggs, Voith, & Huang (2010)	*Redevelopment Authority of the Philadelphia: land-use and policy study*
	HR for public parcels and SFH. Report studying community gardens (571) and Vacant lots (2,500) in Philadelphia, Pennsylvania (2008-2010).
	Includes recommendations for the evaluation of urban agriculture on both a temporary and a permanent basis.
Kulak & Graves (2012)	*Reducing greenhouse gas emissions with urban agriculture: a life cycle assessment perspective*
	Life-cycle analysis of greenhouse gas emissions (GHG) for seven (7) acres of land (2.83 ha) of a community farm (1) in Sutton, South London (2010-2012).
	Community farms can also have a contribution to the reduction of GHG emissions, exceeding the rate of carbon sequestration by parks and city forests.
Kulack & Vasquez (2012)	*Urban agriculture as carbon sinks in Chicago*
	Study of "carbon sink potential of soils" using random selection; four (4) final sites of community gardens (900) in Chicago, Illinois (May 5 to May 30, 2011).
	Urban agricultural soils have the potential to store carbon but very little nitrogen.
Garrett & Leeds (2014)	*The economics of community gardening*
	Negative binomial regression used to examine community gardens (number not disclosed) in Philadelphia.
	The number of community gardens in a census tract is significantly impacted by population density, poverty rate, home vacancy rate, resident's citizenship status, burglary and theft rates, and the number of healthy food corner stores in a census tract.

Table 1. *(continued)* Empirical literature on urban agriculture	
Hedonic Regression (HR); Single-Family Housing (SFH)	
Source	**Title, method and summary**
Declet-Barreto, Brazel, Martin, Chow, & Harlan, (2013)	*Measuring the spatial arrangement of urban vegetation and its impacts on seasonal surface temperatures*
	Ordinary least square (OLS) regression models on ~178 km^2 in urban Phoenix, Arizona. Summer daytime, summer nighttime, winter daytime, and winter nighttime are analyzed to determine the influence of the spatial pattern of urban vegetation on seasonal, daytime, and nighttime land surface temperatures.
	Despite seasonal variation, optimizing the spatial arrangement of green vegetation improves the urban environment and effectively mitigates the urban heat island effect.
van Heezik, Freeman, Porter, & Dickinson (2013)	*Garden size, householder knowledge, and socio-economic status influence plant and bird diversity at the scale of individual gardens*
	Multiple regression on selected 55 gardens across 30 suburbs in Dunedin, New Zealand (2012-2013).
	The size of the vegetated area of household gardens was a substantially more important factor to variations in biodiversity than any other factors.
Oberndorfer et al. (2007)	*Green roofs as urban ecosystems: ecological structures, functions, and services*
	General review
	Vegetated green roofs improve stormwater management, the regulation of building temperatures, reduction in urban heat-island effects, and increase urban wildlife habitat and diversity.

Urban agriculture and property values in St. Louis, Missouri.

The first empirical research that finds a particular relationship between urban agriculture and property prices is conducted by Tranel and Handlin (2006) in St. Louis, Missouri. The study examines 53 gardens, which are part of an urban development initiative called "Gateway Greening." The research does not identify if the garden size is a major factor. Instead, the researchers designated a fixed area of 1,500 feet surrounding each site as a "Garden Impact Area" (GIA). This study was concerned with the effects of GIA at the neighborhood level. The researchers used population census data for 1990 and 2000 to understand the effects of the 53 sites on median housing costs for owner-occupied housing. The methodology used a difference-in-difference technique[20] to control selection biases. The study used the opening of each particular garden as a reference point. Researchers found a positive and significant

[20] The difference-in-differences statistical technique compares the average change of the effect of treatment on a group over time. This technique requires at least two or more distinct time periods for a study sample.

relationship between the GIA and nearby residential properties. Furthermore, the researchers claim that the GIA's are…"more stable than the surrounding areas where there was not an active community development process" (Tranel & Handlin, 2006, p.164) and concluded that the median rent, median mortgage payments, housing costs, taxes, and homeownership rates increased in the immediate vicinity of the community gardens (Tranel & Handlin, 2006).

Urban agriculture and property values in the Bronx Borough, New York City.

The most direct research looking at urban agriculture and housing was conducted in the Bronx borough of New York City by Voicu and Been (2008). The research delimits the study to community gardens only, but accounts for real garden size (square feet area) within the research model. Similar to Tranel and Handlin (2006), this study was designed to measure the effect of the opening of a community garden to estimate the impacts of gardens on property values. The study focused on residential properties within the Bronx Borough. The community gardens dataset included records for location, area, opening date, and land ownership of the recorded sites. This research delivered an initial sample of 636 gardens, reduced to a final valid set of 86 sites. The garden data was paired with transaction prices for all apartment buildings, condominium apartments, and single-family homes from 1974 to 2003. A distinguishing factor is that this Bronx study takes into account the "quality" of the community gardens. To account for garden quality, the researchers conducted a survey to gather qualitative information on community gardens. The economic effect is largest in areas with the poorest neighborhood composition, and there is a significant difference in garden impacts between low and higher income neighborhoods. The researchers note that average impact estimates for the city as a whole may be downwardly-biased because of these socio-economic differences. The study concludes that on average, community gardens have a significant positive effect on surrounding property values (Voicu & Been, 2008).

Comparable literature

The remaining studies listed in Table 1 discuss other empirical effects of urban agriculture or comparable green spaces. Although the Wachter, Scruggs, Voicht and Huang study in Philadelphia does not measure the relationship between urban agriculture components and property prices directly, the objective of the study was to estimate values of vacant parcels and the relationships to nearby properties, which was the basis for a city-wide vacant and open space planning initiative (Wachter et al., 2010). The study used the hedonic method to determine the aggregate value of 2,500 vacant land holdings within the city. The results of this study indicate that the vacant properties are not in any particular high demand for immediate development. This finding is used to support the idea that urban agriculture could be a good temporary land-use solution until such time that the vacant land values rise (Wachter et al., 2010).

A study by Kulak, Graves and Chatterton (2013) measured the carbon sequestration of a community farm in the United Kingdom. The study claims that community farms can contribute to the reduction of greenhouse gas emissions, even exceeding the rate of carbon sequestration from parks and city forests (Kulak et al., 2013). Another study by Kulack and Vasquez (2012) studied four urban agriculture sites in Chicago, Illinois, and found that there are substantial ecological advantages in utilizing urban agriculture within cities. The researchers concluded that, given that there are an expected 900 or more urban agriculture sites within the City of Chicago, these types of green spaces have significant potential to sequester greenhouse gases, and that it is worth calculating this ecological service to the city (Kulack & Vasquez, 2012).

Garrett and Leeds (2014) found that the number of community gardens in a census tract is significantly impacted by population density, poverty rate, home vacancy rate, a resident's citizenship status, burglary and theft rates, and the number of healthy food corner stores in a census tract. The study also suggests that the community gardens function as substitutes for parks, and thus there is a strong case for community gardens to provide useful alternatives to traditional local green spaces (Garrett & Leeds, 2014).

Studies have shown that in inner city areas, parks have a significant potential to reduce both air and surface temperature (approximately 2% and 8% respectively), and that the "Park Cool Island effect" extends to non-vegetated surfaces as well (Declet-Barreto, Brazel, Martin, Chow, & Harlan, 2013). Another study found that optimizing the spatial arrangement of green vegetation not only improves the urban environment, but despite seasonal variation, also effectively mitigates the urban heat island effect. This study also shows that aggregated patterns of grass and trees are preferred for cooling the environment, and that planning for even small patches of vegetation (as small as 2,200 square feet / 200 square meters) improves temperature management, without any substantial drain on critical urban resources such as water (Fan, Myint, & Zheng, 2015). This scale is comparable to an individual property garden or green space scale. In terms of urban biodiversity, another study found that at the individual property scale, the size of the vegetated area was substantially more important to variations in biodiversity than any other variable (van Heezik, Freeman, Porter, & Dickinson, 2013). Similarly, studies show that roofs with a vegetated surface and adequate substrate (or green roofs) provide important ecosystem services. These include improved stormwater management, improvements in the regulation of building temperatures, reduction in urban heat-island effects, and increases in urban wildlife habitat and diversity (Oberndorfer et al., 2007).

Together, these empiric studies indicate that there a need to understand the aggregate economic and ecological values of urban agriculture, as urban agriculture has the potential to contribute to a broad spectrum of issues within cities.

Empirical Studies Part II

Parks, open space, and green cover and the relationships to property values

In the parks, open space, and green cover literature, aspects such as community development, social equity, changes in green coverage, and other environmental impacts have important economic relationships with property valuation. These effects are often explained by factors such as proximity, structure and design, utility, scale, and demographic composition. The research knowledge base related to this body of literature can be applied to the economic relationships between urban agriculture and property values. Table 2 summarizes the empirical findings.

Table 2. Empirical literature on parks, green spaces and comparable studies

Hedonic Regression (HR); Single-Family Housing (SFH)

Source	Title, method and summary
Weicher & Zerbst (1973)	*The externalities of neighborhood parks: an empirical investigation.*
	HR with property values to urban parks in Columbus, OH (1965-1969).
	The study reveals two important characteristics (1) whether the property faces or backs onto the park, and (2) whether the property overlooks recreational facilities or open space. Positive externalities (between 7% and 23%) are generated only for those properties which face open space, and externalities are non-existent in other cases. The externalities represent a substantial fraction of the opportunity cost of the park: 8% for the larger park and 22% for the smaller. These results show that public provision of parks, rather than private, is desirable. However, private provision is optimal where park, and adjacent properties are owned by the same firm.
Hammer, Coughlin, & Horn (1974)	*The effect of a large urban park on real estate value.*
	HR of SFH and Pennypack Park (1,294 acres) in Philadelphia, Pennsylvania (1974).
	Homes located 40 feet from the park had an added value of $11,500 based on their proximity to the park.
Crompton & Love (1990)	*The role of quality of life in business (re)location decisions*
	Survey of businesses (174) in Colorado during a study period of five (5) years.
	Context specific, small businesses are attracted to parks, green utilities and open spaces, and identify this as indicators of higher quality-of-life (QOL) elements.

Table 2. ***(continued)*** **Empirical literature on parks, green spaces and comparable studies**	
Hedonic Regression (HR); Single-Family Housing (SFH)	
Source	**Title, method and summary**
Gao & Asami (2000)	*The external effects of local attributes on living environment in detached residential blocks in Tokyo*
	HR externalities of local attributes in detached residential lots (190) in Tokyo, Japan.
	When the residential lot area is smaller than 110 square meters, being adjacent to a park or playground has a positive external effect; when lot size is large (greater than 150 meters), the external effects are negative. In general, there is an advantage of small parks (or pocket parks) over large size parks in areas with detached residential blocks.
Crompton (2001)	*The impact of parks on property values: a review of the empirical evidence*
	Literature review, United States
	A base point of 20% can be used as a typical premium for homes adjacent or abutting to public parks.
Espey & Owusu-Edusei (2001)	*Neighborhood parks and residential property values in Greenville, South Carolina*
	HR using sales price of SFH and neighborhood parks (24) in the city (1990-1999).
	Type 1 parks had a statistically significant negative effect on the sales prices of homes within 300 feet of the park; 15% between 300 and 500 ft.; 6.5% on the sales prices of homes located between 500 and 1,500 ft. Small, attractive parks had a statistically significant positive effect of 11% on the sales prices of houses within 600 ft. of the park, but no statistically significant effect beyond that.
Miller (2001)	*Valuing open space: land economics and neighborhood parks*
	HR using sales price of SFH (3,200) and urban parks (14) in the Dallas / Fort Worth Metropolitan Area, Texas (January 1998 - May 2000).
	Large parks are more valuable than small parks, but the premium is small relative to the proximity to sales. Series of small parks will add more value. Parks bordering on roads are more valuable than parks bordered by private lots. Small lots value acreage more than large homes do. Depths of parks are valued more than widths. A complex path and difficult access to the park diminishes the value of the park.

Table 2. *(continued)* Empirical literature on parks, green spaces and comparable studies

Hedonic Regression (HR); Single-Family Housing (SFH)

Source	Title, method and summary	
Nicholls (2002)	*Does open space pay? Measuring the impacts of green spaces on property values and the property tax base*	
	Study 1. HR using sales price of SFH (224) and condominiums (74) of "Neighborhood 1" near Barton Creek Greenbelt in Austin, Texas (1999-2001).	Study 1 & 2 Results: The most substantial impacts on property prices were caused by adjacency to a golf course; the premium for such a location ranged from $61,000 to $73,500 (16% to 19% of value), depending upon model specification. Adjacency to a greenbelt also had a significant, positive impact on property prices in two of three cases; premiums ranged from $13,000 to $48,000 (5% to 13% of total value). Impacts of proximity on prices varied with the measurement of distance used.
	Study 2. HR of SFH (240) and condominiums (26) of neighborhoods near Barton Creek Greenbelt in Austin, Texas (1999-2001).	
	Study 3. HR using sales price of SFH near urban parks (2) in Austin, Texas (1999-2001).	Study 3 Results: Park 1: no significant relationship between property value and distance to park. Park 2: relationship between property value and distance to park varied from no significant impact to $10 decline per foot.
	Study 4. HR using sales price of SFH near the College Station Golf Course in Austin, Texas, (1999-2001).	Study 4 Results: Location adjacent to golf course accounted 16-19% of average sales price.
Ernst & Young (2003)	*Analysis of secondary economic impacts New York city parks capital expenditures*	
	Historic survey of value changes in residential and commercial sales. Real estate values, tax assessments, and turnover rates were analyzed for large parks (6) and small parks (30), New York City, New York (1992-2001).	
	Capital reinvestment in parks results in tangible fiscal benefits when they are secured and preserved through effective administration, community participation, and ongoing maintenance.	
Crompton (2004)	*The proximate principle: the impact of parks, open space, and water features on residential property values and the property tax base*	
	Literature Review, United States	
	Preserving open space can be a less expensive alternative to development. The conclusion is that a strategy of conserving parks and open space is not contrary to a community's economic health, but rather is an integral part of it.	

Table 2. ***(continued)*** **Empirical literature on parks, green spaces and comparable studies**		
Hedonic Regression (HR); Single-Family Housing (SFH)		
Source	**Title, method and summary**	
Nicholls (2004)	*Measuring the impacts of parks on property values*	
	Literature Review, United States	
	Overall, positive effects of parks to property values. Echoes findings by Crompton (2004).	
Lindsey, Man, Payton, & Dickson (2004)	*Property values, recreation values, and urban greenways*	
	Study 1. HR using sales price of all residential properties along the Monon Trail in Indianapolis, Indiana (1999-2000).	Study 1 Results: Location within one half-mile had a significant positive effect, about 14% more than the average price.
	Study 2. HR using sales price of all residential properties along other greenways (6) in Indianapolis, Indiana (1999-2000).	Study 2 Results: No significant effects revealed.
	Study 3. HR using sales price of all residential properties in conservation corridors (7) in Indianapolis, Indiana (1999-2000).	Study 3 Results: Location within one half-mile of conservations corridors had a significant positive effect, accounting for 2% more than the average price.
Crompton (2005)	*Impacts of parks on property values: empirical evidence from the past two decades from the United States*	
	Literature Review, United States	
	Parks and open space contributes to increasing proximate property values. It is not possible to discern a generalizable answer with regards to the magnitude of the proximate effect, given the substantial variation in the size, usage, and design of parklands in the studies, and disparities in the residential areas around them.	
Sherer (2006)	*The benefits of parks: why America needs more city parks and open space*	
	Literature Review, United States	
	Evidence demonstrates the benefits of city parks to physical and psychological health and community development.	
Crompton (2007)	*The impact of parks and open spaces on property taxes*	
	Literature Review, United States	
	Over 20 peer-reviewed studies demonstrated that the proximate effect is substantial up to 500-600 feet away from the park (typically three blocks). In the case of community-parks greater than 30 acres the effect may be measurable out to 1,500 feet. 75% of the premium value generally occurs within the 500- to 600-foot zone.	

Table 2. *(continued)* Empirical literature on parks, green spaces and comparable studies	
Hedonic Regression (HR); Single-Family Housing (SFH)	
Source	**Title, method and summary**
Troy & Grove (2008)	*Property values, parks, and crime: A hedonic analysis in Baltimore, Maryland*
	HR for SFH near parks and open spaces in Baltimore, MD (2001-2004).
	Park proximity is positively valued by the housing market, where the combined robbery and rape rates for a neighborhood are below a certain threshold rate, but negatively valued where these crime rates were above that threshold.
Harnik & Welle (2009)	*Measuring the economic value of a city park system*
	HR of all residential properties near National Mall, Washington, D.C.
	All residential properties (apartments, condominiums, row houses, and detached homes) within 500 feet of a park is worth $24 billion (in 2006 dollars). Using an average park value benefit of 5% the total amount that parks increased property value is just below $1.2 billion. Using the effective annual tax rate of 0.58% Washington reaped an additional $6,953,000+ in property tax because of parks in 2006. It must be noted results from this study may be unique due to the meaning, importance and stature that the Washington Mall parks and landscapes have to the US culture.
Netusil, Levina, Shandasb, & Hartc (2014)	*Valuing green infrastructure in Portland, Oregon*
	HR for SFH near green street facilities in Portland, OR (2005-2007).
	Examines proximity, abundance, and characteristics of green street facilities and their relationship with sales prices. Property sales prices are estimated to increase with increase in distance from the nearest green street facility, but to a small degree. Facility type does not have a statistically significant effect, but facility size, proportion of the facility covered by tree canopy, and design complexity do have significant effects on property sales prices nearby.

Key Factors from Literature

Urban agriculture generally rests on three premises: (1) brings agricultural production and distribution closer to the urban citizens; (2) appropriates vacant or underutilized urban spaces with a green amenity (namely living soils and vegetation); and (3) improves lifestyle, health and social utility for urban residents. As a result, urban agriculture contributes to various other aspects in urban and community development, including promoting greater social equity, increasing vegetated open space, and encouraging a range of positive environmental impacts (such as increasing pollinator habitats and affording local stormwater and greenhouse gas emissions management). Since the literature on economic effects of urban agriculture is very limited, it is only possible to understand the empiric economic effects from comparable literature. Considering the urban agriculture typology, the literature closest in type would be urban parks and vegetated open spaces. Urban agriculture and community gardens relate more closely in scale to categories such as "small parks" (Tranel & Handlin, 2006; Voicu & Been, 2008), but have additional secondary contributions and factors related to some of the other "green cover" or vegetated open space studies (Kulack & Vasquez, 2012; Kulak et al., 2013). In summary, ten important factors are noted in the literature: proximity; configuration; scale and quality; variation in definitions; urban scale secondary effects; access and ownership; negative effects; perceptions and activity; retention effects; and environmental effects. These factors are reviewed in the following pages.

1) Proximity

A number of authors review over 30 empirical studies that provide evidence for the economic benefits and subsequent effects of urban parks in cities and neighborhoods. The general consensus is that urban parks and green cover increase nearby property values, and that distance is a major factor (Crompton, 2001; 2004; 2007; Hobden, Laughton, & Morgan, 2004; Nicholls, 2002; Sherer, 2006; Tranel & Handlin, 2006; Voicu & Been, 2008). This distance effect is what Crompton calls "the proximate principle" (Crompton, 2004, p.18). Urban parks increase property values because buyers are generally willing to pay more to live near parks (Crompton, 2001; Crompton, 2004; Miller, 2001). Many of the studies use regression analysis, specifically the hedonic method. The majority of studies within this body of research show significant results between green amenities and property prices, with a typical distance range of up to 2,000 feet. The aggregate findings indicate that properties closer to green space, open space, or green cover pay premiums.

In an extensive body of work, Crompton has drawn measurable conclusions on the proximate effect, also referred to as "the proximate principle" of parks. Proximate principle research and other studies incorporate common distance characteristics such as walking distances or other travel distances (mostly linear) to green amenities (Crompton, 2004). For example, a study by Bolitzer and Netusil in Portland (2002) found that open spaces has a positive effect on the sale prices of homes adjacent to those open spaces (within 100 to 1,500 feet). Homes between 100 feet and 1,500 feet were found to sell for higher prices than homes located farther away (more than 1,500 feet) from the open space being examined (Bolitzer & Netusil, 2000). However, a home location and the Euclidean user travel distance is not sufficient in explaining the whole story of park, green space, or vegetated open space and its influence on neighborhoods (Heckert, 2012; Voicu & Been, 2008; Wachter et al., 2010). Studies relying purely on Euclidean spatial proximity may exclude other influential factors, such as the mobility of residents, degree of access, route network measurements, local political conditions, social barriers to access to green spaces or parks, the type of green space user, neighborhood quality and composition, and the structural configuration of parks or green space (Crompton, 2004; Heckert, 2012; Miller, 2001; Nicholls, 2004; Voicu & Been, 2008). Street network measurements were found to be superior to Euclidean measurements as they best reflect behavior of pedestrians and transport modes. In general, green spaces are accessible from roads or pathways, and a simple straight-line distance measurement may not capture this aspect fairly (Netusil, Levina, Shandasb, & Hartc, 2014; Sander, Ghosh, van Riper, & Manson, 2010).

2) *Configuration*

There is a difference in a property being close to a green space or a property facing a green space. For example, a study by Miller in Texas (2001) examined the economic effects of parks on property values and found that homes facing a neighborhood park have almost a 22% value increase. Although the residential real estate within close proximity (a couple hundred feet) to a community park may provide an increase in value (some as high as 33%), the properties facing the park seemed to have even higher premiums (Miller, 2001).

The design or configuration of the green amenity or green space plays a role. Depths and widths (Gao & Asami, 2001; Miller, 2001) or linear arrangements such as greenways (Nicholls & Crompton, 2005; Nicholls, 2002) have different results. For example, Miller (2001) found that residents place higher values on the depths of parks than on the widths of parks. This, however, varies with type of green space and the scale or size of the open space. Empirical studies on urban agriculture and property prices (Tranel & Handlin, 2006; Voicu & Been, 2008) did not specifically discuss configuration related to gardens or urban agriculture. This may be because most of these sites are so varied in configuration that it does not seem to be a practical consideration, as is the case for planned park landscapes.

3) *Scale and quality*

Miller (2001) and Gao (2001) describes the different effects that larger and smaller parks can have on property values. Miller found that independent large parks seem to be more valuable than independent small parks. However, the large parks have a lower premium compared to small parks, relative to residence’s proximity to the large park (Miller, 2001). Miller also finds that the increase of one acre in the size of a park has a marginal, positive impact of about 3% nearby home sales prices.

Espey and Uwusu-Edusei (2001) studied the aesthetics and scale of 24 neighborhood parks in Greenville, South Carolina. These researchers found that larger, unattractive parks (about 15,000 feet to 90,000 square feet) had a statistically significant negative effect on the sales prices of homes within 300 feet of the park (Espey & Owusu-Edusei, 2001). The larger, unattractive parks showed a significant positive effect of around 15% on the sales price of houses between 300 and 500 feet, and a significant positive effect of about 6.5% on the sales prices of homes located between 500 and 1,500 feet of the park.

This study also showed that small, attractive parks (between quarter acres to 2 acres in scale) had a statistically significant positive effect of only 11% on the sales prices of houses within 600 feet of the park, and that there was no statistically significant effect beyond that range. Still, the researchers state that the greatest impact on housing values was found with proximity to small neighborhood parks, where values can vary with 13% for homes in the 300-500 foot range. Espey and Uwusu-Edusei found that the impacts of medium-sized attractive parks (above 4 acres in scale) extended to 1,500 feet. They key issues were not only the scale and proximity of the parks, but also the quality or attractiveness of the green amenity (Espey & Owusu-Edusei, 2001). In the Espey and Uwusu-Edusei study, the researchers described "quality" in terms of the variety of amenities and/or activities that the park offers, including the presence of a natural area and/or walking trails in the park.

Of the studies on urban agriculture, only Voicu and Been (2008) addressed the quality of community gardens as well as the area of each community garden. Voicu and Been measured quality in terms of survey information on the features of each garden. This includes the accessibility to the general public, fencing attractiveness and permanence, cleanliness, landscaping quality, presence of decorations, existence of social spaces and overall condition of the garden (Voicu & Been, 2008).

4) Variation in definition of green or open space type

The type and definition of the green space or amenity can make a difference in the impact on housing sales prices. Across the literature, similar distance and configuration measurements bring about different results at different urban scales. This is partly due to the difference in types or use of the green amenity, but also partly due to regional differences. A researcher's definitions of relevant terms also strongly influence the findings or outcomes of the study. For example, two studies using the same set of 16,402 single-family residential sales in Portland provided different results. This is due to the different definitions of "green" or "open space." The first study found that the property value impact increased significantly with the size of a generically defined green space amenity (Bolitzer & Netusil, 2000). However, the second study redefined some green amenity types more specifically and found that a residence located a certain distance away from a "natural area park" had a higher premium compared to a "specialty urban park" — parks with a particular distinguishing feature such as a waterbody or a pier. However, the natural parks require largest acreage to maximize the sales price effects (Lutzenhiser & Netusil, 2001).

Both of the studies (Tranel & Handlin, 2006; Voicu & Been, 2008) that most similar to the research described in this dissertation, did not distinguish between variations due to different types of urban agriculture, as both studies focused a priori on community gardens. However, this research includes a distinction between two different types and uses of urban agriculture — the “community garden” as well as the “urban farm” category (as discussed and defined in Chapter One).

5) Urban scale secondary effects

The values of green amenities have different impacts on an individual residential scale as opposed to a municipal or neighborhood scale. For example, a study on the economic effect of urban forests found that the economic relationship between property values and the urban forest is slightly higher at a neighborhood level than at a residential level (Lindsey, Man, Ottensmann, Payton, & Wilson, 2008). Research by Miller (2001) suggests that generally, acreage is valuable to homeowners on smaller residential lots, but a series of small parks may add more value over time within the neighborhood. Crompton (2001; 2005) suggests that the orientation and configuration effect of parks on property values may significantly influence the tax base. A park with a long, linear configuration (or small parks in series) may link a greater quantity of residential properties than a deep, narrow park. A series of small parks have a greater positive economic influence on a greater urban area, which in turn can raise the tax base for the entire neighborhood.

A study on urban trees in Portland, Oregon, found that an additional tree on a rental lot may increase the monthly rent price by $5.62, but a street tree (which fronts a rental lot) contributes almost $21.00 to the rent price (Donovan & Butry, 2011). If one considers the impact on a city-wide scale, this kind of difference of the value of a green amenity between the house or neighborhood level is quite substantial. In a study of New York City parks, Ernst and Young (2008) found that the secondary effects of parks had enhanced local property values on the entire spectrum of residential and commercial property types. These researchers claim that the secondary effects of park spaces and the capital investment in parks could benefit both existing and emergent real estate markets (Ernst & Young & New Yorkers for Parks, 2008). Empirical studies on urban agriculture and property prices (Tranel & Handlin, 2006; Voicu & Been, 2008) did not address any secondary or neighborhood economic effects for the urban agriculture examined.

Crompton further explains that the secondary effects of the economic benefits of parks, green amenities and open space are not always directly captured by a primary evaluation of property values in proximity to the park. More than often, the catchment areas from which users come extend beyond this immediate proximity to the park (Crompton, 2005). In a study of Garfield Park, Chicago, for example, a substantial number of visitors came from outside of the immediate neighborhood (Walker, 2004). This problem of a broader amenity valuation has also been found in studies trying to place value on peri-urban agricultural lands. Agricultural landholders have difficulty in appropriating the amenity values and rents associated with their properties for similar reasons (Beasley, Workman, & Williams, 1986). This would also be true for urban agriculture users and visitors, as it is difficult to track the commodity chains and measure the secondary effects of urban agriculture in neighborhoods (Sharzer, 2012).

6) Access and ownership

The ownership of the green amenity can play a part in understanding how parks, open space or green amenities are influencing property prices (Klaiber & Phaneuf, 2010). A study by Irwin (2002) has found that if the open space is privately owned, the premium is 2.6% as opposed to a publicly-owned open space premium of only 1.2% (Irwin, 2002). However, in the case of urban forests, Lindsey et al. (2008) found that there is a significant change in willingness-to-pay for the amenity of urban forests — the housing price increases in more densely vegetated neighborhoods. Residents seem to place high value on such a green amenity, especially when these pleasing or appreciated vegetated components are not within their private control or responsibility. This presents an interesting opportunity for research on urban agriculture and community gardens in relation to ownership and rent structure (LaCroix, 2010). Many gardens are on some form of rent tenure. For example, in the Been & Voicu (2008) study, 95% were garden sites on publicly-owned parcels which were leased to community groups or residents. Research has not yet empirically shown how this impacts the neighborhood valuations. Empirical studies on urban agriculture and property prices (Tranel & Handlin, 2006; Voicu & Been, 2008) did not address the tenure structure of the urban agriculture.

Access to parks and by whom also plays an important role in regards to economic values in neighborhoods. Miller (2001) explains that a complex or winding path to a park diminishes the value of the park, and that parks bordering roads tend to be more valuable than parks bordered by private lots. Heckert (2012) reviews "user mobility" and "user access" to a park and finds that levels of social equity (for example, disparities in access based on race or socio-economic characteristics), can play a major role in determining which users benefit from the green space.

7) Negative effects of green amenities

Some green spaces have a negative effect on property prices at the neighborhood level. Researchers have found that some residences that border public greenways show a decline in property prices. Also, those residences backing directly onto large parks show little to no relationships between the park and property values (Hammer, Coughlin, & Horn, 1974). Other studies have found that conventional small and medium sized basic parks (defined as parks without any distinct features or special characteristics) showed a negative and statistically significant impact on neighboring property values as opposed to specialty parks (Espey & Owusu-Edusei, 2001). The type of park and program of the green space influences the premium, as passive parks tend to generate greater premiums than active parks (Crompton, 2007). These variations in relationship to property values are often explained by social problems — which includes: (a) the potential invasion of privacy of those residents having properties that directly adjoin these adjacent open spaces; (b) concerns regarding the numbers of strangers who will be passing through local neighborhoods; and (c) fears of increased noise, littering, loitering, trespassing, or vandalism (Grove & Troy, 2008; Nicholls & Crompton, 2005).

One study, which focused on crime and urban parks, observed that parks had a positive influence on the housing market only if the crime level was below a certain threshold. Where crime rates were high, parks were shown to have a negative effect on property values (Grove & Troy, 2008). The monetary effect of a park/open space on property prices are thus expected to vary in relation to crime rates, but also in respect to differing lot sizes, demographics, and locations across a city. Heckert (2012) studied the economic effect of Philadelphia Land Care program and the effects of neighborhood greening strategies. The neighborhood greening strategies showed different impacts on property values at different locations. Heckert found that although proximity to parks and community gardens is associated with higher property valuation, stronger relationships were shown in moderately distressed neighborhoods (Heckert, 2012). It should be noted that this situation could be associated with a gentrification process occurring within these neighborhoods. This gentrification effect was discussed in the study by Been and Voicu who found that the greatest impact of the community gardens were felt in the most disadvantaged neighborhoods (Voicu & Been, 2008).

Heckert also found that minorities and renters in urban areas are more likely to want to live near parks or green space, but typically these groups live near less green space than Caucasians and homeowners do (Heckert, 2012). Living near green spaces may impact preferences or satisfaction for certain residents, and therefore can be an influence how a resident chooses to live in a particular location. This would be especially true where community gardens or other types of open space may afford daily hands-on interactions with these green spaces. Nevertheless, the value attributed to living near green space is highly dependent on neighborhood characteristics and demographic composition.

8) Perceptions and activity

Active greening may combat the perceptions of urban regression, such as blight or weak social control (Heckert, 2012). The visual affirmation of a cared-for environment contributes to an increase in property valuation (Heckert, 2012; Wachter & Wong, 2008). The study of community gardens in New York City maintains that the perception of garden quality is an influential aspect for understanding the overall impact (or value) of urban agriculture in neighborhoods (Voicu & Been, 2008). Troy and Grove (2008) studied the impact of crime, parks, and the housing market in Baltimore, Maryland. These researchers found that the quality and maintenance of a green amenity or open space had a significant impact on whether or not these spaces were perceived as amenities or disamenities (Grove & Troy, 2008).

If quality and appearance signal that an area is cared for, it can also mean that an uncared-for area may produce feelings of distrust and unease. For example, a qualitative study looked at the impact of community gardens and crime (Herod, 2012). Here the research suggests that community gardens can play a role in crime prevention. The Herod study noted that there are two main types of community gardens: place-based community gardens, and interest-based community gardens. Place-based gardens are an active and internal effort at urban revitalization, where interest-based community gardens are more individualistic in nature. It is not clear whether there are differences in crime prevention between the two types since the study only focused on the place-based community gardens (Herod, 2012). However, the research echoes what Crompton and others suggest — that the level of activity, ownership, and perception of visual quality of nearby green/open spaces are key variables in understanding how the valuation changes.

Another study showing that quality and perception both matter was undertaken by Harnik and Welle (2009). Here the research shows that excellent parks may add to 15% to the value of a nearby residence, and in other cases, problematic parks can reduce a home value by 5%. As previously noted, one study found that the appearance of a small or medium-sized park influences the value of neighboring residential properties in South Carolina (Espey & Owusu-Edusei, 2001). Been and Voicu also used appearance as a quality measure in the survey of Bronx, New York community gardens (Voicu & Been, 2008). When researchers found that there was a lack of positive impact on homes in close proximity to a greenway in Lost Creek, Texas, the researchers explained that the character of the greenway was to blame. The residences were set in deep, heavily vegetated areas, and the greenway did not present to them an attractive view when compared to homes farther away and on higher ground (Nicholls & Crompton, 2005).

Researchers therefore consider the quality of green amenities by measure of appearance, specifically whether or not the appearance of open space can determine the level of amenity effects derived from it (Espey & Owusu-Edusei, 2001; Harnik & Welle, 2009; Nicholls & Crompton, 2005; Voicu & Been, 2008). This research suggests that, irrespective of green space type, the quality and maintenance of open space amenities is influential in understanding the economic impact of urban parks and open spaces on housing values. Perceptions of quality and well-maintained open space can be assumed to be important in relation to urban agriculture and community garden sites as well.

There may be a risk in not presenting a true account of how residents perceive, value, and use open space areas if community or neighborhood characteristics are not controlled for (Anderson & West, 2006). Both relative location and neighborhood composition play a vital part role in regards to understanding the story of green amenity and property values. For example, Miller (2001) found that residents of small urban residential lots seem to value green acreage more than residents in larger homes do. Residential lot size, resident and neighborhood composition are all very important factors. Inner-city residents who: (a) live in more dense urban neighborhoods, (b) live closer to the central business district, (c) have higher incomes, (d) live in areas with higher crime rates, or (e) are home to many children, have a stronger desire to be closer to open spaces (Anderson & West, 2006). These residents may thus value parks and open spaces more than other residents do.

It could very well be that a community garden or urban farm may be highly visited, but not really visible to the public and vice versa. Or, in another scenario, a garden may be highly visible, but not accessible to the public because it is private or has controlled access. The study by Voicu and Been (2008) does not discuss in depth the activity levels for community gardens, but they do discuss the possibility that garden impacts may vary over time. Although vegetable gardens can establish relatively quickly, urban agriculture activities may wax and wane according to season. It can also take some time for urban agriculture and community gardens to become established within a city or neighborhood. The benefits of the urban agriculture may only develop over time as residents and communities become more familiar, involved, and committed to the process (Voicu & Been, 2008).

9) Retention effects

Green space and parks can have an attraction and retention effect on both residents and businesses. Communities and neighborhoods with high quality of life ratings have a competitive advantage in the recruitment and retention of talented city workers by firms (Crompton, Love, & More, 1997; Crompton, 2001). The strength of the relationship between a high quality of life and business attraction or retention may vary on an interstate level. Different businesses attract different employees, and many times the quality of life is not necessarily the main reason an employee moves between states or cities (Crompton & Decker, 1990; Crompton et al., 1997). However, on an intra-urban level, this can be quite different. This is evident, for example, in the study of secondary effects of parks in New York City by Ernst and Young (2008). The investment, upgrade, and upkeep of urban parks attract more users and residents, which in turn attracts commercial or retail investment (Crompton, 2001; Ernst & Young, 2003).

In many cases, neighborhoods may not have parks but green coverage still plays a role in changing property values. In a study area five miles from downtown Los Angeles, the neighborhood had no parks but researchers found that an 11% increase in green coverage within 200-500 feet increased the housing sale price by almost 1.5%. This figure of 11% of green coverage relates to about one-third-of-an-acre in size (Pincetl, Wolch, & Longcore, 2003). Another study made a slightly different distinction and compared areas of green cover to “small parks” categories. The researchers found that properties adjacent to places where there is less than 50% of the space covered with green cover showed premiums of 2.8% compared to other properties. Where the green cover was further defined as a “small park” category, there was an increase in the values of adjacent properties by 6.9% (Hobden et al., 2004).

10) Environmental effects

Some research on green cover (including lawns, street tree cover, and vegetated walkways) has shown positive results between property prices and green cover (Conway, Li, Wolch, Kahle, & Jerrett, 2010; Heckert, 2012; Li, 2010; Sander, Polasky, & Haight, 2010; Wachter & Gillen, 2006; Wachter & Wong, 2008). Several studies have also shown that trees alone — separate from any larger green spaces — can increase rental property values (Donovan & Butry, 2011). Many studies explore the relationship between green cover and the urban heat island effects (Declet-Barreto et al., 2013; Fan et al., 2015; Kulak et al., 2013), biodiversity, and habitat (Oberndorfer et al., 2007; van Heezik et al., 2013). In terms of urban agriculture, one study in the United Kingdom has shown that urban agriculture can contribute to the reduction of greenhouse gas (GHG) emissions. This study found that the reduction of the GHG emission levels through urban agriculture even exceeded the rate of carbon sequestration from parks and city forests, indicating that there is great environmental potential and benefit for having urban agriculture typologies in cities (Kulak et al., 2013). Yet, very few studies have explored the direct connection between the increase in biodiversity or reduction in heat island effects and the economic relationship to nearby residential properties.

Figure 3. A typical quarter-acre urban agriculture site in an affluent neighborhood in Minneapolis.

Summary of the Comparable Analysis

In the literature on parks and green/open spaces there are mixed results from the same factors such distances, sizes, orientations or configurations of parks and green space and their relationships to property values. This indicates that multiple dimensions are likely important. Physical attributes such as orientation, quality, amenity, and accessibility are some of the physical features that play major roles in understanding the effect of parks, green/open spaces to properties, but these attributes have different meanings at different urban scales and contexts. The neighborhood composition, characteristics, and neighborhood development trends over time also play a major role in understanding this relationship. The majority of the literature finds positive and contributive effects from parks, green space, and green amenities on property values. The majority of studies focus on low-density settings, which may not show the same characteristics of denser urban neighborhoods. The studies that account for differences in the quality of parks, green spaces or gardens do so in a very broad and general way. Yet, studies that distinguish on quality and appearance of green spaces note that both of these two aspects are important in the analysis. There are several contrasts and similarities between parks or green spaces and urban agriculture sites, which can be summarized below:

1) *Nuisance and perception*

Urban agriculture can provide similar benefits in utility, social inclusion, cohesion, green coverage, and environmental benefits as parks, green/open spaces there do. However, urban agriculture also faces the same barriers such as the possibility of noise, untidiness, and accessibility (Voicu & Been, 2008). As an active growing space, one could argue that urban agriculture provides additional utility (types of activities and outputs) than parks or other passive green spaces — both to active users as well as to passive observers or participants. From this perspective one could also argue that these sites may have higher levels of nuisance. Some people may also associate urban agriculture with other negative attributes, such as perceived odors or visual unattractiveness. As some green/open spaces and parks play a role in diminishing urban property values, this may likewise be the case of some urban agriculture sites. For example, if urban agriculture areas are perceived as unkempt, this could promote the perception that these sites are also indicators of a low quality neighborhood or an otherwise distressed urban environment.

2) Secondary economic effects

Considering that one of the primary claims from the urban agriculture literature is that this land-use improves communities, it seems that there is a great need to better understand the primary and secondary economic effects on a community and neighborhood level. Unlike parks and green space, the secondary economic effects of urban agriculture on a neighborhood level have received relatively little attention. Although some results regarding open spaces and green coverage imply that these spaces improve the surrounding neighborhood in terms of increased property prices, it could also mean that such spaces are systematically located in strong or economically upward trending neighborhoods. In addition, there is a tendency for urban agriculture sites to be located in lower-income communities, since the people in these communities are more likely to have greater need to access healthy fresh food and the land-values are relatively lower than in higher-income neighborhoods and communities.

3) Time constraints

There are differences interpretation of variables and their effects between longitudinal studies and cross-sectional studies due to environmental or political externalities. The relationship over time and the particular point in time is also a factor. A study by Nicholls (2002), for example, mentions the effect of time in measuring the impacts of green space and housing prices in her study. Nicholls indicates that the time of sale for residential sales, specifically the year of sale, was the most consistently influential factor on sales prices of all the variables in her regression models (Nicholls, 2002).

In conclusion, the literature indicates that there is a limited amount of quantitative research available on the urban economic effects of urban agriculture. However, as an active green space, it is reasonable to think that urban agriculture must have urban economic impacts comparable to small neighborhood parks. Active or passive green spaces (including neighborhood parks) have measurable economic and monetary impacts on neighborhood home sales prices. Higher prices indicate higher willingness-to-pay for goods or services, and therefore higher housing sales price can be used as a proxy for the increase in desirability of neighborhoods. The dominant methodology to study this behavior is found in hedonic price models. The following chapter elaborates on the research method to determine if there is any monetary relationship between urban agriculture and home sales prices, and which aspects of urban agriculture sites are the primary drivers of the relationship.

Chapter Three – Research Design

Prologue

The following section includes a description of the introduction to the study area, analytic strategy, the primary methods used, and descriptions of the sample, datasets, and variables. This cross-sectional study used hedonic regression analyses to evaluate the relationship between urban agriculture attributes and property values in Minneapolis, Minnesota. The sample included information on the attributes on structure of the urban agriculture sites, the abundance of urban agriculture sites, and the qualitative components of urban agriculture sites and the possible implications these components may have on neighborhood desirability. The qualitative components are structured into two indexes. The first index captures systemic attributes (including relationship and operational aspects) and the second index captures spatial attributes of the urban agriculture sites (including aesthetics or urban features).

Figure 4. Example of an urban farm (or market farm) in Minneapolis, Minnesota.

Introduction to the Study Area

The study area is the formally-designated metropolitan boundaries of Minneapolis, Minnesota. The area was chosen for two primary reasons — its healthy-living status and pro-active approach to encouraging urban agriculture practices, including community gardens and urban farms (see Figure 4). Minneapolis is a leader in terms of healthy living, which includes the integration of urban agriculture and local food systems into a vibrant network of open spaces. The city is ranked among the top cities in nationwide sustainability indexes (Data360, 2006; Siemens Corporation, 2012), is considered a top city in regards to parks, green space, and recreation (ParkScore, 2015), and has been identified as the top health city in the United States (Forbes Magazine, 2015a).

Minneapolis has an inclusive and pro-active attitude towards urban agriculture. The city has a large number of listings for urban agriculture sites through official (city-sponsored) and less formal community and neighborhood programs. In 2006, Minneapolis was ranked first in "Local Food & Agriculture" in the Sustain Lane "City Sustainability" rankings (Data360, 2006) so it has a history of addressing local food production. Over the last decade a local government organization, Homegrown Minneapolis (HGM), started to develop policies that will allow urban agriculture to advance in the city. HGM's purpose is to support urban agricultural development, provide mechanisms that enhance the local food system, and develop frameworks for community-supported agriculture. One of the products of this organization was the development of an extensive land inventory analysis, where city-owned parcels have been made available for community gardens (Homegrown Minneapolis, 2014). Here citizens or community groups may develop urban agriculture for periods of one-, three- or five-year leases, depending on the level of experience these groups have in maintaining such sites. HGM also helped develop and write the cities' Urban Agriculture Policy Plan, which (among other important contributions) identifies needed initial changes to city zoning ordinances to better facilitate urban agriculture. This plan for urban agriculture was adopted by the Minneapolis City Council on April 15, 2011. The written documents developed during these undertakings provide the common terminology used for this study and within this dissertation.

Beginning in 2011, one goal for Minneapolis was to increase the food producing areas within the city by one acre by 2014. It should be noted that this goal focused on actual food producing areas or growing spaces themselves — such as the square footage of planting beds or planted green spaces. This area calculation does not include any auxiliary spaces, pathways, open spaces or non-productive areas within or around the agriculture site. In many cases, the food producing areas or growing spaces are much smaller areas than the site, where the average crop space per site was only 8,814 square feet, or 0.2 acres.[21] However, in the year 2012 an analysis showed that food producing community gardens in Minneapolis far exceeded the 2011 baseline estimate. In 2012 the HGM estimate for food producing gardens was at about 18 acres. By 2014, the HGM estimate was at almost 21.5 acres — well-surpassing the 2014 target (Homegrown Minneapolis, 2014).[22]

In 2015, the Minneapolis City Council joined a prominent group of local urban farm practitioners on an educational visit to Cuba (Golden, 28 Jan, 2015). Cuba is renowned for its prosperous and sustained urban agriculture practices, having initiated progressive local urban food production in the 1960's.[23] Here the teams investigated how urban agriculture co-ops, compost sites, and urban food systems operated, considering their potential application in Minneapolis. These pro-active initiatives by city leaders and local citizens indicate the success of government actions, supporting continued community interest and participation in creating and maintaining urban agriculture within Minneapolis. Leaders and residents in Minneapolis are dedicated to promoting urban agriculture interests, and the city is eager to unite the private and public sectors in effectively promoting and managing urban agriculture and local food systems.

Minneapolis is often ranked alongside cities such as Portland (Oregon), Chicago (Illinois), Austin (Texas), and Seattle (Washington) for factors regarding health, parks, and urban agriculture. However, compared to these competitors, Minneapolis is a much more affordable place to live. The cost of living is almost 2% below the national average, and compares favorably to the cost of living of cities like New York (30% higher living costs), San Francisco (49%), Chicago (1%), Seattle (21%), Portland (7%) and

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[21] *Homegrown Minneapolis confirmed that their area measurements were focused on the food-producing areas alone. "Quite often, however, the space reported does not reflect the whole lot's area, as the whole lot was not being used to produce food…[for example] patches of beautification (i.e. a boulevard flower bed) separate from the primary growing space were not included in the final garden size" (Homegrown Minneapolis, 2014).*

[22] *The rate of openings and number of sites increased dramatically since 2002-2014. Refer to Figure 10.*

[23] *By the end of 1999, 30% of Havana's available land was under cultivation with over 30,000 people growing food on more than 8,000 parcels in the city (Murphy, 1999). The size and structure of these urban farms and gardens varied considerably (Murphy, 1999; RUAF, 2014), ranging from individual plot gardens cultivated privately to larger commercial groups, individuals or state institutions. Workplace gardens or institution gardens for employees or student consumption were common. These farms were mainly operating as small family-run farms or as farms owned and operated by the state with varying degrees of profit shared with workers. Of the 81,544 acres in agricultural use, 25,946 acres were for "cultivos varios" – various or mixed crop production (Koont, 2009). The workforce for urban agriculture rose with 203% in between 1999 to 2001 – from 9,000 to 23,000. Five years later, the number of people engaged in urban agriculture was 44,000 (Koont, 2009). Havana's urban agriculture landscapes were incredibly productive. From the 3% of these urban agriculture landscapes, the city produced 6.5% of its urban agriculture vegetables. The distribution process happened through direct sales. By November 2006, all but 7,339 acres (8%) of the 88,686 acres were already in use as pastures, forests, and cropland (Koont, 2009).*

Austin (10%) (Forbes Magazine, 2015b). In regards to resident incomes, Minneapolis seems much closer to the majority of urban areas and metropolitan regions across the country, especially when compared to the top performing cities in the United States. This selected study area therefore allows the research findings to be more readily generalizable to broader populations, and also be applicable to (and replicable within) many other cities and communities. Minneapolis also provides the opportunity to study urban agriculture and its relationship to property values within a different climate and urban density than preceding studies (Tranel & Handlin, 2006; Voicu & Been, 2008).

Context Maps

The study area is demarcated to the city limits of Minneapolis and the urban agriculture sites within that boundary. Beyond the city limits, the locations for sites become very sporadic and the city and city-based organizations may not have such a strong influence. The figures below illustrate the study area boundaries, neighborhood contexts, and locations of the urban agriculture sites. The information was reproduced for this research from the Minneapolis Geographic Information System (GIS) database files and map base files. The waterbodies are used as a general point of orientation and reference. The maps below represent neighborhood boundaries effective January 1, 2006.

Figure 5 shows the location of the city of Minneapolis, and Figure 6 shows the study area limits, neighborhoods, and communities as demarcated by Minneapolis. Please refer to the section “Location and neighborhood variables" (page 66) for further detail on these boundaries.

Figure 7 shows the two demographic classes based on median income levels. Please refer to the section “Location and neighborhood variables" (page 66) for further detail on this stratification.

Figure 8 shows the location of the urban agriculture sites identified for this study. Please refer to the section “Urban Agriculture Data” (page 69) for further detail on these locations.

Figure 9 shows the distribution of vacant land parcels across the city as of 2014. Please refer to the section “Location and neighborhood variables" (page 66) for further detail on these vacant land areas.

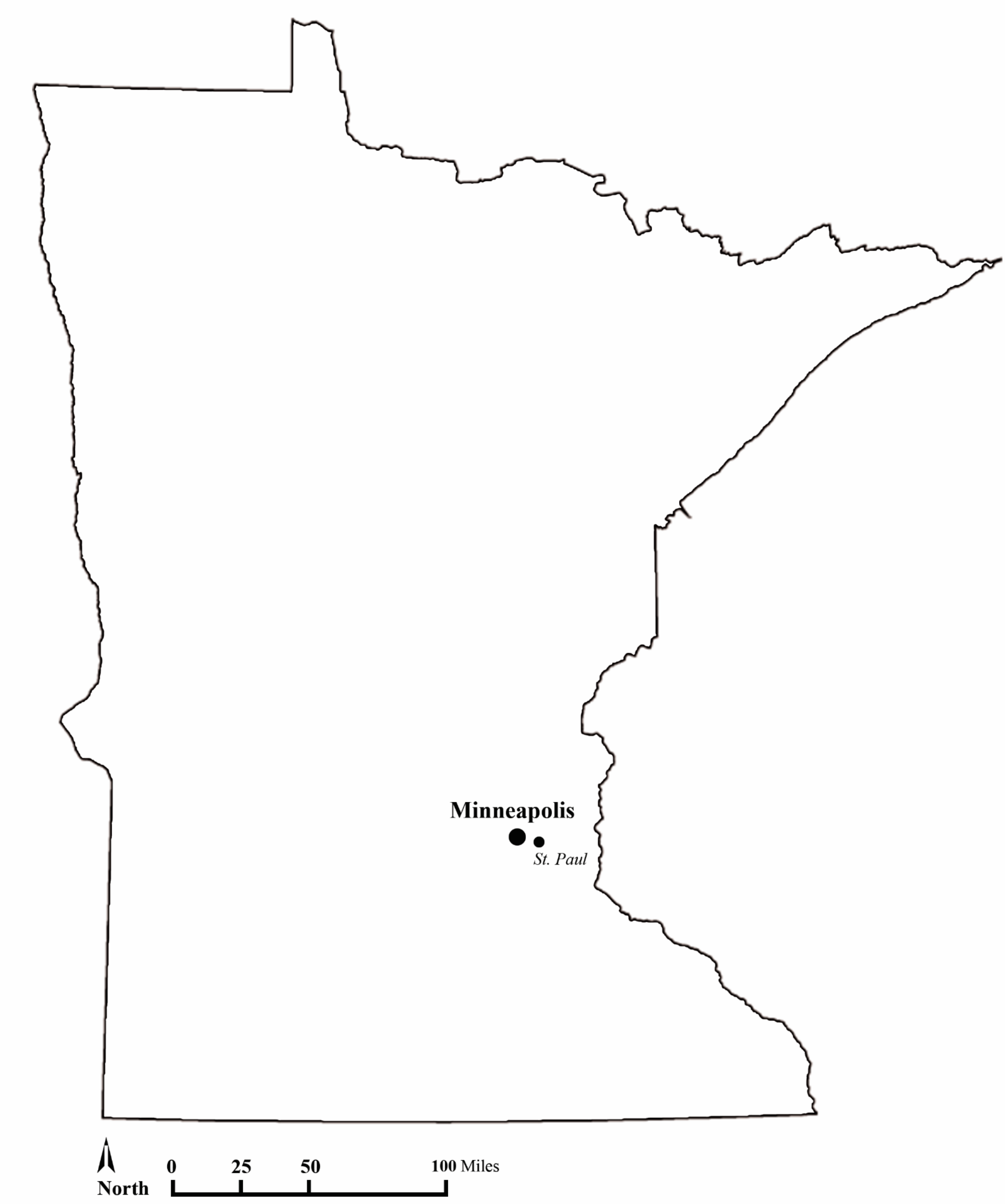

Figure 5. A map of the state of Minnesota, with the location of Minneapolis marked.

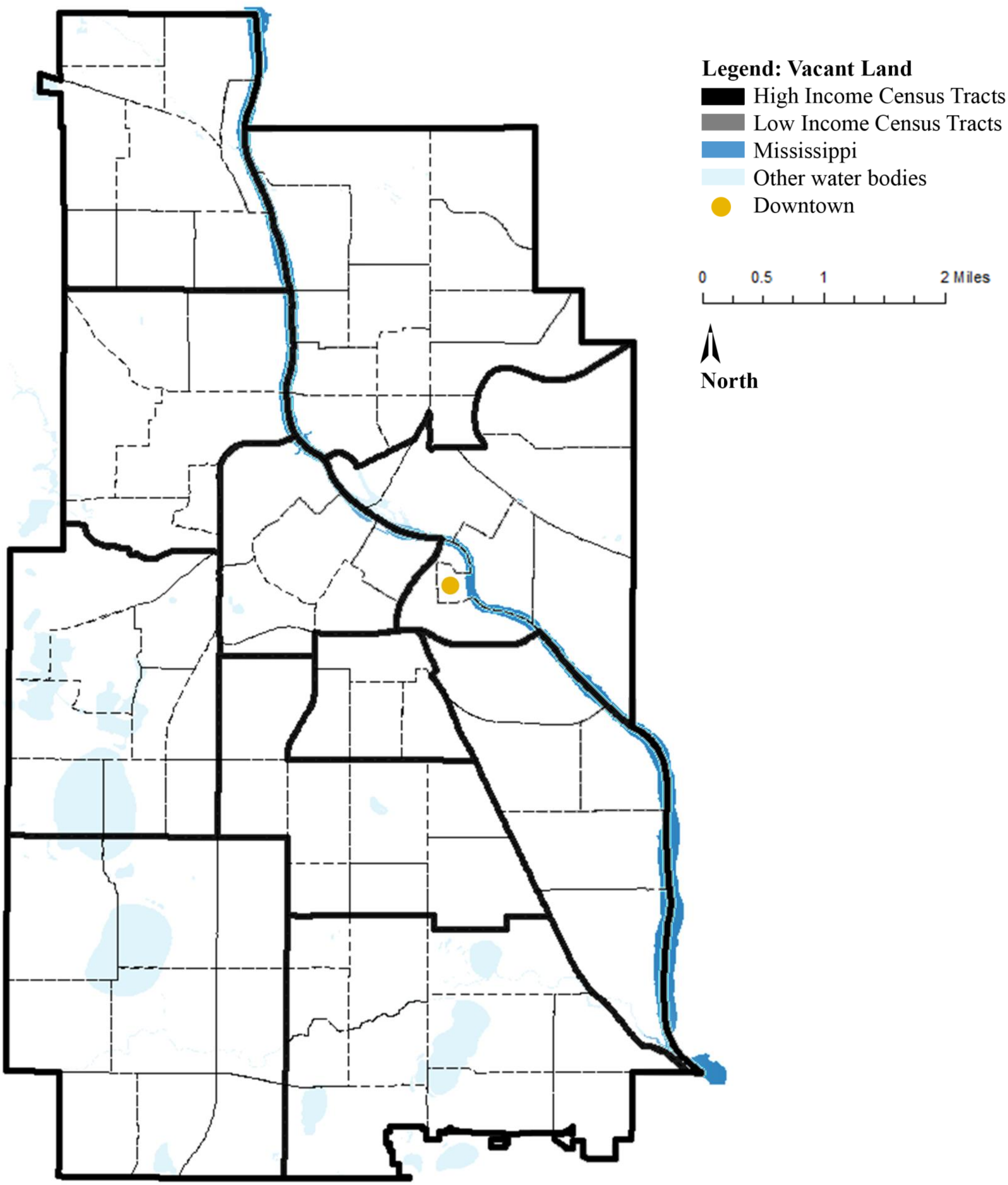

Figure 6. Study area, neighborhoods, and boundaries.

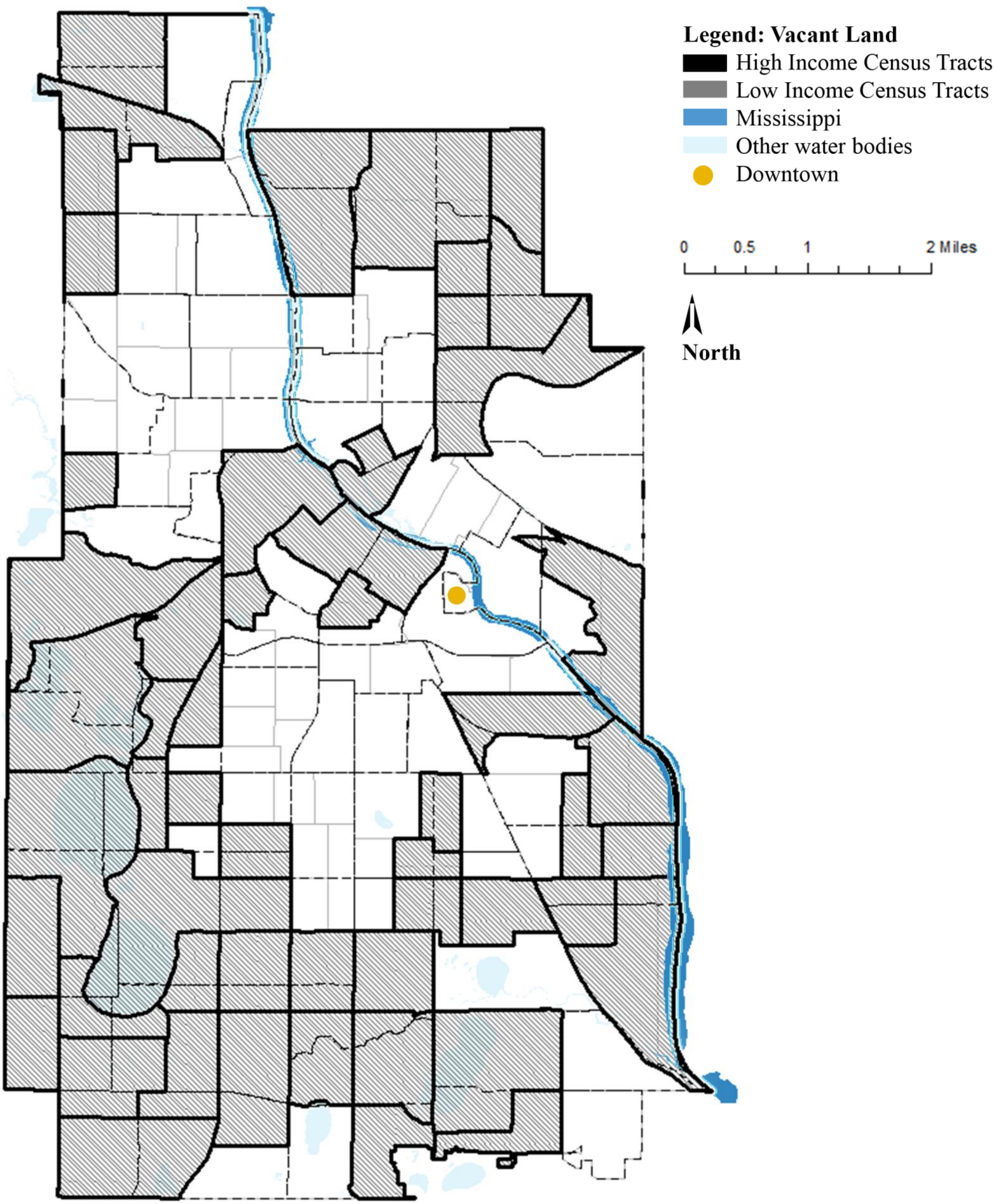

Figure 7. High and low income group census tracts.

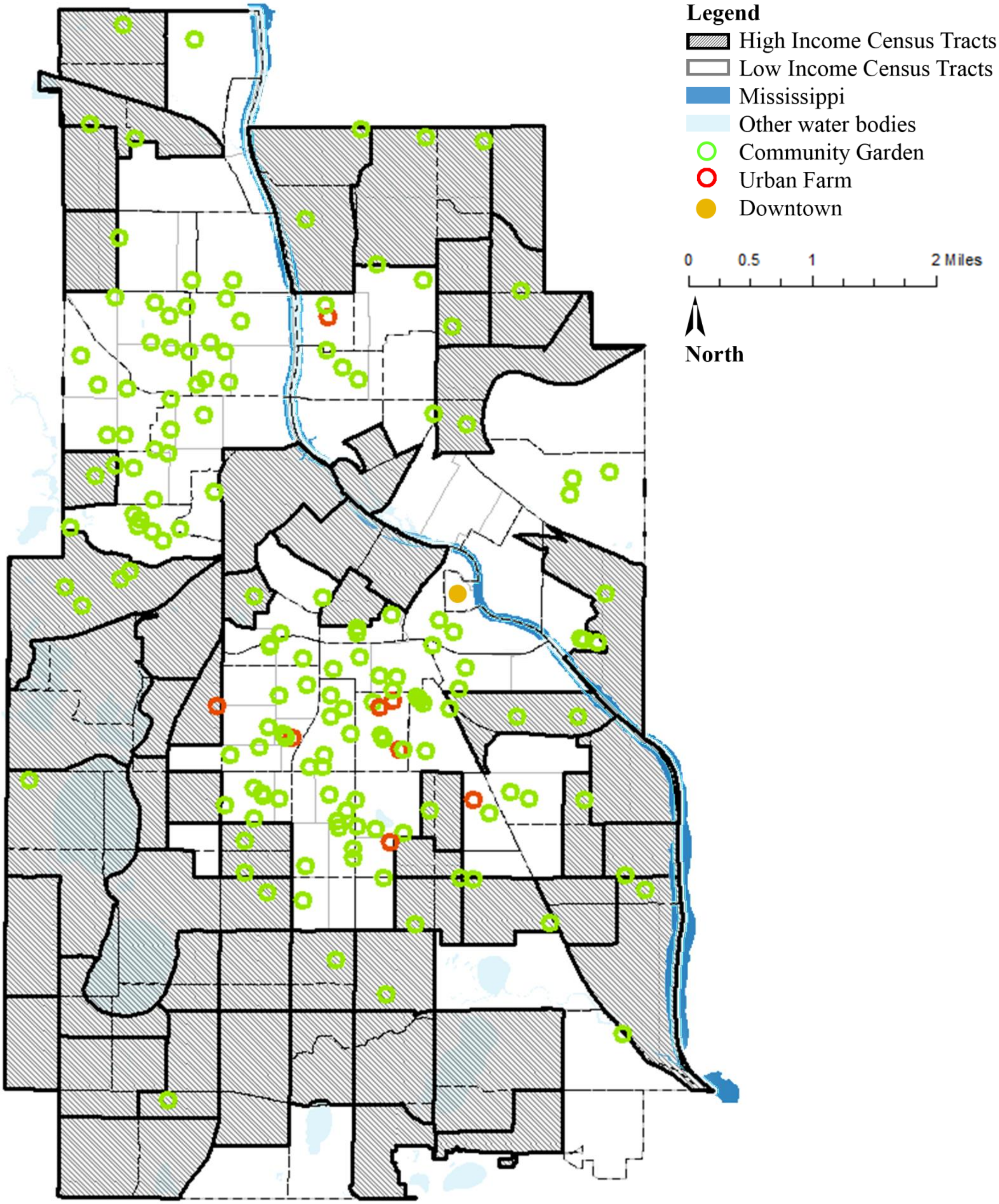

Figure 8. Locations of studied urban agriculture sites.

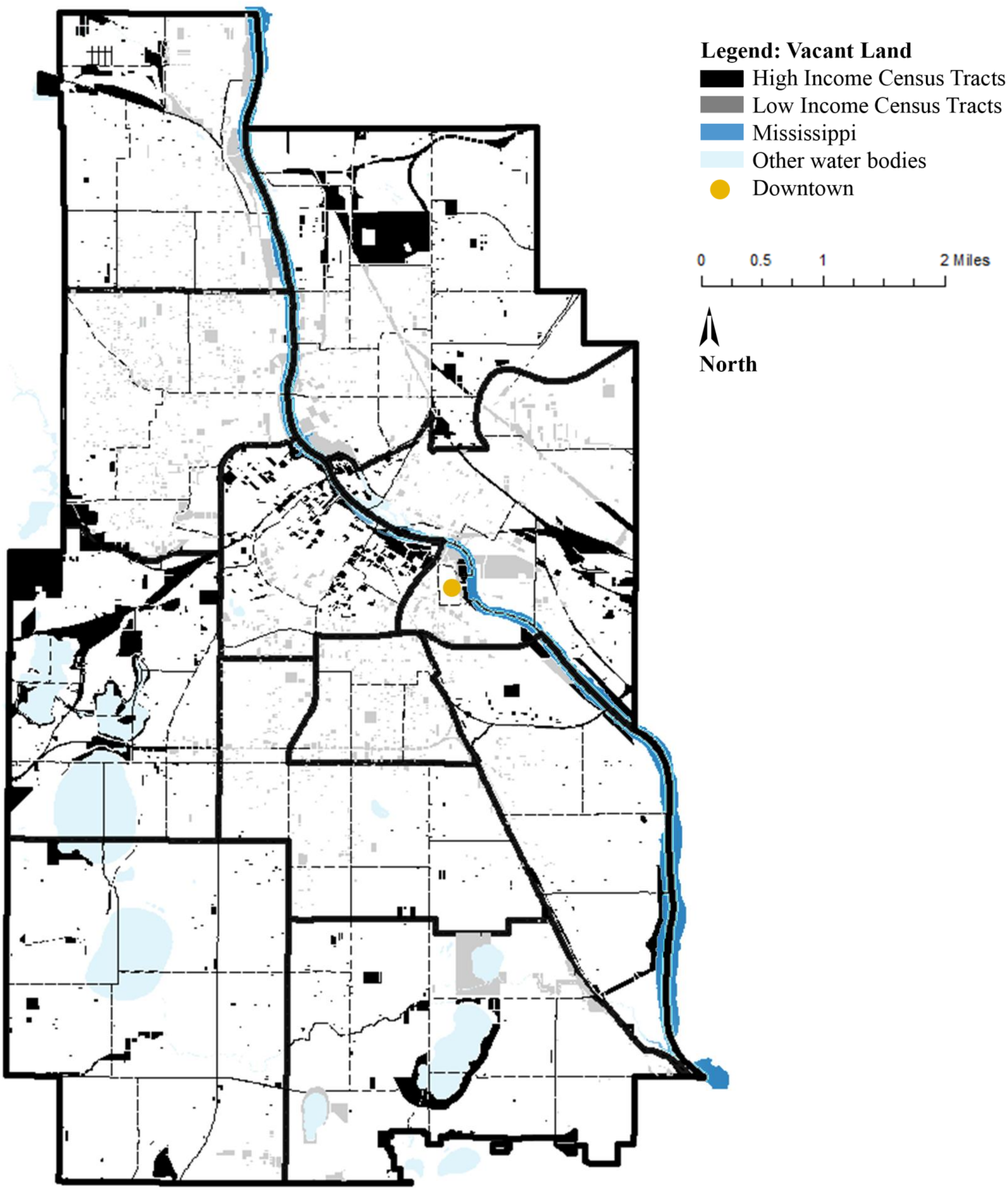

Figure 9. Vacant land areas.

Analytic Strategy

Population and sample frame, unit of analysis, and unit of measurement

The theoretic assumption for the hedonic method is that we study a single heterogeneous commodity where buyer and seller are perfectly matched (Coulson, 2008; Rosen,1974). Through multivariate regression, housing prices and their amenities can be analyzed and compared, but it is not always sensible to compare the relationships of amenities on sales price between different property types. For example, consumers who buy townhomes may have different motivations to purchase than consumers who buy single-family detached housing or apartments. A group of townhouses may share the same land and are therefore inherently different than homes with self-owned land areas. The turnover rates for townhomes are different than other housing types (National Realtors Association, 2014).[24] The differences in sales transactions can be compared most directly if a single uniform property type is used. Furthermore, as of 2013, single-family detached housing was the most dominant housing typology in the United States at 62.5% (American Housing Survey, 2013). Second were buildings with two to four residences (8%), followed by condominiums (8%), and mobile homes (7%). The majority of the literature of hedonic studies on parks, green space, and urban agriculture uses single-family detached housing. To compare these findings to other past and future studies it is most practical to use the same primary unit of analysis.[25] For the reasons above, the study unit of analysis is sales price of single-family housing.

Since the 2012 housing recovery, the year 2014 was seen as the first full year that the housing market recovered to its pre-2008 normality (Carlyl, 2014; Fortune Magazine, 2014; Mathews, 2014). In 2014 the construction industry was starting to take off again (Fortune Magazine, 2014), and the housing market shifted out of a rapid recovery phase to a more stable “new normal” phase (Carlyl, 2014). The unit of measurement is therefore the 2014 sales price in US Dollars ($), as 2014 prices reflect the most recent and relatively stable housing data available.

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[24] *Housing turnover rates can be calculated by dividing existing home sales by estimates of the owner-occupied housing stock.*

[25] *Very few studies have used residential rental data (see as example Donovan & Butry, 2011). Accurate rental data for Minneapolis is not readily available, or is inconsistent and/or questionable.*

Sales price data

The sample of single-family detached housing sales price data was taken from public sales records of single-family housing as recorded by the local metro assessors from January 2014 to December 2014 in the metropolitan area of Minneapolis, Minnesota (Minneapolis, 2014). During January to December 2014, Minneapolis recorded 2,824 arms-length transactions for owner-occupied, single-family detached home sales. None of these home sales were recorded below $10,000. Of the 2,824 recorded single-family home sales, the mean sale price was $255,226 with a standard deviation of $198,865. There was a large range of home sale prices, with the lowest limit right at $10,000, and a maximum limit of $2.7 million. Such a large range of single-family sales prices indicate that there could be other forces at work at the low and extreme high ends of the scale. To eliminate extreme outliers on low-end sales prices and prevent further data recording errors, the average assessed land value was used as a benchmark for the lower limit. The average assessed land value for single-family homes city-wide was $73,531, and the mean assessed land value for 2014 sales was $74,933. However, the mean value for estimated land values for parcels city-wide was $65,638. Rounding down, $60,000 is a more reasonable lower limit for the sales sample. Few sales occurred that exceeded three standard deviations or more from the mean. Exceptionally high sales may not necessarily mean a data entry error, but instead it may refer to some other amenity or special circumstance that spikes up a home sales price. For example, to account for rare and extremely high outliers, sales above three standard deviations above the mean (rounded to $900,000) are also excluded from the study. A reasonable range for the sample would therefore be between $60,000 and to $900,000. This excludes 120 sales or about 10% of the original sales records in Minneapolis .

During GIS spatial joins and queries, only a couple of mismatched addresses and sales price property identification numbers were found. All of these sales entries were re-identified to match properties according to the nearest reasonable address, and these entries were eliminated if the property's location was uncertain. The amended sales data had 2,702 sales entries. The final mean sales price is $245,410, with a standard deviation of $146,892. This adapted sample is seen as representative of the Minneapolis environment in 2014. Even though this sample resulted in a sales price histogram that was skewed slightly to the right, we can still proceed with analysis because of the central limit theorem. The large sample size and the central limit theorem allow the distributions of the average to approach normal irrespective of the sample distribution shape (Agresti & Finlay, 2008).

Table 3 provides the descriptive statistics for the housing sales sample for 2014.

Table 3. Descriptive statistics for sales sample		
Dependent Variable	**Range** *unit*	**Mean** *standard deviation*
Sales price (n = 2,702)	\$60,000 - \$900,000 (2014)	\$245,410 (146,892)

Control Variables

1) Structural and seasonal variables

Data from the County Assessors' Office of Minneapolis contains information on every sale. This includes information on building area, date of construction, the type of bathroom, number of stories, and number of garages.[26] The numbers of bedrooms were not provided with the dataset. However, the varieties in types of bathrooms are indicative of the quality and quantity of the living spaces of the property and remains in the model. The average house that sold during 2014 has a building area of 1,320 square feet, and the average lot size of 5,777 square feet. The average house that was sold was built in the 1930's. The parcel size helps controls for the associated value of the land. Diagnostics indicated that parcel size appeared to be slightly positively skewed, where almost 65% of the parcels sizes were smaller than the mean. Again, due to the central limit theorem, this is not a major concern. The time of the sale is captured in four sales quarters and controls for the seasonality of home sales.[27] Table 4 provides the full descriptive statistics on structural and seasonal characteristics.

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[26] *Variables for "stories" and "garages" are highly correlated with building area and were removed. Similarly, "three quarter bathrooms" and "deluxe bathrooms" were removed, and only "full bathroom" and "half bathroom" were used as controls instead.*

[27] *With initial models tests the months of sale showed no significance across any models, but when the months were collapsed into sales quarters, significant relationships were found.*

Table 4. Descriptive statistics for structural and seasonal characteristics		
Variable	**Range** *unit*	**Mean** (std. dev)
Building Characteristics		
Building Area	200 – 4,424 *square feet*	1320.69 (439.43)
Parcel Area	1,765 - 84,540 *square feet*	5,806.022 (2,100.93)
Full Bathrooms	0 – 3 *count*	1.12 (0.438)
Deluxe Bathroom	0 – 2 *count*	0.023 (0.16)
Three Quarter Bathroom	0 – 4 *count*	0.33 (0.52)
Half Bathroom	0 – 3 *count*	0.24 (0.46)
Garage Stalls	0 – 4 *count*	1.51 (0.65)
Building Age	0 – 131 *years*	83.80 (23.23)
Sales Quarter		
Sales Quarter 1	1 – 510 *dummy*	18.9 (39.13)
Sales Quarter 2	1 - 976 *dummy*	38.52 (48.03)
Sales Quarter 3	1 -1041 *dummy*	51.84 (48.67)
Sales Quarter 4	1 - 175 *dummy*	6.48 (24.60)

2) Distance

In regards to distance as a factor, this study is concerned with a parcels' location within the city and with a parcels' proximity to urban agriculture. The initial model was run on several distance measurements. Proximities were initially measured in Euclidean distance (measured in feet from point to point) as well as street network distances (feet along drivable or walkable streets) for each sales parcel. Street network distance bests reflected the general route behavior of residents within their communities and, by extension, describes how a visitor from outside may move about within the neighborhood. In general people tend to walk or drive along streets and sidewalks and normally do not short-cut through private properties, especially if they are visitors to the area. The network distances provide a better overall model fit, while also reflecting methods of recent comparable literature (Netusil et al., 2014). Ultimately the network distance measurement proved to be superior because it is a route measurement, where Euclidean distance is not a route measurement, but merely a two-dimensional and abstract distance value. Euclidean distance measurements were therefore not used in the final study.

3) Location and neighborhood variables

This section reviews location and neighborhood demographic variables used in this study. Within the city proper, Minneapolis has 11 community districts, 87 neighborhoods, and 144 census tracts. Several neighborhoods or districts had no sales in 2014. Several neighborhoods or districts had no sales in 2014. Please refer to Figure 6 for a graphic representation of the study area.

Location is important to housing choice, as travel-cost to work or proximity to amenities is a major influence for many home-buyers. To measure the relative location choice of a particular sales parcel, this research investigated distances to downtown, neighborhood dummies, community dummies, and socio-economic indicators on the block level, census tract level, and neighborhood level. To understand the socio-economic make-up of different locations, five indicators were tested: (1) the percentage of White population per census tract, (2) median-income per census tract, (3) the number of subsidized housing units per census tract, (4) the location in city, and (5) the number of vacant land parcels in a neighborhood. After several iterations and variations in running the model, the demographic data at a block level were shown to be insignificant predictors whereas census tract level predictors were stronger. Socio-economic measurements were studied at a census tract level only.

The neighborhood population make-up was captured by the percentage of White residents recorded to be living within a specified census tract level. The neighborhood economic condition is captured by the median household income (and income squared) at the census tract level. In order to qualify as a low income household, a household could not have income exceeding 80% of the state median income per household. The median household income for Minnesota in 2013 was $60,702, thus setting the threshold for low income households in Minneapolis at $48,561 (American Housing Survey, 2013). These figures set the majority of sales properties for 2014 within a high income market, as 68% of the sales occurred in high income census tracts.

Likely, some neighborhoods have lower socio-economic conditions than others, and thus some neighborhoods may receive more support from local, state, and federal government entities than others. It was not possible to obtain reliable information on the number of community initiatives in a neighborhood. These initiatives vary drastically over time due to funding limitations, program dissemination across a multitude of different parties, lack of formal registration or formal listings, or having resident privacy/sensitivity protection. The number of subsidized housing units can be used as a measure to capture the less tangible socio-economic conditions within a neighborhood (Ellen, 2007). In this study, the number of subsidized housing units as well as the number of subsidized housing parcels was available. These were paired with the sales data on a census tract level. However, the number of subsidized housing units and the number of subsidized housing parcels were highly correlated, and only the number of subsidized housing units per census tract was tested in the final model. The numbers of subsidized units or parcels per census tract are unnecessary control variables, as they were not significant in any iterations of the model.

The initial rounds of investigation showed that the dummy variables for community districts produced an overall higher model fit than the dummy variables for neighborhoods. This is because the census tract variables adequately explain the surrounding urban conditions in quite a lot more detail than at the neighborhood level, allowing the community district level “location dummy” to capture any remaining unknown qualitative characteristics not captured by the census tract level. Lastly, both Euclidean and network distances to downtown were included in the first iterations of analysis. However, because the sample is controlling for community districts as well as census tract level in such detail, the distance to downtown measurement became redundant, and was omitted from the final model. Finally, the number of vacant land parcels on a census tract level showed a statistically significant relationship with housing sales price and was thus included in the model.

These predictors control for the overall socio-economic and neighborhood conditions of the sale locations. Table 5 shows the descriptive statistics for location and neighborhood data for the sample.

Table 5. Descriptive statistics for location and neighborhood data		
Location		
Variable	**Range** unit	**Mean% of Total** (std. dev)
Community District	Community 1 *dummy*	4.96% (2.18%)
	Community 2 *dummy*	12.76% (33.36%)
	Community 3 *dummy*	10.20% (30.27%)
	Community 4 *dummy*	5.66% (23.10%)
	Community 5 *dummy*	11.58% (31.99%)
	Community 6 *dummy*	0.52% (7.18%)
	Community 7 *dummy*	11.83% (32.30%)
	Community 8 *dummy*	21.23% (40.89%)
	Community 9 *dummy*	1.59% (12.51%)
	Community 10 *reserve*	19.61% (39.70)
Median Income *census tract*	$9,063 - $17,8977 *2010*	69,735.34 (36,065.37)
High Income *versus Low Income*	0 -1 *dummy*	68.21% (46.57)
% White Population *census tract*	9.26% - 93.25% *proportion*	70.97% (21.17%)
# of Vacant Lots *census tract*	29 – 607 *count*	178 (101.36)

Urban Agriculture Data

There are two primary organizations working directly with local food groups in Minneapolis — Gardening Matters and Homegrown Minneapolis. This section discusses data provide by each organization. The first major organization is Gardening Matters, a non-profit organization which started in 2008. This non-profit organization has a large but sporadic database of 761 urban agriculture sites across the entire Minneapolis-St. Paul area. The database is comprised of voluntary, self-reporting information from urban agriculture practitioners or community garden groups. The data was first collected via a hard-copy or printable questionnaire from 2008-2012, and around 2012 the survey and information was transferred to an online survey and map. This map is freely and publically available and accessible online. The non-profit organization willingly shares most information with the city and other interested parties. Although Gardening Matters keeps their databases updated as new information arrives, and participants are allowed to provide new information at any time, the new information is added at irregular intervals. After some investigation it became clear that many of the entries within the Gardening Matters database were not defined to a level that could be used for this analysis. Due to the voluntary nature of the database, many entries were incomplete or information was unclear. Even though the Gardening Matters questionnaire and database categories did provide a foundation for a this research work, much additional consolidation and triangulation work had to be done to ensure that the data was consistent, reliable, and usable.

The second organization is Homegrown Minneapolis. Minneapolis developed a Sustainability Program in 2003, and by 2009 the city compiled the “Living Well Sustainability Report.” During this six-year period, the city revised its “Sustainability Indicators” and extended these indicators by including a “Local Foods” indicator. From this process, a city-led organization called Homegrown Minneapolis was established to facilitate local food systems and urban agriculture. Homegrown Minneapolis conducted a survey in 2012 to investigate the food producing conditions and targets for the city (J. Shey, personal communication, March 20, 2014). A new target was set to increasing the land devoted to producing food in Minneapolis by one acre by the year 2014, using the year 2011 as a baseline mark. Homegrown Minneapolis collaborated with Gardening Matters, and their final database within the report consisted of 106 food producing community gardens only.

In 2010 Minneapolis (via the Homegrown Minneapolis organization) publically announced that they had made 16 sites freely available for urban agriculture. By the years 2014/15 this number increased to over 30 sites (Homegrown Minneapolis, 2014) indicating the local governments’ steady and ongoing commitment to the increase of local foods and urban agriculture within the city. However, many of these newly available sites were not captured in the dataset for this dissertation, as they had not yet been occupied and developed for food production at the time of data collection. Thus, a total of 158 urban agriculture sites were available for examination.[28]

Overview of the Urban Agriculture Sites

Urban agriculture is both a productive activity and a social urban activity. In many cases, community gardens or urban farms are part of youth programs, regeneration or revitalization efforts. Urban agriculture can be managed by either public or private institutions, individuals or combinations thereof. There can be many actors and parties involved and the urban agriculture program may change over time to fit new agendas or be relocated to different lots.

Many of the 2008-2012 Gardening Matters survey questions (and the online questions) allowed for participants to give multiple answers. In some cases the participant who filled out the first survey did not fill out the follow-up survey so the next survey participant would have some contradictory responses regarding the same site. Some of the entries in the datasets provided ambiguous stories. To compile a usable database for this research, several site visits and meetings with the staff of the non-profit organization in Minneapolis were conducted. The location and information provided for each sites was cross-checked with the new data from online surveys that practitioners filed over the years since 2008 for Gardening Matters, and also against the Homegrown Minneapolis report from 2012. During 2014 the new and incoming responses were included and cross-checked with the existing database, and unreliable entries were corrected or updated. The final suitable urban agriculture sample was narrowed down to 158 sites in Minneapolis only. This dataset only include sites that show evidence for a reliable opening date. It is very hard to determine the exact cause and date of each site closure. All sites that have formally closed or show no evidence to suggest that they are being used for urban agriculture purposes have been omitted from the study.

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[28] *After several conversations with staff members and urban agriculture practitioners, there seemed to be a general perception that the non-profit organization had greater direct positive contributions to the state of urban agriculture than the municipal initiative (up to this point in time). However, this perception may not accurately reflect the impact of the municipal organization since the municipal organization is relatively young compared to the non-profit (and it can take some time to effectively mobilize forces and focus efforts). In addition, the city-led organization is working much more in depth within the policy and city-strategic realms, whereas the non-profit organization has direct contact and input with the practitioners (via workshops, leadership training, on-site advice, ongoing site programming, city-wide community events, and other supporting activities).*

1) Opening date

The first hurdle was to determine reliable opening dates for each of the urban agriculture sites. The information was checked, triangulated, and corrected by contacting the supporting neighborhoods or project organizations. Many of these contacts were tracked down via their webpages, Facebook groups, or via other conversations, emails, or phone calls. If the opening data was still unclear, unknown or uncertain, Google Earth was used to scan back in time to the last aerial image with sufficient evidence that the site was used for urban agriculture. For example, many times the site had different year of opening on the records, or there was uncertainty about the opening date. The information was corrected by contacting a representative of the site directly, and if that failed, the site history was traced back using Google Earth satellite imagery to find a reasonable opening date. In all cases, evidence was found for a reasonable and reliable opening date for each site. The mean age for a site is about 10 years, with the oldest listing at 71 years. Over 34% of the sites have records of opening dates older than 10 years.

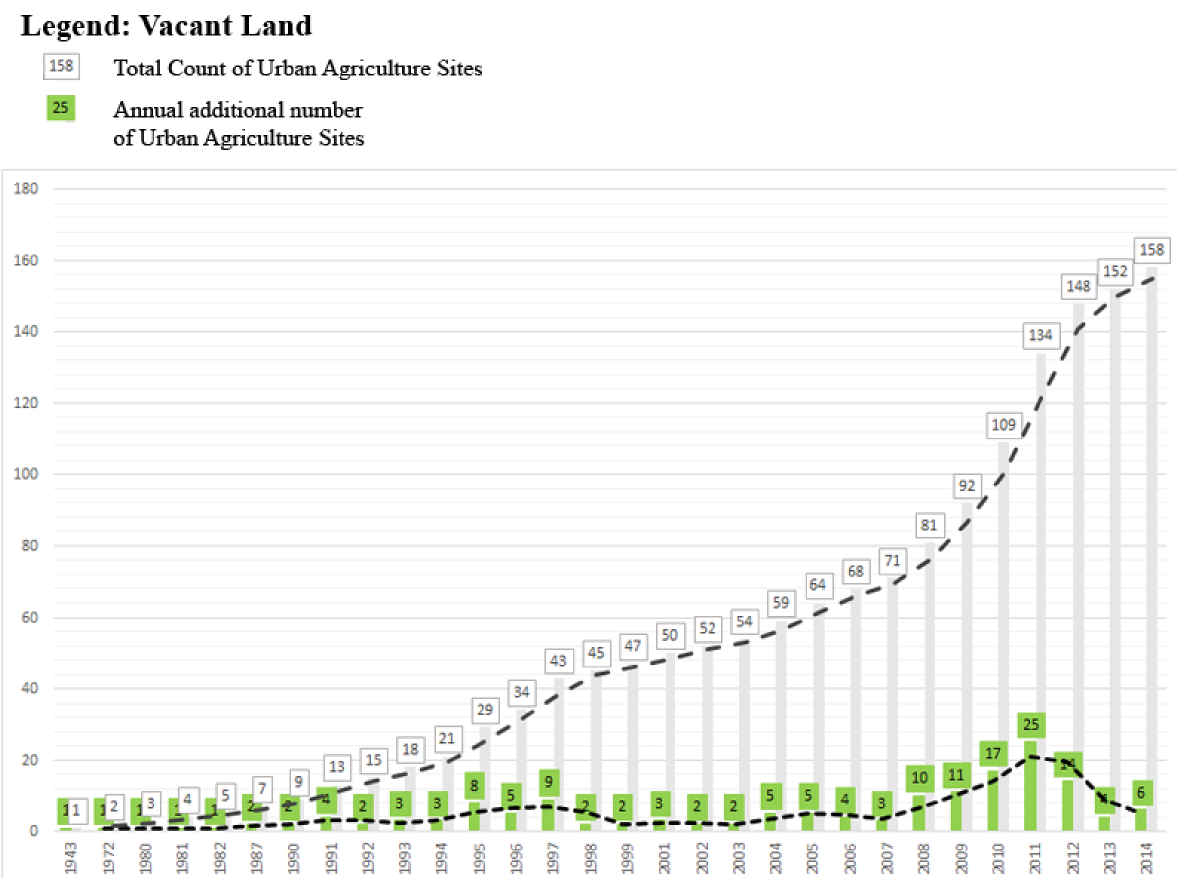

Figure 10. Opening dates and number of sites.

When we compare the opening of new sites per year to the total of active urban agriculture sites in Figure 10 we can see that there is an increase in the number of openings of sites in recent years, with a spike around 2011. Using 2007 as a baseline, the number of site openings almost tripled between 2007 and 2008, and by 2011 there were almost eight times more urban agriculture site openings per year. The opening of Gardening Matters (2008) and the establishment of Homegrown Minneapolis (2010) seem to be associated with these spikes.

The dip in the last couple of years may be explained in several ways. Often sites do not register in time for the surveys, and only register themselves a couple of years later once they are more established. Many sites may register but often do not survive beyond three years (two to three growing seasons). These sites may eventually be dropped from any databases or never even reach any formal listing on a database. In addition, the Urban Agriculture Policy Plan and other supporting activities allowed the entry of urban farms onto the scene. The oldest formally established urban farm in this database is only three years old, but the number of openings increased each year. The activities preceding the establishment of an urban farm usually takes more time, as it is more capital intensive than a community garden. Finally, urban agriculture sites are not required by any regulating authority to formally register themselves. As establishments retroactively register themselves, it is reasonable to assume that the number of openings for this period will likely be recorded more accurately (and also increase in number) in future databases. It is clear that there is systemic support contributing to the abundance of urban agriculture in Minneapolis.

2) Urban agriculture category

Urban agriculture can be classified in several different ways. Most of these classifications depend on the scale and management of the site (Philips, 2013). However, there was no specific option on the Gardening Matters surveys that allowed sites to address their typology (for example whether they function as a school garden, farm-to-table agriculture site, or a for-profit site). Sites only listed themselves either as community gardens or urban farms. In several cases, observation leads one to believe that some community gardens behave more like market gardens, but it was unclear how to make a definitive distinction based on the existing data or without a more rigorous survey. For example, the databases and existing questionnaires do not have detailed information on each of the participants within community gardens, so we are not able to determine if certain individuals sell produce from a community garden at some other location. The decision was made that sites that do not explicitly identify as “urban farms” will be categorized under “community garden” only.

One organization has several urban farms located throughout the city. They run urban agriculture as a primary business and have supporting business services such as renting out tools, providing workshops in agriculture, and providing horticulture or greenhouse services. A distinction could have been made between school-yard gardens or neighborhood gardens, but this difference became ambiguous very quickly.[29] For example, many school-yard gardens or youth programs offer the use of their lots to nearby residents as well, and are not exclusive to a youth demographic. Therefore, only two categories ("community garden" or "urban farm") were considered valid for this study.

3) Lot area

The area covered by each urban agriculture site is measured as the total area occupied by the agricultural activity, supporting amenities, and/or associated infrastructure. This measurement is different to the measurement found in the Homegrown Minneapolis 2012 city survey for a couple of reasons.

First, the Homegrown Minneapolis 2012 city survey was concerned with food producing area alone. However, this study is concerned with the urban agriculture site as an urban space and program. Many other activities happen within the urban agriculture space — for example, public seating or gathering areas, and storage areas or toolsheds. All of these form part of the activity of urban agriculture, are visibly present on the site, and are therefore accounted for in the area measurement.

Second, very few urban agriculture sites in Minneapolis are completely hidden by a high wall or other major visual barrier. Most sites are fully visible to the public, are mostly unfenced, and/or have a permeable fence. To ignore these auxiliary features, one would have to assume that a neighborhood resident or a passerby is also blind to these features, which is highly unlikely. Since aesthetics of neighborhoods parks can play a role in residential property price variation (Espey & Owusu-Edusei, 2001), and highly visible urban agriculture can be seen as having park-like qualities, the urban agriculture "lot area" should be measured in its entirety.

Finally, production areas may change over time according to change of circumstances such as availability of funding, operational limitations, expansions of operations, or external urban factors such as gentrification. This makes "production area" an unreliable measure for the purpose of this study. If production areas of sites expand, the associated activity space related to or supporting food production will likely expand as well. Therefore, using "production area" or growth area is not an accurate measurement to capture the basic effect of urban agriculture as an activity space. Instead, the entire visible urban agriculture site as it is seen from the street is demarcated as the urban agriculture area.

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[29] *The same applies for "primary program" of the site. Many sites have many overlapping programs and activities, which makes it complex and difficult to point the exact primary program for each site in this way. For this reason, program categories are not included as a factor for analysis. Please refer to the Appendix A for a detail description on each program category.*

4) Land ownership of urban agriculture parcels

The urban agriculture sites across the city have a great variety of landowners and organizations associated with each site. There are some discrepancies between the GIS database and the survey results on landownership. For example, some land portions were recorded as belonging to a school, but on the GIS database the land was shown belonging to the city. The GIS database was used as a basis for landownership, and amended with the most recent sales data as deemed necessary for the year 2014. From this record the majority of sites are understood to be situated on private parcels, with only 37% of urban agriculture sites are located on public parcels. The leading landowners are businesses or corporations (18%), faith-based institutions (16%), private individuals (15%), schools or academia (8%), neighborhood organizations (7%), and housing authorities (6%). With the majority of sites situated or owned on private lands, it seems clear that there is strong grassroots support for urban agriculture in Minneapolis.

5) Neighborhood and support organizations

About one third of the sites belong to neighborhood organizations. However, belonging to a neighborhood group does not necessarily mean the site is directly supported in terms of funding or services. In some cases the organization only acts as platform for communication to members or the community in general. In other cases the neighborhood organization owns the land and may lease it out, or is only contributing financially to the urban agriculture site. The majority of sites show evidence of funding or operational service support by an outside organization — that is, receiving support beyond the contributions of participants or members. Many sites indicated multiple partnerships with a variety of local organizations, and some sites even share the same physical spaces (property). Where there was reasonable evidence for outsider organizational support via funding or donation, only the dominant partnership was recognized. Table 6 illustrates the descriptive statistics for the attributes of the urban agriculture data.

Table 6. Descriptive statistics for the attributes of the urban agriculture data		
Category	**Description** *unit*	**Percent of Total** *(n = 158)*
Age	Opening Date *year*	1943 – 2014 (2004)
	Age *years*	0.5 – 71 (9.8)
Type	Community Garden *count*	94.94% (150)
	Urban Farm *count*	5.06% (8)
Scale	Lot Area *square feet*	417.40 – 152,886 (10,285)
	Total Area *square feet*	37.30 acres (1625,040)
Ownership	Public *count*	37.34% (59)
	Private *count*	62.66% (99)
Landowner	Business / Corporation *count*	17.72% (28)
	City / Government *count*	16.46% (26)
	County / State *count*	5.06% (8)
	Faith-Based Institution *count*	15.8% (25)
	Housing Authority *count*	5.69% (9)
	Neighborhood Organization *count*	6.96% (11)
	Non-Profit *count*	1.90% (3)
	Parks *count*	2.53% (4)
	Private Individuals *count*	15.19% (24)
	Railroad *count*	2.53% (4)
	School or Academia *count*	8.34% (13)
	Other *count*	1.90% (3)
Support	Neighborhood Organization *count*	34.17% (54)
	Other Support Organization *count*	69.62% (110)

Detailed Site Characteristics

All urban agriculture sites are not the same. Some sites may have a strong core organizational support or communication methods, but may be in fairly poor physical condition, and vice versa. One has to consider both the organizational and spatial structure differences between the sites. Distinct characteristics of each urban agriculture site can determine the level of quality of the site. It is necessary to construct measures that can fairly equalize the different features of the sites. One way to do this is to create indexes that determine (estimate or project) the overall performance of each site. By constructing indexes, it is easier to compare across different sites and to understand which factors may contribute to or are responding to the model. Two indexes were created in an attempt to capture systemic and spatial conditions independently. Site visits were conducted to observe and record site attributes during 2014 and each site was photographed and documented during these site visits.

1) Participation prioritization

Half the sites prioritize certain participants over others. The reasons for participant prioritization often include a preference for a certain demographic such as ethnic groups, seniors, women, youth, or local residents only. One third of the sites required an annual or monthly participation fee. While the majority of plots allow for communal beds, about 30% of the sites are restricted to individual lots only. This indicates that, although many sites may be free for a resident to access, there is a desire to control the use of the space. Most sites are fairly well organized in terms of membership or participants. If a site shows sufficient evidence for participant restriction, the entry was coded as “1” and “0” if otherwise.

2) Group activities and public participation

The Gardening Matters Survey had questions related to regular, annual, and seasonal meeting dates and group work days. Each entry review was followed up by contacting the primary organization directly, or following the Facebook activities online. If there was sufficient evidence to suggest that the urban agriculture site had regular meetings or group work days, the entry was coded as “1”, and the entry was coded as “0” if otherwise. The majority of sites (71.5%) host some form of regular, annual, or seasonal meeting with members, but only half (53%) provide sufficient evidence for group work days or activities. It was not really possible to determine the frequency of activities accurately, but considering the nature of the program, the majority of these meetings and activities should spike during the summer months. Casual observation during site-visits indicate that there were not too many active participants at a single time, with mostly a few individuals or couples working together or collecting produce from a site.

Gardening Matters is the most prominent organization with an established partnership with the Minneapolis city government. Gardening Matters frequently organizes and supports city-wide events. These events can be seen as a proxy for the level of integration that the urban agriculture sites have with city-sponsored urban agriculture events. Urban agriculture sites may register themselves with Gardening Matters voluntarily and are included in the event schedule. These events usually lasts a couple of days, and includes city-wide tours of urban agriculture sites. A site that commits to more than one city-wide event over the years is presumed to show a higher level of commitment to participate in city-wide initiatives. Thus, if a site participated in more than one city-wide event over two or more years, it is coded as "1" and a "0" if otherwise. Twelve percent (12%) of the sites seem to actively and continuously participate in city-wide initiatives. Many of the other urban agriculture sites (especially market farms and youth program sites) have independent and particular goals and activities which do not always align with city-sponsored efforts and events. Capturing the participation of a site in city-wide event via participation with the Gardening Matters organization shows that a site has a degree of social and systemic integration with organizations and networks outside of the urban agriculture sites' own internal structure.

The Gardening Matters questionnaires address local community events and activities related to urban food production. After investigating the individual entries, webpages, and/or Facebook pages for each site, it was clear that some sites are actively incorporating entertainment or social gathering events in their programming. Following a similar methodology that was used for coding the city-wide events, the sites that indicated that they have hosted or organized more than one annual local event was coded as "1" and "0" if otherwise.

The major difference between city-wide events and local events is the frequency of these events. Most of the sites that host local events are actively promoting or hosting events several times a year, whereas city-wide events generally only take place once a year. This suggests that there may be additional avenues to explore to encourage higher levels of public interaction, and that urban agriculture and food production events are not yet optimized across the city.

3) Public communication and internal communication

Signage is deemed important because it helps to communicate the nature or purpose of the site, as well as any rules or regulations associated with the space. As most sites are within residential areas, good signage helps to create interest from passersby who may otherwise think that the space is unapproachable private property. Legible signage is important because it is often the first communication medium to the general public. The city does not require particular signage or have regulations as to what must be posted on the signs, so content and legibility varied from site to site in Minneapolis. Only 53% of urban agriculture sites studied have a clearly visible signs with an associated name that is legible from the street or sidewalk. Signage that is visible from the street and which contains the name of the site or supporting organization was coded as “1” and “0” if otherwise.

Formal internal communication is indicative of a strong organizational character. The majority of sites indicated that they have formal means of communication via an email list-serve or a phone tree, or a dedicated and active Facebook page with active members. However, some respondents noted that they only have general or basic notices on webpages or other media. Respondents that indicated a formal communication through email or phone trees were coded as “1” and if otherwise as “0.” If there was sufficient evidence for formal communication methods, the entry was coded “1” and “0” if otherwise.

An online presence increases the ease of accessibility of information and increases the level of public communication for the urban agriculture. If the site had a dedicated webpage the entry was coded “1” and “0” if otherwise. A dedicated webpage is considered to be either a full stand-alone webpage, or a nested page or section. However, if the urban agriculture site only had a small paragraph or two attributed to their activities and this information was hard to find, or the information was older than one year, or if there was no communication method listed, the entries were given a “0.” Only dedicated webpages, active Facebook groups, or dedicated nested webpages were considered adequate evidence that the urban agriculture had an active online presence.

Furthermore, Gardening Matters has an online map listing many urban agriculture site across the Twin Cities. A site can volunteer to have certain information accessible to the public via this map, including addresses or detailed descriptions. Not all sites that have dedicated webpages have a presence on this map, especially not market gardens or urban farms. Some sites are dedicated to support the welfare of sensitive demographic groups (for example troubled youth), or have educational, healing, or therapeutic programs. These sites are sensitive to the communities which they serve, and may not want their information made public. However, a site that was present on an online map increases the public accessibility to the site. If the site was listed on this map, the entry is coded as “1” and “0” if otherwise.

It is reasonable to assume that sites that have a particular set of goals, ambitions, or priorities have a higher interest to preserve the urban agriculture program for a longer period of time. These goals are sometimes noted in the survey responses, or are explained on webpages, or were discussed with the researcher through email correspondence. Almost half of the sites have clear goals. Sometimes there is no clear distinction between those activities which relate to stated goals, and activities that are simply reflections of what is going on at the site in general. Those sites that show evidence of particular goals and specific ambitions were coded “1” while sites without clearly designated (or ambiguous) goals or ambitions were coded “0.”

4) Gleaning and contributions

Very few of the urban agriculture sites explicitly donate their produce to the public. Only one third of the sites indicated that they allow the public to glean produce from the site, or are formally registered with a food cluster group. This indicates that the produce for the sites are primarily for individual consumption or sales. However, anecdotal evidence and informal conversations with practitioners suggest that the low level of contributions of fresh produce to the public is more likely due to a lack of coordination between urban agriculture sites and the city food clusters or pantries.

There is a grey area between gleaning food/produce from the site, and stealing food/produce from the site. Many parcels had signs up warning visitors not to steal food from the sites, where many others encouraged gleaning. This is may be another reason for the provision of formal signage for sites, so that there is no further miscommunication to the public. If there is sufficient evidence to suggest that the site actively donates or allows gleaning, the entry is coded "1" and "0" if otherwise. Sites that had signs up asking people not to take produce were also coded with "0."

5) Vested interests

Most of the properties occupied by urban agriculture in Minneapolis (except for the eight urban farms that function as formal commercial agriculture sites) are leased cheaply by either the city or private party, or are donated freely for a period of time. Each site has a different tenure structure or lease period, and some do not have lease periods at all. It is not always possible to determine which sites have extended leases. For a number of sites the nature of land tenure is unclear. Instead of using tenure to understand the vested interest of the particular sites, the duration or age of the site is used as a proxy for tenure. In this way, the tenure condition is captured by the basic assumptions of the dataset: only sites that have continued to remain open and have not been formally closed are included in the data.

The presence of administrative and structural investments, such as liability insurance, soil tests, toolsheds, hoop houses, water barrels, fences, raised beds, threshold entrances, and tended pathways indicate that at least one party shows capital commitment to the site. Only one third of the sites have verified that they have conducted some form of soil test in the past, where almost two thirds of the sites indicated that they are aware of, or are paying, liability insurance. Soil tests and liability insurance requirements are not always mandatory, and may vary with the site conditions, site program, and neighborhood rules. Where evidence was found for these capital interests, the entries were coded "1" and "0" if otherwise.

6) Visibility and access

Very few sites are locked, enclosed, or inaccessible to a pedestrian. For example, almost half of the urban farms are locked but the other urban farms are completely open and accessible. The majority of these sites are easy to enter as a pedestrian. This indicates that the vast majority of the sites are generally accessible to the public without major physical restrictions. It is uncertain exactly why some sites are very defensive and others not, but most likely the cause is simply to prevent theft of produce or equipment. The great majority of sites have their growing spaces clearly visible from the street or sidewalk, with many sites showing threshold entryways (64%) or well-tended pathways (43%).

Some sites show evidence of almost all of the above-mentioned characteristics mentioned as descriptors in Table 7. Others seem to be only focused on particular aspects of urban agriculture, such as community engagement or production, and neglect other aspects. From this global inventory it is clear that some sites may have very high levels of organizational support and good means of communication to the public. However, many sites also have noticeable disamenities, such as disorganized storage and exposed or messy composting areas. Site characteristics can vary quite dramatically from one site to the next. In most cases, however, it appears that the sites behave as attractive public or semi-public open spaces and are most often part of the immediate urban and public landscape. Table 7 provides the descriptive statistics on the detailed attributes of the sites.

Table 7. Descriptive statistics on the detail attributes of the urban agriculture sites

Attribute	**Description**	**% of Total** (*N = 158)*
Participation	Priority or Restriction	56.32% (89)
	Fee	33.54% (53)
	Communal Plots	70.88% (112)
Group Activities	Regular or Seasonal Meetings	71.51% (113)
	Group Work Days	53.16% (84)
	City-wide Events	12.66% (20)
	Local Events	31.01% (49)

Table 7. *(continued)* Descriptive statistics on the detail attributes of the urban agriculture sites		
Communication	Legible Sign Posted	73.42% (116)
	Legible Name (Visible from Street)	52.53% (83)
	Website	60.12% (95)
	Formal Medium of Communication	76.58% (121)
	Present on Online Map	72.78% (115)
	Dedicated Goals	56.32% (89)
Contributions	Glean or Donate Produce	36.70% (58)
	Food Cluster / Pantry	29.74% (47)
Vested Interests	Soil Test	35.33% (56)
	Liability Insurance	62.66% (99)
	Permanent structures	58.85% (93)
	Presence of Fence	44.30% (70)
	Site is Locked	21.5% (34)
	Presence of Public Seating	43.67%) (69)
	Presence of Dedicated Social Spaces	36.70% (58)
	Presence of Decoration	25.05% (38)
	Presence of Tended Internal Pathways	46.20% (73)
	Threshold Entrance	63.93% (101)
Visibility & Access	Growing Space Clearly Visible from Street/Sidewalk	87.34% (138)
	Growing Space meets Build-to Line	53.79% (83)
	Site Edge maintains Street Wall	54.43% (86)
	Direct Pedestrian Access from Sidewalk	75.31% (119)
	No Raised Entry	77.84% (123)
	Equipment Hidden	76.58% (121)
	Compost Pile Hidden or Well-Kept	86.70% (137)

Factor Analysis

The data is very descriptive but complex. To reduce this high-dimensional data, a principle component factor analysis was conducted to build two indexes. Please see Appendix C for complete analysis results. Upon inspection of the Scree plot[30] shown in Figure 11 and the eigen values[31] shown in Table 8, it would seem that only two combinations of factors (Components 1 and 2) are necessary to capture the qualitative effects of the data.

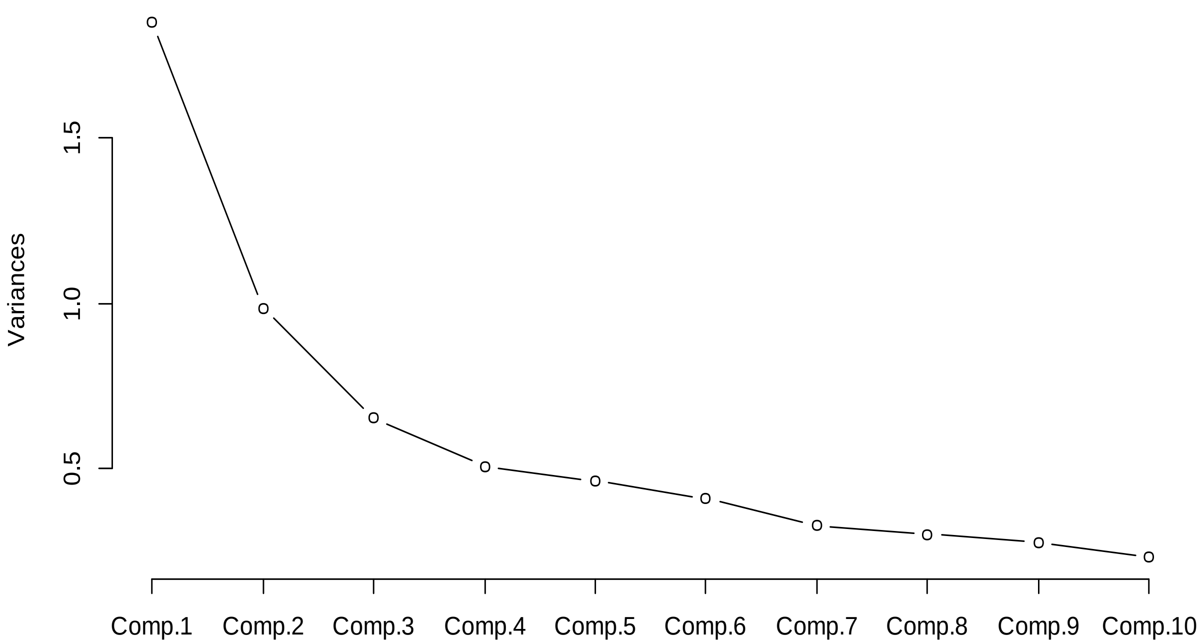

Figure 11. Scree plot for all components.

Nevertheless, one proposition is that systemically and spatially integrated urban agriculture contributes to the desirability of neighborhoods. Therefore, the data were grouped into categories associated with physical and non-physical issues. Physical issues include aspects of a tangible and spatial nature, where non-physical issues include aspects of an organizational or relationship nature. Physical issues and attributes are captured in the Spatially Integrated Index (SPA), and non-physical issues and

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[30] *Scree plot: slopes greater than "1" should be selected, which suggests only two groups of components are necessary.*

[31] *Eigen values: values closest or greater than "1"should be selected, which suggests only two groups of components are necessary.*

attributes are captured in the Systemically Integrated Index (SYS). Both indexes will be explained in the following sections in more detail.

Table 8. Eigen value table for all components								
Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Eigen Values	1.854010	0.983967	0.651484	0.502939	0.459532	0.407262	0.326167	0.298515
Component	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Eigen Values	0.273374	0.229310	0.206408	0.184483	0.161711	0.153039	0.127434	0.103909
Component	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Eigen Values	0.101055	0.092542	0.079872	0.074832	0.066930	0.053929	0.049850	0.044148
Component	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Eigen Values	0.042839	0.037527	0.033802	0.030452	0.027501	0.027166	0.022333	0.019273
Component	**33**	**34**	**35**	**36**	**37**	**38**	**39**	
Eigen Values	0.016894	0.015082	0.012859	0.012338	0.011239	0.008211	0.000000	

Principle component analysis and factor analysis were run to determine the optimal number of components needed for the respective indexes. The results of these analyses are included in the appendixes. The following section describes the composition of the two indexes in more detail.

Systemically Integrated Index (SYS)

The Systemically Integrated Index (SYS) is concerned with characteristics that best describe the vested interests in the site as well as reflect the relationships with the public and outside organizations. As discussed in Chapter One and Two, the collective arguments from the literature imply that systemically integrated urban agriculture has positive effects on a city’s neighborhoods. These arguments have mostly been described by other researchers through qualitative research and limited quantitative research. The aim of this study is to see if there is further evidence for the economic contributions of urban agriculture beyond the commodities produced. The SYS Index captures the systemic information for urban agriculture in Minneapolis, Minnesota. This index is composed based on the combined survey questions conducted by Gardening Matters and Homegrown Minneapolis (including the participant commentary). As previously discussed, follow-up research and site visits were conducted to correct for faulty or incomplete survey entries. Table 9 describes the Systemically Integrated Index components and descriptive statistics.

Table 9. Systemically Integrated Index (SYS) descriptive statistics		
Factor	**Description**	**% of Total** *(N = 158)*
Permanence	>5 Years	58.22% (92)
Participation Control	Participation Fee	33.54% (53)
	Participant Restriction	56.32% (89)
	Communal Plots	70.88% (112)
Supported by an Organization	Church / School / Private Organization / Corporation	69.62% (110)
Vested Interest	Liability Insurance	62.65% (99)
	Permanent Structures (water barrels, hoop houses, tool sheds)	58.85% (93)
	Soil Test	35.33% (56)
Goals	Clear mission statement and/or organizational goals	56.32% (89)
Online Presence	Dedicated Website / Dedicated Facebook Page	60.12% (95)
	Listed on Online Map (GM)	72.78% (115)
On-site Communication	Legible Name (name clearly visible from street)	52.53% (83)
	Presence of Signage (visible from the street)	73.42% (116)
Integration	Member of Neighborhood Organization	6.96% (11)
Group Activities	Regular and/or Seasonal Meetings	71.51% (113)
	Group Work Days	53.16% (84)
Community Interaction	Host to Local Community Events	31.01% (49)
	Participates in City-Wide Events	12.66% (20)
	Listed with a Food Cluster Group	29.74% (47)
	Glean or Donate Produce	36.70% (58)

The Scree plot show in Figure 12 and associated eigen values [32] indicates that the analyzed components can be collapsed into three groupings (Components 1, 2, and 3). The SYS Index is grouped into three major components: permanence, public communication, and operations. If there is sufficient evidence for each attribute within these components, the site scores one point. Points are added together to give an index of the overall systemic performance for each site. Figure 13 illustrates the organization of the components within the SYS Index.

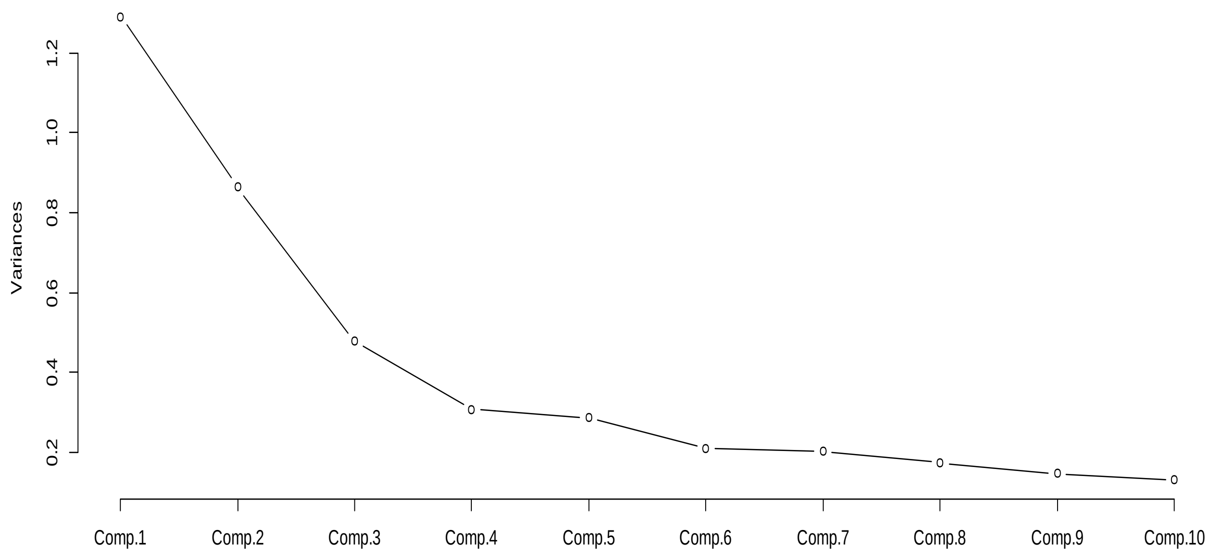

Figure 12. Scree plot for SYS Index.

[32] *The eigen value tables do not need to be shown and discussed each time as eingen values merely support the Scree plot graphic. Please refer to Appendixes for full analysis and outputs.*

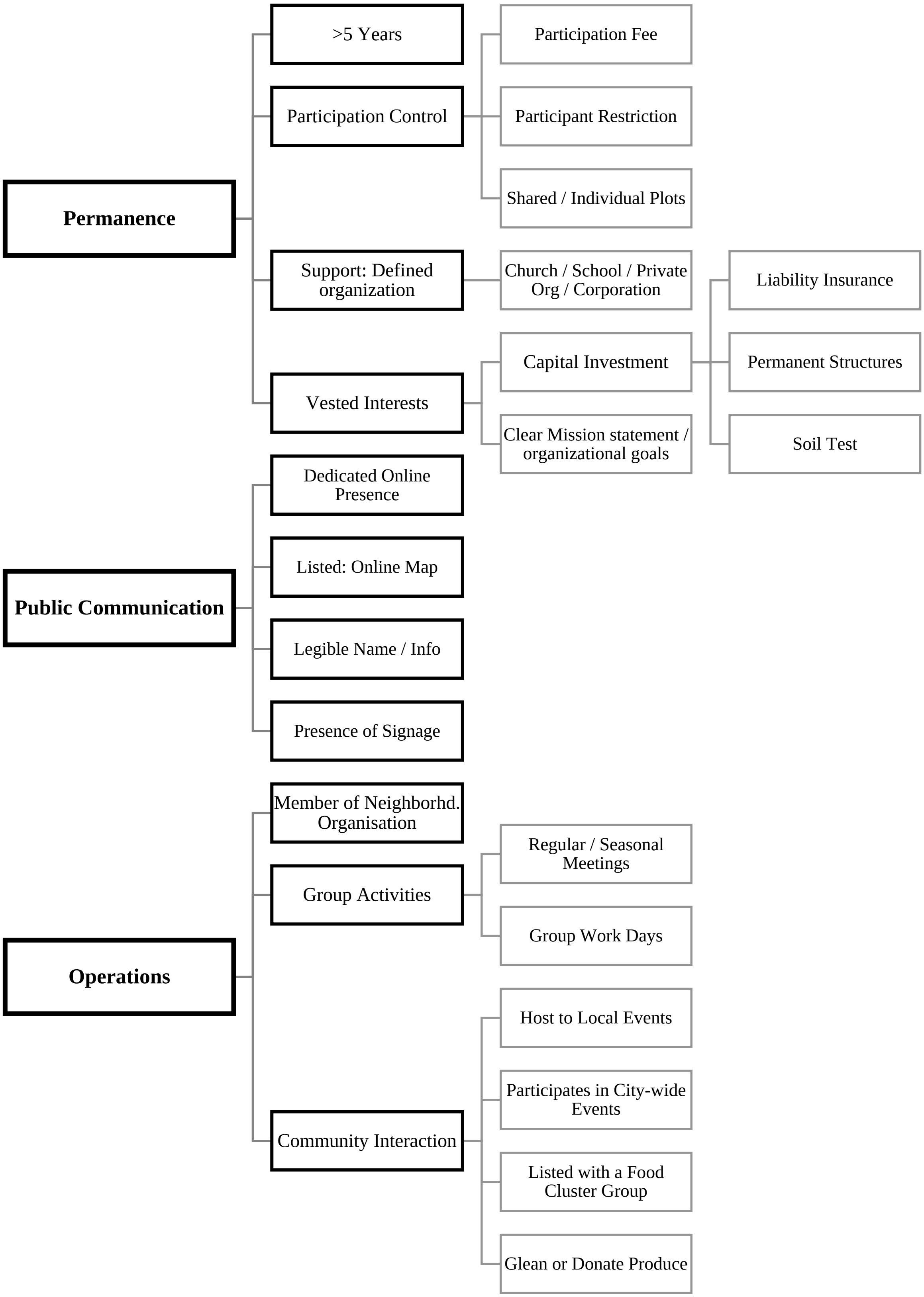

Figure 13. Organization of the components of the SYS Index.

1) Permanence

The first category in the SYS Index describes permanence of the site, which defines the ability of a site to endure over time and the level of commitment from the members or organization. Five years can be seen as a benchmark because the site has seen several growing seasons, and may have survived at least one leadership exchange.[33] The maximum city lease period for a lot is also 5 years. If a site is older than 5 years it would indicate that it has endurance, vested interest, and support from the community.

Commitment can be captured through variables labelled “participation control,” “support,” and “vested interest.” This study is less concerned about the detailed activities of individuals or groups, rather how the urban agriculture site generally operates as an organization and a physical space within the neighborhood fabric. The first indicator is the level of participation of site members, nearby residents or the community, as well as the levels of restriction to people outside of membership, nearby residents or the community. This indicator is captured under “participation fee” and “participant restriction” respectively. Some sites do not have any particular participant restriction, as long as the members contribute via fees. It is safe to assume that sites that have paying members are restricted to a specific group (for example immediate neighbors only, or youth only). Sites where members pay a fee are indicative of organizational strength, and are therefore likely to contribute to the longevity of the site. Other sites indicated that fees are not necessary, but have other kinds of membership restrictions such as “residents only.” Some sites work on a first-come-first-served basis. Sites that encourage a mix of communal and individual plots may have greater success at maintaining members or managing the upkeep of the site. Communal or mixed sites are a likely to have more people present on the site at any given time than those with individual plots only.

The last conditions are captured by the variables “support” and “vested interests” (which includes implied capital contributions). It was not possible to trace the external organizational structures or outside funding mechanisms for each site accurately and directly. Many sites have multiple benefactors or a variety of funding mechanisms through time. However, it was possible to trace if a primary supporting organization is dominant. If a site has clearly noted a dominant benefactor, it indicates that there is a support mechanism outside of the immediate member group. This can contribute to the degree of permanence of the site. Furthermore, even though many sites are situated on private lands, the land is often leased or donated by outside parties. Funds are also spent on permanent structures or technologies. It would not be possible to trace the amount of dollars spent by each site accurately. However, one can

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[33] *This seems to be a general consensus among practitioners: well-established sites are older than 5 years.*

make a basic inventory of core and common items. It is reasonable to assume that administrators or managers of sites who invest in administrative fees, fixed structures, or technology have a higher vested interest in the longevity of the site. Finally, sites with specified written goals and/or clearly stated ambitions are more likely to have a vested interest in the sites' long-term success and contribute to the permanence of the urban agriculture site.

2) Public communication

The next category in the SYS Index is the level of public communication. Not all sites have the same levels of communication to the public, but some sites cover all grounds of communication deemed to be essential by the researcher. Dedicated websites, Facebook groups, email or phone-tree lists, online presence via maps or other listings, and legible names and /or other signage all contribute to a higher degree of public communication.

3) ***Operations***

The final category in the SYS Index describes operational behavior. Sites that regularly participate in events or activities within a neighborhood, or at the larger community or city-wide level, are assumed to have greater operational strength, especially when they have activities and relationships that invoke people outside of their member base.

The final index is scored out of a possible 20 total points, where each attribute is weighted equally. Table 10 shows the Systemically Integrated Index descriptive statistics for the final 158 urban agriculture sites. The histograms for each component showed an even distribution for the category of permanence, very slightly skewed to the left for public communication, and very slightly skewed to the right for operations. Due to the central limit theorem, this slight skewing is not really a concern. When the index is compiled in totality, the histogram showed a normal distribution, indicating that the index is reflecting a fair and accurate rating of the sites.

Table 10. Systematically Integrated Index (SYS) components and descriptive statistics

Component	**Point Score Mean** *(Standard Deviation)*	**Mean Percent** *(Standard Deviation)*
Permanence	5.019 (1.67)	55.55% (17.88%)
Public Communication	2.58 (1.19)	64.5% (29.75%)
Operations	2.68 (1.61)	38.28% (23.00%)
Full SYS Index	0% - 95%	51.77% (17.61%)

Spatially Integrated Index (SPA)

The Spatially Integrated Index (SPA) is concerned with characteristics that best describe the spatial behavior of the site within the neighborhood and in relation to the larger urban setting. Advocates often suggest that urban agriculture could and should have very similar traits to small urban parks or green spaces. Therefore, it can be argued that spatially integrated urban agriculture contributes positively to the neighborhood in similar ways that parks and green spaces do. The SPA Index captures the qualitative spatial information for the urban agriculture. This index is compiled based on site visit observations, aerial and photographic evidence for each of the sites. Each site was visited and documented in 2014. The SPA Index describes the urban qualities and visual features for every site and allows the general spatial attributes of each urban agriculture site to be comparable. Table 11 describes the Spatially Integrated Index components and descriptive statistics.

Table 11. Spatially Integrated Index (SPA) descriptive statistics

Attribute	**Description**	**Percent of Total** (*N = 158)*
Program Visibility	Growing Space Visible from Street	87.34% (138)
Figure Ground	Fully-enclosed Boundary	44.30% (70)
	Meets Build-to Line	53.79% (85)
	Maintains Street-wall Sightlines	54.43% (86)
	Mass on Street Front	91.13% (144)
Unrestricted Pedestrian Access	Site Unlocked	21.5% (34)
	Direct Pedestrian Access	75.31% (119)
	Threshold Entry	63.93% (101)
	No Raised Entry	77.84% (123)
Upkeep	Neat Primary Edge (trimmed public front)	86.00% (136)
	Neat Secondary Edges (clean neighboring front)	77.80% (123)
	Equipment / Storage area Not Visible from Sidewalk	76.58% (121)
	Composting Area Not Visible from Sidewalk	86.70% (137)
	Controlled Interior Edges / Raised Beds / Highly Trimmed Design	86.70% (137)

Table 11. ***(continued)*** **Spatially Integrated Index descriptive statistics**		
Features of Interest	Presence of Public Seating	43.67%) (69)
	Presence of Dedicated Social Spaces	36.70% (58)
	Presence of Decoration	25.05% (38)
	Presence of Tended Internal Pathways	46.20% (73)

The Scree plot slopes show in **Error! Reference source not found.** below, and the eigen values (see Appendix B) indicates that the components can be collapsed into two components (Component 1 and Component 2). The SPA Index is comprised of two major components: urban context and site appeal. These two components describe the level of urban integration and attraction of the space. If there is sufficient evidence for each attribute within these two categories, the site scores one point. Points are added together to give an index of the overall spatial performance for each site. Figure 15 illustrates the organization of the components within the SPA Index.

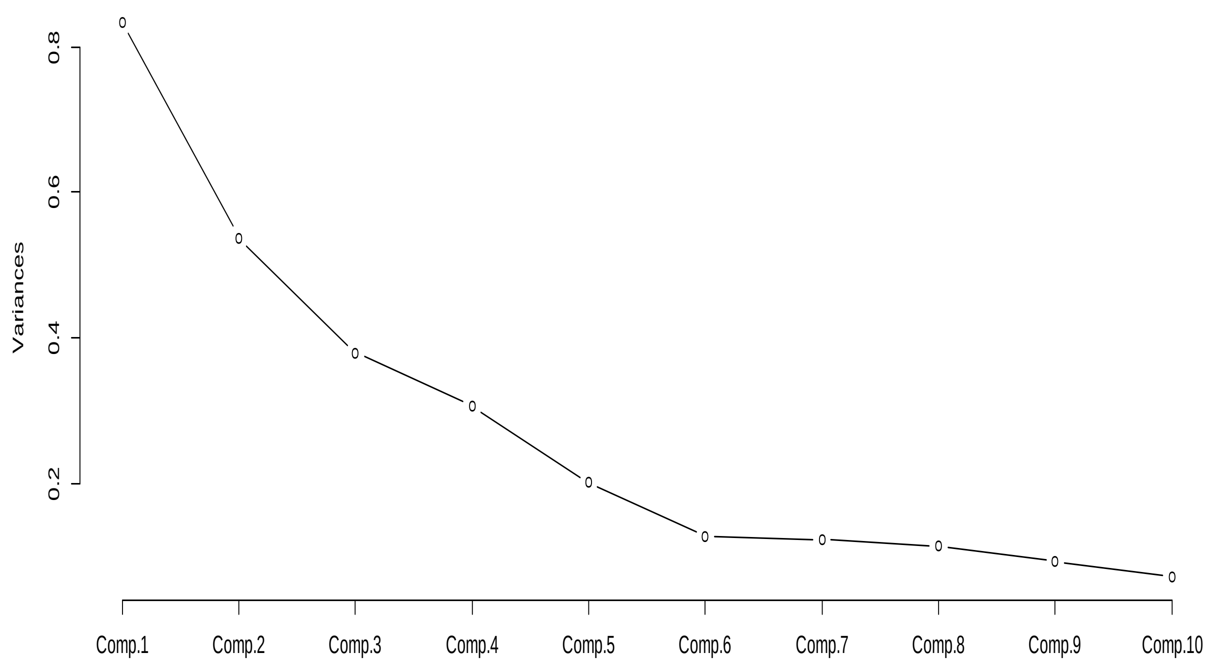


Figure 14. Scree plot for the SPA Index

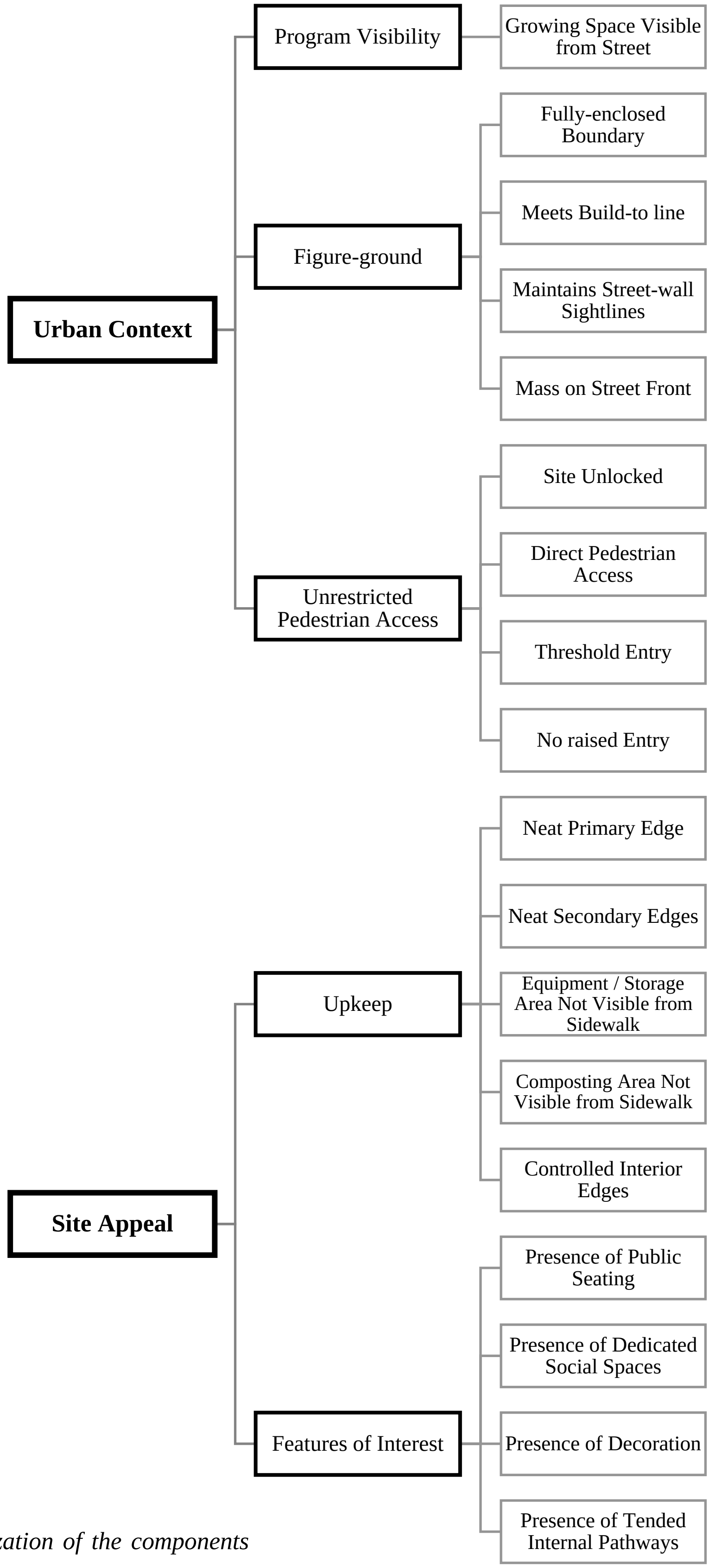


Figure 15. Organization of the components of the SPA Index.

1) Urban context

The first category is the urban context, which is concerned with how the site spatially integrates into its immediate urban surroundings and the level of physical accessibility for the general public. The spatial integration within the urban surrounding can be understood in several ways. The first aspect is the visibility of the program (not counting signage). In other words, can a casual observer recognize the place as an active and productive green space? If the program is not clear, the site may be mistaken for some other form of green passive space or private activity. In the majority of cases it is clear that the site is used for a growing program. However, in many instances the growing spaces are recessed quite far back into the site but are still visible from the street. Sites where growing spaces and program are not easily observable from the street score no points.

The next aspect for spatial integration is the figure-ground of the space. To capture the figure-ground, four measures are used. First, if a fully-enclosed boundary condition is present, such as a full fence or wall, the site scores one point. A fully-enclosed boundary is generally the first feature that defines the area, and contributes to formalizing the urban agriculture into a clearly demarcated space. Such boundaries create strong sightlines which are easily referenced with other structures in the surrounding neighborhood and contribute to the cohesion of the street by forming a street-wall. The fully-enclosed boundary does not have to be full-height, but it must have a distinct vertical dimension. For example, a low stone wall or even a one-foot decorative fence is sufficient. Just under half of the sites show evidence for a fully-enclosed boundary. If the site does not have a fully-enclosed physical boundary, if the boundary is recessed from the street, or is severely discontinuous, the site can still contribute to the street-wall and figure ground in other ways. As many sites do not have fences or physical boundary conditions, other factors (discussed below) must also be considered.

The second factor is the build-to line condition. The majority of the neighborhood lots have built structures that meet the street-facing along what can be called a build-to line. If the urban agriculture site integrates within the urban context, it too should respect the build-to line. This boundary may be met with the edge of growing spaces, pathways, or other structures such as fences or entry-ways. The site scores another point if it clearly meets the build-to line of the lot. If the site features extend beyond the build-to line, it is considered a disruption to the figure-ground of the neighborhood and it does not score a point. If the site features recess from the build-to line, it is also considered to create an irregularity in the figure-ground and it does not score a point. Only 54% of the sites met this condition fully and received one point.

Not all the sites that had fully-enclosed boundaries met the build-to line of the lot, and vice versa. The site may still not contribute to the street-wall in terms of sightlines. For example, the vegetation may be visible and meet the build-to line, but vegetative growth that is too low (for example only several inches high), which does not significantly contribute to sightlines of the neighborhood. For the purposes of this study less than three (3) feet as noted below, does not adequately contribute to the street-wall condition. Furthermore, the street-wall may not always align with the build-to line of the lot, so it is not reasonable to assume that a build-to line meets the street-wall in all cases and for all neighborhoods. Therefore, a third factor for maintaining a strong street-wall condition is sightlines and edges. Sites that have pathways, formal thresholds, structures, or qualifying vertical edges that meet the street-wall edge or continue the street-wall sightline, score another point. In the dataset, 54% of the sites met this condition.

In addition, sites that do not meet the build-to line condition, do not have a continuous enclosure, or are disrupting the street-wall may yet be experienced as an urban space. The fourth and final attribute to consider here is massing, or the visible mass on the street front. The site scores another point if at least three-quarters of the street front has a vegetative or structural mass (or combination of the two) of at least three (3) feet high.

The last component is the level of unrestricted pedestrian accessibility. Permeable public figure-grounds are generally considered to have higher levels of pedestrian accessibility. Unrestricted pedestrian access is one measure of permeability. The first check is whether or not the site is locked and thus inaccessible to the public. Only a quarter of the sites are locked, the majority of which are the urban farms. The vast majority of sites (75%) have direct pedestrian access from the sidewalk but may not necessarily have a threshold entrance (which is deemed to be another measure of accessibility). Only two-thirds of the sites had a clearly marked threshold entrance along the street, be it in the form of an overhead structure, an entrance gate, or clear primary pathway. Additionally, on-grade access from an adjacent sidewalk allows for a high level of accessibility. Most sites (78%) are on grade and show no drastic elevation changes beyond one step or approximately six to eight inches. Together, these four features indicate the level of physical accessibility and permeability the site may have to the pedestrian and driving public. Figure 16 illustrates some of the conditions associated with the SPA Index.

Figure 16. Example of SPA Index condition rules (Streetview image from Google Maps, 2015a).

2) *Site appeal*

The final category is site appeal, which is a set of conditions that capture aesthetic features observable from the street. Each site is markedly different in levels of upkeep, accessibility, and type of features present. Together, these aspects can contribute to the overall appeal or attraction of the site to a casual observer or passerby. To avoid the risk of an excessively subjective view, the aesthetic component is divided into two categories: (1) reasonable evidence for signs of upkeep of the site; and (2) general features interest. Both of these features will only apply for the year 2014 as this is the only year that they could be documented fairly.

Urban agriculture can be a messy activity — tools and equipment lying around, compost heaps, plastic coverings or storage areas, or even untrimmed growing areas are all necessary parts of growing urban agriculture sites. Some people may not find these as particularly attractive features within their neighborhoods. However, if the site has evidence of order and care, it may be deemed more attractive to a casual observer or passerby, when compared to an unkempt space.[34] In order to measure levels of upkeep on a site, it is important to remember that the urban agriculture sites are essentially productive spaces. Therefore, only features that indicate consistent care beyond the primary growing spaces are really indicative that the site is well-maintained.

The first features that indicate the level of care are the edge conditions. If the site shows evidence of a trimmed or maintained street-facing primary edge, the site scores one point. A trimmed primary edge is considered anything that does not disrupt the sidewalk via overgrowth, or where edging is used to demarcate the primary edge. This rule also applies to secondary edges (the edges facing the neighbors). If the secondary edge shows no reasonable evidence for upkeep, or if it shows considerable overgrowth, the site does not score a point. Equipment is an unavoidable component in urban agriculture. However, exposed equipment that is clearly visible from the main street may be seen as unattractive feature to a casual observer. Likewise, exposed compost piles that are visible from the main street may be seen as unattractive. If equipment areas and composting areas are hidden or are not directly observable from the street, the site scores one point respectively. Well defined interior spaces and edges also provide for visual cohesiveness and help make urban agriculture attractive to passersby. Thus, sites that show controlled interior edges via raised beds and/or have dedicated interior pathways scored another point.

Other attractive features may contribute to the appeal of the site as well. For example, a recent study of parks found that every additional ‘attractive’ feature present resulted in a park being nearly three times more likely to be in the high-use category (Edwards, Hooper, Knuiman, Foster, & Giles-Corti, 2015). Many of these features included social spaces, and resulted in significant findings for high-scoring attractive parks. Another study showed that having an attractive, small, open public space nearby was conducive to residents increasing in more recreational walking (Sugiyama, Francis, Middleton, Owen, & Giles-Corti, 2010). If urban agriculture sites are arguably small public parks or open spaces, attractive features that are visible from the street are posited to be very important. A number of sites encourage public interaction, and have spaces dedicated to public seating (67%), or they include gathering areas with tables or overhead structures (37%). Only a quarter of examined sites (25%) have decorations beyond their signage. Decoration is only counted where there are at least three (3) or more purely decorative objects that are larger than a person’s hand or are objects that clearly meant for decorative purposes. Decoration must be evidently visible from the street or sidewalk. Less than three (3) objects, or very small

---

[34] It must be considered that some people may find messy sites attractive. Yet, whether natural or man-made, people generally have a preference for landscapes that show some form of human care or presence (Nassuaer, 1995). Verifying the presence of “features” and reasonable evidence for “upkeep” is the most objective way to compare sites to each other in this research.

objects, may be unnoticeable to a casual observer and are not included. One might argue that sites that have fewer than three (3) objects, but with objects that are very pronounced are still highly attractive, especially when compared to sites that have three (3) or more objects that meet these specified criteria but where these objects are less visible. There may be several ways to interpret aesthetic qualities or preferences. For example, Figure 17 shows a full enclosed large community garden with attractive qualities, including neat interior edges, social spaces, dedicated pathways, and hidden compost areas. Figure 18 highlights a different community garden, showing evidence for unrestricted pedestrian access, raised beds, and almost no decorative objects. Regardless of an individual's taste in regards to the aesthetic quality of these two spaces, as a baseline evaluation, the method described above retains consistency of visual assessments for all urban agriculture sites evaluated.

Figure 17. Example of a very large scale community garden in Minneapolis.

The final index is scored from a total of 18 possible points, where each attribute is weighted equally. Table 12 shows the Spatially Integrated Index descriptive statistics.

Table 12. Spatially Integrated Index (SPA) descriptive statistics

Component	**Point Score Mean** *(Standard Deviation)*	**Mean Percent** *(Standard Deviation)*
Urban Context	5.70 (1.83)	63.33% (20.33%)
Site Appeal	5.64 (1.97)	62.66% (21.88%)
Component	**Range**	**Mean Percent** *(Standard Deviation)*
Full SPA Index	1.67% - 94.4%	63.02% (17.65%)

The histograms for the categories of urban context and site appeal were normal, indicating that the data was fairly distributed. When the index is compiled in totality, the histogram showed a distribution skewed very slightly to the right. However, due to the central limit theorem, this is not really a concern.

Figure 18. Example of a schoolyard farm and community garden.

Variable Design and Selection

The dataset was run with real distance measures (in linear feet), the actual age of each urban agriculture site (in years), and real lot area measurements (in square feet). However, we are also interested to see how different categories of abundance, lot sizes, ages, or qualities compare to each other. Therefore, the same model was run with categorical dummy variables where applicable for categories (2) through (5). This is explained in the following sections.

1) Distance: nearest urban agriculture

Each sales parcel was matched to the nearest street network distance to an urban agriculture site, measured in feet. The sales sample shows a remarkable situation. Almost all sales have at least one urban agriculture site within a street network mile, where the average property sold has four (4) urban agriculture sites within one street network mile. Even though a network mile may span two or more neighborhoods, no sales properties are situated in a neighborhood without an urban agriculture site. The mean distance in feet to an urban agriculture site is 3,517 feet or just over one-half mile, where 78% of sales are within a one-mile distance, 50% within one-half mile, and 20% within a quarter mile. The maximum distance to the nearest urban agriculture site is about two (2) miles, which is only about a 45 minutes walking distance for a healthy adult. This means that city-wide, all of the sales properties have very practical proximities to urban agriculture, and that in addition to street network distances, an abundance measurement for urban agriculture should also be taken into account. Table 13 describes the distribution of urban agriculture sites and sales within high and low income census tracts of Minneapolis for 2014.

Table 13. Distribution of urban agriculture sites and sales (census tracts)

Descriptive Statistics	**Number of home sales** *sample*		**Number of Sites** *all tracts*	
Income Group	*Distance to Community Garden*	*Distance to Urban Farm*	*Community Gardens count*	*Urban Farms count*
High Income *census tract*	1,811	32	36	1
Low Income *census tract*	831	28	114	7

2) *Abundance: nearest urban agriculture*

Across the city, 60% of the neighborhoods have at least one urban agriculture site within their boundaries. Fifty-two percent (52%) of the sales data have at least one urban agriculture site in their neighborhood, and the average number of urban agriculture per neighborhood is 4.5 sites. A quarter of the urban agriculture sites are in high income census tracts. It may seem that vacant land and urban agriculture parcels could be related since generally, it is expected that urban agriculture sites are often created on vacant land parcels. In addition, it is expected that low income tracts have higher numbers of vacant land parcels compared to sales in high income tracts. However, in Minneapolis, the number of vacant properties in high income groups is actually slightly higher than in low income areas. This could be due to the fact that Minneapolis has an extensive park and lake system, which is associated within high income groups. Table 14 describes the distribution of vacant land and income tracts.

Table 14. Distribution of vacant land areas and urban agriculture areas

Descriptive Statistics	**High Income Group** *subset*	**Low Income Group** *subset*
Number of Tracts *in sample*	50	53
Vacant Land Area *in sample*	2,065.54 *acres*	1,557.19 *acres*

Nevertheless, the number of urban agriculture sites is not highly correlated with the availability of vacant land in either income group. Table 15 describes the correlation of vacant land areas with urban agriculture areas.

Table 15. Correlation of urban agriculture and vacant land parcels

Global R Squared *full sample*	**High Income R Squared** *subset*	**Low Income R Squared** *subset*
0.03	0.07	0.15

3) *Scale: nearest urban agriculture*

The urban agriculture lot areas range from just 417 square feet to 3.5 acres (152,460 square feet), where the average lot size is about 0.25 acres or 10,890 square feet (which is close to the median of all property parcels across the city). Considering the average urban agricultural lot size (10,890 square feet) as a base number, the urban agriculture sites can be grouped into small, medium, or large categories.

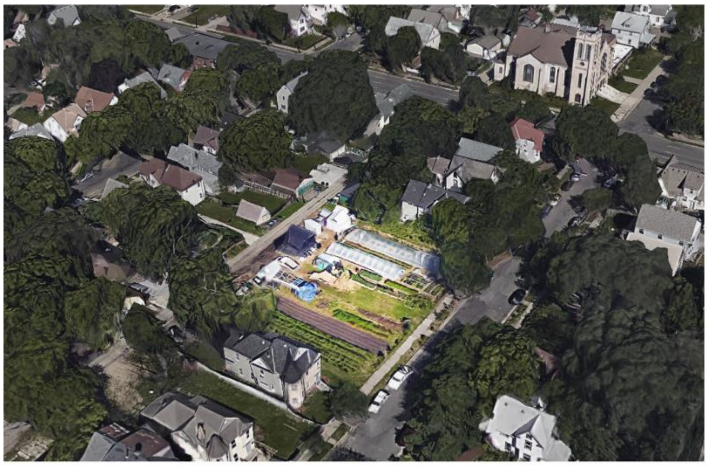
Table 16 describes the distribution of urban agriculture site areas in Minneapolis. Figure 19 shows examples of a typical small site (less than a quarter of an acre), a typical medium site (between quarter and half-acre) and a typical large site (half-acre or larger).

Table 16. Urban agriculture site areas

	Real Lot Size *mean*	**Small** *below 0.25 acres*	**Medium** *0.25 – 0.5 acres*	**Large** *above 0.5 acres*
Urban Agriculture sites *N = 158*	10,285.06 *square feet*	123	22	13
Sales *N = 2,702*	10,632.15 *square feet*	2,113	330	259

Large site (Google Maps, 2015b)

Large site (Google Maps, 2015c)



Medium site (Google Maps, 2015d)

Small site (Google Maps, 2015e)

Figure 19. Large, medium, and small urban agriculture sites in Minneapolis, Minnesota.

4) Age: nearest urban agriculture

The age variable is grouped into three age categories: new, established, or well-established. Based on the fact that the oldest urban farm site is but three (3) years old, the new category captures sites aged between 0 and 3 years. Considering conversations with practitioners and staff of urban agriculture organizations in Minneapolis, an established site could be considered between three (3) and six (6) years of age. This group captures sites that fall within the period where both the Gardening Matters organization (2008) and the Homegrown Minneapolis (circa 2010) programs were established. The well-established category captures the remaining sites, which are older than six (6) years (established prior to the Gardening Matters organization and Homegrown Minneapolis program). Table 17 describes the distribution of the actual urban agriculture age and the three age categories.

Table 17. Real urban agriculture age and age categories

	Real Age *mean*	**New** *0 – 3 years*	**Established** *3 – 6 years*	**Well-established** *6 years +*
Urban Agriculture sites *N = 158*	8.3 *years*	123	22	13
Sales *N = 2,702*	84 *years*	2,113	330	259

5) Quality: nearest urban agriculture

The SPA and SYS real performance measure is captured as a proportion or percentage. First, the models were run with the real performance index, and thereafter with categorical dummies. Each index was divided into three respective categories by means of quantile breaks of the separate Indexes, based on the sales sample. Table 18 provides a summary of the SYS Index and SPA Index in three categories (high, medium, low).

Table 18. SYS and SPA Indexes categories

	SYS High *>70%*	**SYS Medium** *40 - 55%*	**SYS Low** *<40%*
Sales *N = 2,702*	757	625	1,320
	SPA High *>77%*	**SPA Medium** *67 - 77%*	**SPA Low** *<50%*
Sales *N = 2,702*	1,104	697	901

To summarize, Figure 20 explains the variables of interest.

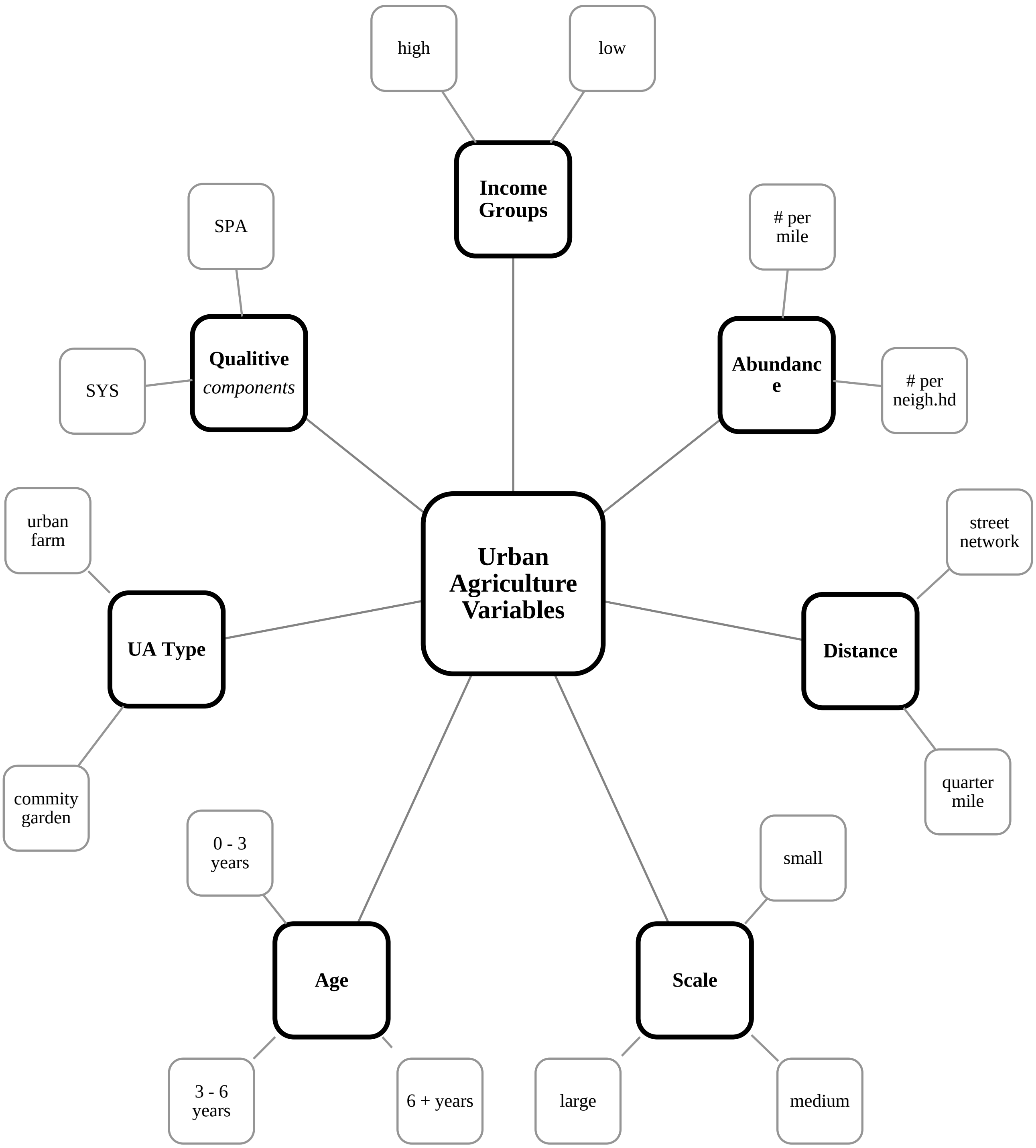


Figure 20. Diagram of the variables of interest.

Basic Model Design

Figure 21 below describes the basic model for this study.

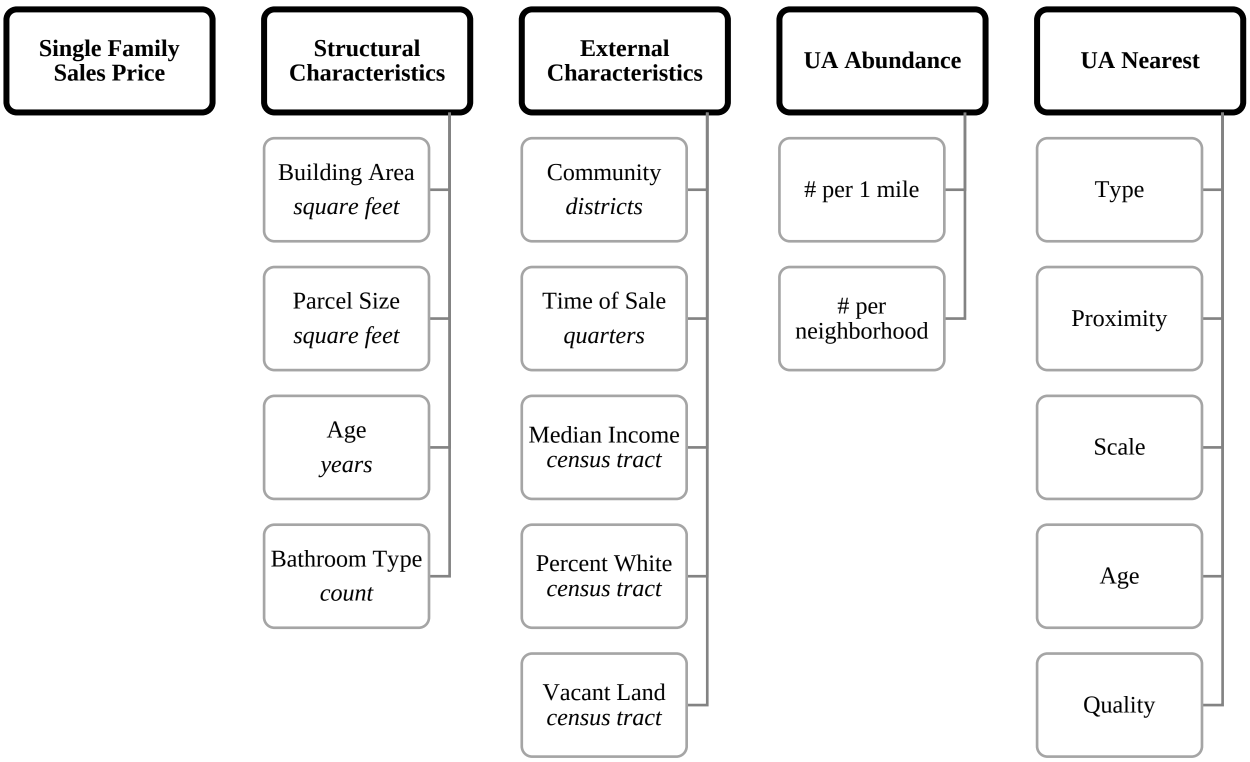


Figure 21. Diagram of model design.

The model can be expressed as:

$$\mathbf{InP}_{idq} = \boldsymbol{\alpha} + \boldsymbol{\beta}\mathbf{X}_{idq}\,(\text{Structure}) + \boldsymbol{\gamma}\mathbf{X}_{idq}(\text{External}) + \mathbf{p1}_{idq}(\text{Distance}) + \mathbf{p2}_{idq}(\text{Distance})^2 + \mathbf{p3}_{idq}(\text{Scale}) + \mathbf{p4}_{idq}(\text{Age}) + \mathbf{p5}_{idq}(\text{\# per Mile}) + \mathbf{p6}_{idq}(\text{\# per Neighborhood}) + \mathbf{p7}_{idq}(\text{SYS}) + \mathbf{p8}_{idq}(\text{SPA})_{\text{i}} + \varepsilon$$

InP is the natural log per unit-sales price of each properties in the sample frame.

The basic model captures the type, proximity, scale, age, abundance, and quality of the urban agriculture associated with a particular sale. Table 19 describes the coefficients for the control variables (α, β, and γ), the urban agriculture variables (ρ), and (ε) is an error term.

Table 19. Independent variables

Variable	Unit *source*	Description	
α	-	intercept	
βX_{dq}(structure)$_i$			
$\beta 1_{dq}$(Building Area)$_i$	Square feet *assessor*	House Quality Proxies: Measured house structural characteristics "X" for house "i" in community district "d, and sales quarter "q"	Structural characteristics capture general composition of homes.
$\beta 2_{dq}$(Parcel Area)$_i$	Square feet *assessor*		
$\beta 3_{dq}$(Full Baths)$_i$	Count *assessor*		
$B4_{dq}$(Half Baths)$_i$	Count *assessor*		
$B5_{dq}$(Build Age)i	Count *assessor*		
γX_{dq}(external)$_i$			
$\gamma 1_{dq}$(Med. Income)$_i$	2010$ *Census 2010*	Neighborhood Proxies: Median household income, percentage white population, and vacant land for property "i" per census tract "c" in district "q"	Controls for the general neighborhood characteristics and captures the immediate neighborhood qualities.
$\gamma 2_{dq}$(Med. Income squared)$_i$	2010$ *Census 2010*		
$\gamma 2_{dq}$(% White)$_i$	Proportion *Census 2010*		
$\gamma 2_{dq}$(% Vacant)$_i$	Count *Metro GIS*		
$\delta 1_{dq}$(quarter)$_i$	Dummy 4, N -1 *assessor*	Time Proxies: Sales quarter dummy variable	Captures the seasonal trend for sales during 2014.
$\delta 4_{dq}$(community)$_i$	Dummy 10, N-1 *Metro GIS*	Location Proxy: Defined as location of sale in community district "d", as designated by Minneapolis	Captures the basic distance and locational differential of properties and remaining variations of property sales at a community level.
$p2_{dq}$(num neigh)$_i$	Count	Number of urban agriculture sites within the same neighborhood of sale "i"	Captures the abundance of sites.
$p3_{dq}$(distance)$_i$	Feet	Street network distance to the nearest UA to sale “i”	Captures the effects of distance.
$p4_{dq}$(distance squared)$_i$	Feet	Street network distance squared to the nearest UA to sale “i”	Captures any distance-decay effects.
$p5_{dq}$(age)$_i$	Count *Dummy*	Real age and dummy of age categories of the nearest UA to sale “i”	Captures the effect of age.
$p6_{dq}$(scale)$_i$	Count *Dummy*	Real lot size and dummy of age categories category of the nearest UA to sale “i”	Captures the effect of scale.
p7(SYS)i	Count *Dummy*	Real SYS Index and dummy of quality categories of the nearest UA to sale “i”	Captures the effect of non-physical aspects.
p8(SPA)i	Count *Dummy*	Real SPA Index and dummy of quality categories of the nearest UA to sale “i”	Captures the effect of physical aspects.

Data Stratification

The data is stratified, and the base model analyzes variations of performances between global or quarter mile distances, income groups, and the type of urban agriculture. Using the global data, a dummy variable is applied on the variables of interest regarding the inquiries.

i) Quarter mile distance

A quarter mile distance is deemed an acceptable threshold for detailed analysis since the quarter mile distance is a comparable base measure with the literature. A quarter mile is assumed to be the distance that an average person is willing to walk (Sugiyama et al., 2010). This distance can be seen as a test on proximity.

ii) Income group

A dummy for high or low income is paired with the variables of interest. This can be seen as a comparison of income groups on a census tract level. The data is then further stratified into the high income group or low income group respectively.

iii) Type

To see if there are any measurable differences between the distance, age, scale, and/or the quality of the nearest site within the different types of urban agriculture, a dummy variable is run on the variables of interest of the global data.[35]

[35] *It should be noted that very few sales occurred near urban farms, compared to community gardens in Minneapolis. This will be addressed in the following chapter.*

Correcting for Spatial Autocorrelation

An ordinary least squares (OLS) Moran's I test indicates that there is spatial autocorrelation in the data. To correct for spatial autocorrelation, the analysis was conducted using procedures mapped out by Anselin and others (Anselin, 2005; Anselin, 1988; Herath, Choumert, & Maier, 2014; Netusil et al., 2014; Romero & Burkey, 2011). Some researchers advocate the "specific to-general approach" whereby Lagrange Multiplier tests (or LM tests) are calculated based on the non-spatial (or the OLS) model (Anselin, 2005; Florax, Holmer, & Reyd, 2003). However, others propose a general-to-specific approach which estimates the Spatial Durbin Model (SDM) first, and thereafter test for model restrictions to spatial lag or spatial error models respectively (LeSage & Pace, 2009; Romero & Burkey, 2011). This study used the second method, as the SDM model nests both spatial lag and spatial error models. The likelihood ratio test is used to determine whether the SDM can be reduced to the lag or error models. However, in this case the model could not be restricted so the full SDM is used.[36] The great advantage of this spatial-regression method over other typical regression practice is that it includes the influences of any omitted variables through the spatially lagged independent variables (Anselin, 1988; LeSage & Pace, 2009; Romero & Burkey, 2011). Thus, the SDM captures the influence of omitted variables that vary across space at a localized level as it accounts for potential nearby proximity effects. A spatial Breusch-Pagan test on the SDM showed there is some residual heteroskedasticity in the data. However, though some research studies have been able to correct for heteroskedasticity by other methods, no such correction has been derived and tested for the Spatial Durbin Model (Romero & Burkey, 2011).[37]

The original data had to be normalized. Distance variables were normalized to units of 1,000's of feet; building area variable was normalized to units of 1,000's of square feet; parcel and lot sizes were normalized to units of 10,000's of square feet; and the median income variable was normalized to units of 10,000's of dollars. The geographic spatial weights were constructed with GeoDa using 16 nearest neighbor's specifications. The majority of the control variable coefficient signs were in expected or explainable directions.

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[36] *Please refer to the Appendix C for full regression and test results.*

[37] *This will not bias the coefficients, but will bias the standard errors.*

Interpretations of the Spatial Durbin Model

Each independent coefficient in an SDM model will have two coefficients — one for the own effect of the variable, and one for the impact on the neighboring X's on sales price. The SDM estimated coefficients do not represent the marginal effects of a change in a variable. Therefore, to easily discuss marginal effects of coefficients we have to use the method by LeSage and Pace calculating the average direct, indirect and total effects for the variables of interest (Herath et al., 2014; LeSage & Pace, 2009; LeSage & Fischer, 2008). These can be understood as follows:

i) The SDM Average Direct Effect

Much like standard OLS interpretation, this will explain the change in Y (sales price) caused by a one unit change in the explanatory variable

ii) The SDM Average Indirect Effect

This explains the impact of all other regions and an individual region "i." The direct impact of variable X is related to a sales parcels' own condition, and an indirect impact points to a spillover effect on other regions.[38]

iii) The SDM Average Total Effect

If all other regions change in variable X in the same way, what will the effect on Y be?[39]

iv) Full effects

This is similar to the full effects of dummies and interactions within OLS models. Full effects will be used to describe interaction variables, especially in relation to the dummy variables in the comparisons models.

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[38] *For example, if a sales parcel with poor structural conditions has a negative and statistically significant indirect effect it means that the parcel in such a poor structural condition negatively affects the value of neighboring parcels. Please refer to a graphic example in Chapter Four -Figure 23.*

[39] *Average Total Effect = Average Direct effect + Average Indirect effect. This interpretation will include both the average direct impact plus the average indirect impact. There is a second interpretation which implies the effect of change of X total impact on all other regions. However, for consistency, we will mostly follow the interpretations discussed in ii) and iii).*

Below is a example (fabricated results) of the interpretation of the SDM models for this research:

	Spatial Durbin Model		
Variable	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
X	0.01*** (0.0406)	0.234*** (1.6355)	0.567*** (1.9382)
X Dummy = 1 or 0	0.01*** (0.0406)	0.234*** (1.6355)	0.567*** (1.9382)

The dummy represents whether or not variable X is in a green (1) or red (0) neighborhood. Holding everything else constant, X has a 2% full direct effect on sales price in green neighborhoods (1), where coefficients add up to approximately 2%. X only has a 1% direct effect on sales price in red (0) neighborhoods. This reasoning extends to the interpretation of the indirect and total effects also, where Average Total Effect = Average Direct Effect + Average Indirect Effect.

In this way the SDM impact estimates not only explain very important characteristics directly, but also of the immediate neighborhood. Making use of this technique the direct effects of urban agriculture can be seen on an individual site (in terms of sales price), while the indirect effects reflect the perspective of society as a whole (neighborhood effects). There is a difference between private impacts (direct) and public impacts (indirect). In other words, we can see if the direct effects of one variable (from a specific region) differ from the effects within a region (or whole group of regions). Since the SDM is a superior technique, this research will not be discussing the OLS results in detail. The OLS results are shown for comparison only.

Hypothesized Variable Relationships

The qualitative literature on urban agriculture claims that there may be direct or distributed economic contributions from the presence urban agriculture sites in neighborhoods. The literature also suggests that the level of integration.[40] The literature review in Chapter Two suggests that the physical quality of the urban agriculture sites in neighborhoods may play an important role as well. Until now, we have had very little evidence for these claims. Therefore, this study aims to understand if there is any evidence for economic contributions of urban agriculture beyond its commodities, and to also provide recommendations for cities regarding the organizational support (systemic attributes) and design (spatial attributes) of urban agriculture sites. This study further includes a measure the abundance of urban agriculture sites on a neighborhood level (which is explained through the findings in the following chapter). Furthermore, the study uses robust spatial autoregressive analysis techniques. In this way the study provides evidence that can expand theoretical and policy discourse on the value of productive landscapes and urban foodscapes in cities.

The findings from the multiple stratification of the dataset can assist planners, designers, and policy makers in understanding the implications for sites of different ages, within different communities, and how to best facilitate the management of urban agriculture sites in order to make them successful. Possible policy implications from the findings are explored and delineated in Chapter Five.

This analysis provides evidence and contributes to the discussion on the role of active productive urban landscapes in urban revitalization, community development, and local food systems. Table 20 illustrates the expected findings for the variables of interest and their relationships with housing sales price.

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[40] *So far in the existing studies on urban agriculture and property prices, the level of integration into a neighborhood has only been captured as a variable of "age" (Voicu & Been, 2008). However, several other studies agree that urban agriculture has a strong social component as part of the activity, and support from various parties and institutions. Refer to "Benefits of Urban Agriculture" in Chapter Two, and" Systemically Integrated Index (SYS)" in Chapter Three.*

Table 20. Expected findings	
Variable	**Expected relationship with sales price** *Direction & Magnitude*
Type	
Nearest: community garden	+ +
Nearest: urban farm	+ +
Distance	
Parcels closer to urban agriculture site	+
Scale	
Bigger UA Lots	+
Age of Site	
Newer UA	+ +
Abundance	
More UA in a mile	+
More UA in neighborhood	+ +
Quality	
Higher Systematic Index	+
Higher Spatial Index	+ +

NOTE: The number of +'s indicate the expected strength of the relationships.
One + means an expected positive relationship. Two ++ means an expected strong positive relationship.

Chapter Four – Findings

The following section uses the hedonic method to investigate the relationship between the urban agriculture attributes and housing sales price on several levels of inquiry. Full results are reported in the appendixes. For this section, the findings will be rounded to the nearest whole number.

The basic model investigates the overall performance of each ordinary least squares (OLS) model, and models were compared using global F-tests and Adjusted R-squared. The global OLS model explains 77% of sale price, indicating that it has high predictive power. Correcting for spatial autocorrelation, the basic model with the full global dataset (hereafter called the Global Model) was run using the Spatial Durbin Model (or method) discussed in Chapter Three. Thereafter, the basic model was applied on four stratified sets of data for general comparison and detail: one for the global data, one for quarter mile comparisons, one for income group comparisons, and one for urban agriculture type comparison. Dummy variables were run for quarter-mile, income groups, and urban agriculture type to illustrate the overall differences between these groups. Next, subsets for each group were taken where applicable, and the results discussed. Figure 22 below illustrates how the data is divided into groups and subsets. Figure 22 also illustrates the structure and the sequence of discussions of this chapter. It should be noted that the sample size for urban farms and the homes sales prices is not adequate for a subset analysis, but the general understanding can be derived from dummy variable interactions and within the other findings.

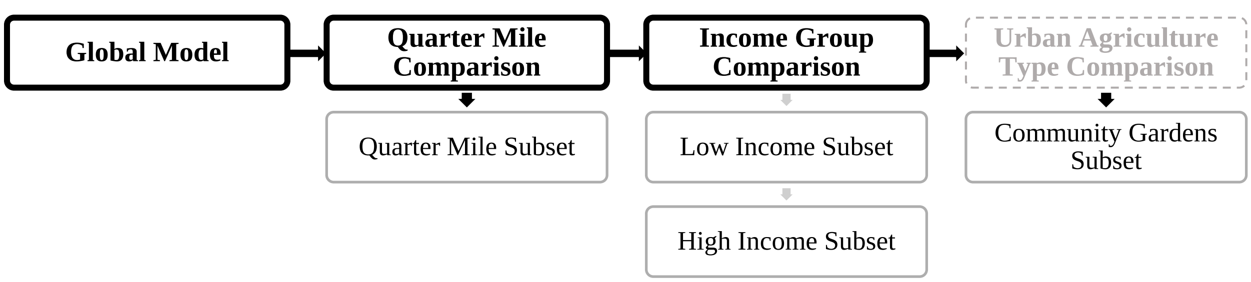


Figure 22. Diagram: data subsets, analysis design and structure of Chapter Four.

Global Results

Tables 21 through 29 present the findings and discussions for urban agriculture variables on housing sale price across the city. The diagrams represented in this section illustrate in principle the implications of the global findings, but can be applied to subsequent findings in a similar fashion. Please refer to the Appendix C for full models and regression outputs.

Urban Agriculture Type

Table 21. Global Model: Urban Agriculture Type

	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Community Gardens *versus Urban Farms*	0.0331 (0.0391)	0.0070 (0.0406)	0.1901 (1.6355)	0.1971* (1.9382)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Correcting for spatial autocorrelation, the Spatial Durbin Model (SDM) results in Table 21 suggests that there is no significant difference between community gardens and urban farms. However, there is a significant and positive total effect of nearby community gardens on housing sales prices, when compared to nearby urban farms. The SDM results indicate that the presence and abundance of nearby sites seem to be important, as the total effect is almost solely dependent on the magnitude of the indirect effect. Holding everything else constant, the total effect of community gardens on housing sales prices is almost 20% larger when compared to urban farms,[41] but the relationship is dependent on the presence of other sites in neighboring regions.[42] To illustrate, using typical home sales of $100,000, home sold in regions with community gardens would sell for about $19,710 more in a typical region, compared to home sales in regions with urban farms.

One explanation for the magnitude of the indirect and total effects is that the majority of the sales sample has proximity to community gardens only. In other words, as urban farms only make up 5% of the

[41] *To calculate values for the log "sales price," we would say that an increase of one-unit in the X coefficient would result in (exp(coefficient)-1)*100 percent change in "sales price" (UCLA: Statistical Consulting Group, 2014).*

[42] *In general, when the word "region" is used in this chapter, it is a geographic manner not related to any particular scale. A region is an area that has common features and shared characteristics, whereas the word "area" will be used to mostly define quantifiable sizes – such as square footage or acreage.*

urban agriculture data in the sample they may not show a direct statistical difference when compared to community gardens. A second explanation is that the majority of the homes sold are situated in high income regions; however, there is only one urban farm in all of the high income regions. There are also higher numbers of both community gardens and urban farm sites in low income regions compared to high income regions. A third explanation may be that generally, land is cheaper in low income regions than in high income regions. As for-profit businesses, urban farms will tend to occupy regions with lower associated land costs as they either have to own the land themselves or are renting from other landowners. In general, community gardens either get land for free or at very low cost (or rents). Table 22 describes the number and type of urban agriculture sites per income group.

However, with such a low sample size for urban farms in different income groups, we cannot compare urban farms to community gardens at this point via subsets of data. A longitudinal study may show a more definite result, but the oldest urban farm is only three years old, which makes it unlikely that we could get a larger sample soon. There is still reason to believe that the type of urban agriculture may yet have effects in other ways. The data is stratified according to quarter mile distance measures and income groups to understand the relationship between urban agriculture types on housing prices in more detail. These results are discussed in later sections of this chapter.

Table 22. Urban agriculture type distribution across income groups (2014)

Income Group	**# of home sales** *closest proximity: community garden*	**# of home sales** *closest proximity: urban farm*	**# of community gardens** *census tract*	**# of urban farms** *census tract*
High Income	1,811	32	36	1
Low Income	831	28	114	7

Proximity

Table 23. Global Model: Proximity

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Distance to UA *1000's feet*	0.0044 (0.0078)	0.0367*** (2.6008)	-0.0521** (-2.1293)	-0.0154 (-1.0192)
Distance to UA squared *1000's feet*	0.0007 (0.0007)	-0.0041** (-2.4732)	0.0060** (2.5500)	0.0019 (1.4555)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
[+] Regression run on the reserve dummy variable. [+ +] Regression run on the collapsed categories, or alternate categories.

Together, the distance variables suggest that proximity to nearby urban agriculture matters to housing sales prices in Minneapolis. From Table 23 we see that the SDM direct impact results for the distance of a home sale to the nearest urban agriculture site is positive and significant at about 4%. This suggests that with an increase in distance from an urban agriculture site, the housing sales prices will increase also. Holding everything else constant, the full direct effect of distance to an urban agriculture site is about 3% on home sales prices. Urban agriculture sites do contribute a very small premium to home sales prices. To illustrate, at a distance of 10 feet (or being right next to the site), the full effect is less than a 10th of a percent. Using a typical figure of $100,000 home sales price, homes closest to an urban agriculture site show sales prices that are only around $32.60 more compared to homes in a similar regions, but without urban agriculture sites. However at distance of 1,000 feet, the full direct effect is 3.26% or $3,260. To illustrate, using a typical figure of $100,000 home sales price, a home sale occurring at 1,000 feet from an urban agriculture site will sell for approximately $3,227 more than a home sold at 10 feet from the urban agriculture site. Thus, although on a global level there is a tiny premium for being next to an urban agriculture site, homes closer to urban agriculture sites show lower sales prices compared to homes farther away, and have higher sales prices compared to homes in regions where there are no urban agriculture sites around at all.[43]

However, the neighboring effects of urban agriculture play an important role in Minneapolis. The full indirect effect of the urban agriculture distance variable has a negative relationship with housing sales prices. Holding everything else constant, when the distances to urban agriculture sites decrease in all other regions, the home sales price closer to an urban agriculture site will increase in a typical region. In other words, even though there is an small associated premium for being right next to an urban agriculture site, in regions where the urban agriculture sites are more dispersed (with greater distances) there is a negative relationship with home sales prices. This suggests that the regions with more urban agriculture sites in closer proximity to home sales have higher associated home sales prices, compared to regions where there are fewer urban agriculture sites around.

For example, if the average distance of all urban agriculture sites to home sales increases by 1,000 feet in a typical region, the neighboring regions will see in housing sales prices that are typically about 5% lower. To understand this visually, please refer to the diagrams in Figure 23. Finally, the square of the distance variable represents a distance decay effect. As the total effect of distance squared is

[43] *A further and more rigorous analysis could explain the exact point at which the impact wears off completely on a city-wide level, but such a study would mostly likely have to isolate each neighborhood of the city and control for influences of the indirect effects. Nevertheless, 1,000 feet is good general point of reference to illustrate the effect, and compare findings to similar studies.*

negative and small (<1%), it means that at greater distance between urban agriculture sites and sales parcels, housing sales prices will increase at a decreasing rate.

Where home sales and urban agriculture sites in neighboring regions are in closer proximities to each other (decrease in distance), housing sales prices in a typical region will likely be higher.

Where home sales and urban agriculture sites are dispersed from each other (increase in distance), housing sales prices in a typical region will likely be lower.

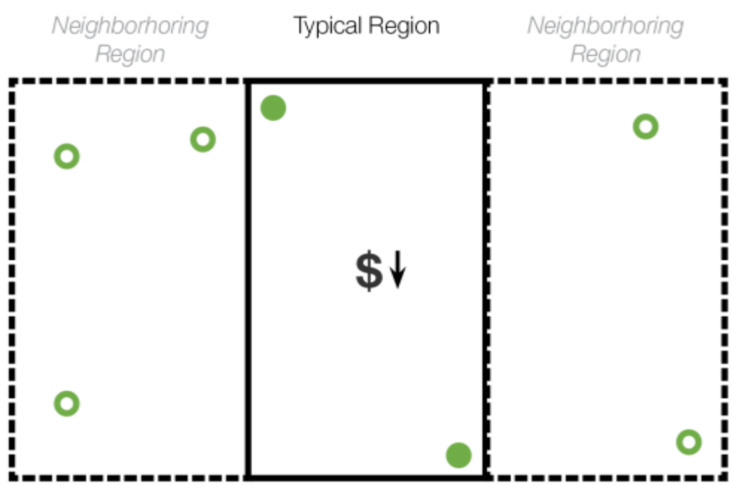


Figure 23. Diagram: distance neighborhood effect of urban agriculture in Minneapolis, Minnesota.

Scale

Table 24. Global Model: Scale				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Lot Area *1,000's of square feet*	-0.0040* (0.0020)	-0.0058** (-2.0714)	0.0119** (2.1198)	0.0061 (1.3404)
Small Site *< quarter acre*	-0.0180 (0.0184)	-0.0849** (-2.4545)	0.1422** (2.4653)	0.0572 (1.4172)
Large Site *> half acre*	0.0013 (0.0016)	0.0035 (1.3832)	-0.0100** (-2.3446)	-0.0066** (-1.9653)
++Below Half Acre *vs above half acre*	-	-0.0359 (-0.7981)	0.1608** (2.0006)	0.1250* (1.9040)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. ++ Regression run on the collapsed categories, or alternate categories.

One expectation is that larger green spaces (sites larger than half an acre) are more comparable in scale to urban parks and should have a greater effect on the desirability of neighborhoods. In Table 24 above, the SDM results show that there is a very small and statistically significant negative direct effect of the real size of urban agriculture on housing sales prices. For every 1,000 square foot increase in scale of an urban agriculture site, associated housing sales prices decrease typically by <1%. To illustrate, only when urban agriculture sites change in scale with about 10,000 square feet (10 times larger, or about a quarter acre) will we see around a 6% negative direct effect on housing sales prices. However, the indirect effect for real distance is positive a statistically significant. This indicates that although there may be a slight penalty for having a big urban agriculture site in close proximity to a home sale, the increase in size of urban agriculture sites have a positive spillover effect on housing sales prices on a neighborhood level of about 1%.

The same behavior of real size is reflected in categories of scale also. Holding all else constant, in all categories of sizes, the direct effects are smaller than the indirect effects. Small urban agriculture lots seem to have a negative direct relationship with housing sales prices of -8.5%, but a larger positive indirect relationship of about 14%. In contrast, large sites have a small direct positive effect (<1%, insignificant) but larger and negative indirect effect (-1%), leading to a negative total effect of <1% on housing sales prices. This result suggests that the presence of smaller sites in neighborhoods is preferable to the presence of larger sites, but being nearer to a small urban agriculture site still shows a penalty.

To examine this further, the categories of scale were collapsed to sites below and above half an acre. Here, we see that the direct effect of sites below half an acre has a negative relationship with housing sales prices, but a strong significant and positive indirect and total effect of about 16% and 12.5% respectively. Together, the above results suggest that, when compared to their large counterparts, the presence of small sites and sites below half an acre in neighboring regions may have a positive association with higher housing sales prices in a typical region. This finding reflects findings in the parks literature, where researchers found there is an advantage of small parks (or pocket parks) over large size parks in regions with detached residential blocks (Gao & Asami, 2001). This implies that small urban agriculture sites may behave in similar ways to small parks, and very large urban agriculture sites may actually be seen as a disamenity. However, the disamenity of larger urban agriculture sites and their effects on housing sales prices is almost negligible when compared to the advantage of smaller urban agriculture sites.

Age

Table 25. Global Model: Age

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Age *years*	0.0058*** (0.0016)	0.0047* (1.8537)	-0.0022 (-0.4350)	0.0025 (0.5747)
New Site *0 - 3 years*	-0.0186 (0.0175)	-0.0489* (-1.7251)	0.0100 (0.1873)	-0.0390 (-1.0238)
Well-established Site *6+ years*	-0.0249 (0.0247)	-0.0860** (-1.9792)	0.0811 (0.8765)	-0.0048 (-0.0436)
+ Established Sites *3 - 6 years*	-	0.0860** (2.1072)	-0.0811 (-0.9680)	0.0048 (0.0194)
+ +Below 6 Years *versus all other*	-	0.0719** (2.0702)	-0.0859 (-1.1950)	-0.0139 (-0.2075)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Table 25 shows that the direct effect for urban agriculture age in years contributes positively and significantly to housing sales price. For every year increase in age of an urban agriculture site, the associated housing sales price also increases with <1%. Although this result shows a small, significant direct effect, its coefficient may still not fully reflect the impact of age of urban agriculture sites on home sales prices. For example, a site may have registered its opening in year X, but only really flourished by the second or third growing season. The true effect of age of an urban agriculture site on housing sales prices may only be reflected after a certain period of time. Therefore this study investigates both real age and categories of age. There are no significant neighborhood effects.

In categories of age we see a much stronger relationship. New sites (0 – 3 years) and well-established sites (6+ years) have a negative direct effect on housing sales prices of about 5% and 9% respectively when compared to established sites (3 – 6 years). For example, a typical home sale of $100,000 dollars near a new site (0 – 3 years) may sell for $4,900 less than a similar home located near an established site (3 – 6 years). A home sold close to an older, well-established site (6+ years) will sell for about $8,600 less than a home sold close to an established site (3 – 6 years). It would seem that both very new and very established urban agriculture sites have more penalties on housing sales prices than those sites that are approximately 3 – 6 years old. This is interesting because with the popular surge in new urban agriculture sites opening city-wide, one would expect new sites to have a positive relationship with sales prices on this global level. A test on all sites below 6 years versus all sites above 6 years revealed comparable results, where urban agriculture sites below 6 years show a positive 7% relationship with home sales prices. This means that, when we collapse the category of age into two groups (below and above 6 years), we see that, on a typical sale of $100,000 dollars, homes near a relatively young site (below 6 years) may sell for $7,190 more compared to a home located near an much older site (above 6 years).

In conclusion, holding everything else constant on a global level, housing sales prices show an increase where urban agriculture sites are between 3 – 6 years old compared to any of the other age categories.

Abundance

Table 26. Global Model: Abundance

	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
# UA per street network mile *count*	-0.0112*** (0.0025)	-0.0192*** (-3.7466)	0.0128 (1.5359)	-0.0064 (-1.1133)
# UA per neighborhood *count*	0.0006 (0.0047)	0.0132* (1.6665)	-0.0253* (-1.9433)	-0.0120 (-1.1884)
+ High number per neighborhood *4 + sites versus other*	-	0.0702* (1.8131)	-0.1032* (-1.7105)	-0.0330 (-0.6737)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

The SDM results in Table 26 suggest that the amount of urban agriculture sites within a region plays a role. First, it would seem that the number of sites in a street network mile has a negative and significant direct effect on housing sales prices of about 2%. This means that as the number of sites goes up in a street network mile, the housing sales prices will likely be lower. There is a positive spillover effect that diminishes total effect of the number of urban agriculture sites per street network mile to a small and insignificant amount (<1%). This suggests that abundance of urban agriculture sites within a street network mile does not really matter to the change in housing sales prices on a neighborhood level.

By comparison, there is a positive direct effect of the number of urban agriculture sites in a neighborhood on housing sales prices. Holding everything else constant, with each additional site in a neighborhood, housing sales prices may increase with about 1% on average. There is a larger negative indirect effect that suggests that with each additional site in a typical neighborhood, the home sales price in a nearby neighborhood may decline with about 2.5% on average. This indicates that neighborhoods with more urban agriculture sites have an advantage over neighborhoods with less urban agriculture sites.

The seemingly contradicting results between abundance of urban agriculture per street network mile and abundance of urban agriculture per neighborhood can be interpreted in several ways. First, the abundance of urban agriculture per street network mile could be interpreted as a nimby response, where people may want to have a high presence of urban agriculture in the city, but do not care to live in regions with a high abundance of sites. Second, the number of sites per neighborhood (real count and category of high abudance) has larger significant indirect effects, suggesting that these variables have more power over the street network mile measure. Third, the street network mile measure will include regions with more than one neighborhood, which may distort our view on the influence of the variable on home sales prices. We can perhaps consider the number of sites within a street mile network as a control variable rather than a predictor variable. Fourth, the presence of urban agriculture sites in a neighborhood is likely correlated with other phenomena such as community initiatives that may not be captured in this dataset.

If we run the model with a category variable for high abundance of sites per neighborhood (versus all other) we see both direct and neighborhood effects play a role. Holding everything else constant, neighborhoods with a high number of urban agriculture sites (4+ sites) have a high, positive direct and significant relationship to housing sales prices of about 7%, compared to neighborhoods with fewer sites. Again, there is a significant indirect effect suggesting that there could be a competition factor involved. If all a neighborhoods has a very high number of urban agriculture sites, the sales price in nearby comparable neighborhoods may be about 10% lower. This finding suggests that, in terms of home sales prices, the neighborhoods with more than four urban agriculture sites may outperform neighborhoods with fewer sites by a great deal. Figure 24 is a graphic interpretation of neighborhood abundance and the associated neighborhood effects on housing sales prices in Minneapolis.

A typical region has lower housing sales prices when the neighboring regions have higher amounts of urban agriculture sites (higher number of sites per neighborhood)

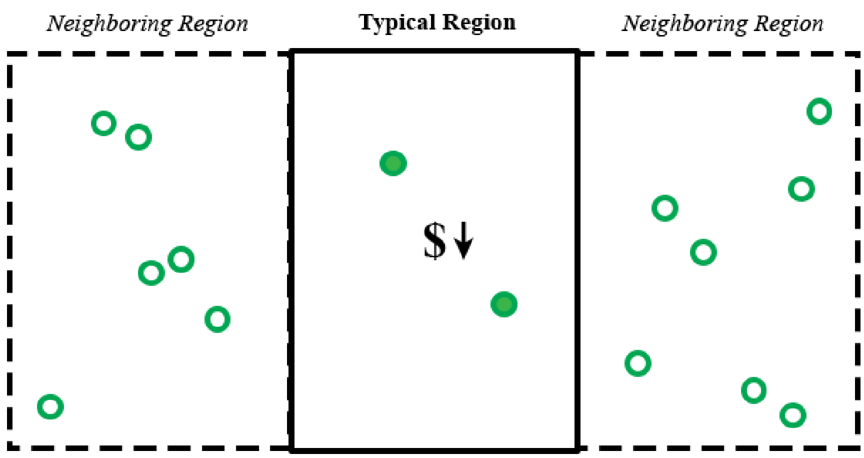


Figure 24. Diagram: neighborhood abundance and the associated neighborhood effect.

Quality

Table 27. Global Model: Quality

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
SYS Index% *proportion*	-0.0202 (0.0379)	-0.0133 (-0.3638)	-0.0264 (-0.2274)	-0.0397 (-0.5054)
SPA Index% *proportion*	0.0476 (0.0618)	-0.2448*** (-2.8266)	0.6002*** (3.0618)	0.3554** (2.2041)
++ SYS High Quality *versus all other*	-	-0.0189 (-0.7764)	0.0202 (0.3461)	0.0013 (-0.0989)
++ SPA High Quality *versus all other*	-	-0.0567*** (-2.7001)	0.1195*** (3.0984)	0.0629** (1.9810)
++ Permanence% *proportion*	-	0.0154 (0.1781)	-0.1326 (-1.0147)	-0.1172 (-1.2380)
++ Communication% *proportion*	-	-0.0216 (-0.5117)	0.0087 (0.1007)	-0.0129 (-0.2255)
++ Operational% *proportion*	-	-0.0111 (-0.1724)	0.0642 (0.5172)	0.0531 (0.5066)
++ Aesthetic% *proportion*	-	-0.1468*** (-3.1033)	0.3422*** (3.4145)	0.1954** (2.3963)
++ Urban Context% *proportion*	-	0.0144 (0.1927)	0.0165 (0.1377)	0.0309 (0.3178)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. ++ Regression run on the collapsed categories, or alternate categories.

The Spatial Integration Index (SPA) and Systemic Integration Index (SYS) is captured as a proportion or percentage. In Table 27, the SDM results do not indicate any significant relationships between housing sales prices and the SYS Index. This is unexpected, as the theory suggests that urban agriculture sites with a high performing SYS Index should have some relationship with home sales prices. There are large and significant effects found in the SPA Index. The SPA Index has a negative direct effect on housing sales price of about 25%, but large indirect and total neighborhood effects of almost 60% and 36% respectively. This finding suggests that on average, we could expect higher housing sales prices in a typical region if the neighboring regions have urban agriculture sites with higher SPA Indexes.

A test was run for highest SPA or SYS Index categories against all lower levels of quality, resulting in slightly lower, but comparable coefficients. However, as with the abundance measure discussion in the previous section, the direct negative effect of the SPA Index could be explained by the nimby effect. The majority of high performing SPA sites are located in the low income census tracts. As urban agriculture is mostly associated with low income regions, the presence of site in a high income region, regardless of its quality, may instead be a signal for urban poverty rather than urban prosperity. However, there is a very large positive and significant indirect effect across the board, and the "SPA High Quality" variable has a positive total neighborhood effect of 6% on home sales prices. This indicates that there may be an initial direct negative association between a nearby urban agriculture site and a home sales price, but that any increase in the quality of the SPA performance in all other regions will likely have higher associated housing sales prices in a typical region, and override all negative direct effects. Figure 25 is a graphic interpretation of the neighborhood effects of urban agriculture sites with a higher quality SPA Index, and housing sales prices in Minneapolis.

A typical region has higher housing sales prices when the neighboring regions have higher quality urban agriculture sites (higher SPA Indexes)

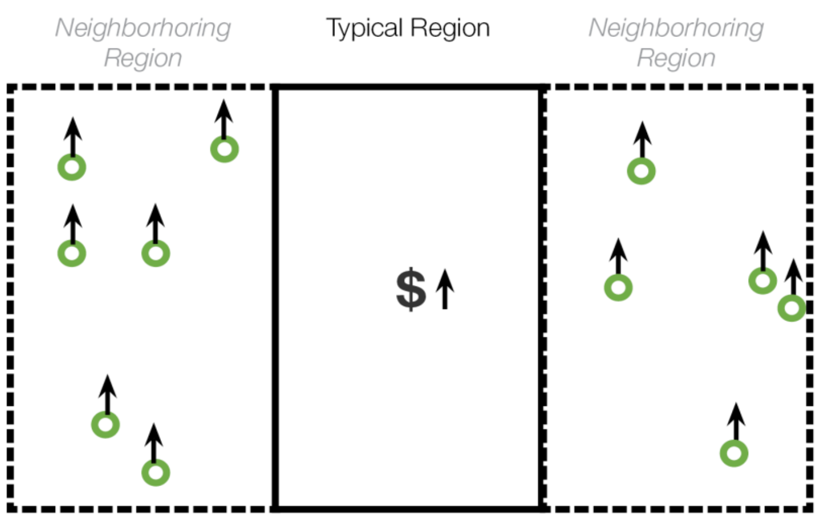


Figure 25. Diagram: SPA Index and the associated neighborhood effect.

Breaking the SPA and SYS Indexes down into their five respective categories, we see that the aesthetic category plays a major positive and significant role with about 19.5% total effect. In a hypothetical situation, if all other sites across the entire city improve their SPA performance by about 4 points (or 22%) on the SPA Index scale only, from this model we could see associated housing sales prices in typical regions increase by about 8%. Please note that, in this situation we have to assume that these newly improved urban agriculture sites need to maintain their enhanced physical quality for a period of at least 3 – 6 years. Also, improvements to the quality of urban agriculture sites will most likely be associated with other phenomena occurring in the city, such as community improvement programs, greening, beautification, youth, or renewal programs. However, this does suggest that even small improvements on the spatial quality of the urban agriculture site (such as proper signage or better integration with the street-wall) could have some impact on the perceived desirability of the neighborhood, as reflected in increases of housing sales prices.

Although the example above is highly theoretical, the finding is encouraging for community planners, designers, and policy makers. The SPA Index is comprised of mostly simple physical or material components, whereas the SYS Index has mostly complex or intensive organizational components. Considering that the majority of urban agriculture sites are in low income regions, this means that with a few cost-effective actions, increasing the SPA Index performance may greatly improve neighborhood desirability as seen through housing sales prices. Table 28 describes the distribution of the highest quality urban agriculture sites and housing sales prices across the city.

Table 28. High Quality Sites

	High Income		**Low Income**	
	count	*% of total sales*	*count*	*% of total sales*
# Sales Close to High SYS Sites	472	17%	285	11%
# Sales Close to High SPA Sites	504	19%	380	14%

Summary Global Results

Table 29 summarizes the global findings, and contrasts the hypothesized directional relationships between the various models and housing sale price from Table 20. The notable and significant findings are marked in grey.

Table 29. Global Results Summary

Variable	**Expected Relationship** Direction & magnitude	**Found Relationship** Description
Type		
Nearest: community garden	+ +	Positive neighborhood relationships.
Nearest: urban farm	++	Weaker impacts than community gardens.
Distance		
Parcels closer to urban agriculture site	+	Small premium closer to UA, but home sales farther away have higher sales $. In regions where UA is has on average closer distances to homes sales than in neighboring regions, sales prices in a typical region tend to be higher.
Scale		
Bigger UA Lots	+	Only great increases in the scale of urban agriculture sites (such as an increase of a quarter acre or more) have a real impact on the associated home sales prices. Small sites show negative direct effects. Large sites show negative neighborhood effects. Small sites and sites below half an acre show large positive neighborhood effects
Age of Site		
Newer UA	+ +	Established sites (3 – 6 years) have a high positive relationship with sales $.
Abundance		
More UA in a mile	+	Small negative direct effects.
More UA in neighborhood	+ +	Neighborhoods with more urban agriculture sites have higher sales $ compared to neighborhoods with fewer sites.
Quality		
Higher Systematic Index	+	No relationships found.
Higher Spatial Index	+ +	Strong positive neighborhood effects.

The number of +'s indicate the expected strength of the relationships.
One + means an expected positive relationship. Two ++ means an expected strong positive relationship.

Quarter Mile Comparison Results

Tables 30 through 35 present the findings for urban agriculture variables on housing sale price within a quarter mile street network distance, compared to sales outside of a quarter mile. A quarter mile distance is indicative of a reasonable walking distance (5 minutes) for pedestrians to public transit or amenities. It is an accepted standard supported by the literature in parks and transit planning (Sugiyama et al., 2010). The model was refitted with a dummy variable to test for the quarter mile effects of sales in close proximity to urban agriculture compared to sales outside of that distance. The abundance variables were included with the other control variables. Please refer to the Appendix C for full models and regression outputs.

Urban Agriculture Type

Table 30. Quarter Mile Comparison Model: Urban Agriculture Type

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Community Gardens *versus Urban Farms*	-0.0306 (0.0521)	-0.0157 (-0.1718)	0.3477* (1.7529)	0.3321* (1.7071)
Community Garden *versus Urban Farm*: Sub QM	0.1283* (0.0747)	0.0779 (0.9537)	-0.3028 (-0.8304)	-0.2249 (-0.6359)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

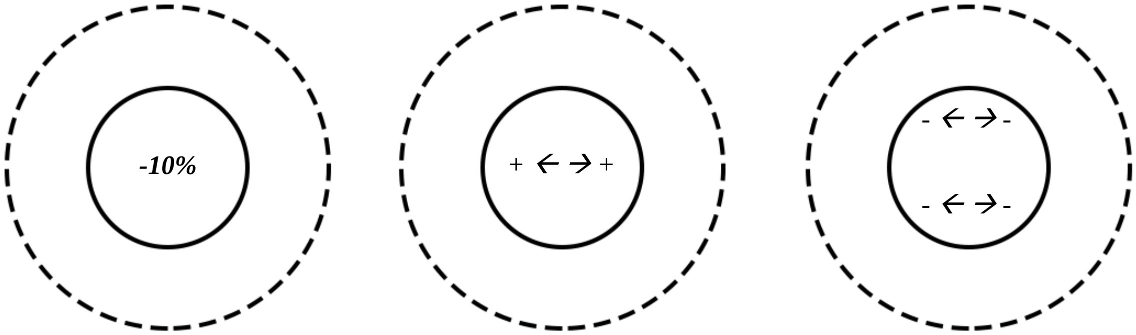
The results from Table 30 describe the type of urban agriculture and housing sales prices inside or outside of a quarter mile distance band. Correcting for spatial autocorrelation, the SDM direct effects results show that there is no statistical difference between types of urban agriculture and home sales prices. The result indicates that there is no real statistical difference regarding the type of urban agriculture within a quarter mile distance either. The full indirect effect suggest that sales community garden site have a much higher positive effect when compared to an urban farms, likely when they are outside of a quarter mile distance.

Proximity

Table 31. Quarter Mile Comparison Model: Proximity				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Distance to UA *1000's feet*	-0.0063 (0.0101)	0.0323 (1.3295)	-0.0566 (-1.5576)	-0.0242 (-1.0297)
Distance to UA squared *1000's feet*	0.0014* (0.0008)	-0.0038 (-1.5985)	0.0064* (1.9593)	0.0025 (1.4313)
Distance to UA: Sub QM *1000's feet*	-0.2317 (0.1550)	-0.3637** (-2.2860)	-1.0714 (-1.3003)	-1.4351* (-1.7005)
Distance to UA squared: Sub QM *1000's feet*	0.1795. (0.0991)	0.2371** (2.3900)	0.7953 (1.4562)	1.0324* (1.8489)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
$^{+}$ *Regression run on the reserve dummy variable.* $^{++}$ *Regression run on the collapsed categories, or alternate categories.*

In Table 31, we see that the distance variables suggest that within a quarter mile distance, close proximity to urban agriculture sites have a negative relationship to home sales prices. Holding everything else constant, homes sold within a quarter mile to urban agriculture sites show lower sales price compared to homes sold outside the quarter mile distance. The SDM direct effects indicate that homes sold inside a quarter mile will likely show about 10% lower sales prices. In addition, as distance increases from the sites, homes that are farther away from an urban agriculture site will likely show slightly higher sales prices compared to homes closer to the site (but still within the quarter mile distance). The SDM results indicate that there are some significant total effects of distance inside a quarter mile, comparable in magnitude to the global model findings. Holding all else constant, for regions where home sales and urban agriculture sites are within quarter mile distances, the total effect suggests that if all regions increase their average distances to urban agriculture sites, the typical region sales prices will likely be much lower. Please refer to Figure 26 for a description of the quarter mile effects of urban agriculture sites on property values. Overall, the total effects of distance echo the global findings.



a) Inside QM

Homes inside a quarter mile of an urban agriculture site will likely be sold for about 10% less than similar homes sold outside of a quarter mile.

b) Inside QM

Homes sold inside a quarter mile, but further away from an urban agriculture site, will likely have higher sales prices, compared to similar sites outside of a quarter mile distance. This effect gets smaller as distances increase.

b) Inside QM

However, if all distances increase (sites become more dispersed), homes sales inside a quarter mile of will likely sell for much less, compared to similar homes sold outside a quarter mile.

Figure 26. Diagrams: quarter- mile effects of urban agriculture sites.

Scale

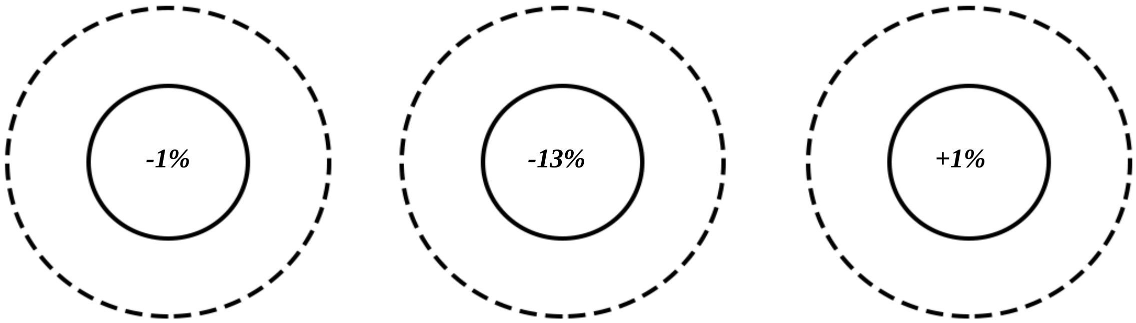
Table 32. Quarter Mile Comparison Model: Scale

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Lot Area *square feet*	-0.0025 (0.0023)	-0.0019 (-0.6043)	0.0108 (1.5306)	0.0089 (1.4887)
Small Site *< quarter acre*	0.0253 (0.0212)	-0.0447 (-1.1043)	0.1311** (2.0822)	0.0864** (1.9712)
Large Site *> half acre*	0.0005 (0.0018)	0.0005 (0.1786)	-0.0089* (-1.6640)	-0.0084* (-1.9557)
UA Lot Area: Sub QM *square feet*	-0.0064 (0.0039)	-0.0123*** (-2.8093)	-0.0020 (-0.1107)	-0.0143 (-1.0057)
Small: Sub QM *< quarter acre*	-0.1736*** (0.0416)	-0.1749*** (-3.6478)	0.0357 (0.1214)	-0.1391 (-1.0968)
Large: Sub QM *> half acre*	0.0038 (0.0034)	0.0089** (2.3837)	0.0018 (0.1081)	0.0106 (0.8698)
++Below Half Acre *vs above half acre*	-	0.0058 (0.1943)	0.2092* (1.8362)	0.2150** (2.3820)
++Below Half Acre: Sub QM *vs above half acre*	-	-0.1343* (-1.9481)	-0.2417 (-0.9430)	-0.3760* (-1.6745)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. ++ Regression run on the collapsed categories, or alternate categories.

The results from Table 32 shows that, holding everything else constant, for every 1,000 square foot increase in scale of an urban agriculture site, housing sales prices within a quarter mile distance could be lower by about 1%, when compared to sites outside of a quarter mile. However, the categories of size play a bigger role, and the results are comparable to the global model. Holding everything else constant, the SDM direct effects indicate that home sales occurring within in a quarter mile of small urban agriculture sites show a difference of about 17.5% lower prices compared to sales outside of a quarter mile. However, sales within a quarter mile proximity to large sites have a positive direct relationship, about 1% higher, compared to sales outside of a quarter mile. On a test between categories of size below or above a half an acre, sites below half an acre and within a quarter mile show about 13% lower home sales prices. It is improbable that such large direct effects differences between small and large urban agriculture sites on housing sales prices are solely related to the scale of urban agriculture site alone. Instead, such large differences between the direct effects suggest that the quarter mile distance band may actually be capturing some other phenomenon, and that urban agriculture is probably a proxy for this phenomenon. Nevertheless, in categories of scale, smaller sites (including the collapsed category for sites below half an acre) show larger negative direct effects with sales price inside a quarter mile when compared to sales outside of a quarter mile. However, there is also a positive spillover effect for sales within a quarter mile of small sites. The total effect of small sites outside of a quarter mile is about 9% higher. Similarly, the total effects of sites below half an acre and outside of a quarter mile, is about 21% higher. This would suggest that if all other regions had small sites or sites below half an acre, the home sales price in a typical region outside of a quarter mile proximity of that site would likely be higher. Figure 27 is a diagram illustrating some of these effects.

These findings reflect the global model findings in regards to distance, but also illustrates that within a quarter mile, the small scale urban agriculture plays a stronger role on a neighborhood level. This suggests that although there could be an advantage to housing sales prices when homes are in closer proximity to smaller urban agriculture sites, this advantage only has effect if the home is at least quarter mile away from these sites. It should be noted that in this study area, many more small sites are situated in lower-income regions and therefore show lower associated home sales prices. One other explanation is that the larger sites are most likely to be older as well, and the increase in real age has positive direct effects on housing sales prices (see the next section).



a) Real Size QM

For every 1,000 square foot increase, direct effect on home sales will likely be 1% lower inside a quarter mile compared to home sales outside of a quarter mile.

b) Below half acre inside QM

The direct effects indicated that homes sales inside a quarter mile proximity to sites below half an acre show sales prices of about 13% less, compared to home sales near much larger sites, and outside of a quarter mile.

c) Large Sites inside QM

The direct effects indicate that homes sales within a large sites show sales prices of about 1% more compared to medium sites.

Figure 27. Diagram: quarter mile effects related to scale.

Age

Table 33. Quarter Mile Comparison Model: Age

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Age *years*	0.0050** (0.0018)	0.0039* (1.6628)	-0.0021 (-0.2940)	0.0018 (0.4174)
New Site *0 - 3 years*	-0.0193 (0.0202)	-0.0739** (-2.3031)	0.0704 (1.2374)	-0.0035 (-0.0182)
Well-established Sites *6+ years*	-0.0055 (0.0280)	-0.0934** (-2.5114)	0.1248 (1.3204)	0.0314 (0.3174)
Sub QM: UA Age *years*	0.0026 (0.0034)	0.0030 (0.7267)	0.0013 (0.0739)	0.0043 (0.2979)
Sub QM: New *0 - 3 years*	-0.0213 (0.0371)	0.0569 (1.3521)	-0.2283* (-1.8023)	-0.1713 (-1.4842)
Sub QM: Well-established *6+ years*	-0.0784 (0.0518)	0.0030 (0.1192)	-0.1831 (-0.9476)	-0.1800 (-0.9773)
+ Established Sites *3 - 6 years*	-	0.0916** (2.1389)	-0.1279 (-1.3388)	-0.0363 (-0.3986)
+ Established Sites: Sub QM *3 - 6 years*	-	-0.0034 (-0.0248)	0.1739 (0.8693)	0.1706 (0.9199)
+ +Below 6 Years *versus all other*	-	0.0696* (1.7549)	-0.1179 (-1.2839)	-0.0483 (-0.5821)
+ +Below 6 Years: Sub QM *versus all other*	-	0.0166 (0.2872)	0.1046 (0.4421)	0.1212 (0.5670)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

At first, the real age variable from Table 33 seems to show that older urban agriculture sites have fewer penalties on home sales.[44] Holding everything else constant, with each year increase in age, homes sold near older sites show sales prices that are slightly higher (<1%). However, when we compare sales prices inside of a quarter mile distance, there is no statistical difference between real age and categories of age regarding urban agriculture sites and home sales prices. When we study established sites (3 – 6 years) on the reserve, we see that established sites have a strong direct positive association with housing sales prices of about 9% more when they are outside of the quarter mile, compared to all other age categories. Collapsing the age categories to sites above or below 6 years, and outside of a quarter mile, we see that newer sites have greater positive direct effects of about 7% more on housing sales prices compared to older sites.

Quality

Table 34. Quarter Mile Comparison Model: Quality

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
SYS Index% *proportion*	-0.0567 (0.0435)	-0.0446 (-0.6160)	0.0070 (0.1112)	-0.0376 (-0.2955)
SPA Index% *proportion*	0.0885 (0.0790)	-0.2389** (-2.1224)	0.5849*** (2.7270)	0.3460** (1.9939)
SYS Index%: Sub QM *proportion*	0.0897 (0.0776)	0.0044 (0.1102)	0.0136 (0.0737)	0.0180 (0.1231)
SPA Index%: Sub QM *proportion*	-0.1192 (0.1276)	0.0083 (0.2782)	-0.0465 (-0.5570)	-0.0382 (-0.4939)
++ SYS High Quality *versus all other*	-	-0.0286 (-0.9815)	0.0286 (0.5142)	0.0000 (-0.0077)
++ SPA High Quality *versus all other*	-	-0.0537** (-2.2157)	0.1222** (2.4630)	0.0685 (1.5711)
++ SYS High Quality: Sub QM *versus all other*	-	0.0189 (0.5190)	0.0431 (0.4010)	0.0620 (0.5987)
++ SPA High Quality: Sub QM *versus all other*	-	0.0183** (0.6341)	-0.0195** (-0.0866)	-0.0012 (0.0922)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. ++ Regression run on the collapsed categories, or alternate categories.

[44] *As a premium represents an added sum (higher price), a penalty suggests a deduction from a price (lower price).*

In Table 34, the SDM results do not show any significant relationship between housing sales prices and the SYS Index in terms of inside or outside of a quarter mile street network of urban agriculture sites. The SPA Index findings and their interpretations are comparable to the results and interpretation from the global model. However, when we look at the “SPA High Quality” variable, the results indicate that there may be an advantage living just outside of quarter mile of a high quality urban agriculture site. The direct effects show that home sold outside of a quarter mile of a high quality site show about 3.5% higher sales prices, compared to homes sold inside of a quarter mile of such sites. In addition, within a quarter mile, an increase from a low quality site to a high quality site (when “SPA High Quality” changes from “0” to “1”) is associated with an average full indirect effect of about 10%. This indicates that, on average, there is a positive association on neighborhood sales prices when low quality urban agriculture sites turn into high quality sites. Figure 28 illustrates a typical urban farm in a low income neighborhood in Minneapolis, which is in a quarter mile street network proximity to single family homes.

Figure 28. Urban farm on underused land in a low income neighborhood in Minneapolis, Minnesota.

Summary Quarter Mile Comparison Results

Table 35 summarizes the quarter mile findings, and contrasts the hypothesized directional relationships between the various models and housing sale price from Table 20. The notable and significant findings are marked in grey.

Table 35. Quarter Mile Comparison Results Summary

Variable	**Expected Relationship** Direction & magnitude	**Found Relationship** Description
Type		
Nearest: community garden	+ +	Outside QM, community gardens have higher positive neighborhood effects compared to urban farms.
Nearest: urban farm	++	No direct difference between urban farms or community gardens inside or outside QM.
Distance		
Parcels closer to urban agriculture site	+	Inside QM, there are penalties closer to UA sites.
Scale		
Bigger UA Lots	+	Outside QM, small sites show positive neighborhood effects. Outside QM, sites below half an acre show the strongest positive neighborhood effects. Inside QM, large sites have positive direct effects
Age of Site		
Newer UA	+ +	Outside QM, UA sites below 6 years have the strongest positive direct effect on sales $. Outside QM, established UA sites (3 – 6 years) have the highest direct relationship with sales $
Quality		
Higher Systematic Index	+	No relationship found.
Higher Spatial Index	+ +	Inside QM, positive neighborhood effects for high quality sites.

The number of +'s indicate the expected strength of the relationships.
One + means an expected positive relationship. Two ++ means an expected strong positive relationship.

Income Groups Comparison Results

In the global model, there was a statistical difference between the real income and housing sales price, as well as within the total effects of high income regions compared to low income regions. Therefore, to determine where these differences are found, the base model was run with a dummy variable for income. Thereafter, the data is stratified to the two subsets to understand the detailed effects within each group respectively. Tables 36 through 41 represent the findings for Income Groups. Please refer to the Appendix C for full models and regression outputs.

Urban Agriculture Type

Table 36. Income Comparison Model: Urban Agriculture Type

	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Community Garden *versus Urban Farm*	0.0542 (0.0504)	-0.0222 (-0.4512)	0.0383 (0.3325)	0.0161 (0.1731)
Community Garden *versus Urban Farm:* High Income	-0.0366 (0.0661)	-0.0076 (0.0070)	0.3942* (1.8360)	0.3866** (1.9691)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Applying the same model, we see that there are significant differences between the type of urban agriculture activity and respective income groups. The SDM results in Table 36 indicate that the presence of community gardens in high income groups is important on a neighborhood level, as the total effects are highly dependent on the magnitude of the indirect effects. Also, the table shows that there is a large, significant and positive indirect effect of nearby community gardens on housing sales prices in the high income group, when compared to a nearby urban farm. This only suggests that the neighboring effect of community gardens in high income regions are associated with higher home sales price on a neighborhood level, more so than urban farms. The table also suggests that there is a difference on a neighborhood level between the respective income groups. These results are further examined in the income subsets discussion later in the chapter, when we stratify the data into the two groups.

Proximity

Table 37. Income Comparison Model: Proximity				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Distance to UA *feet*	0.0214 (0.0144)	0.0550** (2.1751)	-0.0576 (-1.2333)	-0.0025 (-0.0477)
Distance to UA squared *feet*	-0.0024 (0.0014)	-0.0081** (-2.4678)	0.0081 (1.6034)	0.0000 (0.0013)
Distance to UA: High Income *versus Low Income*	-0.0109 (0.0161)	-0.0302 (-1.0314)	0.0281 (0.5520)	-0.0021 (-0.0459)
Distance to UA squared: High Income *versus Low Income*	0.0027. (0.0016)	0.0049 (1.4234)	-0.0037 (-0.6865)	0.0013 (0.3213)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
[+] Regression run on the reserve dummy variable. [+ +] Regression run on the collapsed categories, or alternate categories.

From Table 37 we see that the SDM direct impact results of the street network distance to the nearest urban agriculture site is positive, but there is no statistical significance difference between the income groups. For example, holding everything else constant, the direct effect of distance to an urban agriculture site is associated with about 5% higher home sales price in low income groups, and insignificant in high income groups. This suggests that with an increase in distance, there will be higher prices for sales in low income groups farther away from urban agriculture sites, more so than for sales in high income groups. There are no significant findings for the neighborhood effects of proximity to urban agriculture sites in either income group. In the subset models, the distance variable is interacted with the other variable of interests, and the magnitude and direction of the findings indicate comparable results.

Scale

Table 38. Income Comparison Model: Scale				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Lot Area *square feet*	-0.0080* (0.0036)	-0.0149*** (-2.8452)	0.0232** (2.1016)	0.0084 (0.9158)
Small Site *< quarter acre*	-0.1620*** (0.0394)	-0.2419*** (-3.3881)	0.2716** (2.2847)	0.0298 (0.2892)
Large Site *> half acre*	0.0028 (0.0023)	0.0102*** (3.0480)	-0.0213*** (-3.1605)	-0.0112** (-1.9789)
UA Lot Area: High Income *versus Low Income*	0.0003 (0.0042)	0.0118* (1.8427)	-0.0276** (-1.9753)	-0.0158 (-1.4035)
Small Site: High Income *versus Low Income*	0.2054*** (0.0433)	0.2202*** (3.4434)	-0.2171* (-1.6500)	0.0030 (0.0756)
Large Site: High Income *versus Low Income*	0.0020 (0.0031)	-0.0084* (-1.8401)	0.0252*** (2.6380)	0.0167** (2.1614)
++Below Half Acre *vs above half acre*	-	-0.1223 (-1.1972)	0.3658 (1.6446)	0.2435 (1.1921)
++Below Half Acre: High Income *vs above half acre*	-	0.1900* (1.8411)	-0.4169* (-1.7351)	-0.2268 (-1.0367)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. ++ Regression run on the collapsed categories, or alternate categories.

When we compare high income groups with low income groups, the SDM model results in Table 38 indicate significant findings for real size as well as the categories of urban agriculture sites. The direct effect difference of real size between the income groups is <1%. With an increase in real size, housing sales prices are on average 0.3% lower in high income groups compared to low income groups. However, the direct effect difference of small sites between the income groups is about 20%, where small sites will likely be associated with lower housing sales prices in the low income group. Conversely, the difference in the direct effect of large sites between income groups is about 1%, where large sites will likely be associated with higher housing sales prices in the low income group.

Small lots have greater and positive spillover effects in low income groups when compared to high income groups. This suggests that with the increase in small lots in neighboring regions, home sales price in a typical region of a low income group will increase too. This leads to an overall positive neighborhood effect in low income groups. In general, the direct effect of small lots may show a negative relationship with home sales prices, but small lots have a positive relationship with housing sales prices on a neighborhood scale, especially in low income groups. Large sites show positive full indirect effects in high income groups, but this effect is negligible (<1%). In contrast, large sites in low income groups will have indirect effects of about -2% on home sales prices, when compared to other categories of scale. If we collapse the category variables into sites below or above half an acre, there is direct effect and indirect effects are more pronounced in the high income group than the low income group. These findings will be explored in the income subsets in more depth.

Age

Table 39. Income Comparison Model: Age

Variable	OLS Model	Spatial Durbin Model		
	OLS Coefficients	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Age *years*	0.0076** (0.0027)	0.0032 (0.9765)	0.0017 (0.1330)	0.0048 (0.4827)
New Site *0 - 3 years*	-0.0230 (0.0262)	-0.0443 (-1.2935)	-0.0501 (-0.6819)	-0.0944 (-1.4193)
Well-established Sites *6+ years*	-0.0966* (0.0415)	-0.0821* (-1.6949)	-0.0114 (-0.0390)	-0.0935 (-0.6466)
UA Age: High Income *versus Low Income*	-0.0008 (0.0033)	-0.0002 (-0.0021)	0.0004 (0.0786)	0.0002 (0.0936)
New Site: High Income *versus Low Income*	0.0221 (0.0321)	-0.0289 (-0.5574)	0.1824* (1.8894)	0.1535* (1.8830)
Well-established Sites: High Income *versus Low Income*	0.1375** (0.0489)	0.0410 (0.6382)	0.1549 (0.8487)	0.1960 (1.2413)
+ Established Sites *3 - 6 years*	-	0.0658** (2.1411)	0.0560 (0.7067)	0.1218* (1.8166)
+ Established Sites: High Income *3 - 6 years*	-	-0.0418 (-0.7871)	-0.1327 (-0.9524)	-0.1746* (-1.6888)
+ +Below 6 Years *versus all other*	-	0.0667 (1.3562)	0.0137 (-0.0377)	0.0804 (0.5136)
+ +Below 6 Years: High Income *versus all other*	-	-0.0368 (-0.5702)	-0.0840 (-0.4156)	-0.1209 (-0.7432)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

In Table 39, the OLS model indicates that the age variable plays a statistically significant role and that there is a difference between real age and the two income groups. However, correcting for autocorrelation, the SDM model results show that there are no significant differences regarding the real age of urban agriculture sites between the two income groups. Only the well-established age category shows a possible statistical difference to other categories of age, but there is no difference between high or low income groups. The new sites category indicates that the presence of new sites in neighboring regions would have a stronger association with an increase in average housing sales prices in a typical region. However, this effect is likely greater in magnitude in high income groups compared to low income groups. This suggests that new sites are likely perceived as an amenity in high income neighborhoods. Compared to established sites, well-established sites (6+ years) have a lower direct effect of 8% in low income groups, when compared to high income groups. Although the finding is comparable in scale and magnitude in the low income subset, it is not statistically significant within that subset.

When we run a reserve variable, established sites (3 – 6 years) have about 6% positive direct effects on housing sales prices in low income groups, when compared to high income groups. This finding only means that low income groups have shown higher sales prices where the urban agriculture sites are 3 – 6 years old, compared to any other age category, and that this relationship is stronger in low income groups than in high income groups. For this category, the SDM also shows a significant total effect of about 5% in high income groups, and about 12% in low income groups. When we collapse the variables into sites below or above 6 years we see no statistically direct or neighborhood effect finding that suggest when sites are much older, there is no difference between the income groups. Overall, the SDM results suggest that established sites are positive to both income groups on the total effect neighborhood level. The results also suggest that established sites are likely preferable to either new or old sites in low income regions on a neighborhood level. These findings are explored in more detail in the income subsets analysis later in this chapter.

Quality

Table 40. Income Comparison Model: Quality				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
SYS Index% *proportion*	-0.1184. (0.0645)	-0.0615 (-0.6477)	-0.1067 (-0.5863)	-0.1681 (-0.9841)
SPA Index% *proportion*	0.1755* (0.0811)	-0.0759 (-0.7001)	0.7268*** (2.8017)	0.6509*** (2.9555)
SYS Index%: High Income *versus Low Income*	0.0684 (0.0736)	0.0575 (0.5047)	0.0905 (0.4423)	0.1480 (0.8153)
SPA Index%: High Income *versus Low Income*	-0.3306** (0.1045)	-0.2748* (-1.9497)	-0.4533 (-1.4622)	-0.7281*** (-2.6137)
+ + SYS High Quality *versus all other*	-	-0.0484 (-1.3300)	0.0191 (0.2631)	-0.0293 (-0.4620)
+ + SPA High Quality *versus all other*	-	-0.0251 (-0.9739)	0.1616** (2.1374)	0.1365** (1.9609)
+ + SYS High Quality: High Income *versus all other*	-	0.0752* (1.7577)	-0.0619 (-0.6952)	0.0133 (0.2267)
+ + SPA High Quality: High Income *versus all other*	-	-0.0141 (-0.3611)	-0.1259 (-1.2393)	-0.1400* (-1.6674)
+ + Permanence% *proportion*	-	-0.0806 (-0.8463)	-0.1078 (-0.2804)	-0.1884 (-0.6568)
+ + Communication% *proportion*	-	-0.0222 (-0.3956)	-0.0628 (-0.6238)	-0.0850 (-0.8737)
+ + Operational% *proportion*	-	0.0141 (0.1979)	-0.0236 (-0.1469)	-0.0094 (-0.0625)
+ + Aesthetic% *proportion*	-	-0.0410 (-0.5899)	0.3713** (2.1785)	0.3303** (2.2037)
+ + Urban Context% *proportion*	-	0.0440 (0.4648)	0.0034 (-0.0278)	0.0474 (0.1603)
+ + Permanence%: High Income *proportion*	-	0.1459 (1.0747)	0.0114 (-0.0065)	0.1573 (0.4945)
+ + Communication%: High Income *proportion*	-	-0.0339 (-0.3612)	0.2457* (1.6522)	0.2118 (1.6377)
+ + Operational%: High Income *proportion*	-	0.0145 (0.1256)	-0.1981 (-0.7780)	-0.1836 (-0.8222)
+ + Aesthetic%: High Income *proportion*	-	-0.1330 (-1.5082)	-0.1642 (-0.7388)	-0.2972 (-1.5547)
+ + Urban Context%: High Income *proportion*	-	0.0325 (0.2237)	-0.1136 (-0.3303)	-0.0811 (-0.2869)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Overall, the SYS Index results show lower magnitudes than the SPA Index, but the SDM results in Table 40 find no statistically significant differences between the income groups. The SPA Index has strong and significant positive indirect and total effects suggesting that there is difference between the two income groups and the quality of urban agriculture sites. The full total effect of the SPA Index suggests that with the increase in higher quality urban agriculture spaces in all neighboring regions, the housing sales prices in a typical region will increase more dramatically for the low income group than the high income group. When we break down the SPA Index into distinct levels of high, medium or low quality, we understand this difference better. The high quality SPA sites do not have significant direct effects in either income group. If we only examine very high performing SPA sites, the full total effect is about 14% for the low income group, and a negligible negative effect in the high income group (<1%). The full total effects suggest that, when all other regions have the high quality SPA sites within low income groups, the low income groups will show much higher sales prices compared to the high income group. Keep in mind, the result discusses the difference in price for the income groups, taking the presence of urban agriculture into account. When we separate both indexes into their respective components, the "aesthetic" component seems to be driving the difference between the income groups. This is reflected in the neighborhood effects, where there is are strong indirect and total effects for "aesthetic" components, particularly in the low income group. These findings are explored in more detail in the income subsets analysis later in this chapter.

In summary, there is a difference in the impacts of the qualities of urban agriculture sites and the relationship with housing prices between low or high income groups, and this difference is captured by the SPA Index more so than the SYS Index. Low income groups seem to be more sensitive to this difference. The majority of the findings for quality are not found in the direct effects, but in the neighborhood effects.

Summary Income Group Comparison Results

Table 41 summarizes the income group comparison findings, and contrasts the hypothesized directional relationships between the various models and housing sale price from Table 20. The notable and significant findings are marked in grey.

Table 41. Income Group Comparison Results Summary

Variable	**Expected Relationship** Direction & magnitude	**Found Relationship** Description
Type		
Nearest: Community Garden	+ +	High income: positive neighborhood effects on sales $, when compared to a nearby urban farm.
Nearest: Urban Farm	+ +	
Distance		
Parcels Closer to UA	+	Low income: home sales $ is much higher farther from UA sites.
Scale		
Bigger UA Lots	+	High income: small sites have the positive indirect effect on sales $. Low income: small sites have positive neighborhood effects on sales $, large sites positive direct effects.
Age of Site		
Newer Urban Agriculture	+ +	Both income groups: no practical difference in terms of real age (years).
		Established sites are significant on the neighborhood level, where the low income group has greater positive total effects compared to high income group.
Quality		
Higher Systematic Index	+	High income: high quality SYS have positive significant direct relationship with home $.
Higher Spatial Index	+ +	Low income: "aesthetic" component has stronger neighborhood effects on home sales $ compared to high income group.

The number of +'s indicate the expected strength of the relationships.
One + means an expected positive relationship. Two ++ means an expected strong positive relationship.

Income Subsets

From the previous sets of analysis we can see that there are differences in some variables of interest between high or low income groups. The income subsets investigate and discuss each group respectively. Tables 42 through 52 present the findings for urban agriculture variables on housing sale price for the two groups. In the previous analysis, the real street network distance variables explain the difference between income groups and the distance to urban agriculture sites. In the following subset analysis, the distance variable is interacted with the variables of interest to study if there are any other effects with respects to urban agriculture attributes and their proximity to sales parcels within each group. Please refer to the Appendix C for full models and regression outputs.

Urban Agriculture Type

Table 42. High Income Subset: Urban Agriculture Type

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Community Gardens *versus Urban Farms*	0.1134 (0.0957)	-0.1636 (-1.1049)	1.0389*** (2.9740)	0.8753*** (3.0783)
Community Gardens: Distance to UA *versus Urban Farms*	-0.0141 (0.0284)	0.0204 (0.5120)	-0.1551 (-1.3564)	-0.1346 (-1.2668)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

From Table 42, we see that the full direct effect for urban agriculture type is insignificant in the high income group. However, there are very large spillover effects for community gardens compared to urban farms. It is doubtful that large effects in sales prices are solely related to the presence of urban agriculture activities in the high income group, as there are a lower number of sites in the high income group, and these sites are also typically newer. Instead, such large neighborhood impacts of community gardens in high the income group suggest that the urban agriculture variable may be capturing some other quality or event. Community gardens in high income areas are more likely proxies for phenomena such as increases in green cover, larger lot sizes, and other social or environmental conditions. At this point, the above results only mean that, compared to urban farms, community gardens have a much larger effect in high income areas, and that distance does not seem to play a role when we study type.

Table 43. Low Income Subset: Urban Agriculture Type				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Community Gardens *versus Urban Farms*	-0.0619 (0.0901)	-0.1323 (-1.4642)	-0.0655 (-0.2213)	-0.1978 (-0.7896)
Community Gardens: Distance to UA *versus Urban Farms*	0.0582 (0.0616)	0.1038* (1.9403)	-0.1154 (-0.7083)	-0.0116 (-0.1246)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

In Table 43 we see that, in the low income group, when interacted with distance, there is a positive direct effect between community gardens and housing sales prices of about 10%, when compared to urban farms. This can be expected, because, although urban farms are located almost exclusively in the low income areas, community gardens remain the dominant type. The majority of neighborhood effects for community gardens insignificant in low income regions. These finding echoes the magnitude and scale of the previous discussions.

Scale

Table 44. High Income Subset: Scale				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Lot Area *square feet*	-0.0071 (0.0050)	0.0034 (0.4454)	-0.0506*** (-3.4658)	-0.0472*** (-3.9976)
Small Site *< quarter acre*	-0.0757 (0.0474)	-0.0615 (-0.7528)	-0.2422 (-1.4737)	-0.3037*** (-2.8032)
Large Site *> half acre*	0.0033 (0.0042)	-0.0040 (-0.6093)	0.0373*** (3.1632)	0.0333*** (3.6976)
UA Lot Area : Distance to UA	0.0001 (0.0014)	-0.0011 (-0.6252)	0.0136*** (3.3410)	0.0124*** (3.8372)
Small Site: Distance to UA *< quarter acre*	0.0427** (0.0143)	0.0178 (0.8706)	0.1090** (2.4764)	0.1268*** (3.7434)
Large Site: Distance to UA *> half acre*	0.0000 (0.0012)	0.0011 (0.7127)	-0.0104*** (-3.1630)	-0.0093*** (-3.5396)
+ +Below Half Acre *vs above half acre*	-	0.0643 (0.4546)	-0.3229 (-1.5979)	-0.2586* (-1.6980)
+ +Below Half Acre: Distance to UA *vs above half acre*	-	-0.0121 (-0.3124)	0.1578** (2.2362)	0.1457*** (2.5872)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

When we isolated the high income group, Table 44 indicates that any changes in real size (or categories of size) have no direct effects on housing sales prices. When interacted with distance, small sites show a full total effect of about 17%. With the presence of small urban agriculture sites in other regions, we can expect large increases in sales prices in typical region. When interacted with street network distance, large sites have a positive full indirect effect of about 3%. It would seem that with the presence of large urban agriculture sites in a typical region, the housing sales prices in a neighboring region will likely be higher. Large sites have positive full total effect of about 2%. This suggests that with the presence of large urban agriculture sites in other regions, we can expect increases in sales prices in typical regions also. Compared to medium sites, large sites show positive effects on housing sales prices on a neighborhood level. This idea is reflected by the collapsed category of scales (sites below or above half an acre). At distance "0", sites below half an acre show a large penalty on home sales prices, but with an increase in distance, this penalty becomes less. On average, when interacted with distance, the full total effect findings suggest that where there are sites below half an acre in the neighboring regions, we can associate about 11% lower home sales price in a typical region in the high income group. Overall, large sites seem to have positive indirect and total neighborhood effects.

Table 45. Low Income Subset: Scale

	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Lot Area *square feet*	-0.0045 (0.0082)	-0.0371*** (-3.7512)	0.0821*** (3.8647)	0.0450** (2.4763)
Small Site *< quarter acre*	-0.0450 (0.0869)	-0.4992*** (-4.0243)	0.6633*** (3.1361)	0.1642 (0.9772)
Large Site *> half acre*	0.0044 (0.0052)	0.0189*** (3.1682)	-0.0382*** (-2.8624)	-0.0193* (-1.6642)
UA Lot Area: Distance to UA *square feet*	-0.0011 (0.0039)	0.0136*** (2.7290)	-0.0296*** (-2.6689)	-0.0160* (-1.6835)
Small: Distance to UA *< quarter acre*	-0.0499 (0.0395)	0.1313** (2.2064)	-0.1109 (-1.1107)	0.0204 (0.3587)
Large: Distance to UA *> half acre*	0.0001 (0.0024)	-0.0064** (-2.0673)	0.0150** (2.1094)	0.0086 (1.4278)
$^{++}$Below Half Acre *vs above half acre*	-	-0.1077 (-0.6817)	0.5166 (1.3944)	0.4090 (1.2668)
$^{++}$Below Half Acre: Distance to UA *vs above half acre*	-	0.0259 (0.3534)	-0.2461 (-1.2677)	-0.2202 (-1.2941)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
$^{+}$ *Regression run on the reserve dummy variable.* $^{++}$ *Regression run on the collapsed categories, or alternate categories.*

In low income group, at any given distance, small sites have a much larger direct negative association with housing sales prices when compared to medium sites or large sites (about 37% greater impact). At first, the direct findings seem to support the idea that the presence of small urban agriculture in low income groups may be signaling that a neighborhood is in distress. However, from Table 45 we also see that there are negative full direct effects of real lot size on housing sales prices within the low income group. Holding everything else constant, with each 1000 square foot increase in size, the full indirect effects show about 5% increase in home sales prices, leading to a total full effect of about 3% increase. This would suggest that, on a neighborhood level, with an increase in real size in urban agriculture sites, we should see higher housing sales prices increase as well.

Large sites in low income groups have a significant positive full direct effect on housing sales prices of about 1% only. Large sites also have about 1% indirect effects, which leads to insignificant total effects. Together, the above findings suggest that we will see neighborhood increases in housing sales prices when we increase in scale, but beyond half an acre, these increases will be much less.

The direct findings seem to report that small urban agriculture sites have negative effects on housing sales prices in low income groups. However, the neighborhood effects tell a different story, as increase in scale generally contribute to home sales prices. Overall, because of the very large positive spillover effect of small urban agriculture sites (compared to medium or large sites), and the positive indirect and direct findings of real age, these above results suggest that smaller sites are generally contributing to higher housing sales prices in low income groups on a neighborhood level. Together, these results could mean that the direct effects of small urban agriculture sites are very likely associated with other systemic neighborhood phenomena in low income groups which this dataset and research method may not be able to fully explain.

Age

Table 46. High Income Subset: Age				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Age *years*	0.0098** (0.0037)	0.0009 (0.2401)	0.0272** (2.2824)	0.0281*** (3.1015)
New Site *0 - 3 years*	-0.0483 (0.0427)	-0.0778 (-0.9027)	0.0866 (0.4695)	0.0088 (-0.0381)
Well-established Sites *6+ years*	-0.1165* (0.0510)	-0.0125 (-0.1979)	-0.3156** (-2.0212)	-0.3281*** (-2.8903)
UA Age: Distance to UA *years*	-0.0005 (0.0010)	0.0000 (-0.0494)	-0.0037 (-1.0353)	-0.0037 (-1.3072)
New Site: Distance to UA *0 - 3 years*	0.0257* (0.0118)	0.0020 (0.0324)	0.0434 (1.2985)	0.0455* (1.7151)
Well-established Sites: Distance to UA *6+ years*	0.0386** (0.0141)	-0.0008 (-0.0084)	0.1015** (2.3142)	0.1007*** (3.1707)
+ Established Sites *3 - 6 years*	-	0.0125 (0.0980)	0.3156* (1.8976)	0.3281*** (2.6908)
+ Established Sites: Distance to UA *3 - 6 years*	-	0.0008 (0.0639)	-0.1015** (-2.2662)	-0.1007*** (-3.2132)
+ + Below 6 Years *versus all other*	-	0.0291 (0.2506)	0.3644** (2.3236)	0.3936*** (3.5674)
+ + Below 6 Years: Distance to UA *versus all other*	-	-0.0004 (-0.0059)	-0.1089** (-2.4853)	-0.1094*** (-3.4192)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Within the high income group, there is no statistically significant finding for the direct effects of real age on home sales prices. However, Table 46 indicates that the real age has positive and significant relationships with housing sales prices on a neighborhood level, with indirect and total effects of about 3%. In contrast, the category for well-established sites shows a strong negative association on a neighborhood level, when compared to other age categories. This suggests that within high income groups the increase in real age of urban agriculture sites is generally associated with higher home sales within the neighborhood, but old urban agriculture sites could be seen as a disamenity.

We can see this in the established site category on the reserve, as well as the collapsed variable for sites below or above 6 years. The full total effect findings suggest that established sites show very high positive associations with increase in housing sales prices (about 22%), and below 6 years have an even higher figure (about 28%). One explanation for such unusually high figures could be that, considering the lower amounts of new urban agriculture sites in high income neighborhoods, new urban agriculture sites are most likely situated on pieces of land that has recently been made vacant, or has some other unique history or underlying trend that accompanies higher home sales prices. To investigate, we would have to isolate and compare each neighborhood (which falls beyond this research scope at present). Nevertheless, the general interpretation here is that in high income groups there is a strong positive neighborhood effect for sites below 6 years, whereas older sites reflect lower housing sales prices.

Table 47. Low Income Subset: Age

	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Age *years*	0.0018 (0.0057)	0.0007 (0.2092)	-0.0034 (-0.3447)	-0.0027 (-0.2955)
New Site *0 - 3 years*	-0.1244* (0.0505)	-0.0956 (-1.6206)	-0.1026 (-1.0835)	-0.1982** (-2.2690)
Well-established Sites *6+ years*	-0.0583 (0.0858)	-0.0124 (-0.2166)	0.0241 (0.1643)	0.0117 (0.0779)
UA Age: Distance to UA *years*	-0.0007 (0.0026)	0.0023 (0.5645)	-0.0025 (-0.3141)	-0.0002 (-0.0481)
New: Distance to UA *0 - 3 years*	0.0369 (0.0250)	0.0142 (0.4590)	0.0229 (0.4205)	0.0371 (0.7402)
Well-established: Distance to UA *6+ years*	0.008 (0.0376)	-0.0700 (-1.3161)	0.0780 (0.7282)	0.0081 (0.1386)
+ Established Sites *3 - 6 years*	-	0.0124 (0.1039)	-0.0241 (-0.0627)	-0.0117 (-0.0241)
+ Established Sites: Distance to UA *3 - 6 years*	-	0.0700 (1.5445)	-0.0780 (-0.6725)	-0.0081 (-0.0944)
+ +Below 6 Years *versus all other*	-	-0.0106 (-0.0759)	0.1200 (0.5508)	0.1095 (0.6050)
+ +Below 6 Years: Distance to UA *versus all other*	-	0.0687 (1.5981)	-0.1519 (-1.5750)	-0.0832 (-1.0502)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

In low income groups, Table 47 Table 47 shows that the real age has an insignificant relationship across the board. For age categories, the only meaningful result within low income groups is the total neighborhood effect of new sites (0 – 3 years), which is negative and significant. This could be interpreted as an element of competition in low income groups regarding new sites (0 – 3 years). Within the low income group, when all other regions in the city have new urban agriculture sites, the typical region will have a lower associated sales price of about 20%.

Abundance

Table 48. High Income Subset: Abundance				
	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
# UA per mile (street network) *count*	-0.0155*** (0.0038)	-0.0293*** (-3.9680)	0.0069 (0.5779)	-0.0224*** (-3.2906)
# UA per neighborhood *count*	0.0093 (0.0064)	0.0157 (1.2594)	-0.0037 (-0.1872)	0.0120 (0.9619)
+ High number per neighborhood *4 + sites versus other*	-	0.1156** (2.1028)	-0.0842 (-1.0523)	0.0314 (0.5594)

Table 48 shows that within the high income group, there is a negative 3% direct effect on housing sales prices and abundance of sites within a street mile network. However, there is also a negative total effect of around 2% on a neighborhood level, suggesting that the presence of more sites in all other regions may impact home sales negatively in a typical region in the high income group. In high income groups, more urban agriculture sites in the general area (street mile network) will likely show lower housing sales prices in a typical neighborhood. In contrast, for the category describing a high number of urban agriculture sites in a neighborhood (4+ sites), we see that there is a positive and large direct association with housing sales prices of about 12%, compared to a low abundance of urban agriculture sites in high income neighborhoods. Overall, these findings indicate that there may be a critical limit or an optimal number of sites within high income groups and a certain geographic area — where more sites are likely seen as an amenity on a neighborhood level (4+ sites), yet too many sites are likely seen as a disamenity (reflected in the increase in sites per street network mile). The idea of an optimal number of urban agriculture sites per neighborhood is also seen in the discussion of the low income group subset below. There is the likelihood that urban agriculture sites that are tied specifically to a neighborhood organization in high income areas may have a stronger relationship to housing sales prices than sites that are run independent from the neighborhood organization.

Table 49. Low Income Subset: Abundance				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
# UA per mile (street network) *count*	-0.0062. (0.0038)	-0.0190** (-2.5007)	0.0381*** (3.7284)	0.0191*** (3.0834)
# UA per neighborhood *count*	-0.0084 (0.0080)	-0.0007 (-0.0197)	-0.0602*** (-3.6156)	-0.0609*** (-4.7326)
+ High number per neighborhood *4 + sites versus other*	-	-0.0005 (-0.0254)	-0.1492 (-1.5731)	-0.1497** (-1.9730)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Table 49 shows that within the low income group, there is a direct negative association of around 2% between housing sales prices and the abundance of urban agriculture sites within a street mile network. However, there is a significant and positive indirect neighborhood effect of about 4% for the number of urban agriculture sites within a street mile network on housing sales prices also. This implies that, the increase per network mile of more urban agriculture sites in typical low income regions may contribute to home sales price increases in neighboring regions by about 4%. The total effect is almost 2% also, which suggests that the increase in abundance of urban agriculture sites in other regions will be associated with an increase in housing sales prices in a typical region. Together, these findings suggest that in the low income group, the abundance of urban agriculture sites have overall positive relationships to housing sales prices on a neighborhood level.

There is a negative 6% significant indirect and total effect between the number of urban agriculture sites per neighborhood and housing sales prices in low income groups. This finding is also reflected in the category for high amounts of sites per neighborhood (4+ sites) versus all other. Here, the total neighborhood effect finding is almost -15%. This would suggest that, should all other neighborhoods in low income groups have four or more urban agriculture sites, a typical home sale here would be 15% lower. This can be interpreted that the sites themselves have special features or combinations of features. For example, sites could be four very large urban agriculture farms, or very a bundle of small community gardens or some other combination thereof that the research does not address at this point.

Nevertheless, the contrast in these two findings above suggest that if all other neighborhoods in low income groups raise the amount of urban agriculture sites, the home sales price in a typical neighborhood will likely show lower prices (abundance per neighborhood). However, the abundance of urban agriculture sites across a greater area of low income regions shows a positive relationship with sales prices (abundance per street network mile) Again, as with the high income group, this finding suggests that there may be a critical or optimal number of sites within a neighborhood, particularly in the low income group, as the effect is much more powerful here than in the high income group.

Quality

Table 50. High Income Subset: Quality				
	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
SYS Index% *proportion*	0.1116 (0.1014)	-0.1068 (-0.6294)	0.2162 (0.7614)	0.1093 (0.5233)
SPA Index% *proportion*	-0.5083* (0.2115)	0.1161 (0.3506)	-1.1570* (-1.8944)	-1.0409** (-2.3285)
SYS Index%: Distance to UA *proportion*	-0.0339 (0.0436)	0.0413 (0.5118)	-0.0227 (-0.1297)	0.0186 (0.3081)
SYS Index%: Distance to UA squared *proportion*	0.0014 (0.0042)	-0.0037 (-0.5095)	-0.0050 (-0.4360)	-0.0088 (-1.0828)
SPA Index%: Distance to UA *proportion*	0.1957* (0.0874)	-0.1904 (-1.5389)	0.7282*** (3.0382)	0.5378*** (2.9680)
SPA Index%: Distance to UA squared *proportion*	-0.0142. (0.0075)	0.0201* (1.6840)	-0.0675*** (-3.6260)	-0.0474*** (-3.8200)

Across the board, both Table 50 and show that only the SPA Index has strong neighborhood effects in both income groups. The SPA Index findings indicate significant neighborhood effects, but only when we interact this variable with distance variables. Collapsing the SPA Index into high, medium, and low categories, or testing the respective five components, revealed no statistically significant results in the high income group. It would be better for a future study to isolate this income group and redesign the entire model accordingly, as these results does not provide practical information at this point. Nevertheless, there is reason to believe that new findings (regarding the quality of sites for the subset of income groups) associated with a refitted model would generally be consistent and comparable with the findings in other sections of in this research.

Table 51. Low Income Subset: Quality

	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
SYS Index% *proportion*	-0.0468 (0.1348)	-0.0990 (-0.4233)	-0.6698 (-1.6034)	-0.7688** (-2.2177)
SPA Index% *proportion*	0.0664 (0.1759)	0.3295 (1.5841)	-0.0407 (-0.1640)	0.2888 (0.7566)
SYS Index%: Distance to UA *proportion*	0.0440 (0.0885)	0.0440 (0.3156)	0.1710 (0.6056)	0.2150 (0.9819)
SYS Index%: Distance to UA squared *proportion*	-0.0102 (0.0130)	-0.0049 (-0.2654)	0.0172 (0.4923)	0.0123 (0.5137)
SPA Index%: Distance to UA *proportion*	-0.1228 (0.1258)	-0.3827** (-2.4185)	0.2709 (1.0500)	-0.1118 (-0.2952)
SPA Index%: Distance to UA squared *proportion*	0.0204 (0.0200)	0.0370 (1.4977)	0.0784 (1.3689)	0.1154** (2.2177)
+ + SYS High Quality *versus all other*	-	-0.0961 (-1.3673)	0.0698 (0.4927)	-0.0264 (-0.2704)
+ + SPA High Quality *versus all other*	-	0.0193 (0.4035)	-0.2836*** (-2.8968)	-0.2642*** (-2.9796)
+ + SYS High Quality: Distance to UA *versus all other*	-	0.0226 (0.5833)	-0.0689 (-0.9708)	-0.0464 (-0.9150)
+ + SPA High Quality: Distance to UA *versus all other*	-	-0.0203 (-0.8346)	0.1797*** (2.9409)	0.1594*** (2.9991)
+ + Permanence% *proportion*	-	-0.2269 (-1.2536)	0.1743 (0.3301)	-0.0526 (-0.1378)
+ + Communication% *proportion*	-	-0.1104 (-1.2967)	-0.1005 (-0.4586)	-0.2109 (-1.0174)
+ + Operational% *proportion*	-	0.1994* (1.7000)	-0.4990 (-1.5045)	-0.2996 (-0.9641)
+ + Urban Context% *proportion*	-	0.2196 (1.3212)	-0.3140 (-0.8096)	-0.0945 (-0.2225)
+ + Aesthetic% *proportion*	-	0.1789* (1.7469)	-0.1642 (-0.6773)	0.0146 (-0.0032)
+ + Permanence%: Distance to UA *proportion*	-	0.0798 (0.9047)	-0.2337 (-0.7814)	-0.1539 (-0.4870)
+ + Communication%: Distance to UA *proportion*	-	0.0710 (1.5755)	0.0409 (0.3468)	0.1119 (0.9941)
+ + Operational%: Distance to UA *proportion*	-	-0.1155** (-1.9699)	0.2437 (1.3660)	0.1283 (0.7339)
+ + Urban Context%: Distance to UA proportion	-	-0.1629 (-1.5932)	0.3110 (1.5288)	0.1480 (0.8262)
+ + Aesthetic%: Distance to UA *proportion*	-	-0.1154* (-1.8722)	0.1568 (1.1019)	0.0414 (0.3294)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

In Table 51 we see that there is a strong SYS Index total effect in the low income group. At any given distance, the full direct effect of a higher SYS Index will likely be negative in the low income group, and the SPA Index will likely have no real relationship with nearby home sales prices. This is to be expected as in the low income group the systemic components (such as participant restrictions, communication, or operations) will likely be of more importance than aesthetic spatial components (such as decoration or attractive edges).

This idea is reflected in the neighborhood effects of the high quality SPA sites within a low income subset. At any given distance, the results from this model suggest that full total effects of high quality SPA sites is about -10.5%. This would suggest that if all other regions in the low income subset increased their SPA sites to the highest quality, we could see a decrease in sales price of a typical region in the low income group. Again, this reflects the idea of competition, where neighborhoods with better quality SPA sites will have higher housing sales prices compared to those with lower quality sites.

Breaking the indexes down into their respective components, we see that the operational component has a positive and statistically significant full direct effect in low income groups of about 8%. Similarly, the full direct effect of the aesthetic component shows a direct positive relationship effect of about 6%. In a hypothetical example, this would imply that if we improve (and maintain) the operations performance score by half in all low income groups, across all other regions of the city, we could see the average typical home sales price increase by about 3% in the low income group. Keep in mind, this hypothetical situation is only relevant when we compare similar home sales in low income groups in similar conditions but without urban agriculture sites.

Together, these findings suggest that within low income groups, the SPA Index and its components plays a more prominent role compared to high income groups. This narrative is comparable to the results and discussions in previous sections of the research. However, as with the high income group, a future study should consider refitting the model for the low income groups specifically. It is expected that a refitted model will be generally consistent and comparable with the findings in other sections of in this research.

Summary Income Subsets Results

Table 52 summarizes the income subset findings, and contrasts the hypothesized directional relationships between the various models and housing sale price from Table 20. The notable and significant findings are marked in grey.

Table 52. Income Subset Comparison Results Summary

Variable	**Expected Relationship** Direction & magnitude	**Found Relationship** Description
Type		
Nearest: Community Garden	+ +	High income: $ near community gardens associated with higher sales $ compared to urban farms.
Nearest: Urban Farm	+	Low income: on a direct level, community gardens associated with higher sales $ compared to urban farms.
Scale		
Bigger UA Lots	+	High income: large sites have positive neighborhood effects on sales $. Low income: increase in size show positive neighborhood effects on sales $.
Age of Site		
Newer Urban Agriculture	+ +	High income: strong positive neighborhood effect for sites less than 6 years old, whereas older sites reflect lower sales $. Low income: new sites (0 – 3 years) have negative association with sales $ on a neighborhood level.
Abundance		
More UA in a Mile	+	High income: negative direct and neighborhood effects. Low income: positive neighborhood effects.
More UA in Neighborhood	+ +	High income: neighborhoods with a high number of UA have positive direct effect on sales $. Low income: neighborhoods with more UA have negative direct effect on sales $.
Quality		
Higher Systematic Index	+ +	Low income: operational component has direct strong positive relationship with sales $.
Higher Spatial Index	+ +	Both income groups: element of competition, where higher quality sites in other regions may show lower sales $ in typical region.

The number of +'s indicate the expected strength of the relationships.
One + means an expected positive relationship. Two ++ means an expected strong positive relationship.

Urban Agriculture Type Subset

Urban agriculture type is not statistically significant in the direct effects within the global model or stratified groups, which means we cannot really see a difference between community gardens or urban farms in this data set. A dummy variable for the urban agriculture type was run with the same base model, but very few categories and variables of interest showed a statistical difference between community gardens or urban farms and their relationship with housing sales prices. However, this can be expected as only 5% percent of the sample is associated with urban farms. With such a low subset sample size for urban farms, we cannot compare urban agriculture to community gardens as there is no reliable evidence that urban farms have statistically different behavior than community gardens at this point. Due to the sheer high number of community gardens within the dataset, a subset for community gardens was examined and the findings are presented below. The general findings in this subset are similar to the findings in the global model, since 95% of the sample is of the community garden type. The discussions are brief, and illustrate the general relationships and neighborhood behaviors only. Keep in mind that, because we are keeping a consistent model from the previous sections, the distance variable interacts with all other variables of interest in this subset. The effects of distance are best described in the global model findings section and the quarter mile comparison section, both discussed earlier.

Table 53 through 58 present the findings for community garden variables and their relationships with housing sale price. Please refer to the Appendix C for full models and regression outputs.

Proximity

The discussion below illustrates the general behavior of the distance variable only.

Table 53. Urban Agriculture Type Subset: Proximity

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Distance to UA *1000's feet*	-0.0650 (0.0500)	0.2650*** (3.2746)	-0.6407*** (-4.0955)	-0.3757*** (-3.1101)
Distance to UA squared *1000's feet*	-0.0002 (0.0043)	-0.0283*** (-4.0991)	0.0539*** (4.7557)	0.0256*** (3.0158)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Table 53 illustrates that the distance variable is significant in all instances. With increasing distances from community gardens, homes sold farther away show higher sales prices. There is a premium for being close to the community garden site. There are significant negative indirect and total effects of community gardens on sales price, reflecting the findings in the global model. This suggests that, if all other regions increase their distances from community gardens, the sales price in a typical region will be lower. This means that when neighborhoods have community gardens which are in closer proximity to residences, the housing sales prices will typically be higher, compared to neighborhoods where distances to community gardens are greater. The magnitudes of the findings above are greater when we isolate the community garden subgroup, compared to the global study results (which include the urban farm subgroup). However, this is likely a reflection of the interaction of the distance variable across the model. These general findings support what was found in regards to the proximity and abundance measurements throughout the study.

Scale

Table 54. Urban Agriculture Type Subset: Scale

	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Lot Area *square feet*	-0.0006 (0.0033)	-0.0046 (-0.9416)	-0.0020 (-0.0941)	-0.0066 (-0.7483)
Small Site < *quarter acre*	-0.0822* (0.0341)	-0.1252** (-2.1148)	0.0476 (0.5561)	-0.0776 (-0.9637)
Large Site > *half acre*	-0.0023 (0.0028)	0.0020 (0.5096)	0.0000 (-0.0845)	0.0020 (0.2678)
UA Lot Area: Distance to UA *square feet*	-0.0007 (0.0011)	0.0003 (0.2691)	0.0056 (1.3817)	0.0059** (2.0609)
Small: Distance to UA < *quarter acre*	0.0270* (0.0115)	0.0063 (0.5036)	0.0585 (1.4951)	0.0647** (2.3292)
Large: Distance to UA > *half acre*	0.0007 (0.0009)	0.0000 (-0.0918)	-0.0045 (-1.3590)	-0.0045** (-1.9826)
++Below Half Acre *vs above half acre*	-	0.0180 (0.2455)	-0.1663 (-0.9850)	-0.1483 (-1.1879)
++Below Half Acre: Distance to UA *vs above half acre*	-	-0.0281 (-0.9725)	0.1572** (2.4711)	0.1291*** (2.7042)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. ++ Regression run on the collapsed categories, or alternate categories.

From Table 54, the SDM results indicate that there are no statistically significant direct effects of real size of community gardens on housing sales prices. Holding all else constant, small community garden sites have a direct effect on housing sales prices of about -12%. This is larger than the global model results (-8.5%). With the presence of small community gardens in neighboring regions, a typical region may show higher home sales prices, when compared to the effects of other categories of scale. Large community garden sites have no practical or significant effects on home sales prices. Collapsing the variables into community gardens below or above half an acre, the full indirect and total effects show negative results, when we include the effect of distance. This would suggest that city-wide, community gardens below half an acre are generally associated with higher homes sales prices when compared to their large scale counterparts, but they still have a negative direct effect on housing sales prices.

Age

Table 55. Urban Agriculture Type Subset: Age

Variable	**OLS Model**	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
UA Age *years*	0.0074** (0.0027)	0.0055 (1.4489)	0.0049 (0.6710)	0.0104 (1.7547)
New Site *0 - 3 years*	-0.0920** (0.0291)	-0.0233 (-0.4317)	-0.1620 (-2.1355)	-0.1854*** (-2.9697)
Well-established Sites *6+ years*	-0.1211** (0.0405)	-0.0601** (-0.9341)	-0.1965 (-1.5398)	-0.2566 (-2.5807)
UA Age: Distance to UA *years*	-0.0002 (0.0009)	-0.0005 (-0.4692)	-0.0013 (-0.5491)	-0.0019* (-0.9661)
New: Distance to UA *0 - 3 years*	0.0310** (0.0097)	-0.0114 (-0.8786)	0.0801** (2.7902)	0.0686*** (2.8477)
Well-established: Distance to UA *6+ years*	0.0292* (0.0126)	-0.0152 (-0.7000)	0.0967 (2.3766)	0.0815** (2.6761)
+ Established Sites *3 - 6 years*	-	0.0671 (1.0234)	0.1903** (1.4417)	0.2574** (2.2965)
+ Established Sites: Distance to UA *3 - 6 years*	-	0.0127*** (0.7471)	-0.0913*** (-2.3975)	-0.0786*** (-2.5532)
+ +Below 6 Years *versus all other*	-	0.0590 (0.8560)	0.1685** (1.4363)	0.2275*** (2.3059)
+ +Below 6 Years: Distance to UA *versus all other*	-	0.0097*** (0.6915)	-0.0892*** (-2.3712)	-0.0795*** (-2.6208)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

The SDM results in Table 55 show that within the community garden subset, the real effect of age is not statistically significant. On the reserve, the category for established sites show that, compared to all other age categories, sites between 3 – 6 years have a positive indirect and total effect on housing sales prices of 9% and 17% more when compared to all other age categories. When we collapse the categories into sites below and above 6 years, we see a positive indirect and total effect on housing sales prices of 8% and 14%. This implies that community gardens less than 6 years old, particularly between 3 – 6 years, show the strongest positive relationship to housing sales prices on a neighborhood level.

Abundance

Table 56. Urban Agriculture Type Subset: Abundance

	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
# UA per Mile (street network) *Count*	-0.0110*** (0.0025)	-0.0185** (-3.2970)	0.0093*** (1.2085)	-0.0091 (-2.0454)
# UA per neighborhood *Count*	0.0019 (0.0049)	0.0196 (2.2831)	-0.0341 (-2.7485)	-0.0145* (-1.6048)
+ High number per neighborhood *4 + sites versus other*	-	0.0935** (2.1972)	-0.1542** (-2.4402)	-0.0607 (-1.3213)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

From Table 56 it would seem that the number of community gardens in a street network mile has a significant negative direct effect on home sales prices. This means that as the number of community gardens goes up in a street network mile, the home sale price will typically be lower by about 2%. The indirect effect suggests that an increase in the number of community gardens in one street network mile in a typical region will show about 1% higher housing sales prices in neighboring regions.

The variable that captures the abundance of community gardens within a neighborhood is only significant in the total effect, suggesting that there could be as much as a 1.5% average sales price decrease in a typical region with the increase in number of community gardens sites in neighboring regions. This is reflected in the test for high number of community gardens per neighborhood (4+ sites). Neighborhoods with a high number of community gardens show a significant positive direct effect of about 9% with housing sales prices, compared to neighborhoods with fewer sites. Again, the negative indirect and total effects suggest either an element of competition. When all other regions increase their numbers of community gardens, homes sales prices in a typical region may be lower. The direction and magnitude of these findings are comparable to the global model findings.

Quality

Table 57. Urban Agriculture Type Subset: Quality				
	OLS Model	Spatial Durbin Model		
Variable	OLS Coefficients	Direct Effect Coefficients	Indirect Effect Coefficients	Total Effect Coefficients
SYS Index% *proportion*	0.0403 (0.0758)	-0.0701 (-0.5995)	-0.0366 (-0.1278)	-0.1066 (-0.6328)
SPA Index% *proportion*	-0.1493 (0.1252)	0.2025 (1.1821)	-0.3520** (-1.0676)	-0.1495*** (-0.5502)
SYS Index%: Distance to UA *proportion*	-0.0180 (0.0363)	0.0190 (0.3346)	0.0675 (0.5967)	0.0864 (1.0798)
SYS Index%: Distance to UA squared *proportion*	0.0028 (0.0037)	-0.0013*** (-0.2845)	-0.0049*** (-0.4412)	-0.0062** (-0.7408)
SPA Index%: Distance to UA *proportion*	0.0724 (0.0655)	-0.3240*** (-3.2419)	0.6430*** (3.2326)	0.3190** (2.1008)
SPA Index%: Distance to UA squared *proportion*	-0.0015 (0.0064)	0.0347 (3.5363)	-0.0670*** (-3.6455)	-0.0323*** (-2.3392)
+ + SYS High Quality *versus all other*	-	-0.0107 (-0.4036)	-0.0728 (-0.7762)	-0.0835 (-1.2740)
+ + SPA High Quality *versus all other*	-	-0.0538* (-1.7987)	0.0654 (1.0093)	0.0116 (0.2703)
+ + SYS High Quality: Distance to UA *versus all other*	-	-0.0042 (-0.2281)	0.0465* (1.7031)	0.0422* (1.9506)
+ + SPA High Quality: Distance to UA *versus all other*	-	0.0032 (0.3236)	0.0120 (0.4151)	0.0151 (0.6501)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Table 57 shows no statistically significant effects of the real performance of the SYS Index on housing sales prices. There were no significant findings for the five components of the indexes either; full results are reported in Appendix C. However, there are significant effects of the real performance of the SPA Index. The direct effect shows that an increase in the SPA Index (when interacted with distance) leads to a decrease in home sales prices. When interacted with distance, the significant and positive indirect effect overrules the direct effect of the SPA Index. The full total effects of the SPA Index suggest a neighborhood effect of about 14%. This implies that if all other regions increase their SPA Indexes for community gardens with a couple of percentage points (for example, by 20% more), we could see an associated neighborhood increase on a home sale in a typical region by about 3%. These findings reflect in the categories of highest quality versus all lower levels of quality. Community gardens with high performing SPA Indexes have a negative direct effect on housing sales prices. However, at any given distance, the SYS Index of nearby community gardens will have some positive full indirect effects on home sales prices. However, overall, the SYS Index evidence is not compelling.

Summary Urban Agriculture Subset Results

Table 58 illustrates the income subset findings, and contrasts the hypothesized directional relationships between the various models and housing sale price from Table 20. The notable and significant findings are marked in grey.

Table 58. Urban Agriculture Subset Results Summary

Variable	**Expected Relationship** *Direction & magnitude*	**Found Relationship** *Description*
Type		
Nearest: Community Garden	+ +	Premium closer to community garden, but home sales farther away have higher sales $.
Distance		
Parcels Closer to Community Garden	+	Neighborhoods where community gardens are less dispersed have higher $.
Scale		
Bigger UA Lots	+	Small sites have negative direct impact on home sales $.
Age of Site		
Newer Urban Agriculture	+ +	Community gardens have strongest positive association with sales when they are between 3 - 6 years old. Community garden sites less than 6 years old have premium effects compared to older sites.
Abundance		
More UA in a Mile	+	Small negative direct effects.
More UA in Neighborhood	+ +	Neighborhoods with more community gardens have higher sales $.
Quality		
Higher Systematic Index	+	No strong relationship found.
Higher Spatial Index	+ +	Positive neighborhood effects

The number of +'s indicate the expected strength of the relationships.
One + means an expected positive relationship. Two ++ means an expected strong positive relationship.

Overall Summary of Findings

The base model was applied globally, and was then applied on stratified sets for general comparison and detail. The comparison models show that there are some significant differences between certain variables of interest in high income groups, or within quarter mile thresholds. The subset analysis illustrates some of these differences. Below are the key points from the findings:

1) Type

Generally, community gardens have fewer penalties on housing sales prices compared to urban farms.

- Holding everything else constant, the total effect of community gardens on housing sales prices is almost 20% larger when compared to urban farms.
- Overall, community gardens are likely to have higher direct impacts than urban farms; however, with increase in distance, housing sales prices will increase also.
- Across the board, community gardens have stronger and positive indirect and total effects on with housing sales prices, compared to urban farms.
- No direct difference between urban farms or community gardens inside or outside a quarter mile.
- Outside of a quarter mile, it is expected that community gardens have higher positive neighborhood effects compared to urban farms.
- Overall, for community gardens, there are less direct penalties on sales prices in low income groups than in high income groups.
- Community gardens have larger, positive indirect or total effects within high income group, compared to urban farms. These neighborhood effects are much stronger in high income groups than in low income groups.

2) Proximity

Generally, there is a very small direct effect premium associated with being close to an urban agriculture site.

- However, with greater distances from urban agriculture sites, housing sales prices show increases also.
- In regions where urban agriculture sites have on average closer distances to housing sales, housing sales prices in tend to be higher, when compared to other regions.
- Within a quarter mile of an urban agriculture site, housing sales prices are likely lower.

- Within a quarter mile, sales parcels that are increasingly farther away from urban agriculture sites have lower prices compared to sales parcels closer to these urban agricultures sites.
- Outside a quarter mile, small sites show negative direct effects on housing sales prices, but positive total effects, compared to medium sites.
- Outside of a quarter mile, sites below half an acre show the strongest positive neighborhood effects on housing sales prices.
- Outside of a quarter mile, sites below 6 years have strongest positive direct effect on housing sales prices.
- Inside or outside QM, established urban agriculture sites (3 – 6 years) have the highest direct relationship with housing sales prices.
- In the low income group, there is a greater premium on housing sales prices closer to urban agriculture sites, when compared to the high income group.

3) Scale

Overall, the real sizes of urban agriculture sites have small direct effects on housing sales prices. We will only see measurable effects when we increase urban agriculture sites by at least a quarter acre.

- Globally, an increase of a quarter acre in scale will have about a -6% direct effect on nearby housing sales prices. Similarly, small community gardens (and sites below half an acre) have direct penalties on housing sales prices, compared to larger counterparts.
- However, globally, the presence of small urban agriculture sites (and sites below half an acre) in neighboring regions may greatly and positively impact the home sales price in a typical region. This is true for the type “community gardens” also.
- Inside of a quarter mile, large sites have positive direct effects.
- Outside of a quarter mile, the total neighborhood effects of small sites (and below half an acre) are positive. The presence of small sites in the other neighborhoods has a positive effect on a typical neighborhood, but only when the home sale is at least a quarter mile away from these urban agriculture sites.
- In the low income group, small urban agriculture sites have more direct penalties on housing sales prices, compared to the high income group.
- Large sites have positive neighborhood effects in both income groups, but the effect is larger in the low income group than in the high income group.

- In both income groups, the increase in small lots in neighboring regions show an increase the home sales price in a typical region, but this effect is much stronger in the low income group.
- Typically, in the low income group, when all other neighboring regions have large urban agriculture lots, the sales price is lower. This suggest there is a competitive benefit to have smaller lots within the low income group neighborhoods, as very large lots are associated with a decrease in housing sales prices.
- In the high income group, small sites have the positive indirect effects on housing sales prices, compared to the low income group. However, the total effect of urban agriculture sites below half an acre is negative.
- Typically, in high income groups, when all other neighboring regions have large urban agriculture sites, the region sales price is higher. This suggests that there is likely a benefit to have medium sized lots (quarter to half acre) within high income groups overall, as the neighborhood effects of small lots (and lots below half an acre) are associated with a decrease in housing sales prices.

4) Age

Overall, there are no practical direct effects of real age (in years) of urban agriculture sites on housing sales prices. However, overall, sites less than 6 years of age (particularly established sites between 3 – 6 years) have greater and positive direct effects on housing sales prices compared to older sites.

- Globally, compared to any other age category, established sites seem to contribute the most to housing sales prices on a global level with about 8.5% on housing sales prices.
- Globally, new sites (0 – 3 years) have negative direct effects.
- There is no statistical difference between real age of urban agriculture sites when we compare sales prices inside or outside of a quarter mile distance on a neighborhood level.
- Overall, established sites (3 – 6 years) are significant on the neighborhood level, with greater positive total effects in the low income group, compared to the high income group.
- In the high income group, there are strong positive neighborhood effects for sites below 6 years, whereas older sites reflect lower housing sales prices.
- In the low income group, new sites (0 – 3 years) have negative association with housing sales prices on a neighborhood level. Well-established sites (or sites older than 6 years) have a much larger direct negative associations with housing sales prices than in the high income group. Within the low income group, however, well-established sites are not significant.

- Overall, with an increase in age of community gardens, we see larger positive neighborhood effects on housing sales prices. Newer community garden sites (below 6 years) have positive neighborhood effects when compared to older sites. The greatest increase can be found when community gardens are between the ages of 3 – 6 years.

5) Abundance

Overall, higher amounts of urban agricultures sites show positive neighborhood relationships with housing sales prices.

- Globally, there is an element of competition. If all other neighborhoods increase their number of urban agriculture sites, the home sales price in a typical neighborhood may be lower. Or, the other way around, neighborhoods with more than four urban agriculture sites may show higher housing sales prices on average, compared to neighborhoods with few urban agriculture sites in a comparable region.
- Overall, there seems to be a critical optimal limit to the amount of urban agriculture sites within a neighborhood. This is more evident in low income regions where there are stronger negative associations between the abundance of sites and housing sales prices within a region, than in high income regions.
- However, having too many sites is also seen as a negative, and there is a difference between income groups.
    - In the high income group, there are negative direct and neighborhood effects for the abundance of sites within a network mile.
    - In the low income group, there is a positive neighborhood effect for the abundance of sites within a network mile.
    - In the high income group, neighborhoods with more urban agriculture sites have positive direct associations with housing sales prices.
    - In the low income group, neighborhoods with more urban agriculture sites have negative direct associations with housing sales prices.
- In the low income group, there is a negative direct effect, and also very strong negative spillover effects. This suggests that in low income regions, the increase in urban agriculture sites can be interpreted either as a signal for distress or, that there may be competition factor. However, the former seems more likely.

6) Quality

Overall, the SPA Index shows significant relationships with housing prices on the neighborhood level, and the SYS Index does not.

- The majority of the analysis shows that the SPA Indexes have negative direct effects on housing sales prices, but large and positive neighborhood effects.
- The five components for the SYS and SPA Indexes showed very few statistically significant results across all the analyses.
- The SPA Index effect seems to be driven by predominantly by the "aesthetic" component, as this component shows consistent and similar behavior across all analyses.
- In the low income group, the "aesthetic" and "operational" components showed direct negative effects on housing sales prices, and much larger indirect effects when compared to the other components.

Summary Matrix

Table 59 summarizes the notable significant findings (cells marked in grey) in a matrix form, and contrasts these to the hypothesized relationships from Table 20.

Table 59. Relationships and Findings Matrix

	Expected Relationship	**Found Relationship**			
Variable	*Direction & magnitude*	**Global**	**Quarter Mile Comparison**	**Income Group Comparison**	**Community Garden Subset**
Type Community Gardens	+ +	Community gardens have large positive total neighborhood effects on sales $.	Outside QM: community gardens have higher positive neighborhood effects on sales $ compared to urban farms.	In the high income group, $ near community gardens associated with higher sales $ compared to urban farms.	Small premium closer to community gardens, but homes sales farther away have higher sales $.
Type Urban Farms	+ +	Urban farms have lower overall impact on sales $ than community gardens.	No practical direct effect difference between urban farms or community gardens inside or outside QM.	No direct effect difference between urban farms or community gardens when we compare income groups.	*N.A.*

Table 59. *(continued)* Relationships & Findings Matrix					
	Expected Relationship	**Found Relationship**			
Variable	*Direction & magnitude*	**Global**	**Quarter Mile Comparison**	**Income Group Comparison**	**Community Garden Subset**
Parcels Closer to UA	+	Direct effect premium closer to UA, but homes sales farther away have higher sales $.	Inside QM: sales occurring closer to UA have lower sales $.	In the low income group, there is a direct effect premium on sales closer to UA, but homes sales farther away have higher sales $.	Neighborhoods where community gardens are less dispersed have higher $.
Bigger UA Lots	+	Small sites have positive indirect neighborhood effects. Large sites have very small negative neighborhood effects.	Outside QM: small sites show positive neighborhood effects. Inside QM: large sites show positive direct effects.	High income: large sites have the strongest positive neighborhood effect on sales $. Low income: small sites have strongest positive neighborhood effects.	Small sites have negative direct effects on sales $.
Newer Urban Agriculture	+ +	Established sites (3 – 6 years) have high, positive direct relationship with sales $.	Outside QM: UA sites below 6 years have strongest positive direct effect on sales $. Outside QM: established UA sites (3 – 6 years) have highest direct relationship with sales $	High income: strong positive neighborhood effect for sites below 6 years, whereas older sites reflect lower housing sales $.	Community gardens have strongest positive neighborhood effect with sales when they are between 3 – 6 years old.
More UA in a Mile	+	Negative direct relationship with sales $.	*N.A. (abundance variables used as control variables)*	High income: negative direct and neighborhood effects. Low income: positive neighborhood effects.	Small negative relationship.

Table 59. *(continued)* Relationships & Findings Matrix					
	Expected Relationship	**Found Relationship**			
Variable	*Direction & magnitude*	**Global**	**Quarter Mile Comparison**	**Income Group Comparison**	**Community Garden Subset**
More UA in Neighborhood	+ +	Positive direct relationships with sales $.	*N.A. (abundance variables used as control variables)*	High income: neighborhoods with more UA have positive direct effect on $. Low income: neighborhoods with more UA have negative effect on $.	Neighborhoods with more community gardens have higher sales $ compared to neighborhoods with fewer sites around.
Higher Systematic Index	+ +	No strong relationship found.	No strong relationship found.	Low income: operational component has positive direct relationship with sales $.	No strong relationship found.
Higher Spatial Index	+ +	Positive total neighborhood effects.	Positive neighborhood effects, outside of a QM.	Higher quality sites in other regions may lower sales $ in typical region.	Positive indirect and total neighborhood effects

Chapter Five – Recommendations

This chapter provides conclusions and recommendations for policy, design and planning. The chapter relates the study findings to the research questions, addresses the limitations of this study and discusses opportunities for future research and expansion of the study. The chapter also reviews the broad conclusions of the study findings, and provides recommendations for specific audiences, with suggestions on how various groups — from grassroots developers, to community developers, urban designers, or city planners — can better support the urban agriculture endeavors in Minneapolis. Finally, the study findings indicate that there are a number of opportunities for complimentary research.

Overview

For some time, many urbanists have agreed that a higher diversity of urban activities and higher density of urban spaces create healthier, vibrant, active and attractive places within cities. These aspects are associated with constructive urban growth. Factors of constructive urban growth include urban intensification and increasing socio-economic (Gehl, 2006; Glaeser, 2011; Jacobs, 1961; 1968; Molotch, 1976). The counterpart, dispersed or widespread and low density urban growth, is generally considered destructive to urban sustainability in the long term. Furthermore, advocates claim that contemporary approaches such as smart growth strategies, mixed-use development, green infrastructure development, transit-oriented development and productive landscapes can distribute aggregate benefits in local socio-economic and ecological layers of cities and contribute to constructive growth (Beilin & Hunter, 2011; Nettle, 2010; Song, 2005). In terms of developing healthy cities and attractive cities, the state of urban environmental goods matter a great deal.[45]

Urban agriculture provides services and products to neighborhoods and communities in a multitude of ways (Barrios, 2004; Butler & Moronek, 2002; Colasanti, Hamm, & Litjens, 2012; Despommier, 2010; Guitart et al., 2012; Mees & Stone, 2012; Mougeot, 1999; RUAF, 2014; Smit, 2001). Urban agriculture provides both market goods (produce and services) and environmental goods (environmental externalities). Thus, urban agriculture has utility. Other environmental goods in the urban realm, such as parks or green cover, have measurable relationships to the desirability and growth of

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[45] *Please refer to Endnote 2 - Environmental Goods.*

neighborhoods and urban settlements (Lutzenhiser & Netusil, 2001; Netusil et al., 2014; Wachter & Wong, 2008; Wachter et al., 2010).

One measure of urban growth is urban land desirability. Seen through an economic lens, growth could be understood increase of land-values of urban lands. Land desirability and growth are not mutuality exclusive, where any change in growth is almost always associated with a change in desirability of the land. The historic model for the estimating and determining the use of urban land by a governing body, is based on the productive output of a land parcel (Nijkamp, Rodenburg, & Wagtendonk, 2002). This productive capacity of a landscape determines the value of the land and eventual zoning of the particular regions districts, and thereafter the allowable activities on urban land parcels. Zoning is often structured to ensure complementing urban programs in the pursuit of urban growth or management of incompatible urban activities. Across the literature, zoning has been reviewed as both restrictive and contributive to urban growth and development. In terms of urban agriculture, zoning is usually described as one of the main barriers to overcome as it can inhibit the agriculture as primary or secondary use or restrict direct retail of agricultural products (Mees & Stone, 2012; Mougeot, 2006; Mukherji & Morales, 2013; RUAF, 2014; Smit, 2001; Voigt, 2011)

Although urban agriculture is inherently concerned with production of produce on urban land, the productive capacity of the urban agricultural lands cannot directly compete with the productive capacity of industrialized agriculture (Sharzer, 2012). Nor can urban agriculture compete with rival urban programs such as housing or commercial activities (LaCroix, 2010). The competition with other urban programs intensifies because, in most cases, urban agriculture practices do not primarily have a purely productive goal. More often than not, urban agriculture's main goal is land appropriation or fulfilling a local social development goal (Guitart et al., 2012). A prime example is the appropriation of vacant lands through urban agriculture in "shrinking cities" such as Detroit (Colasanti et al., 2012; Dolan, 2012). Many other cities in the United States are also seeing the phenomenon of the decrease of population and increase of vacant urban land in prominent cities or towns (Brent, 2012; LaCroix, 2010). Some of these cities are proposing urban agriculture as a temporary or even permanent solution (Baltimore, 2013; Cleveland & Chattanooga, 2009; Philadelphia, 2013). Introducing urban agriculture as a temporary land-use strategy can lead some cities to encourage more flexible and new mixed-zoning or land-use conditions. This new flexibility of urban land-use policies and management, especially in the temporary land-use cases, raises questions as to how much these strategies can contribute to increased land values and by extension, increase tax base, and what are the appropriate tools for measuring these effects.

In addition, this study shows that the direct contribution of urban agriculture to land value cannot be measured as a point gain only, but more accurately, the effect of urban agriculture must be measured as a distributed gain. For example, the abundance of urban agriculture sites are more strongly associated with changes in home values than the effect of a single site in a region or area (in this research, considered to be at a community or neighborhood scale). Planning and design strategies should consider the impact of the appropriate number of productive landscapes and urban agriculture within respective communities or neighborhoods.

To date, urban agriculture research is strongly rooted in the qualitative literature, and the body of quantitative research is remarkably small. It is only within the last couple of decades that a major research discourse has developed to focus on localized agriculture in planning agendas (Hodgson et al., 2011; Mees & Stone, 2012; Mukherji & Morales, 2013; Voicu & Been, 2008; Voigt, 2011). Very few studies show the measurable results needed to support urban agriculture in policy and planning (Garrett & Leeds, 2014; Tranel & Handlin, 2006; Voicu & Been, 2008), particularly in denser urban regions. These kinds of studies are only prominent in developed countries, where the planning culture relies heavily on quantitative evidence-based planning and land-use decision making.

From these perspectives, and from general findings and analysis in Chapter Four, we see that when urban agriculture stabilize in a city such as Minneapolis, it becomes a constructive social and environmental good that contributes to the health and desirability of particular regions within the city. Therefore, along with other environmental goods such as parks, clean air, solar/wind resources, and scenery for example, urban agriculture should be included in discussions regarding urban environmental goods, land-use planning/policy-making, public program competition, and urban growth.

Conclusions of the Study Findings

This dissertation asks if there is a relationship between urban agriculture and property values in Minneapolis, Minnesota, and if the findings can inform further planning or design considerations for urban agriculture landscapes. The short answer is: yes and yes. The findings of this study in Minneapolis do not directly dispute previous studies regarding urban agriculture and housing sales prices (Tranel & Handlin, 2006; Voicu & Been, 2008). Rather, the findings add to the discourse on the matter. The findings in Chapter Four illustrate that there is a relationship between urban agriculture and property values in Minneapolis, but that this relationship is complex and has a number of important components to consider. The findings from this study show that the direction and magnitude of the results are comparable to literature on parks and green spaces, but there are some other aspects of this study that should be brought to the attention of urban planning and design fields.

The advantages of using the SDM in determining economic externalities

First, the Spatial Durbin Model (SDM) corrects for spatial autocorrelation, and is a superior model compared to the more standard OLS model in comparable research. Most literature focusing on open space and park studies have not fully embraced SDM models. For sake of consistency, we can use the Voicu and Been (2008) study as an example as it is most analogous to this research, although the reasoning applies to other similar studies. The Voicu and Been study does not address inherent spatial conditions, nor mention how they have been addressed (if at all). The Voicu and Been study results have most likely either over or underestimated the coefficients or provided less accurate significances for estimation. If we proceeded with the exact same technique in our study in Minneapolis, using the OLS results alone one would wrongly conclude contradicting or polarized effects, effects that vary too greatly from what the hypotheses derived from theory or from comparable literature suggests. Similarly, if such studies did not control for spatial autocorrelation, we would have to interpret their results with caution.

Second, the great advantage that the SDM technique brings is that we can now understand and discuss the neighborhood effects of the phenomenon, whereas the majority of other studies (using OLS) cannot discuss this at all. A standard OLS will only address the direct link between single data points and their associated dependent variables, and cannot consider possible spill-over effects. The SDM technique is much more relevant to the fields of community planning and urban design disciplines, as it illuminates the neighboring advantages or disadvantages of particular phenomenon in a region or neighborhood. The majority of the problems in these fields are aggregate in nature, and their questions apply atthe intermediate urban scales — somewhere between the individual and the larger urban region (for example, on a neighborhood or community level). This is exactly the scale where it is particularly hard to measure. For this reason, this study shows how incredibly relevant the SDM is for discussing such socio-economic phenomena.

Third, the topic of this dissertation offers an example of a low exchange-value program (urban agriculture) that can be studied and measured for an economic reflection of value to neighborhoods. The economic effects of low exchange-value programs are generally harder to trace when compared to high exchange value counterparts. In this way, the effects of low exchange-value urban programs (in this case, urban agriculture) can be more readily compared and discussed alongside high exchange-value urban programs. These are traditionally economically competitive urban programs, such as retail spaces or transit. The SDM shows potential to become a highly relevant and standard technique to describe the economic behavior of phenomenon in an urban context, a technique which has yet to solidify its place in the general literature.

A note on regarding different urban contexts

It is interesting to note the similarities of the magnitude and direction of the findings regarding distance effects and the urban context of the study. One would expect that there would be a great difference in the proximities of urban agriculture in Minneapolis versus New York City. After all, there is a great difference in the urban make-up between Minneapolis and New York. For one, the urban density and open space ratios of the respective study regions vary quite a bit. For another, climate and seasonal conditions are also different. In the Voicu and Been (2008) study, the study area is the Bronx, New York, where the open space ration is as low as 2.5 acres per 1,000 residents (Beha, Huber, Marpillero-Colomina, & Szlachetka, 2010) and where there is 1 urban agriculture site per 10,000 residents (ibid, 2010). In contrast, Minneapolis has a much higher open space ratio with 12.9 acres per 1,000 residents (Trust for Public Land, 2011) and 1 urban agriculture site per 2,500 residents (United States Census Bureau). As the competition for open green space in the Bronx is much higher than in a lower density environment such as Minneapolis, this may explain the larger magnitudes in the findings from Voicu and Been. However, controlling for spatial autocorrelation in the SDM in Minneapolis, we find a similar scale of results — yet in a very different urban context. This could mean that the distance effect of urban agriculture is vastly underestimated in the literature so far, and we need more studies of productive landscapes across a variety of urban contexts to get a true account.

Recommendations

The significance of this study is to evaluate several attributes of urban agriculture in an important US city and the relationship to housing sales prices as a proxy for neighborhood desirability. This research provides evidence that can guide the investment of public resources and appropriate policy and ordinances to aid urban development efforts via urban agriculture and local food systems. The implication is that if cities better understand the impact of low-exchange value systems (such as urban agriculture) as part of their integrated urban design or renewal efforts, efficient planning for neighborhoods and urban edges can greatly aid larger processes of urban revitalization, strengthen neighborhood development, and support sustainable growth policies. This research shows that there may be differences in how Minneapolis and other cities should support urban agriculture activities in lower and higher income groups. The research also indicates that there may be other differences too, such as in the age categories, scale, and abundance of the urban agriculture sites across the city regions.

Overall, cities that wish to support a continuing and successful urban agriculture and local food systems strategy should closely examine and revisit relevant planning and policy conditions. In regards to urban agriculture, cities need to address three aspects: (1) zoning and planning regulations; (2) the city's perspective on the role of urban agriculture and food systems in comprehensive planning, green infrastructure design and implementation, and sustainable and resilient urban development; and (3) the supportive roles required for the maintenance in healthy UAFS and local food systems.

1) Revision of zoning and planning regulation.

A vital point to promoting and sustaining healthy urban agriculture systems within communities is to reduce excessive barriers while ensuring best practices and adequate protection for the urban agriculture practitioners and community residents. Communities should consider the full range of possible forms of urban agriculture and develop local policies and regulations appropriate for each type. The model comprehensive plan language and zoning regulations included in the toolkit from Wooten & Ackerman (2011) is a good base to build global definitions from, and can be supplemented by the detailed typologies from Phillips (2013). Cities should establish clear definitions of urban agriculture and neighborhood food systems, and incorporate urban agriculture into the open space land-use zoning category. These definitions will clarify the real and perceived environmental, economic and social risks and benefits, providing a shared and basic vocabulary during community engagement and dialogue. However, the definitions should remain flexible enough so that the program may change with new markets, trends, and developments within each region of the city.

Urban agriculture can facilitate a higher use for vacancy, underutilized or open urban land (Baltimore, 2013; Cleveland & Chattanooga, 2009; Cleveland, 2013; Detroit, 2012b; Schilling & Logan, 2008; Wachter & Gillen, 2006; Wachter et al., 2010). However, few protections are in place to ensure the longevity of urban agriculture sites. For example, it is easy to replace a community garden with a residential development in a residential district where both uses are allowed. This does not generally require much formality, but a hearing or a major policy change typical does. In most urban regions, a change of open space land-use requires a vote by a legislative body or citizens via a public hearing or city council meeting. Some cities preserve undeveloped property, open space, and recreation spaces by defining these places as “protection districts” or “protection zones.” These areas are generally publicly owned open or recreation areas, but can also apply to private land. However, applying open space zoning protections to privately owned land requires caution, especially since governments may not claim any property without providing adequate compensation. Nevertheless, some protective measures should be developed for urban agriculture, particularly regarding the acquisition and tenure of sites.

Zoning should address the issues of primary or secondary land-uses based on the respective urban agriculture definitions, and investigate the feasibility of multi-use zoning in terms of urban agriculture and its practices. This land-use typology may be temporary in nature, but would allow productive environments for otherwise vacant and unproductive parcels to be active until such time that the land is formally designated for part of another urban strategy. For example, urban farming is not allowed as a principle use in downtown Minneapolis; however, there is fallow and vacant land available that could be put to more productive use. It would be commendable to formally allow practitioners the use of such lands, including public property, for urban farms and other productive purpose, even if only for a couple of seasons.

It is recommended that cities amend regulations to allow urban agriculture as a home occupation and commercial activity. Again, a firmer definition base will make it easier for legal agents to raise valid and fair objections, to change conditions, or to file appropriate requests (such as zoning or home occupancy issues) (LaCroix, 2010; Voigt, 2011; Wachter & Gillen, 2006).

There is an opportunity for cities to investigate the possibilities of temporal activities in comprehensive planning. As advocates for urban agriculture claim high use-values (Guitart et al., 2012; Mok et al., 2013; Mougeot, 1999; Mougeot, 2006; Smit, 2001) it is important to understand what urban agriculture and local food systems mean for the parties involved in the political and spatial economy of cities. Urban agriculture may be a very effective way to manage underutilized lands. Considering that the private sector (urban farms) is establishing well in several US cities (Goldstein, 2011) and have the capacity to oversee several sites at once, cities must consider the role that market farms could have in acting as stewards of open and vacant urban spaces.

Finally, this research shows that low cost actions (such as improving aesthetic or attractive qualities of the urban agriculture site) may be very effective ways to develop even the most unattractive sites for greater good. We have the technical and practical answers for productive landscapes, we now need the mechanisms to ensure the longevity of such places.

2) *Developing the city's perspective on the role of urban agriculture and food systems in comprehensive planning.*

Urban agriculture and the city can mutually benefit from integrated and cyclic use of natural resources (Hodgson et al., 2011; Smit, 2001). However, this must form part of a comprehensive planning strategy. For example, urban agriculture is an intensive user of water resources, particularly urban farms or market gardens. If urban farms are to increase in number, scale and capacity, there may be related water policy or stormwater management issues to consider. Some of the issues regarding water policies include cultural acceptability, relative scarcity, reliability, cost, disposal and treatment of the wastewater system in use, environmental conditions, and population health (Smit, 2001). An example of a way to include urban agriculture aspects into comprehensive planning issues would be the process and production of compost, solid waste, and supporting products and byproducts. Farmers and municipal services can benefit from each other by exchanging byproducts. This requires that urban agriculture and local food systems form part of a comprehensive planning perspective, one that can maximize the potential of productive urban landscape systems for cities (Baltimore, 2013; Condon et al., 2010; Viljoen et al., 2005; Voigt, 2011; Wachter et al., 2010).

Another factor to consider is the change in housing and market behavior. Suburban home lifestyles with larger lots are predominantly associated with family-life in much of the US, particularly families with young children. However, several studies have shown that by the year 2040, the ratio of senior citizens, single households, and households without children will dominate the market by a substantial amount. For example, a recent study showed that households without children will comprise about 87% in Kansas City, Missouri, alone, and single-person households will account for about 54% of the share.[46] Furthermore, homeownership rates are projected to fall from 67.2% to 64.5% between the year 2010 and 2040. Therefore the result is that rental housing will account for about half of all new housing needs within the next 30 years (Nelson, 2012). In addition, there is an increasing demand for mixed-use, transit-oriented, smaller residential lots with higher densities and walkable neighborhoods. Besides demands for local food production and increase in access to fresh food sources, together these trends suggest that cities need to provide active green space for citizens, especially those who would not want to make a choice between having their own garden space and living in affordable environments. US development trends also suggest that when residential lots become smaller and smaller, there will be even lower rates of green space within cities, unless they are publicly managed by the city. This further stretch limited resources for parks and recreation boards, which are already spread quite thin. Having more partners on board to help steward open space can benefit the system as a whole. As well as providing strategic green pocket spaces that compliments human scaled walkable environments, integrated urban agriculture practices can both supplement the parks and recreation departments and also help to enrich the variety of leisure and green urban programs in a neighborhood, with relative low costs involved.

3) Developing the city's supportive role for the maintenance of healthy UAFS and local food systems.

Real and perceived health risks related to urban agriculture (particularly livestock or apiary practices) make many urban environments hostile to the establishment of comprehensive and integrated urban agriculture practices (De Zeeuw et al., 2011; Hodgson et al., 2011; Smit, 2001). To minimize health risks and perceptions of health risks, cities should develop guidelines for basic training and health standards that both practitioners and interested residents can participate in.

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[46] *Kansas City, Missouri, has market trends comparable to the national averages (Nelson, 2012).*

Traditionally, there has been limited official support for urban agriculture practitioners. Local authorities have generally not been receptive to farming in cities, and consequently restrain or redirect possible financing mechanisms (Smit, 2001). As part of an integrated local economic strategy, urban agriculture or "economic gardening" can greatly benefit urban communities (Barrios, 2004). Cities can aid, wisely regulate, promote, and create incentives for the urban agriculture systems by providing specific financing structures to various types of practices. Start-up costs or liquid income can be quite different when one compares community gardens, market gardens, or commercial urban farming practices, and there may be several ways to finance and support ongoing practices. Financial and institutional support mechanisms could be developed, such as ensuring that government-related difficulties in acquiring and maintaining sites are removed, or through provision of physical resources or services. Considering other investments, smaller urban agriculture activities do not require an enormous revenue stream (except for fully for-profit urban agriculture entities or cases where intensive year-round greenhouses are operating). They do need continuous revenue streams.[47]

The city can also take a positive position on education for both the farmer and the public through training and technological assistance. Cities can play a major role in integrating urban agriculture with public and private programs. For example, cities can create incentives for local restaurants, hospitals, schools or even offices to exchange particular commodities from local farm systems as part of local socio-economic development. As urban agriculture is not only based in food production, but also many other areas (such as horticulture or flower production), the city can investigate financial mechanisms with local business-owners to promote, develop and integrate larger ecological and/or edible landscapes within the local economy. Online resources, such as interactive mapping of vacant and productive landscapes, can easily be integrated with the existing city public communication tools. If urban agriculture becomes an active and integrative part of multi-family residential development (for example on rooftops or in communal areas), the responsibility of maintaining such places can be spread among a couple of professional and part-time gardeners, and thus spur some low-tech and relatively low-labor job creation.

Continuing support for urban agricultural development and educational programs is quite important. Certification or required continuing education credits could be required for those involved in urban agriculture practice and sales, especially on the commercial level. The result would be that urban

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[47] *This conclusion came from several discussions with the variety of practitioners both in Minneapolis, Detroit, and Kansas City over the course of the research period. The for-profit urban farms do require strategy and planning, and can be capital and resource intensive, just like any other business. However, the recreational or even market-garden urban agriculture sites are not generally considered a large financial project – as long as land or a site is available, basic structures and technology is more than sufficient to meet grower needs.*

agriculture practices could be periodically audited to insure that they are meeting public health standards. Health risk concerns support the idea that urban agriculture practices should be formally recognized by a local authority (Bruinsma & Hertog, 2002; Drescher, 2001; Hodgson et al., 2011; RUAF, 2014; Smit, 2001). If certifications are required, caution should be taken to ensure that certification requirements do not become a burden on the practitioner. Such programs should be conceived and implemented to develop higher quality sites and support structures.

Table 60 describes recommendations for strategic thinking and policy for various audiences.

Table 60. Key Policy Recommendations

Audience	**Key Policy Recommendation**
Local organizations, practitioners, and designers	Introduce suitable tax breaks and financial incentives.
	Coordinate urban agriculture communication and planning efforts with community development and growth management departments.
	Interact urban agriculture stakeholders with open space, recreation, sustainability, and community facility planning processes of the city.
	Develop firmer definitions and a local best practices guidebook.
	Investigate the aesthetic interactions of urban agriculture with neighborhood streetscapes as appropriate to the city or neighborhood.
	Tactically identify key and core urban agriculture sites.
Community planners and policy makers	Review and adapt local zoning codes and policies, future land-use plans and related requirements.
	Conduct an open space and vacant land survey.
	Coordinate urban agriculture communication and planning efforts with local community organizations, residents and community planning staff.
	Document and forecast strategic placement of food or productive landscape resources as appropriate to the city or neighborhood.
	Include a local urban agriculture facilities development in comprehensive plans and community revitalization projects.
	Investigate urban agriculture incentives along with other sustainable design development (for example transit-oriented development (TOD) projects).
	Investigate more flexible leasing and retail options for for-profit urban agriculture activities as appropriate to the city or neighborhood.
	Investigate ways to include urban agriculture either as a temporary or permanent land-use.
	Provide incentives for business-owners to couple with productive landscapes initiatives as appropriate to the city or neighborhood.
	Continually monitor existing sites.

Table 60. *(continued)* Key Policy Recommendations	
Audience	**Key Policy Recommendation**
National, state-wide, and regional public health, planning, and agriculture department planners and policy makers	Encourage a regional approach to spatial and economic local food and productive urban landscape planning.
	Encourage a regional approach to localized food systems planning in terms of cultural and economic diversity related to food and community development.
	Support (legally and financially) localized agriculture practices in urbanized regions, encouraging particularly sites of a quarter-acre in size.
	Coordinate with and provide guidance to food councils, landscape councils, and community planning and policy makers.
	Require food resource distribution and open space planning be done to follow local planning needs and policies, coordinated regionally.

Local organizations, practitioners, and designers

Local organizations, practitioners, and designers are recommended to consider suitable tax breaks and other financial and socio-cultural incentives to maintain and support local urban agriculture sites.

It is clear from this research that there are definite primary and secondary economic externalities to urban agriculture. Urban agriculture transfers wealth unto neighborhoods, and this can be captured in a measurable way. Local authorities can consider introducing suitable tax breaks for urban agriculture practitioners, as well as the lots and properties associated with or in close proximity to such sites. Developments are often requested to produce public improvement plans, or undergo cleanup for brownfield sites. Urban agriculture practices can play a supportive and contributive role here. Similarly, financial incentives (for example minor tax breaks or incentives) are often used to encourage such public improvements or contributions to the urban fabric. Urban agriculture can be deployed as a way to actively improve and maintain public streetscapes or underutilized urban lots, and can also be a good way to participate in cleanup or active restoration of brownfield sites.[48]

To seize opportunities for funding and continuous site support, local organizations, practitioners and designers should be able to engage in open communication with their cities, so to help coordinate planning efforts with community development and growth management departments. The Minneapolis local foods agenda forms part of the overall sustainability initiatives of the city. Minneapolis has a young,

[48] *Minneapolis has not yet explicitly introduced tax breaks or other incentives for urban agriculture practitioners.*

but well-formed food council which builds annual task forces investigating food-related issues of the city. The Minneapolis model shows high levels of interaction and communication with the public, which if successful over the long term, will continue to be a strong example for other cities to follow. The council has recently launched several online tools to facilitate better communication, including maps and other resources, and the site is regularly updated with records of meetings and social media activities (Homegrown Minneapolis, 2014). It is expected that a higher level of interaction and communication between local organizations, practitioners and the city will foster higher and more efficient coordination. In turn, this will enable the longevity of urban agriculture sites so that the benefits to the urban environment can be reaped over time.

One underdeveloped aspect is how urban agriculture could contribute actively in open-space development within the city. Minneapolis, like many other cities, tends to show support for the local foods agenda as part of health or community development, but does not actively promote it in open space development or green facility schemes. This is a missed opportunity for the city. One recommendation is that local organizations and urban agriculture stakeholders should be invited to engage with all open space, recreation, and community facility planning processes of the city, especially under active-living/health, open space conservation, green facilities, and sustainable design frameworks. Strategically developed and supported urban agriculture can greatly benefit neighborhoods beyond the produce from the site alone. A tactical approach to urban agriculture in terms of spatial planning, similar to park and green facility planning, could benefit targeted urban areas in many direct ways (for example via local food production or job creation) and indirect ways (for example by supplementing green-space development and enhancing the economic and also environmental externalities of such spaces). Urban agriculture a type of open space should be included in such plans, and be communicated to and made readily accessible to the public.

There are a multitude of local resources available online via Minneapolis and the local organizations, but a unified, simplified and localized best-practices guide should be developed. The abundance of information does not necessarily mean clarity of information. As each city varies quite dramatically in its rules, regulations, climate and ecology, such a simplified guide can be very practical and provide a point of departure for future discussions.

In areas where urban agriculture sites may be perceived as a disamenity, urban designers and planners should consider buffering techniques. In such cases, one could implement simple visual or physical buffers or controls until these sites stabilize or become more attractive for the community.

An important point from this research is that it would benefit practitioners and organizations to focus on existing sites, before starting new sites. A stronger communication channel between organizations and the city could help facilitate this component. Focusing on established sites will allow such places to settle into the community in a meaningful way, and become stable places of both food related resources and community amenities. That being said, local organizations could benefit if a strategic mechanism can be developed for vacant or underused spaces to facilitate urban agriculture practices. Minneapolis does have an interactive map of vacant parcels, but this is merely that: a map. Showing how urban agriculture can be a triple-bottom line solution is perhaps the best means to turn vacant land into productive land, especially for cities with a strong drive to develop greener, healthier, and active communities.

On the one hand, this research shows that urban agriculture sites seem to have the most impact on neighborhood real estate prices if they occupy spaces for several years at time. However, there is also a reason to rethink urban agriculture landscapes as a temporary land-use — where temporary may be a period of two or three growing seasons or as short as a couple of months only. In many instances (especially small-scale operations) urban agriculture operations can be easy to assemble onto or disassemble off of vacant lands, and to other locations around the city. This aspect may not have the same impact on the immediate local economy, but may have economic implications on a larger scale — such as the city-wide scale. For example, one firm may be able to populate and steward several sites across the city, since vacant urban parcels are often left bare through neglect or in preparation for development. Often, the design and process involved in preparing for development takes several years, and urban agriculture could step in to steward unoccupied urban spaces in the interim. Any change in occupancy of a site will not be a real issue if there are effective planning and support systems in place. Tactical urbanism as a resident-focused development can help a great deal in turning vacant passive spaces into active, productive spaces.

This research shows that of all the aspects of urban agriculture related to neighborhood desirability, the aesthetically pleasing physical components seem to be the strongest factor in influencing nearby property values. Organizations and designers should emphasize the importance of upkeep and general urban design practices. Compared to complex issues such as zoning or city policies, regulations that ensure the proper upkeep of urban agriculture sites and urban design conditions are met are relatively easy to enforce and have a great deal of impact within a neighborhood. Where urban agriculture sites behave as small, pleasing parks, they will have a positive contribution to the neighborhood as a whole.

Local community planners and policy makers

Local community planners and policy makers are recommended to review and refine and revise local zoning codes and policies, as well as future land-use plans and related requirements. This process should be investigated on city-wide and regional levels. A regional strategy for urban agriculture is multifaceted and should be integrated into other socio-cultural urban systems planning.[49] Several of the recommendations mentioned before will also apply on a community planning level. However, there are several direct actions community planners and policy makers can take to include urban agriculture into revitalization efforts on a local level.

First, ensure that urban agriculture planning is coordinated with vacant land or underutilized land development. Urban agriculture can be an excellent steward for vacant spaces and provide a pro-active program to fight blighted environments. A simple publically-available land inventory can ensure that members of the public have access to such sites for immediate use. Community planners should conduct an open space and vacant land survey to identify suitable existing and future sites for urban agriculture practices. This can inform tactical solutions to address the community and environmental needs, and secure optimal locations of food or productive landscapes. Having a solid inventory and trajectory of possible future spaces ensures that resources can be allocated optimally, and local urban agriculture facilities included in comprehensive plans and community revitalization projects. It is important to continually monitor existing sites to provide a reliable city-wide or region-wide inventory to: (1) ensure that funds are allocated to support and develop sites to a higher quality; (2) ensure that best practices are employed and that there is sufficient upkeep regarding the quality of the site and its operations; (3) enable better communication between practitioners, the city and the public to generate and sustain continuous support. This process must be supported with clear communication to the public, especially on the kind of tenure and time allowable on the land for sustainable urban agriculture practices.

Second, community planners are recommended to engage in strong communication and coordinated planning efforts with local community organizations, residents, and community planning staff. Community planners should investigate ways to couple urban agriculture with retail and office sector developments in efficient ways. Urban agriculture practices can result in triple-bottom-line solutions if there is flexibility in the use of open spaces around retail and office areas, or even on rooftops (where funds and technical expertise for the creation of rooftop gardens exist). A more flexible leasing structure could accommodate such programs and provide a productive output for passive open space. Furthermore, community planners are encouraged to investigate the possibility of coupling urban agriculture with community infrastructure and planning, particularly with areas of transit-oriented development (TOD) or other sustainable planning / design initiatives.

[49] *Minneapolis has a city-wide initiative, but it is not clear how this initiative operates within larger regional network, or how this program integrates with other city activities.*

Third, primary and auxiliary incentives should be developed so that registered urban practitioners can appropriate suitable urban spaces easily, and so act as environmental stewards of urban lands. Primary incentives should focus on ways to include urban agriculture either as a permanent, short-term or temporary land-use. Auxiliary incentives could include low-cost or no-cost compost supply, or support through rainwater and stormwater collection from retail or office buildings. Using treated wastewater/greywater to irrigate has the added advantage of providing nutrients to crops, but urban wastewater and stormwater is seldom available to urban farmers. Localized solutions regarding waste and stormwater collection can benefit several parties at once, mutually benefiting governments, residents, local business-owners and urban agriculture practitioners. Cities give incentives and economic support to urban agriculture practitioners, who in turn become stewards of the lands that are not explicitly public parks and so contribute to upkeep and maintenance of areas that may be beyond the immediate priority (and resource capacity) of the city.

Fourth, community planners are recommended to focus on intensification of existing sites as opposed to enlarging the existing urban agriculture sites or opening many new sites. From this research, overall, urban agriculture lots below half an acre have positive neighborhood externalities across the city. However, it should be noted that small sites have less benefits to housing sales prices in low income regions when compared to large sites. Cities would likely benefit most by stabilizing medium-to-large sites in low income regions, and retaining smaller sites in high income regions. This research further suggests that larger urban agriculture sites act as an alternative to park-like amenities for low income groups, whereas smaller or medium sites act as a beautification or leisure amenity for high income regions. With this in mind, cities should consider ways to redistribute resources to meet different goals in different income groups. For example, in low income groups Minneapolis should emphasize food production plus green amenity provision (park-like active space), where in high income communities, the goals should focus on ecological functioning plus green amenity provision (aesthetic emphasis).

National, state-wide, and regional public health, planning, and agriculture department planners and policy makers:

National, state-wide, and regional public health, planning, and agriculture departments should encourage a regional approach to food systems and urban agriculture planning, recognizing the variety of needs of different socio-cultural groups. This includes communicating and coordinating with state planners and policy makers, similar to the recommendations made in the “Local organizations, practitioners, and designers” section above. Furthermore, the federal and state departments of public health or agriculture should help promote and assign one of these entities (perhaps the Department of Agriculture for each state) to coordinate efforts at the local level. These institutions can oversee urban agriculture as an integrated part of open space and food systems facility planning, while prioritizing fund allocation[50] to those districts that demonstrate ways to improve localized food access and effectively address related socio-cultural development needs.

Within Minneapolis, many urban agriculture sites and practices have a strong emphasis on a particular community demographic. This relates to two important local issues: first, that there is a need for culturally specific produce which is readily locally available and affordable. For example, in Minneapolis, the Hmong people are one of the largest groups of urban agriculture practitioners. They grow particular crops for their families and businesses, and also retail a great deal at the farmers' markets. The city can support this socio-cultural aspect through a strategic urban agriculture initiative. Second, the relatively high level of cultural association with urban agriculture may prevent other communities from sustaining equally successful projects, especially if the municipalities are not aware of the importance of locally available and affordable exotic food crops to the socio-cultural welfare of these particular groups. This need can be more readily maintained by an integrated urban agriculture system, especially when a regional food systems planning takes culture, gender, and other socio-economic factors into account (Smit, 2001, Hovorka, et al 2009).

It is recommended that planners, designers, and policy-makers include urban agriculture in required food distribution plans and policies--for example, via and open space planning, revising local and regional planning policies, and coordinating efforts regionally. Municipalities should encourage and incentivize quarter-acre size urban agriculture sites in denser urban areas, especially in low income regions. Again, this can be coupled with green space and community development plans since urban agriculture contributes more to communities than just food produce alone. However, this research shows that there may be a strong negative direct association with urban agriculture in low income groups, because urban agriculture sites may signal areas of urban distress (or abandonment) or be proxy for another underlying phenomenon not yet captured in this research.

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[50] *The allocation of grants and other funds could be made available to districts demonstrating strong urban agricultural programs or practices (namely, programs, practices, or businesses providing meaningful food access and meeting other important socio-cultural development needs).*

Future Opportunities and Expansion of Research

The findings from this dissertation support the claims from the qualitative literature — urban agriculture, and particularly the community garden category, has an economic relationship with neighborhood desirability in terms of home sales price. In most cases, the presence of urban agriculture contributes positively to the neighborhood and is therefore an asset to that urban area. Although low income regions gain slightly more benefits from urban agriculture sites compared to high income regions, globally, the presence of urban agriculture is an amenity rather than a disamenity. This is evident in the positive spillover or neighborhood effects, which are actually stronger in high income regions than in low income regions. A future study could consider a comparison between similar scale amenities and disamenities, such as parking lots, playgrounds or pocket parks versus urban agriculture.

The results show that even though there are penalties associated with being the first or closest neighbor to such a particular urban agriculture site, on a larger scale, that same urban agriculture site plays a positive and constructive role in the neighborhood. In the findings from this study we see that when urban agriculture sites become more dispersed or isolated from residences, there seems to be a negative association with housing sales prices (i.e. desirability). In areas where there are closer proximities between residences and urban agriculture sites, there are stronger and positive relationships with housing sales prices. However, it should be noted that other phenomena may also be taking place that are not yet captured by this particular research method. The study controls for both census tract level and community level (predetermined by the city) which act as a proxies for community trends, conditions, and overall locational preferences. Nevertheless, it would be useful for future studies to examine other detailed factors such as fixed geographic regions (in terms of travel distances), the number of community initiatives related to urban agriculture, funding support and histories, and health indicators. These aspects could help present a different and more descriptive side of the story than this study.

We also know from this study that any change in size of urban agriculture sites only really matters to housing sales prices when there is a dramatic increase — by at least a quarter acre or more. This suggest that there is an abundance of opportunity for urban agriculture to be a non-intrusive urban development technique, and that such sites can become a social and environmental amenity in many other areas of the city. The disamenity of very large urban agriculture sites and their effects on housing sales prices is almost negligible when compared to the advantages of smaller sites. There is also a different attitude in different income groups. Cities should take this into consideration. There may be a small element of competition regarding the abundance of sites in neighborhoods, where neighborhoods with fewer sites perform slightly worse than those with more. For example, this research suggests that four or more sites show greater positive relationships to neighborhood desirability in Minneapolis. Future research may study the exact neighborhoods with high and low abundance of sites to understand the comparative differences in greater detail.

Another useful finding is that relatively new sites show better relationships to housing sales prices globally, but new sites also seem to act as a signal of concern in low income neighborhoods. An opportunity for future study would be to compare the differences for distress signals in cities and urban agriculture to see if there are any relationships. There is a case for urban agriculture as a temporary land-use; however, "temporary" may mean a duration of at least 3 - 6 years. A future study may consider turn-over rates of other urban programs and compare them to urban agriculture sites to see how we can best facilitate urban agriculture in the temporal arena of urban development. Overall, the spatial conditions of the urban agriculture sites (or visual attractiveness and integration of the sites) seems to play a stronger role than the behind-the-scenes activities (such as whether it is associated with a neighborhood organization or not, or whether the site focuses on a youth activities or not). There is good reason to pursue future longitudinal studies, as the aspect of site quality may shed light on the incremental improvements or deterioration of these places over time.

We need more comparative studies regarding urban farms within inner urban areas. This is evident from the results of this dissertation. It would be very hard to make a cross-sectional study without expanding the timeframe drastically, having higher number of urban farms present, or expanding the study area to include outer suburban settings. In this research, if we expand the timeframe we would lose the qualitative components of the sites, as these aspects were only recorded during a single year (2014). Also, since much of the information was not properly recorded prior to 2012, it would be hard to find reliable evidence for many of the systemic or operational aspects. An alternative option is to reclassify the categories of urban agriculture. However, as mentioned in the preceding chapters, the difference between types becomes a bit impractical for this kind of research. For example, it would be very hard for a casual observer or resident (without in-depth knowledge of the space or practice) to determine the difference between a school garden, community garden, or beautification space. The only clear visual difference typically observed between messy non-market agriculture spaces and the more controlled market agriculture sites are features such as locked gates and higher fences, distinct signage, and/or clearly controlled production crop rows or hoop houses.

The research brings to light many issues regarding the empiric study of productive urban foodscapes, and the potential for cities to use these landscapes to their advantage. The research supports the qualitative theories that urban agriculture has relationships with property prices, and broadens the understanding of the limited empiric studies within this topic area. It should be noted that the study has several limitations, but these pose excellent cross-disciplinary avenues for future research. Some technical limitations regarding the method are discussed in Chapter Two — “Limitations to the method.” The time and resources required to do longitudinal studies on multiple cities were not available during the study period, and therefore the data is delimited to a cross-sectional study within a single city. Additional limitations also suggest avenues for future research. For example, the category of urban agriculture is limited to sites that are grounded in the landscape, and excludes sites such as indoor agriculture, rooftop agriculture, or private foodscapes. The study is likewise limited to food production sites, and does not include other products such as aquaponics or apiculture. None of the sites in this study area had evidence for the keeping of small livestock, fish, poultry or practices such as bee-keeping and mushroom or wood harvesting, which could lead to very different results.

The study presents a sturdy framework and reliable data and methods for future research. To summarize, this research shows the following future research opportunities regarding urban agriculture and neighborhood desirability:

i. There is reason to believe that the rental market or migratory communities have different relationships to that of homeowners' markets, and that this may describe a different narrative between productive landscapes and neighborhood desirability.
ii. Similarly, there is reason to believe that the scale of sites may have different relationships in relation to neighborhood desirability when we isolate particular communities or ethnic groups. One example is that the Hmong community has a strong presence and is highly active in urban agriculture in Minneapolis. The Hmong community may have a greater desire for larger urban agriculture sites when compared to other communities (where there is less interests in urban agriculture). Nevertheless, the Hmong community is most likely spread across several parts of the city and does not solely lively within isolated census tract areas. A researcher may not be able to pick up these details in the research presented in this document, and would likely need to take a very different methodological approach.
iii. Residential mobility rates can be a proxy for neighborhood desirability and needs to be considered in future studies.
iv. We need more studies on inter-urban farms and market agriculture typologies. However, inner-city urban farms are generally still a newer phenomenon.
v. The terms "community garden" and "urban farm" could be revisited. For example, we don't know if the terms "community garden" or "urban farm" signal positive or negative associations with different types of neighborhoods (for example, perceptions of what is considered a "good" or "bad" neighborhood). This could be examined.
vi. We need to have qualitative assessments over sustained periods of time to understand aesthetic changes and the resulting social or economic impact of urban agriculture sites within neighborhoods.

vii. Following on points v) and vi) we need to understand how the introduction or removal of urban agriculture may have effects that are comparable to or different from other urban development programs in terms of the gentrification processes.

viii. Future studies could expand geographic categories of impact beyond neighborhood scales (for example, in terms of fixed travel distance according to public transport). This can include comparisons between urban, suburban, and rural communities.

ix. There is reason to believe that the inclusion of other external factors is necessary. For example, community initiatives could be an underlying factor in regards to urban agriculture and neighborhood desirability. Another possibility would be to study the underlying funding support and histories of urban agriculture initiatives. Other indicators could also play a role (such as local urban health indicators, climate, seasonality, and local consumer behavior regarding local foods).

x. A future study could compare similar scale amenities and disamenities (such as parking lots, playgrounds, and pocket parks) versus urban agriculture.

xi. Future studies could compare the differences in distress signals in cities to see if urban agriculture is an indicator of either instable or stable neighborhoods.

xii. Future studies could consider turn-over rates of other urban development programs and compare them to the development of urban agriculture sites to see how planners, designers, and polic-makers can best facilitate urban agriculture in the temporal arena.

xiii. Future studies could isolate neighborhoods with high and low abundance of sites to understand the comparative differences in of neighborhood structure or support systems.

xiv. There is good reason to pursue future longitudinal studies as the aspect of site quality over time may shed light on the incremental improvements or deterioration of such sites.

xv. The type of urban agriculture in this study is limited to sites that are grounded within the urban landscape, and excludes sites such as indoor agriculture, rooftop agriculture, and private foodscapes such as backyard gardens or even office or mix-use development gardens. These types of food production sites could be examined in regards to their impacts on land values and important socio-cultural attributes.

Concluding Remarks

The true value of continuously productive urban landscapes (which includes urban agriculture) is in the aggregate contributions, or externalities, that these landscapes create within a neighborhood and on a city-wide level. It is not suggested that urban agriculture facilities are capable of miraculously reviving depressed communities, solving food insecurities, or replacing components of the agriculture industry sectors. It is likely, however, that urban agriculture contributes substantially to the social, environmental, and economic development of neighborhoods through the positive externalities that these sites create. This contribution is meaningful and can be quantified. This dissertation provides economic evidence that housing prices are associated with urban agriculture sites, both in multiple direct and indirect ways. The key findings from this research has policy and planning implications, and indicates that there is a benefit to incorporating productive landscapes into land-use planning, open space conservation, green facility, and other comprehensive planning/design strategies. There are also many more avenues for research, exploration, and application, with multiple possibilities to integrate productive landscapes into the neighborhoods, development schemes, and urban planning/design thinking. If urban designers, city planners and administrators better understand the economic impact of low-exchange value systems such as urban agriculture within neighborhoods, they may find that these systems can provide low-cost, yet meaningful ways to improve, build or strengthen healthy and resilient communities. Cities and planning regions should consider the social, economic, and environmental contributions that productive landscapes may have, and include these as part of their immediate and long-term design and planning goals. Urban agriculture has the potential to become a valuable asset in the community design and development, urban design, and urban and regional planning toolkits.

Endnotes

Endnote 1 — Use-values and exchange-value. Use-value is a classic economic concept that describes the usefulness that an object or activity has to its bearer (Marx, 1867). Use-value is the value of a good's current, future or potential use (Kolstad, 2011). This includes its utility and/or the gratification derived by its bearer from utilization. This use-value can only be measured in a quantity relative to a similarly realized use-value of some other thing or activity. Exchange-value is a classic Marxian economic concept that describes the power of a thing or activity to command all other things or activities in exchange for itself. No exchange-value can exist unless some use-value is present. The exchange-value of this thing or activity is made concrete and described as “price.” Intrinsically, without a use-value there can be no exchange-value. For example, urban parks have high use-value, subsequently increasing the exchange-value of the land and environment that they occupy (Crompton, 1995, 2005). The land that high-use value programs occupy: (1) often have higher exchange-values and can be traded with relative ease in urban markets; (2) they have intrinsic values to the surrounding urban environment (externalities), and; (3) are protected, designed and supported by the city and residents. Most urban systems (such as transport, infrastructure or public parks) have a fairly direct translation of their utility or use-value to economic value, and bring about higher exchange-values of the occupied and surrounding land. As objects become commodities (because they are produced for a market) their exchange-value erases their useful qualities (Marx, 1867). Land and property values are part of this economic exchange process (Sharzer, 2012).

Endnote 2 - Environmental Goods. An environmental good assumes that when consumers purchase some marketed good, they are implicitly also buying the environmental goods that are associated with it. For example, when a house is bought the buyer receives the house, its neighborhood, and also the inherent environmental characteristics of the neighborhood. The market price amounts to the characteristic values contained in the purchased product or good — the utility of a good. Utility is understood as functions of market goods and environmental goods (Kolstad, 2011). Freeman (2003) describes three ways in which environmental goods have utility to the individual. Environmental goods can produce utility indirectly because it is a factor input in the production of a market good that yields utility (such as living near to a public swimming pool or public recreational park). Environmental goods can be an input in the household production of utility-yielding commodities (such as the availability of solar energy); and finally, environmental goods can produce utility directly by being an argument in an individuals’ utility function (such as scenery or low carbon burning public transportation).

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Appendix A - General

Program Type – Urban Agriculture

Many sites are clear about their primary programmatic purpose, for example, being primarily a site for food production or being primarily an output of a youth program. However, many of the sites also state that their programmatic purpose includes everything from food production, youth education, community development, beautification, and much more. In such cases, where there was evidence that 50% or more of the site area was used for food production, the particular site was classified as a “food production” program type only. If the site had no strong evidence for “food production” it was reclassified as “youth” program or “beautification” program accordingly. Many youth organizations practice on multiple sites. The “beautification” program includes sites that focus primarily on neighborhood beautification, or a program associated with ecosystem activities. As an example, one site is a neighborhood supported agriculture site which primarily focuses on maintaining and attracting a certain species of butterfly within their lot. They commented that they are not restricted to this program alone, and that they may include many other components (such as youth education or community development) at certain times. However, there is no evidence to suggest that food production or youth education is the overriding program, so this site will be classified as a “beautification” program. Using this methodology, 73% of the sites in this study are classified as “food production” programs, where “youth” and “beautification” programs make up the remainder with 13% each. However, because of the overall ambiguity across the sample, the type of program was not included in the factor analysis. Table 61 contains the descriptive statistics for the program type.

Table 61. Program type

Attribute	**Description**	**% of Total** (N = 158)
Program Type	Food Production *count*	73.42% (116)
	Youth Program *count*	13.30% (21)
	Beautification Program *count*	13.30% (21)

Abundance of Sites

Table 62 provides the descriptive statistics for the abundances of urban agriculture sites within a one street network mile from a home sale.

Table 62. Abundance of urban agriculture sites - descriptive statistics

Number of UA *per 1 street network mile*	**Sales Parcels** *2014*	**% of total sales** *2014*
0	590	21.82%
1	510	18.86%
2	398	14.72%
3	294	10.87%
4	172	6.36%
5	122	4.51%
6	71	2.63%
7	85	3.14%
8	52	1.92%
9	43	1.59%
10	66	2.44%
11	49	1.81%
12	34	1.26%
13	21	0.78%
14	32	1.18%
15	27	1.00%
16	38	1.41%
17	22	0.81%
18	21	0.78%
19	15	0.55%
20	9	0.33%
21	10	0.37%
22	8	0.30%
23	4	0.15%
24	3	0.11%
25	3	0.11%
26	3	0.11%
27	1	0.04%
28	1	0.04%

Appendix B - Factor Analysis Outputs

Table 63 through 68 show a principle component analysis standard deviation for the full dataset, the factor loadings, eigen values, and Scree plots for the respective indexes. Tables 70 through 73 show the factor analyses on the SYS and SPA Indexes.

Full principle component analysis results

Table 63. Full principle component analysis results						
Component	**1**	**2**	**3**	**4**	**5**	**6**
Standard Deviation	1.3616	0.9920	0.8071	0.7092	0.6779	0.6382
Proportion of Variance	0.2376	0.1261	0.0835	0.0644	0.0589	0.0522
Cumulative Proportion	0.2376	0.3636	0.4471	0.5116	0.5705	0.6226
Component	**7**	**8**	**9**	**10**	**11**	**12**
Standard Deviation	0.5711	0.5464	0.5229	0.4789	0.4543	0.4295
Proportion of Variance	0.0418	0.0383	0.0350	0.0294	0.0264	0.0236
Cumulative Proportion	0.6644	0.7027	0.7377	0.7671	0.7935	0.8172
Component	**13**	**14**	**15**	**16**	**17**	**18**
Standard Deviation	0.4021	0.3912	0.3570	0.3223	0.3179	0.3042
Proportion of Variance	0.0207	0.0196	0.0163	0.0133	0.0129	0.0119
Cumulative Proportion	0.8379	0.8575	0.8738	0.8872	0.9001	0.9120
Component	**19**	**20**	**21**	**22**	**23**	**24**
Standard Deviation	0.2826	0.2736	0.2587	0.2322	0.2233	0.2101
Proportion of Variance	0.0102	0.0096	0.0086	0.0069	0.0064	0.0057
Cumulative Proportion	0.9222	0.9318	0.9404	0.9473	0.9537	0.9593
Component	**25**	**26**	**27**	**28**	**29**	**30**
Standard Deviation	0.2070	0.1937	0.1839	0.1745	0.1658	0.1648
Proportion of Variance	0.0055	0.0048	0.0043	0.0039	0.0035	0.0035
Cumulative Proportion	0.9648	0.9696	0.9739	0.9778	0.9814	0.9849
Component	**31**	**32**	**33**	**34**	**35**	**36**
Standard Deviation	0.1494	0.1388	0.1300	0.1228	0.1134	0.1111
Proportion of Variance	0.0029	0.0025	0.0022	0.0019	0.0016	0.0016
Cumulative Proportion	0.9877	0.9902	0.9923	0.9943	0.9959	0.9975
Component	**37**	**38**	**39**	**-**	**-**	-
Standard Deviation	0.1060	0.0906	0.0000	-	-	-
Proportion of Variance	0.0014	0.0011	0.0000	-	-	-
Cumulative Proportion	0.9989	1.0000	1.0000	-	-	-

Table 64. Full Eigen Values								
Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Eigen Values	1.854010	0.983967	0.651484	0.502939	0.459532	0.407262	0.326167	0.298515
Component	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Eigen Values	0.273374	0.229310	0.206408	0.184483	0.161711	0.153039	0.127434	0.103909
Component	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Eigen Values	0.101055	0.092542	0.079872	0.074832	0.066930	0.053929	0.049850	0.044148
Component	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Eigen Values	0.042839	0.037527	0.033802	0.030452	0.027501	0.027166	0.022333	0.019273
Component	**33**	**34**	**35**	**36**	**37**	**38**	**39**	-
Eigen Values	0.016894	0.015082	0.012859	0.012338	0.011239	0.008211	0.000000	-

SYS Index Factor Loadings

Table 65. SYS Index Factor Loadings									
Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Fee_1Yes_0	-0.2070	0.2320	0.2080	0.2340	-0.1050	0.1010	0.1680	0.1790	-0.1150
GleaningDo	0.1050	0.4310	0.4630	-0.1600	-0.2950	0.3340	-0.2150	0.3800	0.1160
LiabilityR	-0.2570	-0.1090	-0.1780	0.3020	0.3010	0.4040	0.1820	-0.1290	0.2810
Beds_1Comm	-0.1230	-0.1550	-0.4250	-0.2390	0.1020	-0.2010	0.1090	-0.6040	0.2510
Participan	-0.3500	0.4160	0.3460	-0.2900	-0.1910	-0.4030	-0.1610	-0.2880	0.2890
GroupActiv	-0.3050	-0.2200	0.2070	-0.1610	0.1070	-0.1130	-0.3090	0.1670	-0.1260
Meetings_1	-0.3400	-0.1400	0.2420	-0.1570	0.3230	0.1560	-0.1640	0.3010	-0.1450
SignPosted	-0.3070	0.1590	-0.2520	-0.2000	0.3080	-0.1540	-0.2430	-0.1360	0.2750
GM_Affilia	-0.1720	0.3450	-0.1410	-0.2020	-0.4130	-0.1220	-0.3210	0.1040	0.3770
SoilTest_1	-0.1840	-0.1260	-0.2050	0.3140	-0.3930	0.2260	-0.3160	-0.1570	0.4490
WebPage_1Y	-0.2990	-0.1980	0.1290	-0.2920	0.1750	-0.1280	-0.1410	0.1610	0.3090
SupportOrg	-0.2550	0.3790	-0.1370	0.4620	0.2010	0.1870	0.5310	0.1940	-0.2880
PermStruct	0.1240	0.3020	0.3210	0.2280	0.1170	-0.2880	-0.2830	0.5090	-0.2280
LegName	-0.3540	0.1770	0.2500	0.1750	-0.1110	-0.1540	0.1840	-0.3200	0.4720
NeighbOrg	-0.2650	-0.2070	-0.3250	0.6490	0.1820	-0.1720	-0.1350	-0.1470	-0.2100
LocalEvent	-0.1990	0.2400	0.3440	-0.2420	-0.3880	-0.1600	-0.2500	0.2190	-0.5570
CityEvent	0.2730	-0.1240	0.1110	0.1800	0.1920	-0.1630	-0.7700	0.4050	0.1030
FoodClGr	-0.1670	0.2510	0.1490	0.4440	-0.3610	-0.4380	0.3650	-0.2850	-0.1330
Age5Years	-0.1380	0.4470	-0.2320	0.1060	0.2590	0.1140	0.1960	-0.2130	0.1090
Goals	-0.2740	-0.1560	0.1770	-0.3410	-0.2690	-0.2450	-0.1260	0.5940	-0.2330
Age5_2	-0.1380	0.4470	-0.2320	0.1060	0.2590	0.1140	0.1960	-0.2130	0.1090

Table 65 *(continued)* SYS Index Factor Loadings

Component	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Fee_1Yes_0	-0.1150	0.2730	-0.1310	-0.1390	0.1130	0.4230	-0.3020	0.2070	0.4050
GleaningDo	0.1160	-0.1910	0.1060	0.2250	-0.1940	0.1200	-	-	-
LiabilityR	0.2810	0.3510	-0.3750	-0.1660	-0.1770	-0.2020	-0.2030	-	-
Beds_1Comm	0.2510	-0.2210	0.1170	-0.1090	0.3300	0.1650	-	-	-
Participan	0.2890	0.1320	0.2000	0.1570	-	-	-	-	-
GroupActiv	-0.1260	0.2210	0.1020	0.2140	0.1630	-0.5820	-0.1300	-0.1050	-0.3520
Meetings_1	-0.1450	0.1710	-0.1310	-0.1510	0.6590	-	-	-	-
SignPosted	0.2750	0.2480	-0.1160	-0.2560	0.3050	0.3890	0.3180	-	-
GM_Affilia	0.3770	0.1230	0.2090	-0.2330	-0.2110	-0.2160	-0.3320	-0.1290	
SoilTest_1	0.4490	-0.2640	0.2090	0.1600	0.1630	-0.3000	-	-	-
WebPage_1Y	0.3090	0.1810	-0.2310	0.4610	0.4330	0.2190	0.1430	-0.1010	-
SupportOrg	-0.2880	0.2380	-	-	-	-	-	-	-
PermStruct	-0.2280	0.1780	0.3630	0.1630	-0.1200	0.1700	-	-	-
LegName	0.4720	0.3590	-0.1640	-0.4250	-	-	-	-	-
NeighbOrg	-0.2100	-0.2260	-0.1230	0.2510	-0.2610	-	-	-	-
LocalEvent	-0.5570	-0.1620	-0.2280	0.1120	-	-	-	-	-
CityEvent	0.1030	-	-	-	-	-	-	-	-
FoodClGr	-0.1330	-0.1670	0.1950	-0.2210	-	-	-	-	-
Age5Years	0.1090	-	-	-	-	-	-	-	-
Goals	-0.2330	-0.1760	-0.2050	-0.3060	0.1020	-	-	-	-
Age5_2	0.1090	-	-	-	-	-	-	-	-

Component	**18**	**19**	**20**	**21**
Fee_1Yes_0	-0.3030	-	-	-
GleaningDo	-	-	-	-
LiabilityR	-	-	-	-
Beds_1Comm	-	-	-	-
Participan	-	-	-	-
GroupActiv	-	-	-	-
Meetings_1	-	-	-	-
SignPosted	-	-	-	-
GM_Affilia	-	-	-	-
SoilTest_1	-	-	-	-
WebPage_1Y	-	-	-	-
SupportOrg	-	-	-	-
PermStruct	-	-	-	-
LegName	-	-	-	-
NeighbOrg	-	-	-	-
LocalEvent	-	-	-	-
CityEvent	-	-	-	-
FoodClGr	-	-	-	-
Age5Years	-	-	-	-0.7070
Goals	-	-	-	-
Age5_2	-	-	-	0.7070

SYS Index Scree plot.

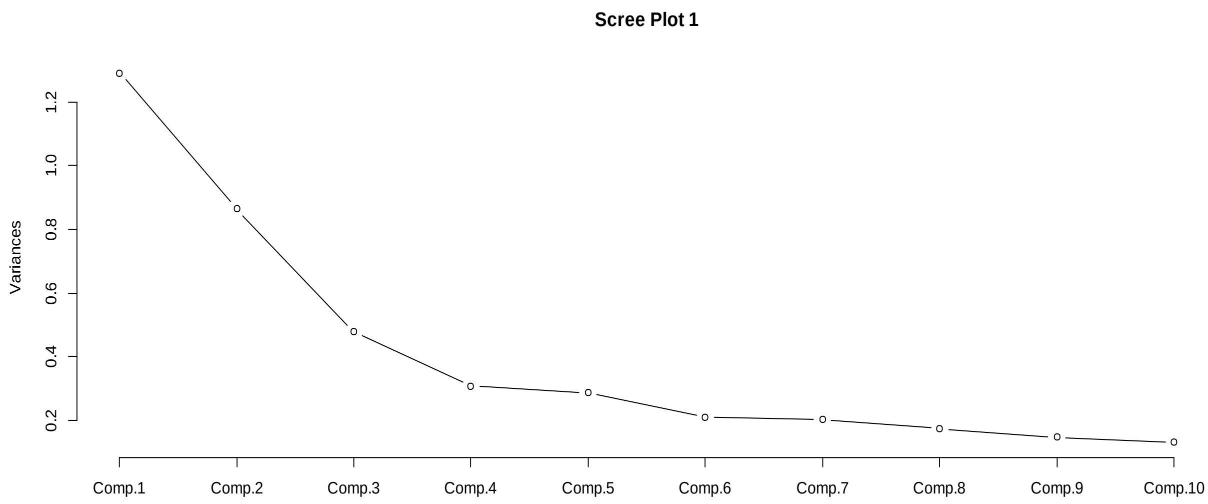

Figure 29. Scree plot for SYS Index.

SYS Index Eigen Values.

Table 66. SYS Index Eigen Values							
Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Eigen Values	1.2907	0.8653	0.4781	0.3077	0.2875	0.2107	0.2030
Component	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Eigen Values	0.1745	0.1479	0.1318	0.1184	0.1083	0.0934	0.0765
Component	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Eigen Values	0.0641	0.0506	0.0432	0.0365	0.0306	0.0223	0.0000

SPA Index Factor Loadings

Table 67. SPA Index Factor Loadings									
Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Visible	0.2490	0.3370	0.1650	0.1240	0.3630	-0.1210	0.4500	0.5790	-0.1910
Fence_1Yes	0.1510	-0.2020	0.1700	-0.5850	0.1010	0.2380	-0.3080	0.2050	0.1220
Locked_1Ye	-0.1020	-0.4170	0.2180	-0.4310	0.2490	0.1300	0.2120	0.2550	-0.1410
Threshold	0.4000	0.3910	-0.3110	-0.1590	-0.1160	-0.1160	-0.3700	0.4330	-0.1060
PedAccess	0.3670	0.2770	0.3800	-0.1220	0.2730	-0.4950	0.2830	0.1410	0.1470
NoSteps	-0.1860	0.1420	0.3250	-0.4340	0.1650	-0.6630	0.2340	-0.2370	0.1100
PrimaryEdg	0.1290	-0.2890	0.2650	0.1200	-0.1930	-0.1180	0.3090	0.3430	-0.1060
SecondEdge	-0.3930	0.2890	0.2150	-0.1440	-0.2960	0.1740	-0.2660	-0.2510	-0.3050
EqNotExp	-0.3070	0.3390	0.2600	-0.3800	0.3000	-0.1040	0.3950	0.1730	-0.3280
CompNotExp	0.1510	-0.2930	-0.2030	0.1370	0.2970	0.5740	0.2350	0.3650	0.2660
IntEdge	0.1480	-0.3140	0.2330	-0.1480	-0.3450	-0.1140	0.2410	-0.4270	0.4850
PublicSeat	0.4710	-0.2250	-0.3680	-0.2510	-0.1990	-0.1370	0.5180	0.3260	0.1290
Decoration	0.2490	-0.2010	-0.4500	0.1500	-0.5990	-0.2900	-0.3700	-0.2590	-0.1060
SocialSpac	0.3300	-0.1250	-0.4690	-0.2970	0.2030	0.4050	0.1900	0.2670	-0.1210
TendedPath	0.3930	-0.1770	-0.4310	0.3230	0.1660	0.5690	-0.1660	-0.3190	-
BuiltTo_1Y	-0.2160	-0.1800	-0.4550	-0.2390	-0.4580	-0.4070	0.3120	0.2100	-0.2440
StreetW_1Y	0.1950	0.4110	0.3130	-0.3050	-0.3470	-0.5070	0.1070	0.1240	-0.3430
F75Front	-0.1320	-0.3670	0.3660	0.7950	0.2330	-	-	-	-
Component	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Visible	0.1640	-0.1340	-	-	-	-	-	-	-
Fence_1Yes	-0.4650	0.2080	0.1270	-0.2340	-	-	-	-	-
Locked_1Ye	-0.5280	0.2610	-	-	-	-	-	-	-
Threshold	-0.2160	0.3040	-0.2250	-	-	-	-	-	-
PedAccess	-0.2280	0.1900	0.2580	-	-	-	-	-	-
NoSteps	-0.1210	-0.1540	-	-	-	-	-	-	-
PrimaryEdg	-0.2470	-0.1860	0.1920	-0.6290	-	-	-	-	-
SecondEdge	0.2330	-0.3250	0.1880	-0.2860	0.2500	-	-	-	-
EqNotExp	0.1700	-0.3570	0.1260	-	-	-	-	-	-
CompNotExp	0.3280	-0.1770	-	-	-	-	-	-	-
IntEdge	0.1510	0.3840	-	-	-	-	-	-	-
PublicSeat	-0.2320	-	-	-	-	-	-	-	-
Decoration	-	-	-	-	-	-	-	-	-
SocialSpac	-0.3230	-0.1420	-0.2040	0.2160	-	-	-	-	-
TendedPath	-	-	-	-	-	-	-	-	-
BuiltTo_1Y	0.1880	0.1170	0.1120	-	-	-	-	-	-
StreetW_1Y	-0.1680	-0.1820	-	-	-	-	-	-	-
F75Front	-	-	-	-	-	-	-	-	-
Component	-	-	-	-	-	-	-	-	-

SPA Index Eigen Values

Table 68. SPA Index Eigen Values							
Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Eigen Values	1.2907	0.8653	0.4781	0.3077	0.2875	0.2107	0.2030
Component	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Eigen Values	0.1745	0.1479	0.1318	0.1184	0.1083	0.0934	0.0765
Component	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Eigen Values	0.0641	0.0506	0.0432	0.0365	0.0306	0.0223	0.0000

SPA Index Scree plot

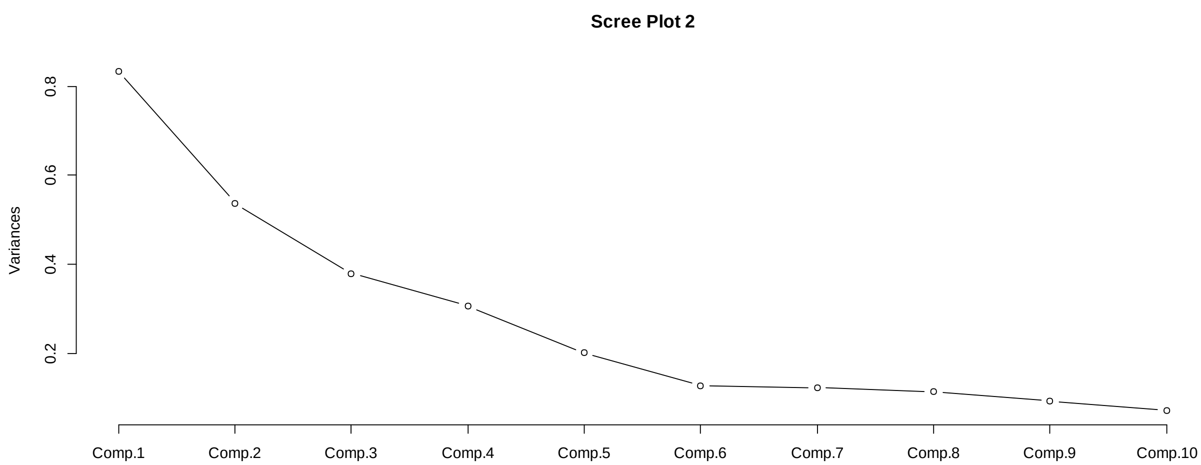

Figure 30. Scree plot for SPA Index.

Appendix C - Full Regression Results

Global Results

Table 69. Global Results: Full Regression Outputs				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Intercept	10.9979*** (0.0971)	-	-	-
Building Area *square feet*	0.7831*** (0.0460)	0.7192*** (16.1662)	0.5997*** (2.8361)	1.3189*** (6.0934)
Building Area squared *square feet*	-0.0888*** (0.0137)	-0.0881*** (-6.3527)	-0.0742 (-1.2114)	-0.1623*** (-2.6186)
Full Bathrooms *count*	0.021* (0.0115)	0.0180* (1.8603)	0.1048 (1.6351)	0.1228* (1.8330)
Half Bathrooms *count*	0.0636*** (0.0112)	0.0533*** (5.5005)	-0.1376** (-2.1640)	-0.0843 (-1.3094)
Lot Area *square feet*	0.0148*** (0.0036)	0.0155*** (4.5555)	0.0113 (0.7997)	0.0268* (1.7568)
Building Age *years*	-0.0010*** (0.0002)	-0.0018*** (-7.8361)	0.0017** (1.9934)	-0.0001 (-0.0532)
Median Income *census tract*	-0.0077 (0.0091)	-0.0397** (-2.3145)	0.0511* (1.9217)	0.0114 (0.6092)
Median Income squared *census tract*	0.0006 (0.0004)	0.0005 (0.6823)	-0.0005 (-0.4505)	0.0000 (0.0018)
# of Vacant Lots *census tract*	-0.0009*** (0.0001)	-0.0001 (-0.3481)	-0.0005 (-1.1759)	-0.0007** (-2.3569)
% White Population *census tract*	0.6308*** (0.0618)	0.4357*** (3.5091)	0.3409* (1.8170)	0.7766*** (6.4185)
Community 1 *dummy*	0.3161*** (0.0332)	0.2726** (2.5362)	-0.0554 (-0.4328)	0.2172*** (3.7404)
Community 2 *dummy*	-0.3511*** (0.0300)	0.0823 (0.5371)	-0.3999** (-2.0771)	-0.3176*** (-4.5838)
Community 3 *dummy*	-0.0605* (0.0254)	-0.0471 (-0.1965)	-0.0158 (-0.1160)	-0.0629 (-1.3610)
Community 4 *dummy*	-0.0125 (0.0519)	0.4513** (2.4472)	-0.5139** (-2.2957)	-0.0626 (-0.4679)
Community 5 *dummy*	-0.1078*** (0.0233)	0.0486 (0.0690)	-0.1559 (-0.3058)	-0.1073** (-2.3415)
Community 6 *dummy*	0.0868 (0.0807)	0.3345 (1.2461)	-0.4972 (-1.0861)	-0.1626 (-0.6961)
Community 7 *dummy*	0.0378 (0.0276)	0.0816 (0.9287)	-0.0427 (-0.3207)	0.0389 (0.7464)

Table 69. *(continued)* Global Results: Full Regression Outputs				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Community 8 *dummy*	0.2111*** (0.0214)	-0.0763 (-1.0690)	0.2419*** (2.9533)	0.1656*** (4.8131)
Community 9 *dummy*	-0.0099 (0.0470)	0.1758 (0.3759)	-0.2405 (-0.4789)	-0.0647 (-0.6027)
Quarter 1 *dummy*	-0.0755*** (0.0225)	-0.0805*** (-3.8377)	-0.0749 (-0.5342)	-0.1554 (-1.1094)
Quarter 2 *dummy*	0.0059 (0.0212)	-0.0055 (-0.2508)	0.0639 (0.6030)	0.0584 (0.5640)
Quarter 3 *dummy*	-0.0128 (0.0210)	-0.0114 (-0.6159)	-0.1004 (-0.7464)	-0.1117 (-0.8293)
High Income *versus Low Income*	-0.0132 (0.0210)	0.0729 (1.5507)	-0.1209* (-1.6815)	-0.0480 (-1.0540)
Community Gardens *versus Urban Farms*	0.0331 (0.0391)	0.0070 (0.0406)	0.1901 (1.6355)	0.1971* (1.9382)
Distance to UA *1000's feet*	0.0044 (0.0078)	0.0367*** (2.6008)	-0.0521** (-2.1293)	-0.0154 (-1.0192)
Distance to UA squared *1000's feet*	0.0007 (0.0007)	-0.0041** (-2.4732)	0.0060** (2.5500)	0.0019 (1.4555)
UA Age *years*	0.0058*** (0.0016)	0.0047* (1.8537)	-0.0022 (-0.4350)	0.0025 (0.5747)
New Site *0 - 3 years*	-0.0186 (0.0175)	-0.0489* (-1.7251)	0.0100 (0.1873)	-0.0390 (-1.0238)
Well-established Sites *6+ years*	-0.0249 (0.0247)	-0.0860** (-1.9792)	0.0811 (0.8765)	-0.0048 (-0.0436)
UA Lot Area *square feet*	-0.0040* (0.0020)	-0.0058** (-2.0714)	0.0119** (2.1198)	0.0061 (1.3404)
Small Site *< quarter acre*	-0.0180 (0.0184)	-0.0849** (-2.4545)	0.1422** (2.4653)	0.0572 (1.4172)
Large Site *> half acre*	0.0013 (0.0016)	0.0035 (1.3832)	-0.0100** (-2.3446)	-0.0066** (-1.9653)
# UA per Mile (street network) *count*	-0.0112*** (0.0025)	-0.0192*** (-3.7466)	0.0128 (1.5359)	-0.0064 (-1.1133)
# UA per neighborhood *count*	0.0006 (0.0047)	0.0132* (1.6665)	-0.0253* (-1.9433)	-0.0120 (-1.1884)
SYS Index% *proportion*	-0.0202 (0.0379)	-0.0133 (-0.3638)	-0.0264 (-0.2274)	-0.0397 (-0.5054)
SPA Index% *proportion*	0.0476 (0.0618)	-0.2448*** (-2.8266)	0.6002*** (3.0618)	0.3554** (2.2041)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
$^{+}$ *Regression run on the reserve dummy variable.* $^{++}$ *Regression run on the collapsed categories, or alternate categories.*

Table 70. Global Data: Moran's I Test		
Moran's I Test (MI)	MI's = 16.6468, p-value < 2.2e-16	
Observed Moran's I	Expectation	Variance
0.0910	-0.0080	0.0000

Table 71. Global Data: LR Tests	
Likelihood Ratio (LR)	= 120.98, df = 36, p-value = 4.032e-11
LR of Durbin	LR of LAG
96.1037	35.6099

Table 72. Global Data: Breusch Pagan Test	
Studentized Breusch-Pagan (BP)	*BP = 198.8498, df = 72, p-value = 8.005e-14*

Table 73. Global Model: Results on Reserve or Collapsed Variables

	Spatial Durbin Model		
Variable	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
[++]Below Half Acre *vs above half acre*	-0.0359 (-0.7981)	0.1608** (2.0006)	0.1250* (1.9040)
[+] Established Sites *3 - 6 years*	0.0860** (2.1072)	-0.0811 (-0.9680)	0.0048 (0.0194)
[++]Below 6 Years *versus all other*	0.0719** (2.0702)	-0.0859 (-1.1950)	-0.0139 (-0.2075)
[+] High number per neighborhood *4 + sites versus other*	0.0702* (1.8131)	-0.1032* (-1.7105)	-0.0330 (-0.6737)
[++] SYS High Quality *versus all other*	-0.0189 (-0.7764)	0.0202 (0.3461)	0.0013 (-0.0989)
[++] SPA High Quality *versus all other*	-0.0567*** (-2.7001)	0.1195*** (3.0984)	0.0629** (1.9810)
[++] Permanence% *proportion*	0.0154 (0.1781)	-0.1326 (-1.0147)	-0.1172 (-1.2380)
[++] Communication% *proportion*	-0.0216 (-0.5117)	0.0087 (0.1007)	-0.0129 (-0.2255)
[++] Operational% *proportion*	-0.0111 (-0.1724)	0.0642 (0.5172)	0.0531 (0.5066)
[++] Aesthetic% *proportion*	-0.1468*** (-3.1033)	0.3422*** (3.4145)	0.1954** (2.3963)
[++] Urban Context% *proportion*	0.0144 (0.1927)	0.0165 (0.1377)	0.0309 (0.3178)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
[+] *Regression run on the reserve dummy variable.* [++] *Regression run on the collapsed categories, or alternate categories.*

Quarter Mile Comparison Results

Table 74. Quarter Mile Results: Full Regression Outputs				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Intercept	10.9951*** (0.1114)	-	-	-
Building Area *square feet*	0.7890*** (0.0462)	0.7146*** (15.9716)	0.5454** (2.2491)	1.2600*** (5.2033)
Building Area squared *square feet*	-0.0907*** (0.0138)	-0.0856*** (-6.3877)	-0.0506 (-0.6330)	-0.1362* (-1.7942)
Full Bathrooms *count*	0.0230* (0.0115)	0.0197* (1.9542)	0.1081 (1.5341)	0.1278* (1.8150)
Half Bathrooms *count*	0.0633*** (0.0112)	0.0509*** (4.9263)	-0.1598** (-2.1692)	-0.1089 (-1.4001)
Lot Area *square feet*	0.0145*** (0.0036)	0.0148*** (4.2402)	0.0123 (0.8324)	0.0271* (1.8299)
Building Age *years*	-0.0010*** (0.0002)	-0.0018*** (-7.5686)	0.0020** (2.2496)	0.0002 (0.2088)
Median Income *census tract*	-0.0059 (0.0091)	-0.0385*** (-2.6055)	0.0517** (2.2855)	0.0132 (0.7253)
Median Income squared *census tract*	0.0005 (0.0004)	0.0005 (0.8332)	-0.0006 (-0.6038)	-0.0001 (-0.0994)
# of Vacant Lots *census tract*	-0.0009*** (0.0001)	-0.0002 (-0.4841)	-0.0005 (-1.1653)	-0.0007** (-2.5664)
% White Population *census tract*	0.6643*** (0.0626)	0.4635*** (4.0138)	0.3210* (1.7398)	0.7845*** (6.3475)
Community 1 *dummy*	0.2920*** (0.0339)	0.2456** (2.4533)	-0.0255 (-0.3022)	0.2201*** (3.7699)
Community 2 *dummy*	-0.3447*** (0.0304)	0.1280 (0.8718)	-0.4480** (-2.5423)	-0.3200*** (-5.0677)
Community 3 *dummy*	-0.0665** (0.0257)	0.0047 (-0.0096)	-0.0780 (-0.3891)	-0.0733* (-1.7429)
Community 4 *dummy*	0.0014 (0.0526)	0.5046*** (2.8295)	-0.5250** (-2.3337)	-0.0204 (-0.2095)
Community 5 *dummy*	-0.1130*** (0.0237)	0.2032 (0.4065)	-0.3105 (-0.6411)	-0.1073** (-2.4179)
Community 6 *dummy*	0.1253 (0.0810)	0.3425 (1.2928)	-0.4418 (-1.0433)	-0.0993 (-0.4998)
Community 7 *dummy*	0.0382 (0.0280)	0.0834 (1.1669)	-0.0325 (-0.4716)	0.0508 (0.7976)
Community 8 *dummy*	0.2037*** (0.0220)	-0.0808 (-0.9722)	0.2406** (2.4674)	0.1598*** (3.7694)
Community 9 *dummy*	-0.0076 (0.0472)	0.2869 (0.6217)	-0.3637 (-0.7628)	-0.0767 (-0.8762)
Quarter 1 *dummy*	-0.0750*** (0.0224)	-0.0775*** (-3.6554)	-0.0592 (-0.3490)	-0.1367 (-0.9032)
Quarter 2 *dummy*	0.0083 (0.0211)	0.0000 (0.0320)	0.1022 (0.8316)	0.1022 (0.8057)
Quarter 3 *dummy*	-0.0104 (0.0209)	-0.0072 (-0.3263)	-0.0647 (-0.4099)	-0.0719 (-0.4417)
High Income *versus Low Income*	-0.0178 (0.0211)	0.0690* (1.7042)	-0.1278** (-2.0544)	-0.0588 (-1.4461)

Table 74. *(continued)* Quarter Mile Results: Full Regression Outputs				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Community Gardens *versus Urban Farms*	-0.0306 (0.0521)	-0.0157 (-0.1718)	0.3477* (1.7529)	0.3321* (1.7071)
Distance to UA *1000's feet*	-0.0063 (0.0101)	0.0323 (1.3295)	-0.0566 (-1.5576)	-0.0242 (-1.0297)
Distance to UA squared *1000's feet*	0.0014* (0.0008)	-0.0038 (-1.5985)	0.0064* (1.9593)	0.0025 (1.4313)
UA Age *years*	0.0050** (0.0018)	0.0039* (1.6628)	-0.0021 (-0.2940)	0.0018 (0.4174)
New Site *0 - 3 years*	-0.0193 (0.0202)	-0.0739** (-2.3031)	0.0704 (1.2374)	-0.0035 (-0.0182)
Well-established Sites *6+ years*	-0.0055 (0.0280)	-0.0934** (-2.5114)	0.1248 (1.3204)	0.0314 (0.3174)
UA Lot Area *square feet*	-0.0025 (0.0023)	-0.0019 (-0.6043)	0.0108 (1.5306)	0.0089 (1.4887)
Small Site *< quarter acre*	0.0253 (0.0212)	-0.0447 (-1.1043)	0.1311** (2.0822)	0.0864** (1.9712)
Large Site *> half acre*	0.0005 (0.0018)	0.0005 (0.1786)	-0.0089* (-1.6640)	-0.0084* (-1.9557)
# UA per Mile (street network) *count*	-0.0112*** (0.0025)	-0.0196*** (-3.9025)	0.0111 (1.5132)	-0.0085 (-1.4191)
# UA per neighborhood *count*	0.0019 (0.0047)	0.0134* (1.7343)	-0.0270** (-2.1149)	-0.0136 (-1.3466)
SYS Index% *proportion*	-0.0567 (0.0435)	-0.0446 (-0.6160)	0.0070 (0.1112)	-0.0376 (-0.2955)
SPA Index% *proportion*	0.0885 (0.0790)	-0.2389** (-2.1224)	0.5849*** (2.7270)	0.3460** (1.9939)
Sub QM *dummy*	0.1323 (0.1416)	0.1977 (1.6429)	0.6897 (1.4365)	0.8873* (1.9289)
Community Garden *versus Urban Farm*: Sub QM	0.1283* (0.0747)	0.0779 (0.9537)	-0.3028 (-0.8304)	-0.2249 (-0.6359)
Sub QM: Distance *1000's feet*	-0.2317 (0.1550)	-0.3637** (-2.2860)	-1.0714 (-1.3003)	-1.4351* (-1.7005)
Sub QM: Distance^2 *1000's feet*	0.1795. (0.0991)	0.2371** (2.3900)	0.7953 (1.4562)	1.0324* (1.8489)
UA Lot Area: Sub QM *square feet*	-0.0064 (0.0039)	-0.0123*** (-2.8093)	-0.0020 (-0.1107)	-0.0143 (-1.0057)
Small: Sub QM *< quarter acre*	-0.1736*** (0.0416)	-0.1749*** (-3.6478)	0.0357 (0.1214)	-0.1391 (-1.0968)
Large: Sub QM *> half acre*	0.0038 (0.0034)	0.0089** (2.3837)	0.0018 (0.1081)	0.0106 (0.8698)
Sub QM: UA Age *years*	0.0026 (0.0034)	0.0030 (0.7267)	0.0013 (0.0739)	0.0043 (0.2979)
Sub QM: New *0 - 3 years*	-0.0213 (0.0371)	0.0569 (1.3521)	-0.2283* (-1.8023)	-0.1713 (-1.4842)
Sub QM: Well-established *6+ years*	-0.0784 (0.0518)	0.0030 (0.1192)	-0.1831 (-0.9476)	-0.1800 (-0.9773)
Sub QM: SYS Index% *proportion*	0.0897 (0.0776)	0.0044 (0.1102)	0.0136 (0.0737)	0.0180 (0.1231)
Sub QM: SPA Index% *proportion*	-0.1192 (0.1276)	0.0083 (0.2782)	-0.0465 (-0.5570)	-0.0382 (-0.4939)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.

Table 75. Quarter Mile Results on Reserves or Collapsed Variables			
	Spatial Durbin Model		
Variable	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
++Below Half Acre *vs above half acre*	0.0058 (0.1943)	0.2092* (1.8362)	0.2150** (2.3820)
++Below Half Acre: Sub QM *vs above half acre*	-0.1343* (-1.9481)	-0.2417 (-0.9430)	-0.3760* (-1.6745)
+ Established Sites *3 - 6 years*	0.0916** (2.1389)	-0.1279 (-1.3388)	-0.0363 (-0.3986)
+ Established Sites: Sub QM *3 - 6 years*	-0.0034 (-0.0248)	0.1739 (0.8693)	0.1706 (0.9199)
++Below 6 Years *versus all other*	0.0696* (1.7549)	-0.1179 (-1.2839)	-0.0483 (-0.5821)
++Below 6 Years: Sub QM *versus all other*	0.0166 (0.2872)	0.1046 (0.4421)	0.1212 (0.5670)
++ SYS High Quality *versus all other*	-0.0286 (-0.9815)	0.0286 (0.5142)	0.0000 (-0.0077)
++ SPA High Quality *versus all other*	-0.0537** (-2.2157)	0.1222** (2.4630)	0.0685 (1.5711)
++ SYS High Quality: Sub QM *versus all other*	0.0189 (0.5190)	0.0431 (0.4010)	0.0620 (0.5987)
++ SPA High Quality: Sub QM *versus all other*	0.0183** (0.6341)	-0.0195** (-0.0866)	-0.0012 (0.0922)
++ Permanence% *proportion*	0.0058 (-0.7519)	-0.0477 (-0.8681)	-0.0419 (-1.5822)
++ Communication% *proportion*	0.0000 (-0.4522)	0.0000 (-0.1584)	0.0000 (-0.4829)
++ Operational% *proportion*	-0.0567 (-0.1802)	-0.1167 (0.8689)	-0.1734 (0.9088)
++ Aesthetic% *proportion*	-0.0202*** (-2.7577)	-0.0179*** (2.8209)	-0.0380* (1.7316)
++ Urban Context% *proportion*	-0.0110 (-0.4385)	0.1255 (0.4915)	0.1146 (0.2911)
++ Permanence%: Sub QM *proportion*	-0.1568 (1.5752)	0.3251 (0.4456)	0.1683 (1.0366)
++ Communication%: Sub QM *proportion*	-0.0424 (-0.5253)	0.0761 (0.4520)	0.0337 (0.3326)
++ Operational%: Sub QM *proportion*	0.1610 (0.1145)	0.1434 (-0.7271)	0.3043 (-0.7476)
++ Aesthetic%: Sub QM *proportion*	-0.0342 (0.9785)	0.1053 (0.3994)	0.0711 (0.6342)
++ Urban Context%: Sub QM *proportion*	0.0104 (0.9671)	-0.2350 (-0.4898)	-0.2245 (-0.2088)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ *Regression run on the reserve dummy variable.* ++ *Regression run on the collapsed categories, or alternate categories.*

Income Comparison Results

Table 76. Income Comparison Results: Full Regression Outputs				
	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Intercept	11.2280*** (0.1034)	-	-	-
Building Area *square feet*	0.7728*** (0.0464)	0.7128*** (16.4478)	0.6280*** (3.1538)	1.3407*** (6.6964)
Building Area squared *square feet*	-0.0844*** (0.0138)	-0.0810*** (-6.0882)	-0.0721 (-1.2155)	-0.1530*** (-2.6409)
Full Bathrooms *count*	0.0238* (0.0115)	0.0197* (1.8456)	0.1037 (1.3590)	0.1233 (1.5499)
Half Bathrooms *count*	0.0687*** (0.0112)	0.0567*** (5.3775)	-0.1239* (-1.7143)	-0.0671 (-0.8731)
Median Income *census tract*	-0.0146 (0.0093)	-0.0447*** (-2.8644)	0.0416* (1.6998)	-0.0030 (-0.2278)
Median Income squared *census tract*	0.0008* (0.0004)	0.0008 (1.0733)	-0.0004 (-0.4053)	0.0003 (0.4656)
# of Vacant Lots census tract	-0.0011*** (0.0002)	-0.0002 (-0.7114)	-0.0006 (-1.2244)	-0.0008*** (-3.1397)
% White Population *census tract*	0.6334*** (0.0663)	0.5351*** (4.0712)	0.1069 (0.5138)	0.6420*** (4.4507)
Building Age *years*	-0.0011*** (0.0002)	-0.0018*** (-7.9918)	0.0021** (2.1892)	0.0002 (0.3036)
Community 1 *dummy*	0.2718*** (0.0352)	0.2772*** (2.6630)	-0.1285 (-1.0942)	0.1486** (2.4237)
Community 2 *dummy*	-0.3702*** (0.0316)	0.0875 (0.5575)	-0.4658** (-2.2755)	-0.3784*** (-5.0042)
Community 3 *dummy*	-0.0740* (0.0292)	0.0862 (0.4892)	-0.2241 (-1.1358)	-0.1379** (-2.3101)
Community 4 *dummy*	0.0039 (0.0546)	0.5086*** (2.6841)	-0.6615*** (-2.7716)	-0.1529 (-1.2815)
Community 5 *dummy*	-0.1218*** (0.0265)	0.1909 (0.3730)	-0.3799 (-0.7694)	-0.1890*** (-3.3627)
Community 6 *dummy*	0.0994 (0.0813)	0.3807 (1.3156)	-0.5723 (-1.2700)	-0.1916 (-0.9266)
Community 7 *dummy*	0.0182 (0.0296)	0.1147 (1.4793)	-0.1435 (-1.3647)	-0.0288 (-0.4673)
Community 8 *dummy*	0.1672*** (0.0245)	-0.0855 (-1.1210)	0.1693* (1.7821)	0.0838* (1.8887)
Community 9 *dummy*	0.0198 (0.0486)	0.3161 (0.7127)	-0.4009 (-0.8308)	-0.0847 (-0.8247)
Quarter 1 *dummy*	-0.0742*** (0.0224)	-0.0844*** (-4.0175)	-0.1563 (-1.2048)	-0.2407* (-1.8010)
Quarter 2 *dummy*	0.0056 (0.0211)	-0.0090 (-0.4497)	-0.0357 (-0.3671)	-0.0447 (-0.4344)
Quarter 3 *dummy*	-0.0071 (0.0210)	-0.0107 (-0.5886)	-0.1198 (-1.0621)	-0.1306 (-1.1315)

Table 76. *(continued)* Income Comparison Results: Full Regression Outputs				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Community Garden *versus Urban Farm*	0.0542 (0.0504)	-0.0222 (-0.4512)	0.0383 (0.3325)	0.0161 (0.1731)
Distance to UA *feet*	0.0214 (0.0144)	0.0550** (2.1751)	-0.0576 (-1.2333)	-0.0025 (-0.0477)
Distance to UA squared *feet*	-0.0024 (0.0014)	-0.0081** (-2.4678)	0.0081 (1.6034)	0.0000 (0.0013)
UA Lot Area *square feet*	-0.0080* (0.0036)	-0.0149*** (-2.8452)	0.0232** (2.1016)	0.0084 (0.9158)
Small Site *< quarter acre*	-0.1620*** (0.0394)	-0.2419*** (-3.3881)	0.2716** (2.2847)	0.0298 (0.2892)
Large Site *> half acre*	0.0028 (0.0023)	0.0102*** (3.0480)	-0.0213*** (-3.1605)	-0.0112** (-1.9789)
UA Age *years*	0.0076** (0.0027)	0.0032 (0.9765)	0.0017 (0.1330)	0.0048 (0.4827)
New Site *0 - 3 years*	-0.0230 (0.0262)	-0.0443 (-1.2935)	-0.0501 (-0.6819)	-0.0944 (-1.4193)
Well-established Sites *6+ years*	-0.0966* (0.0415)	-0.0821* (-1.6949)	-0.0114 (-0.0390)	-0.0935 (-0.6466)
# UA per Mile (street network) *count*	-0.0115*** (0.0025)	-0.0212*** (-3.8356)	0.0125* (1.7035)	-0.0087* (-1.6729)
# UA per neighborhood *count*	0.0019 (0.0050)	0.0114 (1.4485)	-0.0182 (-1.5571)	-0.0067 (-0.7909)
SYS Index% proportion	-0.1184. (0.0645)	-0.0615 (-0.6477)	-0.1067 (-0.5863)	-0.1681 (-0.9841)
SPA Index% *proportion*	0.1755* (0.0811)	-0.0759 (-0.7001)	0.7268*** (2.8017)	0.6509*** (2.9555)
Community Garden *versus Urban Farm:* High Income	-0.0366 (0.0661)	-0.0076 (0.0070)	0.3942* (1.8360)	0.3866** (1.9691)
Distance to UA: High Income *versus Low Income*	-0.0109 (0.0161)	-0.0302 (-1.0314)	0.0281 (0.5520)	-0.0021 (-0.0459)
Distance to UA squared: High Income *versus Low Income*	0.0027. (0.0016)	0.0049 (1.4234)	-0.0037 (-0.6865)	0.0013 (0.3213)
UA Lot Area square feet: High Income *versus Low Income*	0.0003 (0.0042)	0.0118* (1.8427)	-0.0276** (-1.9753)	-0.0158 (-1.4035)
Small Site: High Income *versus Low Income*	0.2054*** (0.0433)	0.2202*** (3.4434)	-0.2171* (-1.6500)	0.0030 (0.0756)
UA Lot Area: Large: High Income *versus Low Income*	0.0020 (0.0031)	-0.0084* (-1.8401)	0.0252*** (2.6380)	0.0167** (2.1614)
UA Age: High Income *versus Low Income*	-0.0008 (0.0033)	-0.0002 (-0.0021)	0.0004 (0.0786)	0.0002 (0.0936)
New Site: High Income versus Low Income	0.0221 (0.0321)	-0.0289 (-0.5574)	0.1824* (1.8894)	0.1535* (1.8830)
Well-established Sites: High Income *versus Low Income*	0.1375** (0.0489)	0.0410 (0.6382)	0.1549 (0.8487)	0.1960 (1.2413)
SYS Index%: High Income *versus Low Income*	0.0684 (0.0736)	0.0575 (0.5047)	0.0905 (0.4423)	0.1480 (0.8153)
SPA Index%: High Income *versus Low Income*	-0.3306** (0.1045)	-0.2748* (-1.9497)	-0.4533 (-1.4622)	-0.7281*** (-2.6137)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.[+] Regression run on the reserve dummy variable. [+ +] Regression run on the collapsed categories, or alternate categories.*

Table 77. Income Comparison Results on Reserves or Collapsed Variables			
	Spatial Durbin Model		
Variable	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
++Below Half Acre *vs above half acre*	-0.1223 (-1.1972)	0.3658 (1.6446)	0.2435 (1.1921)
++Below Half Acre: High Income *vs above half acre*	0.1900* (1.8411)	-0.4169* (-1.7351)	-0.2268 (-1.0367)
+ Established Sites *3 - 6 years*	0.0658** (2.1411)	0.0560 (0.7067)	0.1218* (1.8166)
+ Established Sites: High Income *3 - 6 years*	-0.0418 (-0.7871)	-0.1327 (-0.9524)	-0.1746* (-1.6888)
++Below 6 Years *versus all other*	0.0667 (1.3562)	0.0137 (-0.0377)	0.0804 (0.5136)
++Below 6 Years: High Income *versus all other*	-0.0368 (-0.5702)	-0.0840 (-0.4156)	-0.1209 (-0.7432)
++ SYS High Quality *versus all other*	-0.0484 (-1.3300)	0.0191 (0.2631)	-0.0293 (-0.4620)
++ SPA High Quality *versus all other*	-0.0251 (-0.9739)	0.1616** (2.1374)	0.1365** (1.9609)
++ SYS High Quality: High Income *versus all other*	0.0752* (1.7577)	-0.0619 (-0.6952)	0.0133 (0.2267)
++ SPA High Quality: High Income *versus all other*	-0.0141 (-0.3611)	-0.1259 (-1.2393)	-0.1400* (-1.6674)
++ Permanence% *proportion*	-0.0806 (-0.8463)	-0.1078 (-0.2804)	-0.1884 (-0.6568)
++ Communication% *proportion*	-0.0222 (-0.3956)	-0.0628 (-0.6238)	-0.0850 (-0.8737)
++ Operational% *proportion*	0.0141 (0.1979)	-0.0236 (-0.1469)	-0.0094 (-0.0625)
++ Aesthetic% *proportion*	-0.0410 (-0.5899)	0.3713** (2.1785)	0.3303** (2.2037)
++ Urban Context% *proportion*	0.0440 (0.4648)	0.0034 (-0.0278)	0.0474 (0.1603)
++ Permanence%: High Income *proportion*	0.1459 (1.0747)	0.0114 (-0.0065)	0.1573 (0.4945)
++ Communication%: High Income *proportion*	-0.0339 (-0.3612)	0.2457* (1.6522)	0.2118 (1.6377)
++ Operational%: High Income *proportion*	0.0145 (0.1256)	-0.1981 (-0.7780)	-0.1836 (-0.8222)
++ Aesthetic%: High Income *proportion*	-0.1330 (-1.5082)	-0.1642 (-0.7388)	-0.2972 (-1.5547)
++ Urban Context%: High Income *proportion*	0.0325 (0.2237)	-0.1136 (-0.3303)	-0.0811 (-0.2869)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.+ Regression run on the reserve dummy variable. ++ Regression run on the collapsed categories, or alternate categories.*

High Income Subset Results

Table 78. High Income Subset Results: Full Regression Outputs				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Intercept	11.3300*** (0.2175)	-	-	-
Building Area *square feet*	0.8499*** (0.0539)	0.7759*** (15.2890)	0.9324*** (3.4486)	1.7082*** (6.0499)
Building Area squared *square feet*	-0.1038*** (0.0161)	-0.0961*** (-6.4569)	-0.1713** (-2.0782)	-0.2673*** (-3.1073)
Full Bathrooms *count*	0.0348* (0.0138)	0.0389*** (2.9921)	0.1708** (2.3436)	0.2097*** (2.7538)
Half Bathrooms *count*	0.0665*** (0.0130)	0.0518*** (4.6035)	-0.1503** (-2.1521)	-0.0985 (-1.3103)
Lot Area *square feet*	0.0165*** (0.0043)	0.0172*** (4.1239)	0.0144 (0.8010)	0.0316* (1.7526)
Building Age *years*	-0.0007* (0.0003)	-0.0015*** (-5.1433)	0.0024** (2.3035)	0.0009 (0.8218)
Median Income *census tract*	-0.0244* (0.0119)	-0.0737*** (-3.2326)	0.0421 (1.4295)	-0.0315* (-1.6718)
Median Income squared *census tract*	0.0012* (0.0005)	0.0019* (1.9132)	-0.0006 (-0.5156)	0.0013 (1.6359)
# of Vacant Lots *census tract*	-0.0010*** (0.0002)	-0.0001 (-0.1929)	-0.0011* (-1.7222)	-0.0012*** (-3.2374)
% White Population *census tract*	0.7109*** (0.0767)	0.2629 (1.3059)	0.5364** (2.1578)	0.7992*** (6.0597)
Community 1 *dummy*	0.1655*** (0.0431)	0.6952** (2.3471)	-0.6162* (-1.8625)	0.0790 (1.0356)
Community 2 *dummy*	-0.4140*** (0.0363)	-0.2399 (-0.7960)	-0.0674 (-0.2855)	-0.3073*** (-4.4535)
Community 3 *dummy*	-0.1880*** (0.0337)	0.3717 (1.2034)	-0.5769* (-1.8155)	-0.2051*** (-3.6999)
Community 4 *dummy*	-0.2097*** (0.0313)	0.4857 (0.9375)	-0.6680 (-1.2582)	-0.1824*** (-3.4203)
Community 5 *dummy*	-0.0883* (0.0350)	0.1011 (0.7518)	-0.0847 (-0.5154)	0.0164 (0.3059)
Community 6 *dummy*	0.0715* (0.0302)	0.0522 (0.5445)	0.0142 (0.1146)	0.0663 (1.4978)
Community 7 *dummy*	-0.1174 (0.0752)	0.3716 (0.7037)	-0.5856 (-0.9089)	-0.2140 (-1.2195)
Quarter 1 *dummy*	-0.0929*** (0.0272)	-0.0795*** (-2.9307)	-0.1789 (-1.1410)	-0.2584 (-1.5783)
Quarter 2 *dummy*	-0.0107 (0.0257)	0.0032 (0.2779)	0.0294 (0.2788)	0.0326 (0.3223)
Quarter 3 *dummy*	-0.0290 (0.0254)	-0.0088 (-0.2462)	-0.1231 (-0.9161)	-0.1319 (-0.9332)
Community Gardens *versus Urban Farms*	0.1134 (0.0957)	-0.1636 (-1.1049)	1.0389*** (2.9740)	0.8753*** (3.0783)

Table 78. *(continued)* High Income Subset Results: Full Regression Outputs

	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Distance to UA *1000's feet*	-0.1465* (0.0739)	0.0974 (1.0557)	-0.5198** (-2.4444)	-0.4224** (-2.2794)
Distance to UA squared *1000's feet*	0.0086. (0.0050)	-0.0149* (-1.8590)	0.0491*** (3.9163)	0.0342*** (3.9748)
UA Age *years*	0.0098** (0.0037)	0.0009 (0.2401)	0.0272** (2.2824)	0.0281*** (3.1015)
New Site *0 - 3 years*	-0.0483 (0.0427)	-0.0778 (-0.9027)	0.0866 (0.4695)	0.0088 (-0.0381)
Well-established Sites *6+ years*	-0.1165* (0.0510)	-0.0125 (-0.1979)	-0.3156** (-2.0212)	-0.3281*** (-2.8903)
UA Lot Area *square feet*	-0.0071 (0.0050)	0.0034 (0.4454)	-0.0506*** (-3.4658)	-0.0472*** (-3.9976)
Small Site *< quarter acre*	-0.0757 (0.0474)	-0.0615 (-0.7528)	-0.2422 (-1.4737)	-0.3037*** (-2.8032)
Large Site *> half acre*	0.0033 (0.0042)	-0.0040 (-0.6093)	0.0373*** (3.1632)	0.0333*** (3.6976)
Small: Distance to UA *< quarter acre*	0.0427** (0.0143)	0.0178 (0.8706)	0.1090** (2.4764)	0.1268*** (3.7434)
Large: Distance to UA *> half acre*	0.0000 (0.0012)	0.0011 (0.7127)	-0.0104*** (-3.1630)	-0.0093*** (-3.5396)
# UA per Mile (street network) *count*	-0.0155*** (0.0038)	-0.0293*** (-3.9680)	0.0069 (0.5779)	-0.0224*** (-3.2906)
# UA per neighborhood *count*	0.0093 (0.0064)	0.0157 (1.2594)	-0.0037 (-0.1872)	0.0120 (0.9619)
SYS Index% *proportion*	0.1116 (0.1014)	-0.1068 (-0.6294)	0.2162 (0.7614)	0.1093 (0.5233)
SPA Index% *proportion*	-0.5083* (0.2115)	0.1161 (0.3506)	-1.1570* (-1.8944)	-1.0409** (-2.3285)
UA Lot Area: Distance to UA *square feet*	0.0001 (0.0014)	-0.0011 (-0.6252)	0.0136*** (3.3410)	0.0124*** (3.8372)
Community Gardens: Distance to UA *versus Urban Farms*	-0.0141 (0.0284)	0.0204 (0.5120)	-0.1551 (-1.3564)	-0.1346 (-1.2668)
UA Age: Distance to UA *years*	-0.0005 (0.0010)	0.0000 (-0.0494)	-0.0037 (-1.0353)	-0.0037 (-1.3072)
New: Distance to UA *0 - 3 years*	0.0257* (0.0118)	0.0020 (0.0324)	0.0434 (1.2985)	0.0455* (1.7151)
Well-established: Distance to UA *6+ years*	0.0386** (0.0141)	-0.0008 (-0.0084)	0.1015** (2.3142)	0.1007*** (3.1707)
SYS Index%: Distance to UA *proportion*	-0.0339 (0.0436)	0.0413 (0.5118)	-0.0227 (-0.1297)	0.0186 (0.3081)
SYS Index%: Distance to UA squared *proportion*	0.0014 (0.0042)	-0.0037 (-0.5095)	-0.0050 (-0.4360)	-0.0088 (-1.0828)
SPA Index%: Distance to UA *proportion*	0.1957* (0.0874)	-0.1904 (-1.5389)	0.7282*** (3.0382)	0.5378*** (2.9680)
SYS Index%: Distance to UA squared *proportion*	-0.0142. (0.0075)	0.0201* (1.6840)	-0.0675*** (-3.6260)	-0.0474*** (-3.8200)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
[+] *Regression run on the reserve dummy variable.* [+ +] *Regression run on the collapsed categories, or alternate categories.*

Table 79. High Income Subset Results on Reserves or Collapsed Variables			
	Spatial Durbin Model		
Variable	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
+ + Below Half Acre *vs above half acre*	0.0643 (0.4546)	-0.3229 (-1.5979)	-0.2586* (-1.6980)
+ + Below Half Acre: Distance to UA *vs above half acre*	-0.0121 (-0.3124)	0.1578** (2.2362)	0.1457*** (2.5872)
+ Established Sites *3 - 6 years*	0.0125 (0.0980)	0.3156* (1.8976)	0.3281*** (2.6908)
+ Established Sites: Distance to UA *3 - 6 years*	0.0008 (0.0639)	-0.1015** (-2.2662)	-0.1007*** (-3.2132)
+ + Below 6 Years *versus all other*	0.0291 (0.2506)	0.3644** (2.3236)	0.3936*** (3.5674)
+ + Below 6 Years: Distance to UA *versus all other*	-0.0004 (-0.0059)	-0.1089** (-2.4853)	-0.1094*** (-3.4192)
+ High number per neighborhood *4 + sites versus other*	0.1156** (2.1028)	-0.0842 (-1.0523)	0.0314 (0.5594)
+ + SYS High Quality *versus all other*	0.0577 (1.1394)	-0.0975 (-1.0465)	-0.0398 (-0.5831)
+ + SPA High Quality *versus all other*	-0.0895 (-1.5910)	0.0515 (0.5792)	-0.0380 (-0.4503)
+ + SYS High Quality: Distance to UA *versus all other*	-0.0144 (-1.0941)	0.0403 (1.5429)	0.0259 (1.2433)
+ + SPA High Quality: Distance to UA *versus all other*	0.0165 (1.0819)	0.0014 (0.0588)	0.0178 (0.7230)
+ + Permanence% *proportion*	0.2107 (0.9234)	-0.3159 (-0.7832)	-0.1052 (-0.3465)
+ + Communication% *proportion*	0.0464 (0.4342)	0.0741 (0.3143)	0.1205 (0.7324)
+ + Operational% *proportion*	-0.1486 (-0.9299)	-0.0063 (-0.0610)	-0.1550 (-0.6283)
+ + Urban Context% *proportion*	0.2094 (0.9240)	-0.0381 (-0.1603)	0.1713 (0.7036)
+ + Aesthetic% *proportion*	-0.3225** (-2.1598)	0.4635 (1.4647)	0.1410 (0.5565)
+ + Permanence%: Distance to UA *proportion*	-0.0680 (-1.0529)	0.0907 (0.6148)	0.0227 (0.1342)
+ + Communication%: Distance to UA *proportion*	-0.0262 (-0.7631)	0.0233 (0.4304)	-0.0029 (0.0398)
+ + Operational%: Distance to UA *proportion*	0.0561 (1.1692)	-0.0381 (-0.2901)	0.0179 (0.2074)
+ + Urban Context%: Distance to UA proportion	-0.0411 (-0.6801)	0.0152 (0.1472)	-0.0259 (-0.1993)
+ + Aesthetic%: Distance to UA *proportion*	0.0513 (1.1443)	-0.0362 (-0.2433)	0.0151 (0.1833)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Low Income Subset Results

Table 80. Low Income Subset Results: Full Regression Outputs				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Intercept	11.4600*** (0.2620)	-	-	-
Building Area *square feet*	0.6823*** (0.0935)	0.6804*** (7.1382)	0.1839 (0.4190)	0.8643** (2.1911)
Building Area squared *square feet*	-0.0919** (0.0294)	-0.0929*** (-3.1481)	-0.0130 (-0.0324)	-0.1059 (-0.8146)
Full Bathrooms *count*	-0.0076 (0.0204)	-0.0126 (-0.5682)	-0.0601 (-0.8461)	-0.0727 (-0.9464)
Half Bathrooms *count*	0.0323 (0.0212)	0.0166 (0.8558)	-0.1591* (-1.8519)	-0.1425 (-1.5670)
Lot Area *square feet*	0.0130* (0.0066)	0.0117** (2.0230)	0.0392* (1.8288)	0.0509** (2.3305)
Building Age *years*	-0.0018*** (0.0004)	-0.0020*** (-5.6537)	0.0020 (1.6284)	0.0000 (0.0751)
Median Income *census tract*	-0.1219. (0.0688)	0.1182 (0.8371)	-0.2484 (-1.3204)	-0.1302 (-1.3358)
Median Income squared *census tract*	0.0194* (0.0111)	-0.0214 (-0.9318)	0.0471 (1.5886)	0.0256* (1.6923)
# of Vacant Lots *census tract*	0.0194. (0.0111)	-0.0214 (-0.9318)	0.0471 (1.5886)	0.0256* (1.6923)
% White Population *census tract*	0.5783*** (0.1052)	1.0223*** (3.7264)	0.0388 (0.2018)	1.0611*** (6.0457)
Community 1 *dummy*	0.4170*** (0.0893)	0.3029 (1.2227)	-0.0119 (-0.0923)	0.2911 (1.1622)
Community 2 *dummy*	-0.3939*** (0.0458)	-0.9065*** (-4.0458)	0.6818*** (2.7492)	-0.2247*** (-3.4318)
Community 3 *dummy*	0.1166* (0.0568)	0.2658 (0.6525)	-0.1394 (-0.3158)	0.1264* (1.6572)
Community 4 *dummy*	-0.0451 (0.0468)	0.6725 (1.0290)	-0.7603 (-1.1580)	-0.0878 (-1.6287)
Community 5 *dummy*	0.0672 (0.0815)	0.4750 (1.1856)	-0.6821 (-1.5158)	-0.2071** (-2.0519)
Community 6 *dummy*	0.1258** (0.0458)	0.3494 (1.3379)	-0.2828 (-1.0402)	0.0666 (0.9435)
Community 7 *dummy*	0.0465 (0.0772)	-0.0717 (-0.2642)	0.4709 (1.1513)	0.3992 (1.5313)
Community 8 *dummy*	0.0951 (0.0664)	0.2131 (0.4554)	-0.1961 (-0.4028)	0.0170 (0.1886)
Quarter 1 *dummy*	-0.0484 (0.0379)	-0.0566 (-1.4138)	0.1892 (1.3145)	0.1327 (0.8881)
Quarter 2 *dummy*	0.0161 (0.0357)	0.0096 (0.2472)	0.2334* (1.7277)	0.2429* (1.7223)
Quarter 3 *dummy*	0.0214 (0.0353)	0.0160 (0.4530)	0.2701* (1.8545)	0.2861* (1.8674)

Table 81. *(continued)* Low Income Subset Results: Full Regression Outputs				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Community Gardens *versus Urban Farms*	-0.0619 (0.0901)	-0.1323 (-1.4642)	-0.0655 (-0.2213)	-0.1978 (-0.7896)
Distance to UA *1000's feet*	0.1152 (0.1182)	0.0064 (0.0867)	0.0449 (0.0485)	0.0513 (0.0958)
Distance to UA squared *1000's feet*	-0.0179 (0.0119)	-0.0333* (-1.9478)	-0.0386 (-1.1593)	-0.0719** (-2.4581)
UA Age *years*	0.0018 (0.0057)	0.0007 (0.2092)	-0.0034 (-0.3447)	-0.0027 (-0.2955)
New Site *0 - 3 years*	-0.1244* (0.0505)	-0.0956 (-1.6206)	-0.1026 (-1.0835)	-0.1982** (-2.2690)
Well-established Sites *6+ years*	-0.0583 (0.0858)	-0.0124 (-0.2166)	0.0241 (0.1643)	0.0117 (0.0779)
UA Age: Distance to UA *years*	-0.0007 (0.0026)	0.0023 (0.5645)	-0.0025 (-0.3141)	-0.0002 (-0.0481)
New: Distance to UA *0 - 3 years*	0.0369 (0.0250)	0.0142 (0.4590)	0.0229 (0.4205)	0.0371 (0.7402)
Well-established: Distance to UA *6+ years*	0.0088 (0.0376)	-0.0700 (-1.3161)	0.0780 (0.7282)	0.0081 (0.1386)
UA Lot Area *square feet*	-0.0045 (0.0082)	-0.0371*** (-3.7512)	0.0821*** (3.8647)	0.0450** (2.4763)
Small Site *< quarter acre*	-0.0450 (0.0869)	-0.4992*** (-4.0243)	0.6633*** (3.1361)	0.1642 (0.9772)
Large Site *> half acre*	0.0044 (0.0052)	0.0189*** (3.1682)	-0.0382*** (-2.8624)	-0.0193* (-1.6642)
UA Lot Area: Distance to UA *square feet*	-0.0011 (0.0039)	0.0136*** (2.7290)	-0.0296*** (-2.6689)	-0.0160* (-1.6835)
Small: Distance to UA *< quarter acre*	-0.0499 (0.0395)	0.1313** (2.2064)	-0.1109 (-1.1107)	0.0204 (0.3587)
Large: Distance to UA *> half acre*	0.0001 (0.0024)	-0.0064** (-2.0673)	0.0150** (2.1094)	0.0086 (1.4278)
# UA per Mile (street network) *count*	-0.0062. (0.0038)	-0.0190** (-2.5007)	0.0381*** (3.7284)	0.0191*** (3.0834)
# UA per neighborhood *count*	-0.0084 (0.0080)	-0.0007 (-0.0197)	-0.0602*** (-3.6156)	-0.0609*** (-4.7326)
SYS Index% *proportion*	-0.0468 (0.1348)	-0.0990 (-0.4233)	-0.6698 (-1.6034)	-0.7688** (-2.2177)
SPA Index% *proportion*	0.0664 (0.1759)	0.3295 (1.5841)	-0.0407 (-0.1640)	0.2888 (0.7566)
Community Gardens: Distance to UA *versus Urban Farms*	0.0582 (0.0616)	0.1038* (1.9403)	-0.1154 (-0.7083)	-0.0116 (-0.1246)
SYS Index%: Distance to UA *proportion*	0.0440 (0.0885)	0.0440 (0.3156)	0.1710 (0.6056)	0.2150 (0.9819)
SYS Index%: Distance to UA squared *proportion*	-0.0102 (0.0130)	-0.0049 (-0.2654)	0.0172 (0.4923)	0.0123 (0.5137)
SPA Index%: Distance to UA *proportion*	-0.1228 (0.1258)	-0.3827** (-2.4185)	0.2709 (1.0500)	-0.1118 (-0.2952)
SYS Index%: Distance to UA squared *proportion*	0.0204 (0.0200)	0.0370 (1.4977)	0.0784 (1.3689)	0.1154** (2.2177)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Table 82. Low Income Subset: Results on Reserve or Collapsed Variables			
	Spatial Durbin Model		
Variable	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
+ + Below Half Acre *vs above half acre*	-0.1077 (-0.6817)	0.5166 (1.3944)	0.4090 (1.2668)
+ + Below Half Acre: Distance to UA *vs above half acre*	0.0259 (0.3534)	-0.2461 (-1.2677)	-0.2202 (-1.2941)
+ Established Sites *3 - 6 years*	0.0124 (0.1039)	-0.0241 (-0.0627)	-0.0117 (-0.0241)
+ Established Sites: Distance to UA *3 - 6 years*	0.0700 (1.5445)	-0.0780 (-0.6725)	-0.0081 (-0.0944)
+ + Below 6 Years *versus all other*	-0.0106 (-0.0759)	0.1200 (0.5508)	0.1095 (0.6050)
+ + Below 6 Years: Distance to UA *versus all other*	0.0687 (1.5981)	-0.1519 (-1.5750)	-0.0832 (-1.0502)
+ High number per neighborhood *4 + sites versus other*	-0.0005 (-0.0254)	-0.1492 (-1.5731)	-0.1497** (-1.9730)
+ + SYS High Quality *versus all other*	-0.0961 (-1.3673)	0.0698 (0.4927)	-0.0264 (-0.2704)
+ + SPA High Quality *versus all other*	0.0193 (0.4035)	-0.2836*** (-2.8968)	-0.2642*** (-2.9796)
+ + SYS High Quality: Distance to UA *versus all other*	0.0226 (0.5833)	-0.0689 (-0.9708)	-0.0464 (-0.9150)
+ + SPA High Quality: Distance to UA *versus all other*	-0.0203 (-0.8346)	0.1797*** (2.9409)	0.1594*** (2.9991)
+ + Permanence% *proportion*	-0.2269 (-1.2536)	0.1743 (0.3301)	-0.0526 (-0.1378)
+ + Communication% *proportion*	-0.1104 (-1.2967)	-0.1005 (-0.4586)	-0.2109 (-1.0174)
+ + Operational% *proportion*	0.1994* (1.7000)	-0.4990 (-1.5045)	-0.2996 (-0.9641)
+ + Urban Context% *proportion*	0.2196 (1.3212)	-0.3140 (-0.8096)	-0.0945 (-0.2225)
+ + Aesthetic% *proportion*	0.1789* (1.7469)	-0.1642 (-0.6773)	0.0146 (-0.0032)
+ + Permanence%: Distance to UA *proportion*	0.0798 (0.9047)	-0.2337 (-0.7814)	-0.1539 (-0.4870)
+ + Communication%: Distance to UA *proportion*	0.0710 (1.5755)	0.0409 (0.3468)	0.1119 (0.9941)
+ + Operational%: Distance to UA *proportion*	-0.1155** (-1.9699)	0.2437 (1.3660)	0.1283 (0.7339)
+ + Urban Context%: Distance to UA proportion	-0.1629 (-1.5932)	0.3110 (1.5288)	0.1480 (0.8262)
+ + Aesthetic%: Distance to UA *proportion*	-0.1154* (-1.8722)	0.1568 (1.1019)	0.0414 (0.3294)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.

Community Garden Subset Results

Table 83. Urban Agriculture Type Subset Regression Results				
	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Intercept	11.2538*** (0.1252)	-	-	-
Building Area *square feet*	0.7937*** (0.0536)	0.7394*** (14.9563)	0.7469*** (2.8106)	1.4863*** (5.4555)
Building Area squared *square feet*	-0.0931*** (0.0167)	-0.0936*** (-6.1025)	-0.1291 (-1.5634)	-0.2227*** (-2.6312)
Full Bathrooms *count*	0.0250* (0.0116)	0.0267** (2.5357)	0.0996* (1.6641)	0.1262** (2.0187)
Half Bathrooms *count*	0.0617*** (0.0113)	0.0485*** (5.0162)	-0.1128* (-1.8413)	-0.0643 (-1.0451)
Lot Area *square feet*	0.0142*** (0.0037)	0.0155*** (4.4150)	0.0246* (1.7188)	0.0401*** (2.8073)
Building Age *years*	-0.0010*** (0.0002)	-0.0018*** (-7.6619)	0.0021** (2.5671)	0.0004 (0.4211)
Median Income *census tract*	-0.0093 (0.0066)	-0.0179 (-1.4461)	0.0139 (0.8113)	-0.0040 (-0.3443)
Median Income squared *census tract*	0.0007* (0.0003)	-0.0003 (-0.3424)	0.0010 (1.0044)	0.0007 (1.3376)
# of Vacant Lots *census tract*	-0.0008*** (0.0002)	-0.0004 (-1.0813)	-0.0003 (-0.5259)	-0.0006*** (-2.6965)
% White Population *census tract*	0.6023*** (0.0618)	0.4112*** (3.2665)	0.3159* (1.7835)	0.7271*** (7.1288)
Community 1 *dummy*	0.2692*** (0.0357)	0.2591** (2.0291)	-0.0894 (-0.5879)	0.1696*** (3.6687)
Community 2 *dummy*	-0.4090*** (0.0302)	-0.2436 (-0.9286)	-0.1370 (-0.3793)	-0.3805*** (-7.2010)
Community 3 *dummy*	-0.0967*** (0.0253)	-0.0644 (-0.3649)	-0.0537 (-0.3047)	-0.1182*** (-2.8168)
Community 4 *dummy*	-0.0678 (0.0529)	0.1965 (0.7036)	-0.2836 (-0.9647)	-0.0871 (-1.0207)
Community 5 *dummy*	-0.1482*** (0.0236)	-0.0844 (-0.2241)	-0.0439 (-0.0601)	-0.1283*** (-3.6859)
Community 6 *dummy*	0.1139 (0.0873)	0.2027 (0.7750)	-0.2139 (-0.4646)	-0.0112 (-0.1497)
Community 7 *dummy*	-0.0091 (0.0275)	0.0790 (0.7798)	-0.0818 (-0.6534)	-0.0027 (-0.0050)
Community 8 *dummy*	0.1312*** (0.0248)	-0.0586 (-0.7614)	0.1732* (1.7673)	0.1147*** (2.7503)
Community 9 dummy	-0.0591 (0.0471)	0.0712 (0.1220)	-0.2384 (-0.4855)	-0.1672** (-2.2937)
Quarter 1 *dummy*	-0.0793*** (0.0226)	-0.0771*** (-3.4437)	0.0693 (0.6801)	-0.0078 (-0.0456)
Quarter 2 *dummy*	0.0026 (0.0213)	-0.0008 (0.0553)	0.2204** (2.0754)	0.2196** (2.0074)
Quarter 3 *dummy*	-0.0139 (0.0211)	-0.0071 (-0.2371)	0.0474 (0.3978)	0.0402 (0.3374)
Distance to UA *1000's feet*	-0.0650 (0.0500)	0.2650*** (3.2746)	-0.6407*** (-4.0955)	-0.3757*** (-3.1101)

Table 82. *(continued)* Urban Agriculture Type Subset Regression Results				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Distance to UA squared *1000's feet*	-0.0002 (0.0043)	-0.0283*** (-4.0991)	0.0539*** (4.7557)	0.0256*** (3.0158)
UA Age *years*	0.0074** (0.0027)	0.0051 (1.2496)	0.0060 (0.7599)	0.0111* (1.7037)
New Site *0 - 3 years*	-0.0920** (0.0291)	-0.0207 (-0.3963)	-0.1680** (-2.1361)	-0.1887*** (-3.0326)
Well-established Sites *6+ years*	-0.1211** (0.0405)	-0.0522 (-0.7166)	-0.2184* (-1.7084)	-0.2705*** (-2.8485)
UA Lot Area *square feet*	-0.0006 (0.0033)	-0.0046 (-0.9416)	-0.0020 (-0.0941)	-0.0066 (-0.7483)
Small Site *< quarter acre*	-0.0822* (0.0341)	-0.1252** (-2.1148)	0.0476 (0.5561)	-0.0776 (-0.9637)
Large Site *> half acre*	-0.0023 (0.0028)	0.0020 (0.5096)	0.0000 (-0.0845)	0.0020 (0.2678)
UA Age: Distance to UA *years*	-0.0002 (0.0009)	-0.0004 (-0.3308)	-0.0015 (-0.5659)	-0.0020 (-0.9011)
New: Distance to UA *0 - 3 years*	0.0310** (0.0097)	-0.0098 (-0.7076)	0.0761*** (2.7232)	0.0662*** (2.7637)
Well-established: Distance to UA *6+ years*	0.0292* (0.0126)	-0.0184 (-0.8535)	0.1032** (2.4952)	0.0848*** (2.8519)
UA Lot Area: Distance to UA *square feet*	-0.0007 (0.0011)	0.0003 (0.2691)	0.0056 (1.3817)	0.0059** (2.0609)
Small: Distance to UA *< quarter acre*	0.0270* (0.0115)	0.0063 (0.5036)	0.0585 (1.4951)	0.0647** (2.3292)
Large: Distance to UA *> half acre*	0.0007 (0.0009)	0.0000 (-0.0918)	-0.0045 (-1.3590)	-0.0045** (-1.9826)
# UA per Mile (street network) *count*	-0.0110*** (0.0025)	-0.0175*** (-3.4429)	0.0077 (0.9996)	-0.0098* (-1.9126)
# UA per neighborhood *count*	0.0019 (0.0049)	0.0935** (2.1972)	-0.1542** (-2.4402)	-0.0607 (-1.3213)
SYS Index% *proportion*	0.0403 (0.0758)	-0.0603 (-0.5168)	-0.0476 (-0.1732)	-0.1079 (-0.6723)
SPA Index% *proportion*	-0.1493 (0.1252)	0.2196 (1.3339)	-0.3599 (-1.0444)	-0.1402 (-0.4920)
SYS Index%: Distance to UA *proportion*	-0.0180 (0.0363)	0.0183 (0.3639)	0.0682 (0.6367)	0.0865 (1.3006)
SYS Index%: Distance to UA squared *proportion*	0.0028 (0.0037)	-0.0007 (-0.2059)	-0.0063 (-0.5898)	-0.0070 (-0.9795)
SPA Index%: Distance to UA *proportion*	0.0724 (0.0655)	-0.3410*** (-3.5218)	0.6577*** (3.5236)	0.3167** (2.1384)
SYS Index%: Distance to UA squared *proportion*	-0.0015 (0.0064)	0.0368*** (3.7007)	-0.0704*** (-4.2264)	-0.0336*** (-2.7049)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
$^{+}$ *Regression run on the reserve dummy variable.* $^{++}$ *Regression run on the collapsed categories, or alternate categories.*

Table 84. Urban Agriculture Type Subset: Results on Reserve or Collapsed Variables			
	Spatial Durbin Model		
Variable	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
++Below Half Acre *vs above half acre*	0.0180 (0.2455)	-0.1663 (-0.9850)	-0.1483 (-1.1879)
++Below Half Acre: Distance to UA *vs above half acre*	-0.0281 (-0.9725)	0.1572** (2.4711)	0.1291*** (2.7042)
+ Established Sites: Distance to UA *3 - 6 years*	0.0127*** (0.7471)	-0.0913*** (-2.3975)	-0.0786*** (-2.5532)
++Below 6 Years *versus all other*	0.0590 (0.8560)	0.1685** (1.4363)	0.2275*** (2.3059)
++Below 6 Years: Distance to UA *versus all other*	0.0097*** (0.6915)	-0.0892*** (-2.3712)	-0.0795*** (-2.6208)
+ High number per neighborhood *4 + sites versus other*	0.0935** (2.1972)	-0.1542** (-2.4402)	-0.0607 (-1.3213)
++ SYS High Quality *versus all other*	-0.0107 (-0.4036)	-0.0728 (-0.7762)	-0.0835 (-1.2740)
++ SPA High Quality *versus all other*	-0.0538* (-1.7987)	0.0654 (1.0093)	0.0116 (0.2703)
++ SYS High Quality: Distance to UA *versus all other*	-0.0042 (-0.2281)	0.0465* (1.7031)	0.0422* (1.9506)
++ SPA High Quality: Distance to UA *versus all other*	0.0032 (0.3236)	0.0120 (0.4151)	0.0151 (0.6501)
++ Permanence% *proportion*	0.1124 (0.9300)	-0.2124 (-1.0342)	-0.1000 (-0.6520)
++ Communication% *proportion*	-0.0685 (-0.9790)	0.1217 (0.9339)	0.0532 (0.5268)
++ Operational% *proportion*	0.0059 (0.0047)	-0.1386 (-0.6455)	-0.1327 (-0.7380)
++ Urban Context% *proportion*	-0.0866 (-0.6797)	0.1133 (0.3654)	0.0267 (0.0774)
++ Aesthetic% *proportion*	-0.0803 (-0.9219)	0.1297 (0.7574)	0.0494 (0.3929)
++ Permanence%: Distance to UA *proportion*	-0.0367 (-0.8781)	0.0474 (0.6258)	0.0107 (0.1808)
++ Communication%: Distance to UA *proportion*	0.0109 (0.3883)	-0.0334 (-0.6149)	-0.0225 (-0.5273)
++ Operational%: Distance to UA *proportion*	0.0061 (0.2505)	0.0778 (0.8402)	0.0839 (1.0534)
++ Urban Context%: Distance to UA proportion	0.0099 (0.1870)	0.0272 (0.2765)	0.0371 (0.4560)
++ Aesthetic%: Distance to UA *proportion*	-0.0052 (-0.2134)	0.0263 (0.2556)	0.0210 (0.2140)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. ++ Regression run on the collapsed categories, or alternate categories.

Urban Agriculture Typologies Comparison Results (Urban Farm)

Table 85. Urban Agriculture Type Comparison Regression Results				
	OLS Model	Spatial Durbin Model		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
Intercept	11.0873*** (0.0747)	-	-	-
Building Area *square feet*	0.7753*** (0.0462)	0.7194*** (17.3711)	0.6198*** (3.0283)	1.3392*** (6.3483)
Building Area squared *square feet*	-0.0825*** (0.0137)	-0.0828*** (-6.7174)	-0.0845 (-1.4820)	-0.1672*** (-2.8392)
Full Bathrooms *count*	0.0243* (0.0115)	0.0223* (1.9595)	0.1295* (1.8814)	0.1517** (2.1581)
Half Bathrooms *count*	0.0675*** (0.0112)	0.0564*** (5.5890)	-0.1074 (-1.4716)	-0.0510 (-.6907)
Median Income *census tract*	-0.0064 (0.0091)	-0.0411** (-2.3985)	0.0544** (2.1420)	0.0133 (.8408)
Median Income squared *census tract*	0.0006 (0.0004)	0.0006 (.7824)	-0.0007 (-.6162)	-0.0001 (-.1666)
# of Vacant Lots census tract	-0.0008*** (0.0001)	-0.0002 (-.5808)	-0.0005 (-.9521)	-0.0006** (-2.2958)
% White Population *census tract*	0.6247*** (0.0621)	0.4191*** (3.2268)	0.3381* (1.8787)	0.7571*** (5.9290)
Building Age *years*	-0.0010*** (0.0002)	-0.0018*** (-7.9604)	0.0013 (1.5027)	-0.0005 (-.5581)
Community 1 *dummy*	0.3091*** (0.0327)	0.2562** (2.4800)	-0.0461 (-.3755)	0.2101*** (3.2276)
Community 2 *dummy*	-0.3583*** (0.0296)	0.0246 (.0555)	-0.3571* (-1.6749)	-0.3326*** (-4.7852)
Community 3 *dummy*	-0.0663** (0.0251)	-0.0607 (-.3741)	0.0052 (.1144)	-0.0554 (-1.0463)
Community 4 *dummy*	-0.0220 (0.0508)	0.3747** (1.9664)	-0.4516* (-1.8538)	-0.0769 (-.6267)
Community 5 *dummy*	-0.1123*** (0.0233)	0.2182 (.4505)	-0.3287 (-.6893)	-0.1104** (-2.4757)
Community 6 *dummy*	0.0869 (0.0804)	0.4892* (1.8402)	-0.7322 (-1.6166)	-0.2430 (-.9965)
Community 7 *dummy*	0.0305 (0.0268)	0.0893 (1.1771)	-0.0511 (-.5273)	0.0382 (.7486)
Community 8 *dummy*	0.2062*** (0.0215)	-0.0921 (-1.0736)	0.2587*** (2.6713)	0.1666*** (4.4766)
Community 9 *dummy*	-0.0128 (0.0463)	0.3173 (.7272)	-0.3852 (-.8251)	-0.0678 (-.6652)
Quarter 1 *dummy*	-0.0757*** (0.0225)	-0.0820*** (-3.8003)	-0.0568 (-.3558)	-0.1387 (-.9066)
Quarter 2 *dummy*	0.0053 (0.0212)	-0.0058 (-.2753)	0.0721 (.7048)	0.0662 (.6379)
Quarter 3 *dummy*	-0.0121 (0.0210)	-0.0116 (-.5899)	-0.0862 (-.6375)	-0.0979 (-.7022)
High Income *versus Low Income*	-0.0157 (0.0210)	0.0815* (1.7884)	-0.1381** (-2.0456)	-0.0565 (-1.4583)

Table 84. *(continued)* Urban Agriculture Type Comparison Regression Results				
	OLS Model	**Spatial Durbin Model**		
Variable	**OLS Coefficients**	**Direct Effect Coefficients**	**Indirect Effect Coefficients**	**Total Effect Coefficients**
# UA per Mile (street network) *count*	-0.0120*** (0.0024)	-0.0188*** (-3.6741)	0.0099 (1.3125)	-0.0089* (-1.7894)
# UA per neighborhood *count*	0.0013 (0.0046)	0.0161** (2.0541)	-0.0261** (-1.9967)	-0.0100 (-.9173)
Well-established Sites	-0.0176 (0.0247)	-0.0701* (-1.7454)	0.0865 (1.2021)	0.0164 (.3565)
UA Age *years*: Community Garden *versus Urban Farm*	0.0058*** (0.0016)	0.0038 (1.4601)	-0.0017 (-.3708)	0.0021 (.4756)
Community Garden *versus Urban Farm*: Distance to UA	0.0056 (0.0075)	0.0470*** (3.0787)	-0.0650*** (-2.8815)	-0.0179 (-1.2293)
Community Garden *versus Urban Farm*: Distance to UA squared	0.0006 (0.0006)	-0.0046** (-2.5058)	0.0066*** (2.7867)	0.0020 (1.6439)
Community Garden *versus Urban Farm*: UA Lot Area *square feet*	-0.0041* (0.0020)	-0.0028 (-.9568)	0.0077 (1.4691)	0.0049 (1.2590)
Community Garden *versus Urban Farm*: SYS Index%	-0.0118 (0.0373)	0.0504 (.8164)	-0.0732 (-.6670)	-0.0228 (-.2995)
Community Garden *versus Urban Farm*: SPA Index%	0.0727 (0.0464)	-0.1093 (-1.3038)	0.4101*** (2.9105)	0.3007*** (2.8007)
Community Garden *versus Urban Farm*: New Site	-0.0121 (0.0168)	-0.0285 (-1.1420)	-0.0076 (-.1694)	-0.0361 (-.9656)
Community Garden *versus Urban Farm*: Small Site	-0.0112 (0.0162)	-0.0310 (-.9515)	0.0782 (1.5472)	0.0472 (1.3264)
Community Garden *versus Urban Farm*: UA Lot Area: Large	0.0013 (0.0016)	0.0010 (.3751)	-0.0067 (-1.6040)	-0.0057* (-1.9008)

*Model Coefficients with *P < .10; **P < .05; ***P < .01; ****P < .001*
OLS: Standard Errors reported in parenthesis. SDM: Simulated Z-Values reported in parenthesis.
+ Regression run on the reserve dummy variable. + + Regression run on the collapsed categories, or alternate categories.