Local Food Initiatives

GEOG402
16 October 2013

Lyndsey Kelly
Andreas Wilson
Sarah Worthington

Abstract

Local food security is a growing issue in modern urban environments. Garden City 2.0 is a social enterprise focused on creating a greater level of food security and resilience within Christchurch. Their key objective is to take greater ownership of the local food sector in the city, with particular regards to releasing this potential in a post-earthquake Christchurch. This vision can be released within either the public or private sectors of recovery through the realisation of community gardens or urban farming. The aim of this project is to determine the benefits of urban farming and how they can be realised in a resilient post-earthquake Christchurch. This was determined through the investigation of two case studies: a community garden within the "Breathe" Residential Demonstration and urban farming for the purpose of service-based food production. An economic analysis was undertaken to determine and discuss the viability of two such food resilience applications in Christchurch.

I. Introduction

Local food security is a growing issue in modern urban environments. Rapid levels of urbanisation have been occurring on a global scale over the last half century, with 50% of the world's current population residing in urban areas; this figure is expected to increase to 60% by 2030 (WHO, 2013). Population rise escalates the issue of food security, as demand for food increases in urban areas. Current food systems are heaviliy reliant on fossil fuels and extremely vulnerable to impending peak oil and climate change. There is therefore an urgent need to rethink urban food systems in order to make them more resilient and sustainable in the future.

Community gardens and urban farming are direct responses to the increasing issues of food security in urban areas. These processes set out to centralize and diversify food production on a more localised scale. Thus, the direct benefits of accessible, locally grown fresh produce provide a greater level of security and resilience within local food systems. Christchurch is an example of an urban area that is starting to realise the benefits of community gardens and urban farming processes. The 2011 Earthquakes created social and economic dysfunction and disconnection within the city. The recovery processes within Christchurch has sought to create a more sustainable and resilient urban environment, both in the context of disaster recovery, and in the promotion of Christchurch as a 'green city.'

This report sets out to explore how the benefits of community gardens and urban farming can be realised in a resilient post-earthquake Christchurch. After undertaking a detailed literature review on the benefits of community gardening it was found that there is a significant gap in existing literature that investigates economic benefits. This report seeks to fill this gap through by investigating the economic viability of two case studies within the Christchurch city center: a community garden within the "Breathe" Residential Demonstration and urban farming for the purpose of service-based food production.

II. Literature Review

There is substantial literature investigating the benefits of community gardens. This literature review serves to outline the key social and environmental benefits of community gardens in an urban environment, and how this contributes to urban food resilience. This provides a foundation and rationale for the investigation of similar community-driven food production schemes in a Christchurch context, and their associated economic benefits.

Social Benefits

The social benefits gained from community gardening are the most widely discussed in literature. These benefits can be recognised at both an individual and community level. For an individual, the key benefits are linked to the positive influence of gardening on physical and social health. Community gardening has been shown to influence physical health by

providing a form of physical exercise, encouraging individuals to live a more active lifestyle, and encouraging healthy eating (Guitart et al., 2012). Gardening is one of the most commonly practiced forms of physical activity and a large number of studies have demonstrated its direct association with improved health and decreased levels of obesity (Armstrong 2000; Castro et al., 2013; Guitart et al., 2012; Pate et al., 1995; Teig et al., 2009). These links have also been demonstrated in a more general sense in literature showing the significant health benefits of nature in urban environments by drawing people outdoors, thereby encouraging physical activity.

Community gardening offers further benefits by providing access to fresh organic produce (Armstrong, 2000; Castro et al., 2013; Guitart et al., 2012; Teig et al., 2009). This provides educational opportunities to learn about food production and healthy eating. For example, Blair et al. (1991) determined that community gardeners consume a greater amount of fresh vegetables compared to non-gardeners, thus significantly improving overall nutrition.

In addition to these physical benefits there are also a number of social benefits that can be gained as a result of the increased social interactions that occur in a community garden setting. Community gardens provide a physical location for individuals to meet and develop valuable networks with others in their community. Healthy social networks, often referred to as social capital, have been shown to have a number of health benefits (Armstrong, 2000). These benefits are a result of the individual support that an individual can draw upon, the sharing of advice and resources, and increased trust and social connection in a community (Armstrong, 2000). These connections can improve health through the diffusion of beneficial information and a feeling of belonging that significantly improves an individual's well-being.

The benefits that result from social interactions in a community garden environment are also valuable for the community as a whole. There has been a substantial amount of literature which investigates the role of community gardens in community development (Armstrong, 2000; Saldivar-Tanaka & Krasny, 2004; Holland, 2004; Stocker& Barnett, 1998; Guitart et al., 2012; Teig et al., 2000). Similar to the pathways of individual benefits, these benefits result from increased social capital. The fundamental nature of a community garden, that is, the communal use of a plot of land for growing food, requires a reasonable degree of social interaction and the formation of positive social networks in order for the garden to function effectively. For this reason, a community garden often becomes a central place of focus where valuable relationships are developed within a community that encourage communal action for the greater good of the community as a whole. This is particularly valuable for deprived neighbourhoods as it provides an opportunity to collectively address issues within a community. The primary distinctive feature of community gardens that sets it apart from other community engagement initiatives is that fact that the garden is never complete and involvement is often an ongoing commitment (Stocker & Barnett, 1998). The development of social connections are therefore ongoing and will continue to improve. Case studies on community gardens around the world have illustrated that the ongoing social development that occurs often results in the garden becoming a common meeting place. The space therefore becomes an area where unrelated social gatherings occur, thereby providing further opportunities for community engagement that extend beyond those who wish to grow vegetables in the garden.

Environmental Benefits

There are a number of ecological benefits that can result from community gardens. At the most basic level, community gardens can be beneficial to the environment as they often occupy degraded, under-utilised land chosen by communities wishing to improve the environment in which they live. By using the land for growing food, the land is restored to a more natural state which over time can reduce soil erosion and improve soil quality and biodiversity in that area (Lohr & Park, 2003).

Community gardening also provides a source of locally grown food, providing an alternative to imported produce, and reducing the environmental effects resulting from the "food miles," and thus its carbon footprint (Gardening Matters, 2012). Recent literature has also begun to investigate the ways in which community gardening impacts attitudes and behaviours in relation to broader environmental issues (Holland, 2004; Turner, 2011). Participating in a community garden facilitates personal connections and interaction with the environment, often resulting in increased environmental concern. This can result in individuals and communities being more inclined to take up behaviours such as recycling, reduction in energy use, and a decrease in auto-dependency. Participating in a community garden thus serves as a first step in changing how people think about, and interact with, the environment. These changes in mind set are fundamental to building healthy ecosystems within urban environments and increasing sustainability.

Community gardens also provide a direct benefit to the urban environment. Gardens create more pervious surfaces allowing for groundwater recharge (Gardening Matters, 2012). Gardens also filter rainwater, thus helping to improve the water quality of lakes and rivers while improving drought resistance (Lohr & Park, 2003). Increased vegetation in an urban environment has been shown to reduce air pollution by restoring oxygen to the air through gas exchange systems of leaves and soils (Gardening Matters, 2012). Furthermore, urban vegetation can reduce the "heat island" effect, thus lessening the need for air conditioning (Gardening Matters, 2012). Further benefits include improved soil quality and greater diversity of soil organisms, insects, wildlife and plants, better drought resistance (Stolze et al., 2000).

Resilience

Food security is a key component of resilience for people living in urban environments. Cities are often thought of as separate entities essentially detached from their broader life-support systems instead of as a fully integrated urban activity (Barthel & Isendahl, 2012). This idea is historically strongly linked to transport technology innovations which enabled the transport of food over long distances. Industrial innovation and cheap and efficient travel lead to the first wave of space-time compression, thereby separating local agricultures as obsolete in the understanding of the city as an autonomous social system (Barthel & Isendahl, 2012). In today's society, space-time compression is driven by the internet, jet travel, and globalised economies. Geographic barriers and distances are of decreasing concern. Global food systems, particularly in large cities, are completely enabled by fossil fuels for fertilisation, transport, packaging, and distribution. However, the

vulnerability of this system to peak oil and climate change poses major threats to urban food supply. Of primary concern is the rapid vanishment of spaces for urban food production. Barthel & Isendahl (2012) conclude that designing urban resilience requires the re-ignition of urban minds about the close connection between urban people and their life supporting systems.

Broadly speaking, food security is where people have physical and economic access to sufficient, safe, and nutritious foods to meet their dietary needs (Barthel & Isendahl, 2012). Food systems are therefore the chain of activities which connect food production, processing, distribution, consumption, and waste management (Barthel & Isendahl, 2012). Resilience considers the adaptive capacity of societies to externally imposed change, such as climate change, while continuing to function and prosper (Buchmann, 2009). Social and cultural diversity, in the form of diversity of knowledge, as well as ecological diversity in the diversification of accessible resources reduce vulnerability of the food system while providing components that facilitate adaptive renewal following a disturbance (Buchmann, 2009).

Virtually all of the world's population growth is predicted to occur in cities and their urban landscapes, with the UN estimating a global increase from 2.9 billion urban residents to nearly 5 billion by 2030 (ACCCRN, 2013). Increased predicted climatic variability such as flood and drought events pose further risk to food security and social-ecological resilience. The effects of urbanisation and climate change are converging and threatening quality of life and economic and social development.

There are several areas in which agriculture will be strongly affected by climate change. Firstly, changing climate conditions will both negatively and positively shift the parameters of agricultural production in different parts of the world (Almas & Campbell, 2012). Crop yields from some varieties will decline due directly to rising temperatures (Almas & Campbell, 2012). Water availability for irrigation will decline in some areas, and the frequency of extreme weather events such as storms, droughts, and floods will negatively impact agricultural products throughout the world (Almas & Campbell, 2012). To survive the combination of climate change and population increases, the world must therefore learn to sustainably produce enough food for 9 billion people.

It is also important to consider additional potential disruptions to food security which could influence the future resilience of global agriculture. Biosecurity and pandemics represent a major cause for concern in the agricultural sector. Past examples include the 2001 foot-and-mouth disease outbreak in the UK, the 2009 Swine Flu epidemic, and the Varroa mite which caused the collapse of honeybee colonies around the world (Almas & Campbell, 2012). Energy and peak oil also pose significant concern. The sudden spike in world oil prices was a large contributor to the global food crisis of 2008 (Almas & Campbell, 2012). Additionally, the intensification and industrialisation of farming systems has resulted in a higher reliance on fossil-fuel derived inputs into farming. The cost of using heavy machinery, heating of greenhouses and stock houses, fertiliser manufacture and petrochemically derived pesticides are all linked to the price of oil (Almas & Campbell, 2012). Any disturbance to fossil fuel production or distribution therefore heavily impacts these processes, therefore putting the entire agricultural system at risk. Finally, the global financial crisis has been

directly linked to unsafe lending practices and the enabling of greater extension of credit to vulnerable customers such as farmers (Almas & Campbell, 2012). Ongoing subsidies for US farming are under threat for the first time, while in Denmark and other European countries, farm bankruptcies may threaten banks with heavy lending in agriculture (Almas & Campbell, 2012

The inevitable future shocks to the existing food systems will challenge our detached view of cities and life-supporting systems, and the monotonous systems with which we operate. New modes of diverse food production and distribution networks non-reliant on fossil fuels will therefore contribute to a more resilient food system in the face of climate change and peak oil.

III. Garden City 2.0

Garden City 2.0 is newly founded social enterprise in Christchurch. Part of this social enterprise is the delivery of food bags containing organic, locally grown fruits and vegetables to residents of Christchurch. This group has been an important catalyst in the promotion of healthy eating via community garden and urban farming initiatives. Founder and co-director Bailey Perryman stated that the key objective of Garden City 2.0 was to take greater ownership of the local food sector in Christchurch, with particular regards to releasing this potential in a post-earthquake Christchurch (Garden City 2.0, 2013).

The name Garden City 2.0 embodies the holistic aim of re-imagining and re-developing the way we understand and define Christchurch as a garden city. It seeks to realise the potential of garden space not just for aesthetic purposes, but in terms of resilient food production. As such, Garden City 2.0 is *a newimproved version of the garden city* (Garden City 2.0, 2013). Garden City 2.0 has recognized the potential of urban farming in Christchurch to promote and educate the public on sustainable and resilient food systems. Their key initiatives have been focused on the inclusion of urban food production within the rebuild of the central city.

IV. Governance

The concept of governance is important to consider within the context of both community gardens and urban farming in Christchurch. Though its concept is abstract in nature, governance plays an important role in determining how we organise and structure our society. Governance refers to the multi structured concept that determines how different parties govern within society (Robert et al., 2007). Governance is traditionally exercised by local and national government, with particular regard to how their decisions govern our actions (i.e. policy makers and city councils). Governance, also extends to the level of the individual; this is referred to as self-governance, which considers the extent to which an individual can govern their actions (Sørensen & Triantafillou, 2009). The complexity of this

concept is evident when considering the different entities which contribute to governance within urban landscapes. Entities such as city councils have a strong influence on the urban landscape; this is indicative of the current context of Christchurch, in which the city recovery has been strongly governed by entities with centralized governance structures such as the Christchurch City Council (CCC), Christchurch Central Development Unit (CCDU) and the Canterbury Earthquake Recovery Authority (CERA).

The two concepts of community gardening and urban farming inherently represent two different forms of governance structure. To understand this difference, it is necessary to establish some key distinctions in concepts and practices. The governance of urban farming and community gardens is structured in different ways, with particular reference to who contributes to the garden, and who receives the benefits.

Community gardens are representative of a public sector approach. Resilience within a community garden is determined by community input, which requires community cooperation and social organization. Inputs from individuals create food networks that are centrally governed by both individuals and the community. As such, food security and resilience is recognized by community ownership, organisation, and participation driven by social initiatives.

Urban farming is more representative of the private sector approach to creating resilient food systems. It provides the opportunity for businesses and social enterprises such as Garden City 2.0 to grow and sell fresh vegetables within an urban setting. The key benefits of urban farming (particularly in regard to developing resilient food systems) is the increased availability and accessibility of fresh food within the urban environment, particularly with regards to food miles. The privatization of urban farms creates a more decentralized form of governance and management compared with community gardens. Both of these different forms of governance structures are represented within the two case studies considered in this report.

V. Research Aims

The aim of this project is to determine the benefits of urban farming and how they can be realised in a resilient, post-earthquake Christchurch. This was determined through the investigation of two case studies: a community garden within the “Breathe” Residential Demonstration and urban farming for the purpose of service-based food production. An economic analysis was undertaken to determine and discuss the viability of two such food resilience applications in Christchurch.

VI. Case Study #1: Community Gardening - "Breathe" Residential Development

Background & Objectives

The CCC is currently planning the "Breathe" Residential Demonstration adjacent to Latimer Square (Figure 1) which consists of medium-density living based on sustainability, innovation and a strong sense of community (CCDU, 2013). The "Breathe" development will house between 75 and 140 dwellings within the urban village. According to the Christchurch City Development Unit (CCDU) city plan, the land directly opposite the "Breathe" urban village is vacant, with no future development plans. This investigation therefore sought to determine the production capacity and economic viability of this 0.4 acre section (see Figure 1).

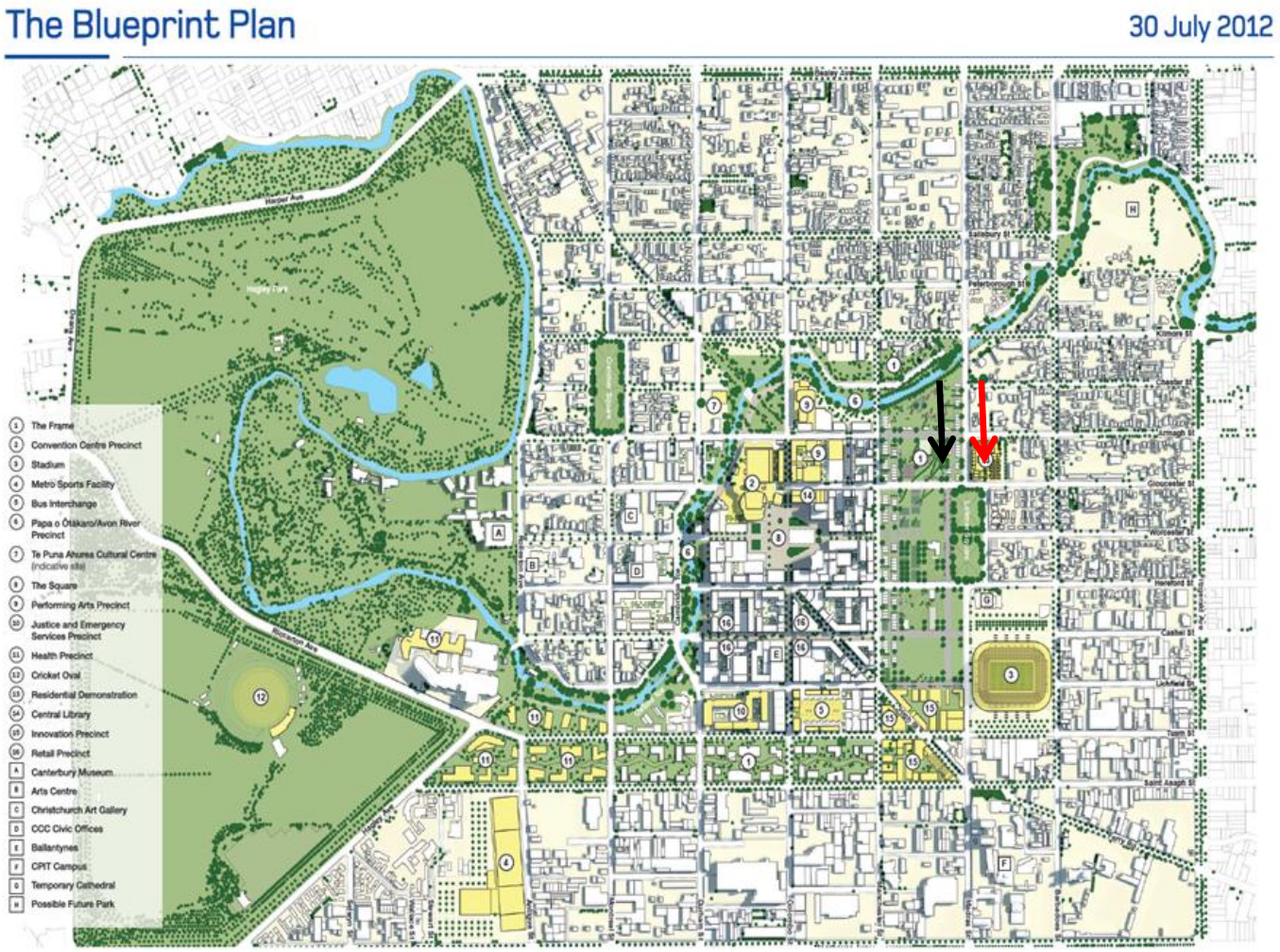

Figure 1. The Blueprint Plan showing the location of "Breathe" (red arrow) and location of potential community garden site (black arrow).

Food Production Viability

Garden City 2.0 currently grows and distributes roughly eight different vegetables that contribute to the daily recommended intake of three servings of vegetables: spinach, carrots, potatoes, cabbage, beetroot, chard, pumpkin, and brussel sprouts. Based on organic farming vegetable yields (Relf, 2009; Garden of Eden Project, 2013), a pound per acre yield was established for each of these vegetables (Table 1).

Vegetable	Yield: Lbs/Acre/Year
Spinach	11,000
Carrot	19,400
Potato	15,200
Cabbage	13,700
Beetroot	10,800
Chard	17,400
Pumpkin	32,600
Brussel Sprouts	9,000

Table 1. Yearly vegetable yields in pounds per acre per year

Small Plot Intensive (SPIN) farming was used as a tool to validate the viability of a 0.4 acre urban farm opposite "Breathe." SPIN farming is based on transforming backyard, front lawn, or neighbourhood lots to productivity and profitability that surpass traditional home gardening practices (SPIN Farming LLT, 2013). SPIN farming is production based, sub-acre in scale, low capital intensive, entrepreneurially driven, and environmentally friendly (SPIN Farming LLT, 2013).

Based on SPIN farming, a 0.5 acre land parcel can accommodate 240 25ftx2ft (50 square feet) crop beds. 0.4 acres can therefore accommodate 192 beds. As one acre is the equivalent of 43,560 square feet, the yield per square foot of land, thus yield per bed, was calculated (Table 2).

Vegetable	Yield: Lbs/square foot	Yield/Bed/Year (Lbs)
Spinach	0.253	12.626
Carrot	0.445	22.268
Potato	0.349	17.447
Cabbage	0.315	15.725
Beetroot	0.248	12.397
Chard	0.399	19.972
Pumpkin	0.748	37.420
Brussel Sprouts	0.207	10.331

Table 2. Organic crop yields per year of each vegetable

According to the New Zealand Nutrition Foundation (2013), 1 cup of vegetables constitutes one full serving (½ cup for greens such as spinach). Table 3 below depicts the number of

cups per pound of each vegetable. From the values in Tables 2 and 3, the number of cups per bed per year for each vegetable was calculated by multiplying yield per bed by cups per pound. Apart from spinach, these values represent servings per bed per year, as 1 cup of vegetables constitutes one full serving. Spinach was multiplied by two, as one serving of vegetables is ½ cup. From this table we can determine that the average servings per bed per year isroughly 62.

Vegetable	Cups/Lb	Cups/Bed/Year	Servings/Bed/Year
Spinach	0.500	6.313	12.626
Carrot	3.500	77.938	77.938
Potato	2.000	34.894	34.894
Cabbage	4.500	70.764	70.764
Beetroot	2.500	30.992	30.992
Chard	2.000	39.945	79.890
Pumpkin	4.000	149.679	149.679
Brussel Sprouts	4.000	41.322	41.322
AVERAGE			**62.263**

Table 3. Servings per bed per year of each vegetable

The eight vegetables used in this study take an average of 2.5 months to grow from seed to harvest. As such, each bed has the ability to produce multiple harvests throughout the year. Given this information, we have conservatively assumed that in a given year, three growing cycles can be completed within a community urban farm environment. The type of vegetable grown will depend on season, however given we have determined that the average servings per bed per year (per one cycle of growth) is 62, the type of vegetables will not significantly impact our results. As such, we determined the number of servings per bed per year given three cycles of "harvesting" for each vegetable. These values were then divided by 365 (Table 4) to give the average number of servings per bed per day for each vegetable, and as a whole (0.51).

Vegetable	Servings/Bed/Yr (x3)	Servings/Bed/Day
Spinach	37.88	0.10
Carrot	233.82	0.64
Potato	104.68	0.29
Cabbage	212.29	0.58
Beetroot	92.98	0.25
Chard	239.67	0.66
Pumpkin	449.04	1.23
Brussel Sprouts	123.97	0.34
TOTAL	1494.32	4.09
AVERAGE	186.79	0.51
In 192 Beds		**98.26**
People per day		**33**

Table 4. Servings per bed per day averages

As previously mentioned, a 0.4 acre parcel of land can accommodate 192 beds. Given that the average servings per bed per day is 0.5 from a single bed, a 0.4 acre parcel of land can

produce, on average, 99.2 servings of vegetables a day. Given that each individual requires three servings of vegetables a day, a 0.4 acre parcel of land can therefore feed, on average, 33 people per day across a given year. According to Statistics New Zealand (2006), the average household (dwelling) in 2006 was 2.6 people, and was projected to decrease to 2.4 by 2031. We have therefore assumed an average of 2.5 people per household for this development (e.g. 187-350 people total). An urban farm of this size can thus feed approximately 20% of the population that can be theoretically housed within the Breathe site. It is important to consider that these figures were gained by assuming a minimum yield output, as well as limited knowledge of vegetation production by those who would facilitate the garden. Therefore with an increased knowledge of food production, this community garden could potentially yield greater amounts of vegetations, which in term could feed a greater number of Breathe residents.

Economic Viability

SPIN farming recommends 40-45 hours of work for garden maintenance during the summer, or peak months, and 30 hours during non-peak months; giving an average of 40 hours per week over the year. Assuming a population of 33 can be sustainably fed from the urban farm throughout the year, each individual would need to contribute approximately 1 hour and 12 minutes per week; this translates to roughly 10 minutes per day. As such, an urban farm such as this is economically viable in terms of time requirements.

Socioeconomic benefits of this community garden include: improved diet, money savings, and feeling of self-sufficiency (Patel, 1991; Lackey, 1998).In addition to the economic incentive of money saved on household vegetable spending, community gardens and urban farms have significant positive effects on surrounding property values. In New York City, neighbourhood property values in the poorest neighbourhoods raised by as much as 9.5% within five years of a community garden's opening (Been & Voicu, 2006). Furthermore, studies show that the establishment of community gardens may shrink the difference in prices between homes in affluent and non-affluent neighbourhoods by as much as 27% within the same five year period (Rede et al., 2012). In Milwaukee, Wisconsin, community gardens have lead to increased property values in the immediate vicinity with the average garden estimated to add approximately $9,000 a year to the city tax revenue (Gardening Matters, 2012). This positive effect can encourage local government investment in community gardens and other forms of green space due to the payoff for the surrounding community, and ultimately, the city. Increased tax revenues from such gardens offer further incentive for developers and governments alike to finance such endeavours.

Further municipal benefits of community gardens, and of specific relevance to Christchurch, is that community gardens provide a retreat from the noise of urban environments, and have been shown to attract small businesses looking to relocate (Sherer, 2006). The development and maintenance of gardens space has also been shown to be less expensive than parkland areas, as gardens require little land and 80% of their cost is in labour (Gardening Matters, 2012). Costs can be further reduced due to volunteer labour.

Discussion

A number of assumptions have been made in this analysis. Firstly, we assumed that vegetable yields will be similar to average organic farming yields found from a range of online resources. As there is not much literature available on Christchurch organic farming yields, values and thus production capacity may differ. Further investigations may be required in this regard.

Secondly, we assumed that growing conditions will remain constant throughout the year, and each bed will produce the same weight (and thus servings) of vegetables as beds with the same crop. We have also assumed that production of crops will remain constant throughout the year, and thus its capacity to sustainably feed the residential development. As such, we have assumed that the urban farm will be managed in a way that ensures crops are planted and rotated in stages that ensure sustainable garden practices. This can be accomplished through counsel from an experienced gardener to ensure the garden is set up and managed appropriately to meet its full production potential. These assumptions can be validated based on Garden City 2.0's current urban farming production and experience.

We have also assumed that each individual fed by the urban farm will participate in gardening. As the demographic of the "Breathe" development is unclear, it is possible that many young children and elderly will not be able to contribute due to physical constraints. It is also possible that many individuals will choose to not contribute at all, thus increasing the total time required by participating individuals.

According to the findings from Active New Zealand 2007/2008 survey, roughly 28% of all New Zealand adults participate in gardening, with the average adult gardening two days out of seven for an average of 237 minutes (just under 2 hours) per week (Active NZ, 2008). Assuming 28% of the "Breathe" Development participates in the urban farm (e.g. 28% of 33, or 9 people); each of those 9 people would need to contribute roughly 264 minutes per week. This is only just above the current time spent gardening by New Zealand adults. Therefore, despite the assumptions made, an urban farm scheme of this nature remains seemingly viable.

Furthermore, 192 beds in a 0.4 acre lot comprise roughly 55% of the total land area. This is to provide for walking and working areas, compost bins, storage areas, etc. Given the empty space, there is potential to grow herbs and fruit trees, thus maximising the potential of the urban farm while remaining interactive and easily maneuverable.

VII. Case Study #2: Urban Farming - Service-Based Food Production

Background & Objectives

Urban farming can also be used to provide service-based businesses such as cafes and restaurants with locally grown organic produce. This concept is already being explored to some extent at C1 Espresso on High Street. This investigation sought to determine factors affecting the economic viability of urban farms to provide locally-grown, organic produce for service-based food industry.

Economic Viability

Local food systems offer a range of benefits for food outlets such as cafes and restaurants. Organic food is growing in popularity, with an Ohio State University survey finding 41% of parents are buying more organic foods despite the sluggish economic recovery (Schubert, 2010). This has flow-on effects to local cafes and restaurants. While buying organically can cost a restaurant more than purchasing from conventional produce suppliers, consumers are willing to pay extra at restaurants that serve organic and locally grown food. For example, 65% of consumers said they would be willing to pay 10% more to dine at a green restaurant (Schubert, 2010).

Urban farming is also an entrepreneurial endeavor that encourages job growth while rebuilding the local economy (Vines, 2010). Table 5 below show the results from an investigation by Lohr & Park (2003), reviewing the economic, social, and environmental benefits associated with organic agriculture in the United States. The measurable impacts are quantified by comparing selected indicators of benefits in counties with organic farms to counties without. This study offers preliminary evidence that organic farms may generate a range of direct and indirect benefits, with 26 out of 36 indicators favouring organic systems. This study further shows that counties with organic farms have stronger local economies and contribute more to total sales, net revenue, farm value, taxes, payroll, and purchases of fertilizer, seed, repair, and maintenance services. Organic farmers are also more likely to support rural development through consumer sales, employee hire, and higher workers pay. Organic farmers therefore directly contribute to the local economy, and can be sustained through local cafes and restaurants.

Indicator	Units	Mean With Organic	Mean Without Organic	Best Performance With Organic	Best Performance Neither	Best Performance With Conventional
Farm Economy (+)						
Total farm sales	dollars per farm	111,696	99,075	X		
Total farm expenses (-)	dollars per farm	85,358	76,748			X
Net return to agricultural sales	dollars per farm	25,813	22,226	X		
Market value of land and buildings	dollars per farm valued	511,250	474,740	X		
Local Economy (+)						
Property taxes paid	dollars per farm paying	95,000	84,479	X		
Hired worker payroll	dollars per farm hiring	24,145	16,685	X		
Fertilizer purchased	dollars per farm buying	8,681	7,770	X		
Agricultural chemicals purchased	dollars per farm buying	7,306	7,340		X	
Livestock and poultry purchased	dollars per farm buying	38,232	40,733		X	
Commercially mixed feed purchased	dollars per farm buying	26,763	36,201			X
Seed, bulbs, and trees purchased	dollars per farm buying	6,976	5,215	X		
Custom work, machinery rented	dollars per farm renting	5,110	4,758		X	
Repair and maintenance purchased	dollars per farm buying	6,268	5,365	X		
Farm Ownership (+)						
Sole proprietorship	percent of all farms	84.2	85.2			X
Family held corporation	percent of all farms	5.2	4.4	X		
Female farmer	percent of all farms	9.3	8.9	X		
Renting some or all land (-)	percent of all farms	41.5	48.1		X	
Operator Characteristics (+)						
Operator lives on farm	percent of all farms	72.1	68.0	X		
Farming principal occupation	percent of all farms	53.4	48.7	X		
Full-time farming	percent of all farms	65.4	62.7	X		
Years operating present farm	average years	20.5	20.1	X		
Rural Development (+)						
Direct-to-consumer sales	dollars per farm	5,247	3,489	X		
Worker pay	dollars per worker	4,122	3,675	X		
Workers hired	workers per farm	5.1	4.0	X		
Farms with net losses (-)	percent of all farms	47.8	50.2	X		
Bird and Wildlife Habitat (+)						
Idle or in permanent cover crops	acres of cropland	14,476	9,790	X		
Idle, cover cropped, or woodland	acres of farmland	27,487	24,019	X		
Land under CRP/WRP	acres	13,297	9,230	X		
Chemical Use (-)						
Fertilizer use	acres per farm using	204.94	200.70	X		
Insecticide use	acres per farm using	153.67	183.15X			
Herbicide use	acres per farm using	240.09	240.27	X		
Nematicide use	acres per farm using	20.22	37.48X			
Runoff Risk (-)						
Agricultural impact index	weighted index	0.85	1.03X			
Nitrogen runoff index	weighted index	0.79	1.03X			
Pesticide runoff index	weighted index	0.94	1.01	X		
Sediment runoff index	weighted index	0.86	1.02X			

Table 5. Indicators tested for counties with or without organic farms (Lohr & Park, 2003)

Discussion

The benefits of organic farming are clear from the literature and case studies discussed. It is expected that further economic benefits will arise due to the decrease in food miles from urban farm to business. Urban farming also creates a market for restaurants and cafes, as

organic compost from coffee and food waste can be sold to urban farmers, or supplied in return for reduced produce prices. Such transactions and arrangements are mutually beneficial and environmentally responsible while supporting local business.

It is likely that urban farms will see comparable municipal economic benefits to community gardens such as increased property values and attraction of more local business. Urban farms create a destination for locals and tourists alike; and interactive place to learn about local organic agriculture, support local business, and contribute to a more resilient Christchurch.

VIII. Applications: Christchurch as a Resilient City

As stated previously, Garden City 2.0 is a new and improved version of the garden city. Its aim is to recognize the potential of urban farming in Christchurch to promote and educate the public on sustainable and resilient food systems. We have only considered two case studies in this investigation. However, we recognise that other benefits of urban farming exist, and the many ways in which these benefits can be realised in a resilient Christchurch.

As previously discussed, 28% of all New Zealand adults currently garden. With green space and community gardens at the forefront of community aspirations for the Christchurch rebuild as evidenced through the "Share an Idea" campaign, it is likely that increased community garden and urban farming initiatives will encourage more people to garden in their own homes, participate in community gardening, and/or buy local organic produce. As such, by living with nature, and engaging in local organic food production, people will begin to behave with resilient sensibilities and live a more sustainable urban life.

Community gardens and urban farming can take on many different forms in an urban environment. In the first case study, we analysed the viability of beds as a community garden organisational method. However, such beds can be deployed throughout the city; they are not restricted to a square plot of land. For example, vegetable beds can be planted along the sides of buildings, or incorporated into green roofs or ledges. While such designs may not be as viable in terms of sustainable food production, they serve to reinforce the urban farming culture, and contribute to the re-imagining of the garden city.

Impending climate change and peak oil emphasise the need to build a resilient city. Christchurch is particularly aware of this need having experienced such drastic shocks to the system and infrastructure during the earthquake series beginning September 2010. Initiatives that help build resilience is therefore something the community wants and needs. Creating a resilient food system is a vital step in this process; not only for food security, but to reap the social and environmental benefits which make a community stronger and more able to withstand future shocks. Future earthquakes are inevitable in Canterbury, thus so too is the need to diversify our food system.

In addition to educational, ecological, social and resilient benefits, community gardens and urban farming contribute towards a biophilic city. Biophilia is the inherent connection that humans share with the environment and the benefits that are gained as a result of this (Beatley 2011). Biophilic infrastructure has often been deployed in the form of green walls and roofs, parks and gardens. Such examples can be seen in cities throughout the world such as Singapore (Biophilic Singapore, 2012). Community gardens represent a form of biophilia that not only provides a daily dose of nature, but also creates a space where people can directly engage with nature in an urban environment and contribute towards resilient and sustainable living. Creating a biophilic Christchurch is particularly important in the wake of the earthquakes and subsequent vacant spaces. The rebuild has created an opportunity to incorporate more forms of green space, and thus biophilia, into the city.

IX. Conclusion

Community gardens and urban farming represents a re-imagined Garden City founded on values of resilience and food security. There is ample literature regarding the social and environmental benefits of community gardens in an urban environment. The two case studies explored in this report offer further analysis into the economic benefits of community gardens and urban farming, and how these two initiatives can be realised in a resilient, post-earthquake Christchurch. The results from these two studies provide evidence as to their potential economic viability. Further studies on organic agricultural yields in Christchurch may be needed to provide a further level of confidence in the analysis. However, we are confident in our analysis, and an urban farm's ability to provide social, environmental, and economic benefits to Christchurch.

References

(ACCRN) Asian Cities Climate Change Resilience Network. (2013). "What is Urban Climate Change Resilience." Retrieved 19 August, 2013, from www.acccrn.org/uccr/what-urban-climate-change-resilience

Active New Zealand (2008). Sport and Recreation Profile:Gardening. *Findings from the 2007/08 Active New Zealand Survey.* Retrieved 19 September, 2013, from http://www.activenzsurvey.org.nz/Documents/sport-profiles/Gardening.pdf

Almas, R. & Campbell, H. (eds) (2012). "Rethinking Agricultural Policy Regimes: Food Security, Climate Change and the Future Resilience of Global Agriculture." Emerald Group Publishing Limited: United Kingdom.

Armstrong, D. (2000). A survey of community gardens in upstate New York: Implications for health promotion and community development. *Health and Place*, 6(4), 319-327.

Barthel, S. & Isendahl, C. (2012). Urban Gardens, Agriculture, and Water Management: Sources of Resilience for Long-Term Food Security in Cities. *Ecological Economics, 86,* 224-234.

Beatley, T. (2011). Biophilic Cities: Integrating Nature into Urban Design and Planning. Washington, DC: Island Press/Centre for Resource Economics.

Been, V. & Voicu, I. (2006). "The Effects of Community Gardens on Neighbouring Property Values." *The New York University Law and Economics Working Papers: New York University School of Law.* Retrieved 26 September, 2013, from http://nccommunitygarden.ncsu.edu/researchBeen&VoicuEffectof%20CG%20of%20Property%20Value.pdf

Blair, D., Giesecke, C. & Sherman, S. (1991). A Dietary, Social and Economic-Evaluation of the Philadelphia Urban Garden Project. *Journal of Nutrition Education*, 23, 161-171.

Buchmann, C. (2009). Cuban Home Gardens and Their Role in Social-Ecological Resilience. *Human Ecology, 37*, 705-721.

Castro, D, Samuels, M, & Harman, A. (2013). Growing healthy kids: a community garden-based obesity prevention program. *American Journal of Preventive Medicine*, 44(3), 193-199.

(CCDU) Christchurch Central Development Unit. (2013). "Residential Demonstration Project." Retrieved 20 September, 2013, from http://ccdu.govt.nz/projects-and-precincts/residential-demonstration-project

Gardening Matters. (2012). "Multiple Benefits of Community Gardening." Retrieved 30 September, 2012, from http://www.gardeningmatters.org/sites/default/files/Multiple%20Benefits_2012.pdf

Garden of Eden. (2013.) "Crop Yield Verification." Retrieved 1 September, 2013, from http://www.gardensofeden.org/04%20Crop%20Yield%20Verification.htm

Holland, L. (2004). Diversity and connections in community gardens: a contribution to local sustainability. *Local Environment,* 9(3), 285-305.

Lackey, J.F. (1998). Evaluation of Community Gardens. *A Program of the University of Wisconsin Cooperative Extension.* Retrieved 26 September, 2013, from http://www.uwex.edu/ces/pdande/evaluation/pdf/comgardens.PDF

Lohr, L. & Park, T.A. (2003). Improving Extension Effectiveness for Organic Clients: Current Status and Future Directions. *Journal of Agricultural and Resource Economics, Western Agricultural Economics Association*, 28(3).

Newman, P. (2012). Singapore: Biophilic City. Retrieved from http://biophiliccities.org/blog-singapore/

New Zealand Nutrition Foundation. (2013). *Fruit and Vegetables.* Retrieved 25 September, 2013, from http://www.nutritionfoundation.org.nz/nutrition-facts/food-groups/fruit-and-vegetables

Patel, I.C. (1991). Gardening's Socioeconomic Impacts: Community Gardening in an Urban Setting. *Journal of Extension, 29*(4).

Rede, S., Farahmand, F., Meloche, L., Shi, W., & Sui, C. (2012). Assessing the Economic and Social Impact of Community Gardening in Allegheny County. *Carnegie Mellon University: Heinz College.*

Relf, R. (2009). Leafy Green Vegetables. *Virginia Cooperative Extension: Virginia Tech.* Retrieved 27 September, 2013, from http://pubs.ext.vt.edu/426/426-408/426-408.html#L4

Roberts, Wright & O'Neill. (2007). Good governance in the Pacific? Ambivalence and Possibility. *Geoforum 38*, 967–984.

Saldivar-Tanaka, L, &Krasny, M. (2004). Culturing community development, neighborhood open space, and civic agriculture: The case of Latino community gardens in New York City. *Agriculture and Human Values*, 21(4), 399-412.

Schubert, F. (2010). *Exploring and Predicting Consumers' Attitudes and Behaviours Towards Green Restaurants* (Master's thesis, The Ohio State University, Columbus, Ohio, USA.).

Sherer, P.M. (2006). "The Benefits of Parks: Why America Needs More City Parks and Open Space." Retrieved 2 October, 2013, from http://www.tpl.org

Sørensen, E., & Triantafillou, P. (Eds.). (2009). *The Politics of Self Governance*. Ashgate Publishing.

SPIN Farming LLT. (2013). "SPIN - A New Way to Learn to Farm." Retrieved 21 August, 2013, from http://spinfarming.com/whatsSpin/

Statistics New Zealand (2006). "National Family and Household Projections." Retrieved 24 September, 2013, from http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/projections-overview/nat-family-hhold-proj.aspx

Stocker, L, & Barnett, K (1998). The significance and praxis of community-based sustainability projects: Community gardens in western Australia. *Local Environment*, 3(2), 179-189.

Stolze, M., Piorr, A., Häring, A. & Dabbery, S. (2000). The Environmental Impacts of Organic Farming in Europe. *Economics and Policy, 6*.

Teig, E, Amulya, J, Bardwell, L, Buchenau, M, Marshall, J, & Litt, J. (2009). Collective efficacy in Denver, Colorado: Strengthening neighborhoods and health through community gardens. *Health and Place*, 15(4), 1115-1122.

Vines, E. (2010). Growing Economic Gardens. *American City & County 125*(4), 36.

World Health Organisation (WHO). (2013). Retrieved 15/10/2013 from http://www.who.int/gho/urbanhealth/situation_trends/urban_population_growth_text/en/