

Harvesting healthy habits?

An evaluation of the Macquarie University community garden

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Abstract

The World Health Organization (WHO) warned about rapid urbanization and declared Non-communicable diseases (NCDs) and their increasing rates a major public health concern. In response, world leaders agreed on the importance of integrating sustainable development in health promotion to ensure a better and more sustainable future to all. Building supportive environments is recognised as a cost-effective intervention to promote healthy lifestyles and choices. There is a growing body of evidence showing how urban agriculture, specifically community gardens, can contribute in achieving sustainable development and improve health. As one of the strategic initiatives for sustainability, the Macquarie University (MQ) community garden provides access to outdoor gardening infrastructure and opportunities for staff, students and broader community members. However, to date, the garden and its impacts on health and wellbeing have not been evaluated. Therefore, this research project served as a formative evaluation of the Macquarie University community garden. It explored the garden's demographic characteristics and participation patterns. Also, it explored perceived benefits and risks as well as enablers and barriers associated with participation in the garden. This research study adopted a mixed method approach to collect data. A cross-sectional survey collected data on participant's demographics, their engagement with the garden, their fruit and vegetable consumption, their physical activity levels and social connectiveness. The gardeners' experiences at the garden, the benefits and risks involved alongside the different barriers and motives to participation were explored using semi-structured interviews. It found that MQ community garden offered many benefits to its users such as the ability to grow organic produce, increase physical activity and improve food literacy, mental health and social connectedness. Moreover, the MQ community garden showed potential to contribute to the United Nations Sustainable Development Goals (SDGs). Furthermore, this project shed light on the higher education sector's role in promoting and contributing to the health of the university's community and in achieving SDGs to ensure a better world for future generations.

Statement of originality

This work has not previously been submitted for a degree or diploma in any university.

*To the best of my knowledge and belief,
the thesis contains no material previously published or written by another person
except where due reference is made in the thesis itself.*

Bachar Skayni

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"فلا البعد يعني غياب الوجوه ولا الشوق يعرف ... قيد الزمان" – فاروق جويدة.

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List of acronyms and symbols

ABS	Australian Bureau of Statistics
ADG	Australian Dietary Guidelines
AES	Australian Eating Survey
ARFS	Australian Recommended Food Score
COP	Conference of the Parties
CCA	Copper Chromate Arsenate
FFQ	Food Frequency Questionnaire
GPAQ	Global Physical Activity Questionnaire
GHK	Growing Healthy Kids
HPU	Health Promoting Universities
SC-IQ	Integrated Questionnaire for Measuring Social Capital
MQ	Macquarie University
MET	Metabolic Equivalent
NSW	New South Wales
NCD	Non-Communicable Diseases
PA	Physical activity
SIPAQ	Single Item Physical Activity Questionnaire
SEM	Socio-Ecological Model
SES	Socio-Economic Status
SAKG	Stephanie Alexander Kitchen Garden
SDGs	Sustainable Development Goals
SDSN	Sustainable Development Solutions Network
AIHW	Australian Institute of Health and Welfare
UN	United Nations
US	United States
WFR	Weighed Food Record
WHO	World Health Organization

Chapter 1: Introduction

1.1 Research background

Today, there is a growing body of evidence around urban agriculture, specifically community gardens and their role in building healthier sustainable cities.¹⁻⁴ Community gardens are rapidly gaining popularity due to their potential to affect people's lifestyles, drive positive behavioural changes and promote health to individuals and communities.⁵ Community gardens have been described as open green spaces often built on vacant plots of land in urban areas and involves different stakeholders such as governments, local councils and wider community.

Historically, the use of community gardens dates to the early 19th century in Britain, where plots of land were allocated to the poor to grow and harvest vegetables.^{6, 7} During the great war, "Victory Gardens" and "War Gardens" provided 40% of fruits and vegetables consumed in the United States of America.⁸ In the last few decades, community gardens have become increasingly widespread in developed countries in recognition of their value as tools to promote health and protect the environment. World leaders are all taking part in the global efforts made to face climate change and improve people's health along with the environment they live in.⁹ Those efforts are following a different approach to health and wellbeing by prioritizing the importance of the built environment using settings-based approaches to health promotion.¹⁰ The *Paris Agreement* underlined the importance of such approaches and was followed by the new set of the Sustainable Development Goals (SDGs).¹¹ The Sustainable Development Solutions Network (SDSN) reported that governments, businesses and organisations in many countries are showing interest in the SDGs and started responding and implementing them in their operating models.¹² SDSN also highlighted the role that universities may play in achieving the SDGs. Universities sit in unique positions within societies. They form a platform for the dissemination and the discovery of knowledge and are "*powerful drivers of global, national, and local innovation, economic development and social wellbeing*".¹²

On this ground, this research project considered a health promotion initiative implemented by Macquarie University (MQ) who built a community garden accessible for all MQ staff, students and the wider community on its Macquarie park campus. This project evaluates the garden, as to date, there has been no evaluation conducted on its benefits to the MQ community and its importance as a health promotion initiative.

It is important to highlight that community gardens require thorough planning and implementation in order to successfully serve as a body that can drive behavioural change and promote health using available resources and addressing different issues of concern for a community. At the same time, evaluating health promotion initiatives is crucial for sustaining the designed and planned program as well as for sharing accountability with different stakeholders in the project.¹³ In other words, for health promotion to be efficient and effective, it requires a continuous cycle of

assessing, planning, acting, implementing, and evaluating.¹⁴ Health promotion practitioners evaluate to answer questions about the program's performance and whether it is delivering the desired outcomes or not.¹⁵ Moreover, evaluation is essential to acquire a better understanding of the program's impact on individuals, to inform policy and decision making, and to justify a program's current funding.¹⁵ Finally, individual's participation was another factor standing behind the success of the garden. Evaluating this factor is important to better understand what affects participation alongside people's engagement and interaction with the garden if we are to successfully increase participation rates and make best use of the gardens.

1.2 The purpose

This study considers the community garden at Macquarie University and investigates its physical environment, the participants lived experiences, demographic characteristics and gardening-related behaviours. This study looks into the varied health benefits and risks of engaging in gardening activities and spending time in the community garden. Data about participant characteristics, their past and present experiences in participating in community gardens and their harvested produce were collected. Also, this study examines the impact of gardening on participant's physical activity and lifestyle choices by enquiring about visits' frequencies to the community garden, time spent performing gardening tasks, methods of transport for travelling to and from the garden, and whether the garden helps participants to live a healthier and more active lifestyle. Furthermore, this study looks at community gardeners' fruit and vegetable consumption and how it varies with their gardening experience and practices as well as the impact of community gardening on social capital. Finally, this project explores the motives underpinning people's participation in community gardens, including potential enablers of and barriers to gardening, providing a deeper understanding of what affects participation rates at the MQ community garden.

1.3 The research aims and research questions

The overall aim of this research is to conduct a formative evaluation of the MQ community garden and gain in-depth knowledge about the garden and its demographics, explore the risks and benefits of participating in the garden and understand the different facilitators and barriers associated with accessing and utilising the garden.

The following research questions were developed to address the overall aim of this research project:

RQ1: *“What are the demographic characteristics, lifestyles and participatory behaviours of the MQ community garden users?”*

RQ2: *“What are the benefits and risks perceived by the MQ community garden participants and how does gardening affect their overall health and wellbeing? (e.g. Physical activity, fruits and vegetables consumption...)”*

RQ3: *“What are the barriers and facilitators encountered by the MQ community garden users when accessing and utilising the garden?”*

1.4 The significance of the study

The finding of this project will help evaluate the current situation of the Macquarie University community garden and gain better insight about the present participation patterns, the users' demographics and their lifestyles. This will inform the development of guidelines to increase the involvement in the MQ community garden and better incorporate the garden within the university's day-to-day procedures. Both the MQ community garden and the Macquarie University will benefit from this study as the former will facilitate growth and development while the latter will better ingrain sustainability and health promotion into Macquarie University. Thus, this project paves the way for embedding the SDGs developed on a global level into local practices, through the university's communal engagement. Consequently, the findings of this study will help share recommendations for successfully planning and designing future urban community gardens from a health perspective avoiding the known risks associated with exposure to gardening and enhancing positive factors affecting participation. Finally, this project included all the garden community such as students, staff and wider community members. The findings from this study will contribute to future research endeavours in health promotion by evaluating gardening potential to improve people's lifestyles, health and well-being.

1.5 The conceptual framework

The conceptual framework for this research project was developed based on a socio-ecological model and literature on community gardens. The Socio-Ecological Model (SEM) helps explain how humans and the environment in which they live interact and may influence their behaviours and lifestyles.¹⁶ This model originated from Urie Bronfenbrenner's ecological system theories originally developed to explain a child's interaction with its environment and the direct impact of the latter on the child's growth and development.¹⁷ Bronfenbrenner translated this theory to human development and nested the individual in the middle of several interconnected circles representing different ecological environments.¹⁸ They are a set of four different systems: micro-, meso-, exo- and macro-system.¹⁹

Each environment has a different level of influence on individuals. The microsystem includes a series of activities, roles and interpersonal skills that individuals experience in a specific setting. Those roles, activities and skills are called the elements of the microsystem.²⁰ A setting however is defined as a place where the developing individual can engage in face to face interaction.²⁰ The current study's microsystem incorporated community gardens as the specific setting in which the developing human (in this case the gardeners) engage in face to face interaction, with a series of activities, roles and tasks performed at the garden such as gardening activity, consuming produce, connecting with nature, socializing and many other. The second ecological environment in Bronfenbrenner's model is the mesosystem. A mesosystem is a group of microsystems, that includes different interrelated settings where the developing person actively participates such as schools, workplaces and neighbourhood.¹⁹ At the garden, gardeners grow, develop and learn skills that can be used beyond the garden, such as at the gardener's home since they were found to have an impact on their household member's diet and fresh produce consumption,²¹ in their neighbourhood by learning interpersonal skills⁵ and at their workplaces by improving their mental health.²² The third ecological environment is the exosystem. Contrary to the mesosystem, the exosystem includes one or more settings that do not include the developing person as an active participant but rather contain events that impact, or are impacted by, what occur in the settings actively involving the developing person.¹⁹ Bronfenbrenner presents the parent's network of friends, the local school board activities and the parent's workplaces as examples of a child's exosystem. The present study considers the Macquarie University community garden, which follows several policies designed by the university that impact and are impacted by what happens in the garden. Moreover, the studies look into the garden and sustainable development, which in turn is affected by national and international policies, specifically by the SDGs. Community gardens can address the following SDGs: Good health and wellbeing (SDG3), Reducing inequalities (SDG10), Climate action (SDG 13) and Life on land (SDG15). Hence the exosystem includes university policies as well as the mentioned sustainable development goals. Finally, the last ecological environment is the macrosystem, which contains a uniformity of lower-order systems (the exo-, meso- and micro-) that can exist at a cultural or subcultural level.¹⁹ This study's

macrosystem can be formed by different form of urban agriculture, however, for the purpose of this study, the macrosystem is not investigated as it is outside the scope of this project. Figure 1.1 shows an illustration of the four ecological systems as explained by Bronfenbrenner while Figure 1.2 shows how this model was translated to this study's purpose.

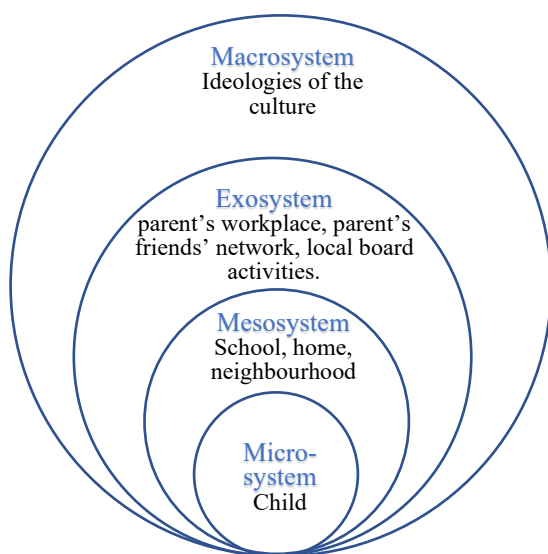


Figure 1.1 illustration of the four ecological systems as explained by Bronfenbrenner

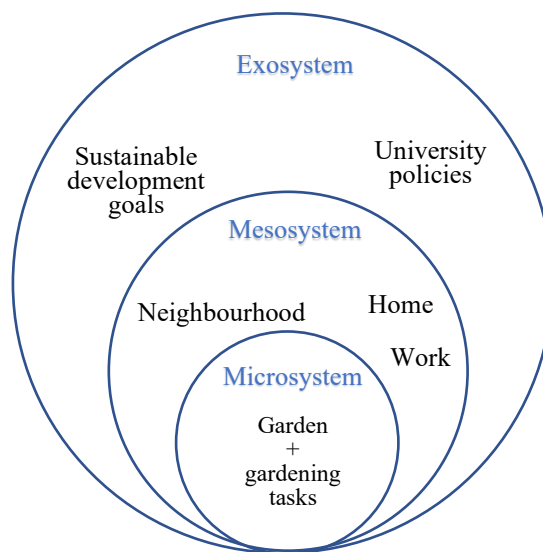


Figure 1.2 Illustration of the study's framework adopted from Bronfenbrenner original model

Exploring the microsystem: its relationship with sustainable development

As explained earlier, the microsystem is a set of elements in a given setting. Those elements are the factors of activities, roles and interpersonal skills that can be performed in this setting.¹⁹ Bronfenbrenner defines a specific type of activity which he calls “molar activity” as “an ongoing behaviour possessing a momentum of its own and perceived as having meaning or intent by the participant in the setting.”²³ In other words, for an activity to be influential on the participant development, it needs to form a continuing process with a perceived meaning for the participant that provides him with its own initiative to persist through time and accomplish the task. An activity can have a time perspective, goal structure and can invoke other people, objects and events not necessarily available in the same immediate settings.²³ Examples of activities in a child environment are building a tower of blocks, digging a ditch, or reading a book.²⁰ In the garden, gardeners also engage in similar molar activities such as preparing the soil, planting crops or engaging in and carrying on a conversation with another person. For the purpose of this study, all of those elements were grouped under the term “individual participation” and nested in the very centre of the microsystem.

The literature review sheds light on a variety of outcomes from participating in the garden. The following chapter elaborates about those findings. In a snapshot, individual participation in the community gardens resulted in a feeling of connectedness with nature,²⁴ food waste awareness, improved physical activity, increased participation in active transport,^{8, 25} improved mental health,²² increased social connections,²⁶ and increased healthy food consumption.^{8, 27} Furthermore, the literature reported that community gardens provided better access to fresh produce,^{28, 29} few financial benefits, better immigrant health³⁰ and community empowerment.⁸ In a recent quasi-experimental study, Tharrey et al.³¹ looked into community garden and their link to promoting sustainable lifestyles. Each of the community garden participation's outcome was considered a lifestyle component (such as social connections, physical activity, connection with nature). Those components were grouped following the three dimensions of sustainability they interconnect with and promote: environment, health and economic.³¹ For example, Participation in the garden provide individuals access to fresh produce and add to their lifestyles the choice of consuming them. This lifestyle's component interacts with sustainability's economic

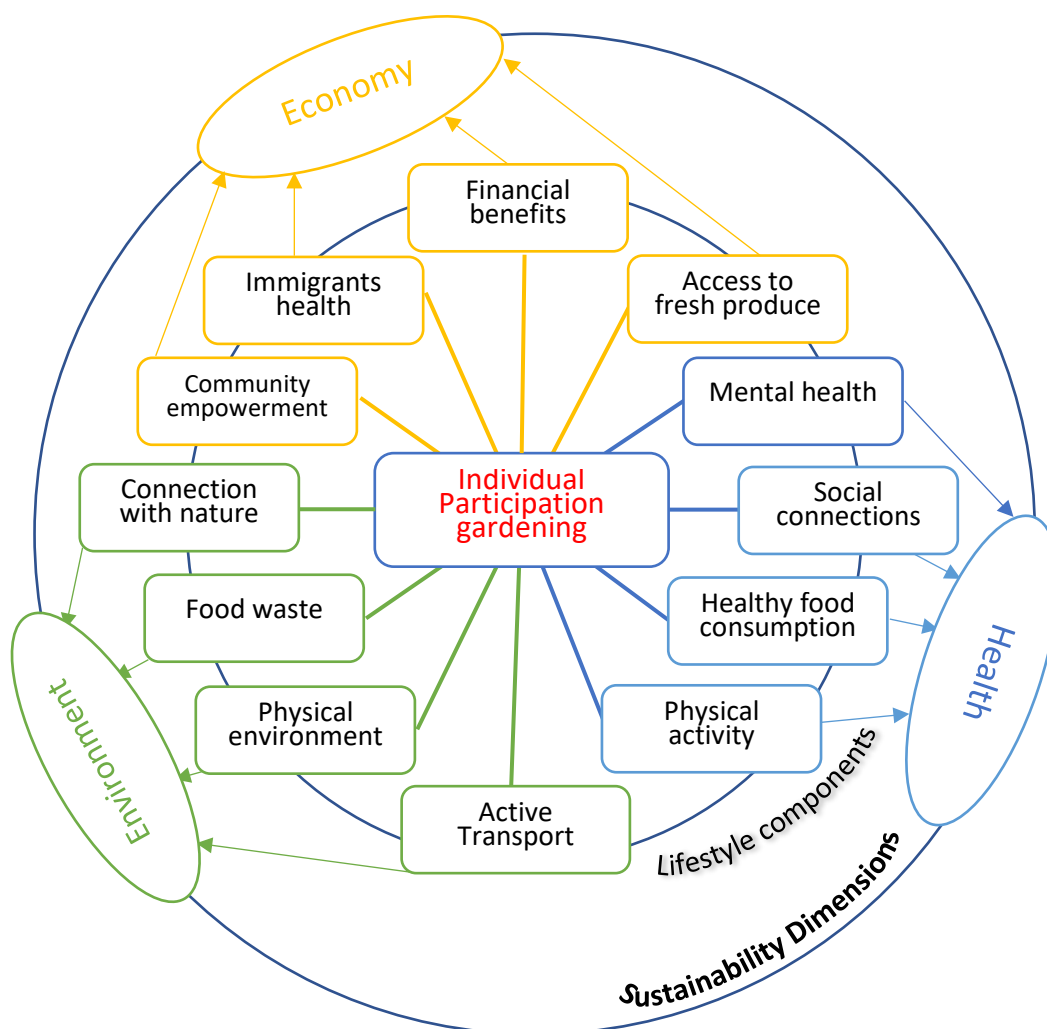


Figure 1.3 the garden's microsystem and how individual participation impact different lifestyles components

dimension as It can financially support individuals by reducing their food expenses. I used and adjusted the same model to fit this study's purposes. Figure 1.3 illustrates the garden's microsystem and how individual participation impact different lifestyles components and in turn sustainability's dimensions.

1.6 Thesis outline

This thesis consists of five main chapters opening with Chapter 1 as an overall introduction. Chapter 1 presented an introduction to the problem, stated the study purpose and research significance and closed with the development of the conceptual framework uniquely tailored for this study. Chapter 2 introduces the study background then elaborates the literature review focusing on the benefits and risks of community gardens, the barriers and facilitators to participation in the garden and the role of universities in promoting health and wellbeing through the garden. Then, Chapter 3 expands on the methodologies used to answer the research questions and details the research design along with the data collection and analysis methods. Chapter 4 presents the results of this project while chapter 5 concludes this thesis with a discussion about the findings alongside recommendations and implications for future research.

Chapter 2: Literature review

2.1 Introduction

This literature review discusses the body of evidence available about community gardens, it presents the benefits of its implementation as a health promotion strategy and its potential in addressing various Sustainable Development Goals (SDGs). This takes part of the efforts made to face rapid urbanisation's challenges, reduce non-communicable diseases (NCDs) and provide health equity and equality to individuals and communities. It also highlights the possibility of implementing a community garden within a university setting, as part of the bigger role that the higher education sector plays in achieving sustainability. The first section of this literature review discusses urbanisation and its impact on human health, behaviour and lifestyles. It underlines the relation between health and environment and presents urban agriculture as a promising intervention in achieving some of the SDGs. The second section of this review explores different health benefits and risks involved when participating in community gardens. The third section of this chapter describes different barriers and facilitators related to participation in community gardens. The last part of this review discusses the role of universities in implementing community gardens in order to achieve sustainability targets. It elaborates on Macquarie (MQ) University's sustainability plan and implementation of MQ community garden available for students, staff and the community.

This review considered a large number of peer-reviewed articles searched through many databases such as Medline, PubMed, Cochrane library, and Embase. Also, it includes data search through OVID and google scholar. A combination of key search terms were used including: *"urbanisation"*, *"non-communicable diseases"*, *"chronic diseases"*, *"environment"*, *"health promotion"*, *"urban agriculture"*, *"sustainable development"*, *"social sciences"*, *"community garden"*, *"gardening"*, *"benefits"*, *"risk factors"*, *"barriers"*, *"facilitators"*, *"higher education"*, *"sustainable development goals"*, *"gardeners"*, *"health promoting settings"*. The search strategy covered many articles using databases relative to public health and environmental sustainability. In addition, reference lists of some key articles were reviewed.

2.2 Urbanisation and health

2.2.1 From rural to urban: more than a migration

In its 2018 report “World Urbanization Prospect”, the United Nations (UN), stated that 55% of the world’s population now resides in urban areas, projected to reach 68% by 2050.³² Figure 2.1 shows the evolution of the world’s urban and rural population from 1950 to 2050. UN defines urbanisation as *“a complex socio-economic process that transforms the built environment converting formerly rural into urban settlements, while also shifting the spatial distribution of a population from rural to urban areas. It includes changes in dominant occupations, lifestyle, culture and behaviour, and thus alters the demographic and social culture of both urban and rural area”*.³³ The changes include the shift from agricultural employment sectors to non-agricultural industrialised sectors,³⁴ changes in dietary intake (e.g. high energy and fat dense diets),³⁵ faster pace of life, reduced travel distances, higher access to services, better access to public transport and many others. This global movement is driving economic growth,³³ reducing poverty³³ and playing a major role in human development.³³

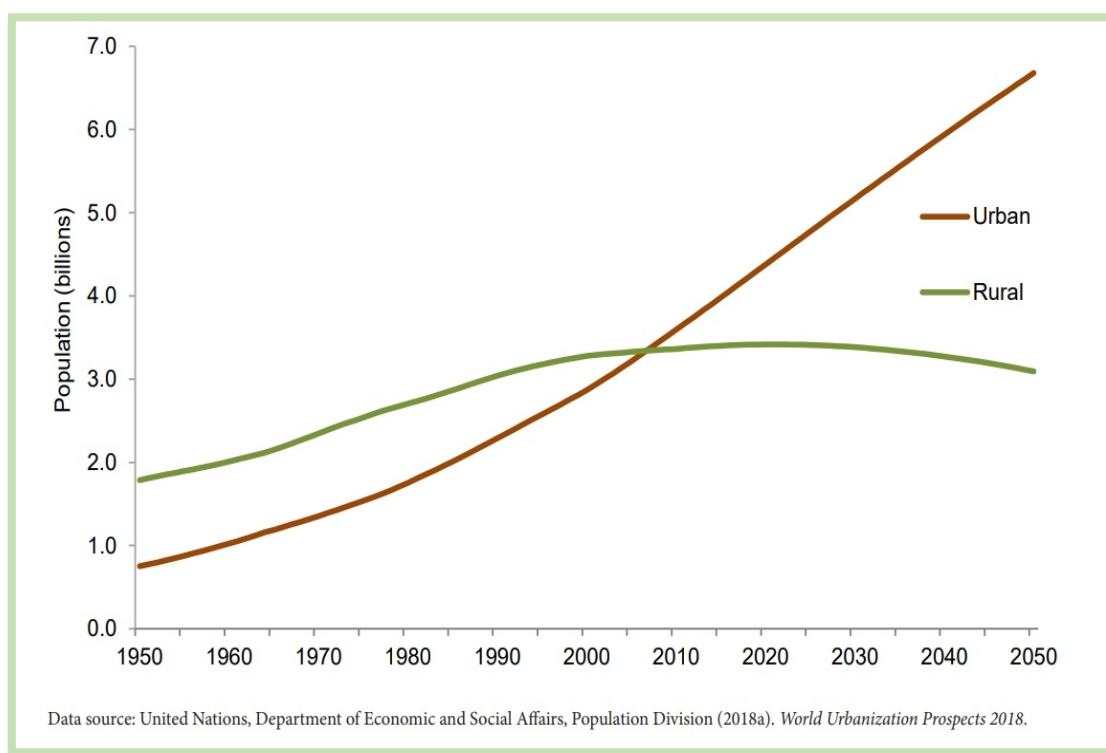


Figure 2.1 urban and rural population of the world 1950 – 2050³³

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2.2.2 The challenge of the century

Urbanisation is growing at an accelerated rate and this rapid movement is becoming a “major public health challenge for the 21st century”³⁶ that the World Health Organization (WHO) warned about in its report “our cities, our health, our future”.³⁶ With a fast growing population and a lack of basic infrastructures, health inequalities are increasing in urban areas due to varied social and economic inequities.³⁷ The rise of megacities created new challenges to our health and environment such as an increase in greenhouse gas emission leading to a poorer air quality, increased traffic movement and road injuries, degradation of green areas and overheating, unhealthy diets, physical inactivity and sedentarism.³⁸⁻⁴⁰ This change consequently led to an increase of NCDs.³⁹ Worldwide, NCDs were the leading cause of death accounting for 71% of the 57 million global deaths in 2016.⁴¹ Leading the list were cardiovascular diseases (44% of all NCDs and 31% of global deaths), cancers (22% of all NCDs and 16% of global deaths), chronic respiratory diseases (9% of all NCDs and 7% of all global deaths) and diabetes (4% of all NCDs and 3% of all global deaths).⁴¹ It is important to note that 75% of all global deaths, caused by NCDs, were premature. In Australia, NCDs were behind the main leading causes of death, with cardiovascular diseases at the top of the list, followed by dementia and Alzheimer diseases, cerebrovascular diseases, lung cancer and chronic obstructive pulmonary diseases in 2016 as well.⁴²

The World Economic Forum in collaboration with the WHO estimated the average cost of NCDs for a “business as usual” model (where the rate of NCDs continues increasing and the intervention’s efforts to contain it remain static) to average around US\$500 billion per year. In total, from 2011 to 2025, the economic loss due to NCDs will reach a total of US\$ 7 trillion.⁴³ However, WHO Director-General Dr. Tedros Adhanom Ghebreyesus pointed out in the 2017 WHO’s NCDs progress report that most premature NCD’s death can be prevented or delayed.⁴⁴ An action plan, “Best-Buy” was developed to prevent and reduce NCDs rates. It includes a set of cost-effective NCD intervention strategies with an estimate cost of US\$ 2 billion per year.⁴⁵ The interventions address different risk factors of NCDs such as tobacco use, alcohol consumption, unhealthy diets and physical inactivity by implementing individual and environmental changes such as taxation on tobacco, educating individuals and raising awareness, promoting healthy habits and building supportive environments.⁴⁶

2.2.3 Health and environment: a two-way interaction

One of the major changes within the rural to urban migration is the change in the built environment from green and open landscapes to narrow streets crowded with building blocks. The expansion of urban areas and the increased population place pressure on the natural environment through the demand for land, energy and water resources as well as through emission of greenhouse gas and waste production.⁴⁷ In return, this change in the natural environment will have its impact on people’s health. In its 2016 report, “Australia state of the environment”, the department of the environment and energy in the Australian government highlighted the impact

of climate change on Australian cities, such as a higher frequency in natural disasters (heatwaves, floods, fires), higher temperature degrees in several cities and sea level rise for the coastal cities, all impacting people's health.⁴⁷






The interaction between environment and health has been well explained in the Ottawa Charter for Health Promotion.⁴⁸ It stated that changing patterns of life, work and leisure have a significant impact on people's overall health and wellbeing. It also identified the need to build supportive environments as a main future strategy for health promotion. Today, it is recognised that the environment where people live and interact with is a direct stimulator to their individual choices and decision making, affecting their behaviours either positively or negatively.^{49, 50} Changes at individual and environmental levels are necessary for enabling people to take control over their health and inform their decision making. A successful behaviour change model that translates this into practice is the socioecological model that acknowledge the importance of a two-way interaction between individuals in communities and their natural environment.¹⁸ Today, there is a worldwide movement towards building supportive environments such as building sustainable healthy cities and green urban planning, that proved essential to control NCDs rates⁵¹ by improving people's lifestyles and driving healthy behavioural change as well as reduce and limit our environmental footprint. Different cities and states in many countries such as in The United Kingdom⁵², Scotland⁵³ and Australia⁵⁴ implemented health policies that focus on establishing sustainable environments such as providing green spaces within urban settings as a practical cost-effective way to improve people's health. This movement marks the values of a holistic health approach and underlines the efforts proposed by WHO 'Best-buy' action plan marking the shift from focusing on individual risk factors to broader perspective integrating the nature and sustainable environments as part of the prevention and the road to achieve greater equity.

2.2.4 Urban agriculture: a promising path for sustainable cities

“The future of the world’s population is urban”, the UN department of economic and social affairs stated.^{33, 55} It is important to understand the changes required to adapt to the fast-growing population and the rapid urbanisation rate WHO warned about. As a plan to end poverty, protect the planet and ensure peace and prosperity to all people, the UN agreed and adopted a list of 17 SDGs in September 2015, as part of the 2030 agenda for sustainable development. The UN addresses urbanisation and its common challenges in Goal 11- Sustainable cities and communities. It underlines the need to plan and build sustainable green cities. Urban agriculture seems to be a promising strategy that brings us a step closer to sustainable urbanisation.⁵⁶ It takes the form of greenhouses, community and rooftop gardens, indoor farms and edible green walls. The most traditional form of urban agriculture is community gardens. Community gardens has been defined as open green spaces managed and developed by local residents,⁵⁷ they form an environment for people to interact with nature. It can build resilient communities, reduce food insecurity and increase people’s sensitivity to food waste. In addition to addressing SDG 11, when successfully implemented, community gardens can reduce health inequalities and socio-economic disparities by providing access to fresh produce, empowering communities, offering financial benefits and playing an important role in vulnerable population’s health such as immigrants. This role of the garden help achieving the 10th SDG - Reduced inequalities. It can also serve as a place to promote health and wellbeing aligning with the targets of the 3rd SDG - Good health and wellbeing. Community gardens can provide access to a variety of fruits, vegetables and herbs which may consequently lead to increased consumption of fresh produce. Also, it can enhance the local food system and address food insecurity. Moreover, spending time at the garden weeding, mulching and performing other gardening tasks counts towards the daily individual level of exercise and meeting physical activity’s guidelines. Also, studies showed that community gardens can play a major role in building social capital and bringing communities together, improving social networks which may positively impact mental health.^{28, 58-60} Therefore, community gardens could be seen as a potential strategy in promoting healthy behaviours in order to reduce NCDs. Furthermore, the more gardens are implemented in a city the bigger the access to green spaces. Good implementation of urban agriculture and the provision of green vegetation within the city walls has its environmental benefits as well. It can reduce our environmental footprint and take action to combat climate change and its impact (SDG 13- Climate action).^{24, 25,}

⁶¹ Finally, this green habitat can foster different shapes of life on land and create a protective ecosystem for different species to live in. It has the capacity to host and protect a variety of native fauna and flora (SDG 15- Life on land). Table 2.1 lists all the sustainable development goals that urban agriculture such as community gardens can help in achieving if implemented as health promotion strategy.

Table 2.2.1 List of the sustainable development goals addressed by community gardens

	<ul style="list-style-type: none"> • Promote healthy eating. • Increase physical activity. • Improve mental health. • Reduce NCD risks.
	<ul style="list-style-type: none"> • Access to fresh fruits and vegetables. • Access to a safe place for all to exercise.
	<ul style="list-style-type: none"> • Sustainable urban agriculture. • Reduce food wastage.
	<ul style="list-style-type: none"> • Increased green spaces in the city. • Reduce environmental footprint.
	<ul style="list-style-type: none"> • A protected environment for fauna and flora to live and thrive.

2.3 Gardening: its benefits and contribution to the SDGs

2.3.1 Promoting good health and wellbeing

It is agreed upon the importance of insuring healthy lives for everyone if we are to build healthy societies and sustainable cities. WHO's constitution consecrates the "highest attainable standard of health as a fundamental right of every human being".⁶² The third sustainable development goal on the 2030 sustainable development agenda, "Good health and well-being", underlines the necessity of promoting healthy behaviours to everyone. It targets premature mortality from NCDs and aims to reduce its rates by one third end of 2030 (Target 3.4). As a health promotion intervention, community gardens offer a multifaceted approach targeting different aspects of human behaviour, reducing NCDs risk factors and promoting health and wellbeing.

Healthy food consumption: Fruits and vegetables

A healthy diet lies on a balanced consumption of fruits and vegetables. The Australian Dietary Guidelines (ADG) recommends consuming at least six serves of vegetables for men (five for women) and two serves of fruits per day for men and women alongside maintaining a rich varied

diet.⁶³ Reduced consumption of fruit and vegetables has been linked to poorer health outcomes and an increased risk of NCDs ^{64, 65} and vice-versa, increased consumption has varied positive health outcomes related to different chronic diseases such as cardiovascular diseases, diabetes and different site-specific cancers.⁶³ The Australian Institute of Health and Welfare (AIHW) reported that in 2017-18, only 1 in 10 adults met the recommendations for daily vegetable consumption,⁶⁶ while 5 to 7 serves of discretionary foods were consumed per day by adults in 2011-12.⁶⁶ Eating a lot of discretionary food alongside a low consumption of fruits and vegetables is considered a risk factor for type 2 diabetes, cardiovascular diseases, overweight and obesity,⁶⁶ and in return 7.3% of the total burden of disease in Australia was due to poor diet in 2015.⁶⁷ This warrants further research on how to increase the consumption of fruits and vegetables in order to improve health outcomes.

There is a growing body of evidence indicating that community gardens may have positive impact on fruits and vegetables consumption. Research showed that gardeners tend to consume more fruits and vegetables per day than non-gardeners⁸ and less baked goods and soft drinks.⁶⁸ In a study of 766 participants in Flint, Michigan, Alaimo et al.²¹ measured fruit and vegetable consumption in a household with a at least one community garden member. They found that households with a gardener member were 1.4 times more likely to consume fruits and vegetables per day than households without a member participating in gardening activities. Also, they were 3.5 times more likely to consume fruits and vegetables five times per day.²¹ Similar findings were reported by Zoellner et al.⁶⁹ through a mixed methods study in the Dan river region in the United States (US) of America which found that gardeners wish to eat more fruits and vegetables, however, cited a higher vegetables availability than fruits availability in participants homes. Wakefield et al.²² in Toronto, Canada conducted a qualitative study and reported that participants ate more vegetables due to their involvement in the gardens.

Participation in community gardens had a positive impact on children and adolescents' dietary behaviours. It increased their fruits and vegetables intake ^{5, 21, 69} and reduced their consumption of fast and sugary type of food, replacing them with healthier alternatives.⁵ Growing Healthy Kids (GHK) is a US community-based intervention program using community gardens as an educational platform to reduce childhood obesity rates.⁷⁰ Weekly gardening workshops and nutrition classes took place at the gardens; as well as monthly social events. Parents reported a 28% increase of daily fruit consumption during the program and 33% increase in vegetable consumption,⁷⁰ translating to two additional fruit serves per week and 4.9 additional vegetable serves per week. "LA sprouts" is another school-based gardening intervention culturally tailored for Latino kids in Los Angeles schools. The intervention showed a significant 22% increase in dietary fibre intake for the entire sample.⁷¹ Another role that community gardens played in children's nutrition is changing their perception of fruits and vegetables, causing a change in their behaviour. This was significantly marked in children and youth, where quantitative studies showed that gardening increased their fruits and vegetable preferences. ^{30, 69} The Stephanie

Alexander kitchen garden (SAKG) is a program that introduces food education into schools, teaching kids the health benefits of fresh seasonal food. The children attended a gardening class and a kitchen class every week of their school year. Gibbs et. al.⁷² evaluated the SAKG's achievement in increasing children willingness to try new food and promote healthy eating in the Victorian state, Australia. They designed a two years mixed method comparative study. Both quantitative and qualitative results showed an increase in children's willingness to try new food and the program was successful in promoting a healthier diet for children, however only reported in the study's qualitative results.⁷²

Mental health and psychosocial wellbeing

WHO defined mental health as *"a state of wellbeing in which every individual realises his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community"*.^{73, 74} In Australia, the national survey of mental health and wellbeing for adults estimated that 20% of the population experienced a common mental health disorder (Anxiety disorder, affective disorder, substance use disorder) in the last 12 month period in 2007.⁷⁵ Also, a total of 9.1 billion AU\$ was spent on mental health services in 2016-17.⁷⁵

In order to build healthy communities and societies, mental health should be integrated in the core of preventive strategies. Community gardens successfully fit WHO's description of mental health. First, it provides participants the ability to cope with stress; community garden participants perceived their time spent in the garden as highly valuable where they get to relax, escape the city noises, feel comfortable and gain a sense of accomplishment.^{58, 59} They stated that the opportunity to interact with nature was relaxing and calming. For example, in the qualitative study by Wakefield, one of the participants said that *"sometimes when you are stressed out [...] when you go to the gardens, you feel different"*.²² Kingsley et al.⁵⁹ described community gardens as a *"sanctuary from pressures of the world"*.⁵⁹ Second, the gardens provided a chance for people to *"work productively and fruitfully"*. Work (noun)⁷⁶ is an activity involving mental or physical effort done in order to achieve purpose or results. Gardening requires both type of efforts (mental and physical) and participants are rewarded by harvesting crops instead of earning money. They reported feeling satisfied when harvesting good crops⁷⁷ especially that they get to share it with neighbours; making them feel warmly welcomed.²² For example, in Wakefield study, one participant stated: *"I give away tomato, I enjoy it because when I reap, my friends come and share [...] they give me warm reception"*.²² Third, participants in community gardens were able to contribute to their communities. Studies reported how gardeners felt a sense of belonging to a broader community, as well as a feeling of pride, achievement and contribution to the local community.^{22, 59, 77-79} Moreover, community gardens showed a positive link in addressing mental illnesses and helping individuals suffering from mental health problems recover faster.⁸⁰ Hence in the garden, individuals are able to reach a state of mind that has a positive impact on their mental health and wellbeing.

Social connections

As part of their social wellbeing, people aim to build relations and interact with others in their environment. Community gardens are places where people plant, grow and harvest crops. However, a frequent benefit of community gardens reported by gardeners, volunteers and garden coordinators is its impact on social life and social connectiveness.^{28, 59, 60, 81} Gardens are perceived as a place to develop individuals networks by meeting new people, making friendships and building rapport.²⁸ Individuals from all socio-economic status (SES) are given an opportunity to join group efforts, work towards collective goals and actively engage with their community.⁸¹ One of the studies showed that community garden helped people to take out of isolation when migrating to different neighbourhoods.⁵⁹ Also, it offered a non-threatening way to spend time outdoor and engage with people.⁶⁰

Physical activity

Physical inactivity is responsible of 6% of global deaths and was ranked as the fourth leading risk factor for global mortality.⁸² Globally, 1 in 4 adults and 3 in 4 adolescents fail to meet the WHO's recommended daily activity levels.⁸² In 2012, physical inactivity bore 6% of the burden of NCDs caused by coronary heart diseases, 7% of type 2 diabetes, 10% of breast cancer and 10% of colon cancer.⁸³ While in Australia, 1 in 2 adults did not meet the Australian physical activity guidelines in 2017-18⁸⁴ and physical inactivity was responsible of 2.6% of the total burden of diseases in 2011.⁸⁵ This increased to 9% when combined with obesity and overweight.⁸⁵

Studies reported a positive dose-response between physical activity and risks of all-cause mortality,⁸⁶ hence the important protective role that physical activity plays in preventing NCDs. As part of the prevention, WHO published its global action plan 2018-2030; "*More active people for a healthier world*", that underlined the importance of physical activity and the necessity of integrating it in different settings and places where people live, work and play.⁸² During gardening activities, gardeners engage in physical activity by performing different tasks such as weeding, seeding, mulching, composting and many other tasks requiring a certain physical effort. Many studies investigated the link between participating in community gardens and physical activity and found that gardening is positively associated with PA. Sommerfeld et al.⁸⁷ reported that 38% of gardeners reported being "very active" compared to 20% in the non-gardener's sample.⁸⁷ Interviewed gardeners considered gardening as a form of exercise important to keep them active.²² Similar findings were reported by other studies, where participants perceived being more active after they have started gardening.^{24, 69, 78, 88}

2.3.2 Reducing inequalities

Sustainable development cannot be achievable if not all people share equal opportunities and receive the same chances and services for a better life.⁸⁹ Inequalities between people can be based on their age, sex, religion, race, social class, ethnicity, disability and many others.⁸⁹ If not addressed properly, inequality can affect not only economic growth but damages the efforts made to reduce poverty and eradicating people's sense of achievement and self-worth. This in turn can increase crime levels, deteriorate the environment and spread diseases all impacting people's health and wellbeing.⁸⁹ Studies revealed that community gardens can help reduce inequalities among people by accessing fresh produce,^{5, 24, 28, 29} empowering communities,^{24, 29, 60, 78} providing financial benefits and improving immigrants' health.^{8, 22, 58, 77}

Access to fresh produce

Other than increasing fresh fruit and vegetable consumption, community gardens are looked at as a neighbourhood platform to access fresh produce, overcoming food deserts and high prices of fruits and vegetables. Community gardens can address issues regarding food insecurity and poor food literacy especially in disadvantaged neighbourhoods. Armstrong²⁹ reported that the gardens were a source of fresher and better tasting food for gardeners as well as a food source for low socio-economic neighbourhoods.²⁹ Similar findings were reported by Hanna et al. investigating the outputs of community gardens, 39 out of 44 participants stated having access to fresh fruits and vegetables through the ability to grow them in their community garden.²⁴ Out of 93 gardeners from 20 different gardens in St. Louis, USA, 35.5% of participants indicated that access to fresh produce was a major benefit of the gardens.²⁸ Adults are not the only one gaining access to fresh produce, youth participating in community gardens in Michigan, USA reported having an easy access to a large variety of fruits and vegetables.⁵

Community empowerment

Julian Rappaport introduced the notion of empowerment in social work and psychiatry. He described it "*as a process: the mechanism by which people, organizations, and communities gain mastery over their lives*".⁹⁰ Apart from connecting people, community gardens encourage participation in decision making and taking active communal roles.^{24, 29, 60, 78} The viability and sustainability of the gardens rely on collective decisions which cannot be achieved without different individuals positively interacting with each other and working their collective interest to overcome different issues the gardens face over time.^{24, 60} In some neighbourhoods, this interaction went beyond the garden's extent. Some neighbourhoods reported increased social cohesion, reduced littering, and crime watch efforts.²⁹ Connecting with people, participating in decision making and targeting local issues are all empowerment processes involved in gardening, that contribute to empowerment outcomes such as enhanced health, social networks and wellbeing.⁷⁸

A corner stone in immigrants' health

Immigrants are vulnerable groups of people trying to adapt to a new environment. Today, countries have developed policies to ensure legal, safe and orderly migration but WHO states that more work is required to protect migrants' rights, treat them equally and care for their socioeconomic wellbeing.⁹¹ Studies revealed potential for community gardens to positively impact immigrants' health in different ways.^{8, 22} For example, the gardens provide a space where new immigrants can connect with each other²⁴ as well as with other citizens around them. Having access to their own garden to freely farm provoke a sentiment of belonging.⁷⁷ In a study about African immigrants in Queensland, Australia, participants stated *"In Africa, it is the citizens who have gardens, foreigners do not have gardens. Now I have a garden, I feel like a citizen"*.⁷⁷ This clearly denotes a perceived link between land tenure, gardening and becoming a citizen. The bond between human and earth is very important for many cultures, being able to produce familiar crops provided comfort and relief for many immigrants.⁷⁷ It also made building relations with others easier. Gardening is a skill they master, resulting in harvesting good crops, which they can confidently share with neighbours from different backgrounds.⁷⁷ Wen Li et al.⁵⁸ explained the psychological importance of gardening. It *"is a mean of putting down roots, of rethinking the self and making a place of one's own"*.⁵⁸ Immigrant gardeners tend to *"repair the biographical disruption and loss of domestic control by establishing biographical continuity across time and space between past lives and their present ones"*.⁵⁸ With appropriate access, it is easy for immigrants to recreate familiar scenes, habits and activities from their past than recreating the past itself.⁹² It reflects a deeply rooted world in immigrants home, where they felt happy and protected.⁵⁸ Moreover, gardens were reported to be a place of control over land by shaping, fostering and nurturing it, as well as control over the domestic setting. In Wen Li et. al's⁵⁸ study about Chinese immigrants in New Zealand, a participant stated that *"The garden is a place where we can control our vegetables. My daughter and my grandson sometimes make me angry. My vegetables never did"*. Sandler et al.⁹³ succeeded in reconnecting Native American youth to their culture through gardening interventions.⁹³ In addition, gardens took a supplementary aspect, filling gaps in immigrants' diets. As immigrants tend to settle in "food deserts" areas⁹⁴, access to fresh fruits and vegetables is limited and expensive.⁹⁵ Gardens provided the chance to plant and eat culturally appropriate food that is often expensive, if found, in supermarkets.²² A participant in a study done by Wakefield et. al in south-east Toronto cited *"We were part of a different country [...] our taste is related to our products [...] I grow our country's spinach in my garden"*.²² Finally, gardens serve as an escape from daily stress that immigrants face. In the gardens, they talk their native language, without stress, pressure and most importantly, without feeling judged by others.⁵⁸

Financial Benefits

Community gardens can provide a partial source of income. Few studies investigated gardening and planting crops to earn money.^{8, 24, 96} However, further studies are required in this field and development of appropriate measuring tools is essential.⁸ Growing and harvesting fruits and vegetables have the potential to bring a financial income to the gardener's family. In a study about community gardens in Philadelphia, few participants gardened for profit²⁴ whether directly selling the crops or using herbs collected from the garden to create a product and sell it. Although most of the gardeners were not selling their produce, they were substituting store bought food with garden grown produce.⁵⁸ This way reducing their costs and expenses on food, as community gardens provided cheaper access to fresh fruits and vegetables.^{22, 58} A study conducted on a rural garden also noted that women in Mali increased their purchasing ability through gardening activity and gained control over their income and expenses.⁹⁷

2.3.3 Climate action and life on land

To this date, 186 countries have ratified the Paris agreement on climate change adopted during the Conference Of the Parties (COP 21) in 2015.⁹⁸ The summit quickly became a landmark in the history of fighting climate change as for the first time, all nations came together to take action and reduce climate change impact and take further measures to protect the environment. Everyone is affected by climate change. Weather conditions are quickly changing, sea levels are on the rise and green gas emissions are the highest to be recorded so far.^{99, 100} Sustainability cannot be achieved by only ensuring equal health opportunities to everyone or by reducing economic disparities between population. Environmental issues need to be addressed as well. SDGs 13 and 15; climate action and life on land; urge to combat climate change and point out the need to protect, restore and promote sustainable use of terrestrial ecosystems by protecting biodiversity and sustainably managing natural environments. Other than providing varied health outcomes, a community garden doubles as a green zone and open space to interact with nature. It can serve as a platform to educate and raise awareness about the environment and climate change, for different age groups.²⁵ Gardens can help people reconnect with nature and restore the human ecological connection²⁴ hence promoting healthy environmental behaviour within cities. Moreover, Nova et al.⁶¹ showed that urban organic gardening practice in community gardens was associated with an improvement in individual behaviour and an increase in environmental awareness levels.⁶¹ People engage in environmental-friendly activities such as recycling, composting and encouraging green transportation method which eventually lead to improvement in air and water quality, better waste management and reduced greenhouse gas emissions.⁶¹ However, further studies are needed in this field. Furthermore, a community garden is a hosting body to a diversity of species such as bees, butterflies, worms and birds that in turn form the start of a diverse and healthy ecosystem chain. It encourages life on land within urban settings and reduce the loss in biodiversity.¹⁰¹ The presence of native flora in the garden can attract native animals and invertebrates to this ecosystem,¹⁰¹ hence playing a role in protecting and preserving the native environment.¹⁰¹

2.4 Gardening: the risks

With the spread of community gardens and their use in different countries, concerns over usage safety started to emerge in the literature, with some studies focusing on gardening risks over the last few years. Community gardens are places where people have direct contact with land, vegetation and a variety of agricultural products and manure. For safe usage and effective implementation of community gardens as a health promotion strategy, it is important to take into consideration all possible risks.

Soil contamination

Garden's plots are subject to contamination by various factors impacting soil quality. A common one is soil contamination by heavy metals such as lead (Pb), metal, arsenic and cadmium. It is a topic studied and observed in many gardens.¹⁰²⁻¹⁰⁸ In the US, a Los Angeles project studying over 12 different urban gardens shared concerns about the soil quality.¹⁰² While on the eastern side of the country, 44% out of 54 gardens in New York had at least one soil sample containing lead above its guidance value.¹⁰³ A high lead abundancy was found in studies conducted in different countries including Australia.¹⁰⁴⁻¹⁰⁸ Studies have showed a strong link between the level of soil contamination and the history of the land site. Heavy metals and toxicants are abundantly found in sites that witnessed detrimental human activity such as fuel, coal and oil combustion, waste incineration, industrial waste dumping and the use of paint with high lead concentration.^{8, 103} Another factor influencing soil and produce quality is the location of the garden in the urban setting.¹⁰⁹ Gardens built near highways, busy intersections and heavy traffic roads were found to absorb chemical elements derived from particles present in the urban environment¹⁰⁹ and accumulate them on leaves, stems and crops. Once watered (by rain or by gardeners) those chemical elements are then absorbed by the soil and contaminate it.¹⁰⁹ Other studies found that different crops have different absorption properties of various chemical elements and are affected by the characteristics of the adjacent urban environment.^{110, 111} Also, road proximity can increase soil contamination as rain water can run off the road to the adjacent soil and carry with it several chemical agents such as acid, grease, oil and heavy metals.¹¹²

Poor gardening practices

Another risk to participants in community gardens is the lack of awareness and proper knowledge of good and safe gardening practices.^{8, 28} Studies showed that the usage of copper chromate arsenate (CCA) wood in building raised soil beds in some community gardens is harmful for the gardeners consuming crops harvested from those beds as the copper, arsenic and chromium used to treat the wood can diffuse in the surrounding soil used in high raised bed with CCA treated wood.¹¹³⁻¹¹⁵ Other hazardous risks poorly reported in community gardens are the use of chemical pesticides and fertilisers, crops consumption without washing, lack of hands hygiene post-gardening and bad posture while gardening for older adults.^{28, 116, 117}

2.5 Gardening: barriers and facilitators

Community gardens are becoming popular due to their health, economic and environmental benefits. Promoting health through a community garden has a lot to offer. Literature reported several factors that can render the gardens more appealing to participants and others that can form a barrier to participation and reduce its rates.

Facilitators

A common facilitator found was the garden's proximity to the gardener's houses.^{22, 118} Community gardens located in a proximity to gardener's houses not only witnessed higher visit's frequencies compared to gardens located in a distal location from the gardener's houses²² but also visits from different groups of people such as children, families and people with disabilities.¹¹⁸ Another factor found to increase participation is the accessibility level to the garden.¹¹⁸ In an intervention study in El Paso, Texas, accessibility to the garden was increased by effective space management as well as by providing access to different marginalised groups (ramps for people with disabilities were installed in the garden and high bed soils were used for plots).¹¹⁸

Barriers

Few studies reported on barriers to participation in gardening activities. In a sample of 169 gardeners, Ornelas et al.¹¹⁹ reported low levels of self-efficacy (80%) and behavioural capability (82%) related to gardening as a barrier to participation.¹¹⁹ The study measured self-efficacy and behavioural capability based on the social cognitive theory where self-efficacy referred to the level of a participant's confidence in their ability to complete a task while behavioural capability referred to their ability to perform a behaviour through essential knowledge and skills. Other barriers mentioned in the literature were the weather, lack of support and information, funding and lack of resources.^{22, 118-120}

However, gardeners' participatory behaviour alongside with barriers and facilitators to gardening remain an understudied part in the literature. If we are to successfully design community gardens and implement health promoting strategies towards sustainable urbanisation, a thorough and detailed explanation of the underlying participatory mechanisms, its barriers and facilitators as well as an understanding of people's participation motives is essential. Therefore, this research aims to address this gap in the literature by investigating those factors from participants perspectives by answering the following research question:

RQ3-What are the barriers and facilitators encountered by the MQ community users when accessing and utilizing the garden”?

2.6 Gardening: health promoting universities

To promote health and reduce inequalities via community gardens, they need to be implemented in settings-based approaches since *"Health is created and lived by people within the settings of their everyday life; where they learn, work, play, and love"*.⁴⁸ Also, based on the socio-ecological model, to induce behavioural change, community garden interventions require integration at a micro level where individuals can directly interact with their environment. Those settings can be a variety of places such as schools, hospitals, universities and neighbourhoods. In 1986, WHO launched its *"Healthy Settings Program"* based on building healthy cities to improve the quality of life and help achieve equity and equality for all ¹²¹ as well as to integrate health promotion with sustainable development, marking the change from a problem-based (medical) approach to a settings-based (organisational) approach in health promotion.¹²² A part of that movement was launching the *"Health Promoting University (HPU)"* initiative in 1995, underlining the universities commitment to health, health promotion and education of students, staff and wider communities.¹²³ Therefore, universities can form an excellent platform for urban agriculture interventions. In fact, the role that universities play in promoting health and ensuring a better future for everyone was once more established in the SDG's content. The SDGs not only recognise the importance of education in sustainable development but also highlight the need of research guidance to better implement different interventions.¹² It addresses universities as organisations and institutions with impact and influence on their environment.¹² In Australia, universities came together to work towards sustainability and health promotion.¹² The Sustainable Development Solutions Network (SDSN) - Australia/Pacific region - in collaboration with different Australian universities such as Macquarie University, University of Technology Sydney and Monash University published a guide for universities and higher degrees institutions to act and contribute in the realisation of the SDGs. In New South Wales (NSW), Macquarie university committed to the principles of sustainability and took a multi-levelled approach in developing a sustainable campus and shifting to a health promoting university. Part of this plan, MQ revitalised its garden and transformed it to a community garden accessible to staff, students and the wider community. The garden has potential to serve as a health promotion strategy encouraging healthy and sustainable behaviour. However, no research about its usage, demographics, participant's characteristics and participatory behaviour was conducted. This data is essential to better develop a gardening intervention and inform policy decision making about achieving sustainability through the implementation of community garden. The following research questions were developed to address this gap:

RQ1 *"What are the demographic characteristics, lifestyles and participatory behaviour of the MQ community garden's users?"*

2.7 Conclusion

This chapter reviewed the literature relevant to the research project elaborated in this thesis. It discussed urbanisation and reviewed why it is referred to as the challenge of the century. It looked at possible solutions to overcome this challenge and help ensure a better future for people and communities. Further, it presented urban agriculture, specifically community gardens, as potential health promotion intervention elaborating on what community gardens offer in terms of its health benefits and risks involved as well as listing participation barriers and facilitators. However, the literature presented related to community gardens in general. There is limited research on the benefits of community gardens in a university setting. This research projects aims to fill this gap in the literature by answering the following research question:

RQ2: “What are the benefits and risks perceived by the MQ community garden’s participants and how does gardening affect their overall health and wellbeing? (e.g. Physical activity, fruits and vegetables consumption...)”

Finally, this literature review discussed the influence of universities on the wider community and highlighted the important role they play in achieving sustainability by adopting interventions such as community gardens. The following chapter presents the methodology used for this research project. It describes in detail two studies designed to collect data to answer the research questions.

Chapter 3: Methodology

3.1 Introduction

The literature review in chapter 2 started by presenting the current trend in urbanisation and the role it plays in human development. It highlighted different environmental and health challenges occurring with population growth and urbanisation's rapid pace then linked it to an increase in Non-Communicable Diseases (NCDs), forming a major public health challenge. The review also underlined the interaction between health and environment alongside the importance of building supportive environments to improve people's health and promote wellbeing. Today, there is a growing body of evidence around urban agriculture and the role it plays in urban planning, improving the built environment, changing people's lifestyles and impacting their health. The previous chapter explored community gardens; a common form of urban agriculture as a potential solution to the lack of green spaces in cities, to reduce NCDs rates and to promote health. It dissected different health benefits and risks from participating in community gardens, as well as it listed various participation's barriers and facilitators. It explored the use of a community garden in a university setting and highlighted its capacity to serve as an effective health promotion strategy. Finally, chapter 2 pointed out the need to better understand individual's participation at the Macquarie university (MQ) community garden in order to develop guidelines and inform policy development for a health promoting university. This research project aimed to investigate the MQ community garden user's demographic characteristics and their understanding of perceived health benefits and risks. Also, it aimed to summarise the enablers and barriers in accessing and using MQ community garden. The findings of this research project will inform the development of recommendations and resources needed to increase the use of MQ community garden. This chapter provides an overview of the methodology used to answer the proposed research questions. It describes the research paradigm used and elaborates the methods used to collect and analyse the data.

3.2 Research paradigm

Historical context

In his book "The structure of scientific revolution", Thomas Kuhn; American philosopher; was the first to adopt the term "*paradigm*" to indicate a philosophical way of thinking in natural sciences.¹²⁴ Prior to that, French philosopher Auguste Comte proposed that the best way to understand human behaviour is based on experimentation, observation and reason established on experience. He defined a new worldview to research, *positivism* or *positivist paradigm*, adopting David Hume's theory of the nature of reality and Rene Descartes's epistemology. Hume believed in the use of senses to generate knowledge about reality¹²⁵ while Descartes, however, believed that reason is the best way to know what is true.¹²⁶ Hence, positivism affirms that what is true can

be observed empirically and explained with logical analysis and rejects previous metaphysics theories.¹²⁷

The rise of social sciences witnessed the emergence of a new paradigm; *interpretivist paradigm* (also known as constructivism) developed as a critique of positivism. Bogdan and Biklen stated that reality is socially constructed.¹²⁸ Guba and Lincoln noted that the interpretivist paradigm aims to understand the subjective world of human experiences and interpret the subject's own perspective.¹²⁹

Those two paradigms dominated the social sciences,¹³⁰ with the positivist paradigm implying the use of quantitative methods while the interpretivist connoted qualitative research methods. However, with research progress, several philosophers argued that it is not possible to acquire new knowledge and sense what is true in the real world by only empirical observations nor by only accounting for social reality. Philosophers and researchers such as Teddlie, Tashakkori, and Patton highlighted the need to combine different methods instead of diametrically opposing them in order to better understand human behaviour. Their efforts resulted in creating a new paradigm, the *pragmatic paradigm*, which support the use of mixed methods and seek to utilise all what could help with knowledge discovery.¹³¹⁻¹³³ The strength of this paradigm lays in its combination of qualitative and quantitative methods that together allow a better understanding of participant's actual behaviour, beliefs, motives and perspectives that drove those behaviours as well as their anticipated consequences.

Therefore, this research adopts the pragmatic paradigm with a worldview that grants the use of mixed methods to best suit the purpose of the study itself which in this case is to understand the MQ community garden demographics, their opinions about the benefits and risks of participating in the garden as well as the motives that stand behind their participatory behaviour. It seeks to explore participants' individual experiences as well as measure their social and lifestyle behaviours.

3.3 Research design

This research used a mixed methods approach and consisted of two studies. Study 1 was a cross-sectional survey developed to investigate MQ community garden users' gardening behaviour. Study 2 used a qualitative approach to explore MQ community garden users' gardening experiences. Both studies are described in more detail below.

3.3.1 Study 1: a cross-sectional survey

Survey is a common tool used to gather data in scientific research¹³⁴ due to its relatively quick data collection, low costs and the possibility of measuring multiple variables and outcomes at a single point in time. This survey was chosen as a data collection tool to answer the following research question:

***RQ1:** What are the demographic characteristics, lifestyles and participatory behaviour of the MQ community garden's users?*

Development of the survey

The survey was developed using the MQ Qualtrics online platform (Refer to [Appendix 1](#) for a copy of the survey). It contained five main sections which included questions about: 1) gardener's engagement with the MQ garden; 2) networks and social connections; 3) the gardener's fruit and vegetable consumption; 4) the gardener's physical activity related behaviour; and 5) the gardener's demographic characteristics. All these sections are described in more detail below. Table 3.1 provides an overview of survey questions and sources used.

Gardener's engagement with the MQ garden. This section contained questions about the gardeners' past experiences in gardening and their current participation in MQ community garden. It included a set of six questions specifically developed for this study and covers the gardeners' visits frequencies, the main activities performed at the garden and the kind of crops grown in their plots. It also asked about what the gardeners harvest from their plots and how/where they use this produce.

Gardeners' fruit and vegetable consumption. This section examined gardeners' fruit and vegetable consumption by using the food frequency questionnaire (FFQ) developed by researchers at Newcastle University as part of the Australian eating survey (AES). This tool was validated by comparing it to the Weighed Food Record (WFR) with a median ICC = 0.47.¹³⁵ The FFQ was recently developed to examine dietary behaviours in adult Australians over a six month recall period¹³⁵ and contains 120-item grouped by different food subgroups as follow: drinks, breads and cereals, dairy food, main meals, sweets and snacks and fruits and vegetables. When completed, the AES allow us to calculate the "Australian Recommended Food Score" (ARFS). For the purpose of this study, only the fruits and vegetables subgroup was considered, encompassing 20 vegetables' and 12 fruits' items.¹³⁵ Each item-question requires an individual response that can range from "never" consumed to consumed "4 or more times per day" and upon which grants a score point as shown in table 3.1 below. Briefly, most items were assigned one point with additional points awarded for increased consumption of vegetables. The ARFS is obtained by summing all the scored points within the food subgroup and reflected the variety of fruits and vegetables consumed as shown in table 3.2 below.

Table 3.1 Scoring for the ARFS

Food group	Items giving 1 point	Items giving more than 1 point	ARFS
Vegetables	3–4 nightly meals with vegetables; ≥ 1 per week of each of the following vegetables: potato, pumpkin, sweet potato, cauliflower, green beans, spinach, cabbage or Brussels sprouts, peas, broccoli, carrots, zucchini or eggplant or squash, capsicum, corn, mushrooms, tomatoes, lettuce, celery or cucumber, avocado, onion or leek or shallots/spring onion.	2 points for $5 \geq$ nightly meals with vegetables	21
Fruits	≥ 1 piece of fruit per day, ≥ 1 per week of each of the following fruit: canned fruit, fruit salad, dried fruit, apple or pear, orange or mandarin or grapefruit, banana, peach or nectarine or plum or apricot, mango or paw-paw, pineapple, grapes or strawberries or blueberries, melon (any variety).	-	12

Table 3.2 ARFS scoring categories

	Needs work	Getting there	Excellent	Outstanding	Max points
Vegetables	<12	12 – 14	15 – 16	17+	21
Fruits	<5	5 – 6	7 – 8	9+	12

Gardener’s physical activity. The Australian physical activity and sedentary behaviour guidelines for adults aged 18 to 64 years old recommend an accumulation of 150 to 300 minutes of moderate intensity physical activity (PA) or 75 to 150 minutes of vigorous intensity PA or an equal sum of both.¹³⁶ It also recommends a similar value for seniors aged more than 65 years old however do not specify a certain minimum but rather advice to perform moderate PA for 30 minutes “on most days”.¹³⁷ For the purpose of this study, the two age categories were merged and looked at whether they succeed in accumulating 150 to 300 minutes of moderate physical activity per week. Two measures were used. The first was the Single Item Physical Activity Questionnaire (SIPAQ) (one week recall period version) developed by Milton et al.¹³⁸ SIPAQ is a simple tool that showed a good reproducibility (Spearman’s $r = 0.72$), accurately classified participants by meeting the recommended physical activity guidelines (Kappa= 0.63 95% CI 0.54 to 0.72) and compared to the Global Physical Activity Questionnaire (GPAQ), showed modest concurrent validity ($r = 0.53$).¹³⁸ SIPAQ was presented to participants as follow: “*In the past week, how many days have you done a minimum of 30 minutes of physical activity, which was enough to raise your breathing rate. This may include sport, exercise, brisk walking, cycling (for recreation/for travel). Please do not include housework physical activity that may be part of your job*”. Seven answer

options were provided ranging from “*once per week*” to “*7 times per week*”. Gardeners met or did not meet the guidelines based on the scoring in table 3.3 below.

The second measure was adjusted for this study in order to integrate the participant’s gardening time as part of their weekly physical activity and then look at whether gardening helped them meet the physical activity guidelines. Two questions were added to the survey to calculate this measure. The first asked participants to report how many gardening sessions they perform per week while the second collected data about the average time spent gardening during each visit. To calculate the total time spent gardening, number of sessions was multiplied by the average time spent gardening: “*total time gardening = number of sessions per week x average time spent per session*”. To determine the intensity of participants’ physical activity while gardening, the research candidate consulted the “Physical Activity Compendium – MET intensities”.¹³⁹ The Physical Activity Compendium assigns a metabolic equivalent (MET, 1 MET is defined as 1 kcal/kg/hour and is roughly equivalent to the energy cost of sitting quietly)¹³⁹ value to different forms of activity. “General gardening” has a MET of 3.8 METs assigned.¹³⁹ The World Health Organization (WHO) labels a moderate intensity any activity that has a MET value between 3 and 6 METs,¹⁴⁰ hence general gardening is considered a moderate level physical activity and matches the guideline requirements. The candidate then re-calculated the number of participants who meet the physical activity guidelines (this time including gardening activities) based on the scoring in the table 3.3 below.

Table 3.3 Scoring used for meeting the national physical activity guidelines

	Met PA guidelines	Did not meet PA guidelines
SIPAQ	Completed a minimum of 30 mins \geq 5 days/week	Completed a minimum of 30 mins < 5 days/week
Gardening as moderate PA	Total gardening time \geq 150 minutes/week	Total gardening time < 150 minutes/week

Networks and social connections. This section aimed to collect data on various dimensions of social capital at the MQ gardening community. The questions were derived from the Social Capital Integrated Questionnaire (SC-IQ) developed by the world bank.¹⁴¹ The SC-IQ addresses six dimensions of social capital and the questions were developed to generate quantitative data on various dimensions of social capital.¹⁴² Three of those dimensions were used to measure social capital in the garden as follow: Trust and solidarity, collective action and cooperation, social cohesion and inclusion. Each of the SC-IQ questions were drawn from prior survey on social capital where it has demonstrated its reliability, validity and usefulness¹⁴¹. Table 3.4 lists the questions used and their answer options.

Table 3.4 Measured social capital dimension, questions and answer options. Derived from the SC-IQ.

Measured social capital dimension	Question	Answer options
Trust and solidarity	In general, do you agree or disagree with the following statements: <ul style="list-style-type: none"> ○ Most people in the MQ community garden can be trusted. ○ Most people in the MQ community garden are willing to help me if needed. ○ In the MQ community garden, one must be alert, or someone is likely to take advantage of him. 	Seven items Likert scale: "Strongly disagree", "Disagree", "Somewhat disagree", "Neither agree nor disagree", "Somewhat agree", "Agree" and "Strongly agree".
	Since you started at the MQ community garden, have you worked with others to do something for the benefit of the garden?	"Yes, specify", "Maybe, specify" No
Collective action and cooperation	Please answer the following: <ul style="list-style-type: none"> ○ If someone went away for a week or more, how likely is it that other gardeners will take care of their plots? (e.g. weeding, watering, harvesting) ○ If there was a certain problem in the garden (e.g. water shortage, lack of tools), how likely is it that other gardeners will cooperate to try to solve the problem? 	Five items Likert scale: "Very likely", "Somewhat likely", "Neither likely nor unlikely", "Somewhat likely", "Very likely".
Social cohesion and inclusion	How strong is the feeling of togetherness or closeness in MQ community garden?	Five points Likert scale from 1 to 5 where 1 means "feeling very distant" and 5 means "feeling very close"

Gardener's demographics characteristics. The last section of the survey included questions to gather data about the gardeners' demographic characteristics. It consisted of six questions investigating the participants' age, gender, employment status, main spoken language and the number of people living in the household. Some of those questions were developed for this survey while others were taken from the Australian Bureau of Statistics (ABS) such as the employment status classification.

A full survey is presented in [Appendix 1](#). The survey was piloted with four people to test the understanding of the questions and the duration of the survey. Only minor wording changes were made. The duration of the survey averaged around 15 minutes.

Recruitment of participants

A *purposive sampling* was used to recruit participants for the survey. Singleton described it as a sampling method that selects cases based on their knowledge and experience with the studied phenomenon of interest.¹⁴³ In order to use MQ community garden, all potential gardeners need to register officially by filling a form and paying a small annual fee. MQ community garden president is responsible for the registrations and mailing list. There were 35 people registered as active gardeners at the time of this research project. There were a diverse group of people, including MQ University students, staff and members of the local community. Only registered members who use the garden were selected to participate in this research project. The survey was distributed in September 2019 and kept open until mid-October. First, MQ community garden president was contacted and informed about this research project. Then, a short description about this research project with a link to the online survey was distributed via the MQ community garden's monthly electronic newsletter ([Appendix 2](#)). Further, the link to an online survey was emailed to all gardeners via email by the garden's president ([Appendix 3](#)). In addition, the research candidate attended monthly gatherings at the garden so called "Working Bees", where printed paper-based surveys were distributed to participants as some of them may not have access to the online platforms. The mixed methods of survey distribution allowed to reduce the sample coverage error and give all participants a chance to be included.¹⁴⁴

Data analysis

The survey data was collected from two different sources: the survey's online platform (N= 4) and the paper-based survey version data (N=12). The paper-based surveys were manually entered into the Qualtrics platform by the research candidate, under a unique portal separated from the online filled ones. Then data was exported under SPSS format and the analysis performed with SPSS (V27.0.0). Once imported to the software, data was cleaned, organised and recoded. No missing data was found in the surveys. A descriptive analysis was performed on the six different survey blocks, starting with describing the sample demographics, followed by participation patterns, the end of harvested produce, physical activity, fruits\vegetables consumption and social capital. Scoring was used for the physical activity and the fruits and vegetables consumption and tabulation was performed where needed.

Ethical considerations

Macquarie University Human Research Ethics Committee granted the ethics approval (RE:5201955599785). The informed consent form was embedded in an online survey as a cover page ([Appendix 4](#)).

3.3.2 Study 2: semi-structured interviews

The second part of this research project aimed to explore the gardeners' experiences in participating in MQ community garden. Although quantitative data provided good information about participants gardening behaviour, their lifestyle and dietary intake, a qualitative approach was needed to explore in-depth gardeners' experiences. In particular, to discover the barriers and enablers to using the garden and the benefits and risks involved. Also, it aimed to explore the motives behind individual participation and gain advice on how to promote and advertise the garden in order to increase participation. The interview was developed to answer the following research questions:

RQ2) *What are the perceived benefits of the MQ garden and its impact on its users' health and overall wellbeing? (e.g. Physical activity, fruits and vegetables consumption...)*

RQ3) *What are the barriers and/or facilitators encountered by the MQ community garden users when accessing and utilizing the garden?*

The interview guide

Semi-structured interviews are a popular form of data gathering in qualitative research.¹⁴⁵ They allow in-depth understanding of the subject's own perspective and experience. Semi-structured interviews are based on an interview guide ([Appendix 5](#)) that covers a series of questions grouped by themes.¹⁴⁶ This research project aimed to explore four different areas through the interviews: 1) gardening perceived benefits; 2) gardening risks; 3) the barriers to participation; and 4) participation facilitators. Table 3.5 shows the different topics with question's samples.

Recruitment of participants

Similar to the purposive sampling method used in the survey, the interview followed a *sequential sampling* method. All the participants on the email list were invited to register their interest in participating in this study. The description of this research project (Study 1 and Study 2) was included in the monthly newsletter inviting participants to email the research candidate if they wanted to be interviewed. Also, gardeners who filled the survey were invited to register their interest to be interviewed at the end of the online survey. The participants were redirected to a different webform in order to ensure the anonymity. In addition, printed copies of the invitation were distributed during monthly "Working Bees" at the garden.

Table 3.5 sample questions of the interview guide

Main topic addressed by the interview guide	Question's examples
Visiting MQ community garden's benefits as perceived by participants	<ul style="list-style-type: none"> • What do you get out of your garden visits? • Could you describe your participation in the working bees?
Experienced facilitators to garden's visits	<ul style="list-style-type: none"> • What would make your visits to the garden easier? • What resources are available for you to use in the garden? What support do you require while gardening?
The potential for the garden as a health promotion tool	<ul style="list-style-type: none"> • Are you aware of any workshops or events that are happening in the garden now or have happened in the past? Did you attend? • How do you think MQ staff and students could benefit from participating in the garden?
Barriers to accessing the garden	<ul style="list-style-type: none"> • Based on your experience, what are the factors that might make you postpone or cancel your visits to the garden?

Procedure

Face-to-face semi-structured interviews were conducted to collect data between September and October 2019. The interviewees were informed that the interviews would be audio-recorded and were given the possibility to review and modify the transcript. All the interviews were conducted by a single interviewer- the research candidate. The interviews averaged around 30 minutes.

Data analysis

The investigator interviewed all gardeners who registered their interest and consented for the interviewing phase (N= 10). The research candidate randomly selected two professionally transcribed transcripts and compared them with the original audio recordings to assess accuracy.¹⁴⁷ Then, participants' names were removed to ensure confidentiality, and numbers were assigned instead for each transcript.

Thematic data analysis was used to search, review and report themes. This was guided by Braun and Clark six phases guidelines to analyse quantitative data.¹⁴⁷ First, the research candidate ran the audio records then read all the transcripts twice to familiarise himself with the data. Second, all the data set was electronically coded and collated using Nvivo by one researcher. Third, codes were merged into subthemes. Fourth, subthemes were merged into themes. The research team which consisted of the candidate and two senior researchers in public health met on a regular basis to review codes, subcategories and categories in order to increase the trustworthiness of the qualitative research findings.¹⁴⁸ Once satisfactory, the fifth phase consisted of refining those themes and reporting the data.

Ethical approval

This study had approval from the Macquarie University Human Research Ethics Committee (RE:5201955599785).

3.4 Conclusion

This chapter presented the methodology used for this research project. It outlined the pragmatic paradigm as the chosen lens driving this research. It then explained the overall research design and the different approaches used to conduct this project. This turned into explaining the two studies underlying this research, as well as the methods used to collect data (survey and semi-structured interviews). The following chapters present and discuss the findings of each of these studies.

Chapter 4: Results

4.1 Introduction

After discussing the research methodology in the previous chapter, chapter 4 comes to present the findings of this research project. First, it explores the survey results then illustrate the interviews findings. Chapter 5 will then present an elaborated discussion of those results.

4.2 Garden description

The Macquarie University (MQ) community garden is an urban community garden located at Macquarie Park, in suburban Sydney. The land is owned by the MQ and the garden stretches over 2550 m² of land and is limited from the north-west by a motorway (M2 motorway) and a suburban road from the south-east and south west. The garden has 70 plots divided into 40 individual ones, 17 empty plots, and 13 communal ones (marked with a yellow “X” on the map). Plots areas average around 14.5 m². The garden has a shed built for stacking tools and resources (marked with a red “X” on the map). This is where paper based surveys were kept for gardeners to fill out. The garden is fenced with a 2-meter fence and one main entry gate. The gate is locked at all times and a lock code is circulated between gardeners, so they have access to it at any time they want. The figure 4.1 shows an aerial view of the garden and figure 4.2, 4.3, 4.4, 4.5 and 4.6 show pictures from the garden. Only members manage the garden, they elect a president and treasurer for the administrative part. Annual memberships are used to fund the garden.



Figure 4.1 Aerial view of the garden – Source: Google earth 2019



Figure 4.2 A gardener's produce



Figure 4.3 Communal table where gardeners put produce to be shared



Figure 4.4 A communal plot



Figure 4.5 A gardener's plot



Figure 4.6 Garden's landscape

4.3 The Survey findings

4.3.1 Demographics

The study sample contained a total of 30 gardeners who actively participate in gardening activities at the MQ community garden. In total, 16 respondents completed the survey, with a participation rate of 53.3%. The participants were surveyed over a period of six weeks, most of whom were females (68.8%) and aged between 36 years and 65 years old (75%). The majority of the gardeners were local community members living in proximity to the MQ community garden (68.8%) while the other gardeners were staff working at MQ (18.8%) and non-local community members (12.5%) living in another neighbourhood and visit this garden as it is the nearest to them. Interestingly, no respondents indicated they were MQ students however the research candidate met few students during his weekly visits to the garden and during the “Working bees” (a communal workshops to take care of the garden). In terms of employment, 75% of the sample were employed while 25% were unemployed (out of which, 50% were retired). English was reported as the main language spoken at home (56.3%), followed by Farsi (25%) and Chinese (18.7%). When asked about the number of people living at the same household, 62.5% of gardeners reported living with one other person while the others shared their houses with more than two people. Table 4.1 shows the demographic characteristics of study participants.

4.3.2 Participation patterns in the garden

More than half of the sample (68.8%) reported they have been gardening in general (in different gardens) for more than 11 years. The rest of respondents (31.3%) had less gardening experience which varied from one to three years. When asked about the participation at MQ community garden specifically, 56.3% of gardeners reported that they have been gardening at MQ community garden for less than a year, while the others (43.8%) have been there more than a year with some stating 12 years (SD 48.5; IQ 25-75 [1.6-45]). When asked about the frequency of weekly garden visits, majority of the gardeners (62.5%) stated visiting the garden once to twice per week while other participants (25%) were visiting more frequently as per three to four times a week. Only two gardeners (12.5%) reported visiting the garden five times or more per week. The average time spent in the garden during each visit was about one hour and 45 minutes (mean: 105 minutes) and three quarters of the gardeners (75%) reported spending one to three hours per visit at the garden. In terms of produce grown at the garden, all respondents reported planting vegetables with majority also planting different varieties of herbs (68.8%) as well as flowers (68.8%). Planting fruits was less common with 18.8% of the sample reporting doing this. The above results are represented in table 4.1 below.

Table 4.1 Demographic characteristics and gardening experience of MQ Community garden members (N=16)

Variable	N	(%)
Gender		
Female	11	68.8
Male	5	31.3
Age		
26 – 35 years old	2	12.5
36 – 65 years old	12	75.0
>65 years old	2	12.5
Community		
MQ student	0	0.0
MQ staff	3	18.8
Local community member	11	68.8
Other (e.g. Non-local community member)	2	12.5
Employment status		
Full-time employment	8	50.0
Part-time employment	4	25.0
Unemployed	2	12.5
Retired	2	12.5
Language spoken at home		
English	9	56.3
Farsi	4	25.0
Chinese	3	18.8
People living at household		
2	10	62.5
3	3	18.8
4	3	18.8
Past gardening experience		
0 – 1 year	2	12.5
2 – 3 years	3	18.8
>8 years	11	68.8
Visits frequencies		
1 – 2 times per week	10	62.5
3 – 4 times per week	4	25.0
Nearly everyday	2	12.5
Nature of crops planted		
Vegetables	16	100.0
Herbs	11	68.8
Flowers	11	68.8
Fruits	3	18.8

	Median [25 th -75 th]	Mean (SD)
Present gardening experience at the MQ garden (months)	9.0 [1.6 – 45.0]	35.4 (48.5)
Visit duration (minutes)	90.0 [60 – 142.5]	105.9 (57.8)

4.3.3 Promoting good health and wellbeing

Fruit and vegetable consumption

Participants were asked about their fruit and vegetable consumption in the last six months with the aim to investigate the variety of fruits and vegetables consumed. Based on the Australian Recommended Food Score (ARFS), 56.3% of respondents achieved “excellent” or “outstanding” scores for variety in fruits consumed. However, only 37.5% of gardeners scored “excellent” or “outstanding” scores for variety in vegetables consumed. (Table 4.2).

Physical activity

In regards to the single item questionnaire used to capture data on whether participants meet the recommended national guidelines on physical activity for adults, more than half of the gardeners (56.3%) did not meet the recommended physical activity guidelines (defined as an accumulation of 2.5 to 5 hours of moderate physical activity per week). However, in the second measure used to calculate physical activity and which included gardening activities as part of the gardeners’ weekly physical activity levels, 56.3% of the sample met the physical activity guidelines. This highlights the importance of gardening in participants weekly physical activity (table 4.2).

Active transport

The gardeners were asked about their travel to and from the garden to investigate whether gardening promote an active lifestyle and hence a choice of active transport instead of motorised vehicles. The results showed that 62.5% of the gardeners preferred to use active method of transports such as walking and biking to travel to and from the garden (table 4.2).

Table 4.2 Healthy eating/Physical activity related behaviours reported by MQ community gardeners (N=16).

Variable	N	(%)
Variety of consumed vegetables		
Needs work	4	25.0
Getting there	6	37.5
Excellent	5	31.3
Outstanding	1	6.3
Variety of consumed fruits		
Needs work	2	12.5
Getting there	5	31.3
Excellent	6	37.5
Outstanding	3	18.8

SIPAQ		
Meet the guidelines	7	43.8
Does not meet the guidelines	9	56.3
Gardening as moderate PA		
Meet the guidelines	9	56.3
Does not meet the guidelines	7	43.8
Use Active transport to get to\leave the garden		
Yes	10	62.5
No	6	37.5

Social capital

Overall, the findings regarding social capital due to participation in the garden showed positive outcomes (Table 4.3). The first set of questions consisted of indicators about trust and solidarity that capture cognitive social capital. The majority of respondents agreed that they can trust others in the garden and reported that the more time they spend in the garden the more they get to know and trust the people in it. In the second set of questions used to capture collective action and cooperation in the garden, 93.8 % of the gardeners reported working collectively for the benefit of the garden and the community. Three quarter of respondents reported collaborative work and cooperation to take care of other people plots in their absence and get together to face arising challenges in the garden. Finally, social cohesion was also observed in the garden where 75% of the gardeners reported having a feeling of togetherness and closeness with each other in the garden.

Table 4.3 Descriptive analyses of three social capital dimension in the garden: trust, collective action and social cohesion

Variable	N	(%)
Most people in the garden can be trusted		
Strongly disagree	0	0.0
Disagree	0	0.0
Somewhat disagree	1	6.3
Neither agree nor disagree	0	0.0
Somewhat agree	2	12.5
Agree	8	50.0
Strongly agree	5	31.3
Most people in the garden are willing to help		
Strongly disagree	0	0.0
Disagree	0	0.0
Somewhat disagree	0	0.0
Neither agree nor disagree	1	6.3
Somewhat agree	3	18.8
Agree	5	31.3
Strongly agree	7	43.8
In the garden, one needs to be alert or someone is likely to take advantage of them		
Strongly disagree	5	31.3
Disagree	4	25.0
Somewhat disagree	1	6.3
Neither agree nor disagree	4	25.0
Somewhat agree	2	12.5
Agree	0	0.0
Strongly agree	0	0.0
More time spent in the garden, more trust		
Agree	15	93.8
Disagree	1	6.3

Have you worked with others for the benefit of the garden?		
Yes	15	93.8
No	1	6.3
Likelihood of other gardeners taking care of someone's plots in their absence		
Very unlikely	1	6.3
Somewhat unlikely	3	18.8
Neither likely nor unlikely	3	18.8
Somewhat likely	8	50.0
Very likely	1	6.3
Likelihood of people working together to solve a problem occurring in the garden		
Neither likely nor unlikely	4	25.0
Somewhat likely	3	18.8
Very likely	9	56.3
Feeling of togetherness		
1 – Very distant	0	0.0
2	1	6.3
3	12	75.0
4	3	18.8
5 – Very close	0	0.0

4.3.4 The use of harvested produce

Gardeners showed responsible environment-friendly behaviour when it came to what they did with their excess produce (Table 4.4). Four participants indicated that they never had excess produce, reducing the sample size of this section to 12 gardeners. Out of those, no one threw away any of their harvested produce. Instead, the majority of participants reported preserving their excess produce (58.4%) by preserving them in form of jams or pickles, others (41.7%) reported storing the excess produce (e.g. freezing it). Finally, one quarter of the gardeners (33.3%) reported composting any excess produce left.

No one reported growing crops to sell their produce and 75% of gardeners did not consider their plots in the garden as an income source. However, when asked whether participants consider that what they harvest from the garden impacts their weekly spending on fruits and vegetables, 56.3% of the gardeners stated that it reduced their weekly costs on fruits and vegetables and thus helped them financially.

Table 4.4 The use of harvested produce (N=16) and the end of excess produce (N=12) reported by the MQ community gardeners

Variable	N	(%)
Harvested produce end		
Consume it	15	93.8
Share it with others	14	87.5
Exchange it with others	3	18.8
Sell it	0	0.0
Rely on the produce as a source of income		
Yes	4	25.0
No	12	75.0
Harvested produce reduces weekly food cost		
Yes	9	56.3
No	7	43.8
Harvested excess produce end		
I never had excess produce	4	25.0
Throw it away	0	0.0
Share it with others	11	91.7
Preserve it	7	58.4
Storing it	5	41.7
Compost it	4	33.3

4.4 MQ gardeners' perceptions of the benefits of gardening and enablers and barriers to its access and utilisation

Nine gardeners participated in face to face interviews and one gardener was interviewed over the phone. Two of those participants were males and eight females. Participant's names were replaced with numbers for anonymity. Four main themes emerged from the thematic data analysis: 1) improving health and wellbeing; 2) Caring for the environment; 3) Experiential learning and skill development; 4) Obstacles and challenges to participation. each theme is explored and described below with quotes selected from the interviews to better illustrate the participant's perspectives.

4.4.1 Improving health and wellbeing

Mental health

The majority of gardeners considered gardening an important activity that positively contributes to their mental health state and wellbeing. Participants expressed being stressed throughout the day, especially due to work commitments stating that *"I have a stressful job"*, *"your daily work usually stresses you"*, *"before, I was tired and depressed"*. It helps them *"escape a lot of daily stress"* and brings comfort, happiness and relaxation to their lives. One participant had a unique approach to the garden, it gave him a sense of freedom and he enjoyed gardening activities as it formed a high contrast compared with his work tasks and duties, as he stated:

I work in a laboratory, it is a very sanitised, fluorescent light place and you need to be very careful. Here, [in the garden], it is the complete opposite... you don't have people at work or family nagging you, it is your own thing that you are doing, and it is kind of a fun thing. [Participant 9]

Another gardener stated that gardening made her feel good and helped her through the pain as she was diagnosed with cancer a few years ago but she is now cancer-free:

I always came [to garden], even if I was in pain. As it helped me mentally. After gardening, I felt good. [Participant 7]

Several gardeners expressed a positive connection with nature through gardening. They described the garden as a calm and peaceful place where they can get in touch with natural elements such as the earth, sun and wind. They enjoyed being outdoors. One participant who has been in the garden for seven month stated she was enjoying *"watching plants grow, watching how they interact with the seasons and thunders and everything"* while another participant said: *"really nice to sit there and ground yourself back into nature and get away from your computer screen."* This connection with nature and its importance to individuals alongside its impact on their mental health was even linked to different cultural beliefs and expressed not as an optional activity but rather an essential and irreplaceable one for some cultures. The following comment is an example of this:

“If you know Chinese medicine, you will know that to us, it is very important for us to get in touch with the earth and at the same time being exposed to the sun. it is very important. Not like... irreplaceable by anything else like a vitamin D pill.” [Participant 3]
Furthermore, the garden not only brought happiness and value to the participants but also helped them relax. They considered gardening as any other activity they might do to help them relax and calm their minds, for example:

I think it is like a sort of dose of good hormone really”; “it makes me relax. Like music. I love music and singing. I love- Like that.”; “it is similar to my yoga class”

[Participant 6]

Physical activity

More than half of participants emphasised the importance of physical activity. Gardeners showed a concern about their future fitness levels and autonomy during the interview. More specifically, they stated that they want to be physically active and independent when they get older and achieve daily tasks on their own and believed that gardening will allow them to achieve it. Some of them indicated feeling remarkably better and more energised after gardening activity. Some of them stated they were even visiting the garden when they felt down or tired as they knew that gardening would help them feel physically better. Statements such as the following: *“before I come here, I am so tired, I cannot do it. But then once I come here and do all of that activity, I feel much better physically”*, *“by the end of the day, I feel better, like I have done physical work”* [Participant 3] and *“it is tiring, but it feels good”* emerged several times during the conversations. Other gardeners believed that gardening actually contributed towards their fitness levels as well as their body musculature and physiology as it allowed them to perform different body movements with varied range of motions and intensities. They also stated that this kind of functional movement is absent from their daily activities, especially that within urban areas as they had more of a sedentary lifestyle, as an example of this:

“I do weeding and bush regeneration, so I think when o those kinds of activities you're using totally different muscles....stuff that you wouldn't necessarily think about doing, like being quite close to the ground and squatting and being on your knees They're not really activities that we do in our day to day lives and we're sitting at a computer or we're sitting on the couch, we're sitting at a dining table...are very important for mobility.” [Participant 8]

Fruits and vegetables consumption

When gardeners were asked about their diet in relation to fruit and vegetable consumption, the answers among them varied. Few gardeners did not feel any change in their fruit and vegetable consumption but some of them reported that gardening made them aware that they were not consuming enough fruits and vegetables. For example, *“I now know that I do not eat enough vegetables and fruits, someday I don't eat fruits at all.”* One gardener consumed good amounts

fruits and vegetables before starting gardening but had noticed a decrease in junk food consumption after. Two sisters who were living and gardening together believed that the increased fruit and vegetable intake was boosting their immune system. More specifically, they reported that one of them (the younger sister) started consuming higher amount of fruits and vegetables after gardening while the other (elder one) consumed less fresh produce and noticed that she was falling sick more often than her little sister.

Gardeners emphasised that planting their own produce was also a healthier alternative than buying it from supermarkets as they were aware of the soil quality and organic practices which they believed had an impact on their produce's quality. Moreover, the garden provided access to the produce which is not easily found or accessible due to high prices. The following comments are examples of this:

Like I've got a Bush tucker section in my native garden and I think that's probably the best one when thinking of food that you cannot get at the supermarket. [Participant 8]

Well fruits and vegetables are very seasonal here in Australia, you don't always find them and so the prices vary a lot. Such as cauliflower, I find it very expensive in here. [Participant 10]

Finally, several participants stated that because of their gardening practices, they were more willing to try and even plant vegetables that they would not normally consume. This was noted among adults as well as children. For example, some gardeners reported that their children were more willing to try new vegetables when they are get to play in the dirt and get involved in the planting procedure. Children were able to see how different vegetables were growing from seeds and how they finally end on their plates. The following quotes as an example of this:

It opens their [the children] mind a bit more for trying out fruit and vegetables. I mean, we grew radishes, and because of the fact they grew them, they wanted to try it. They hated it though! Ha-ha! And you can't really blame them. [Participant 9]

It is really nice to sort of try new things because I've tried different vegetables that I wouldn't necessarily, normally eat. [Participant 8]

Financial Benefits

Participants compared their produce to organic produce found on supermarket's shelves and on several occasions, stating the following: "*cheaper alternative*", "*organic more expensive in supermarkets*", "*cheap eating*". Also, gardeners found that growing their most frequently consumed fruits and vegetables in their garden is a good way to reduce their weekly spending costs on food. Some gardeners even reported planning to be completely self-sufficient in the future and were experimenting different techniques to do so. The following comment as an example of this:

I saw the prices of some fruits and vegetables that I usually consume a lot and they were quite expensive, so I thought it would be good to start growing them. [Participant 10]

I'd like to have a plot of different things that we like to eat and so then we can always just grow them and not have to ever go to the supermarket for most things.

[Participant 8]

In addition, one family of gardeners found that gardening increased control over their income, as they changed their habits as a family. They prefer spending more time gardening rather than spending money on other activities and purchases, as they stated:

We usually went to the shopping centre. Usually you'll spend. You lose your money and you lose your mind, because after you go back home, you're tired. You are exhausted after shopping. Now, on weekends, we come to the garden, we feel way better after and we do not even spend money! [Participant 5]

Social wellbeing

Participants reported going to the garden not only to take care of their plots but to socialise and get in touch with other people. They considered it an opportunity to expand their networks and make new connections. Moreover, the gardeners stated that the garden allowed them to discuss with fellow gardeners their common topics of interest such as health, daily life related issues, social events and different gardening practices. Also, newcomers and joiners stated that they visited the garden when other gardeners were around as they could meet them, initiate conversations, learn from their experiences and get to know how the garden works, the following comments as an example of this:

Yeah, it's nice to spend time with people, like minded individuals, ask them questions, learn things from them. [Participant 9]

I think it's nice to share your experiences, whether it's like, "Hey, this didn't work." Or, "Hey, I really found this worked." Or whatever it happens to be or just chatting to someone about their day. I think it's really beneficial for both people. [Participant 8]

The MQ community garden organises a working bee every first Sunday of the month. It is a communal workshop where gardeners get together and take care of the garden's space and communal plots. When asked about the reasons to participate in such activities, gardeners revealed a sense of responsibility towards their community of gardeners and a sense of belonging to it. Strong emotions such as guilt and letting others down were expressed in case the individual could not attend the workshop, the following quotes as an example of this:

Yes, I try to [attend working bee]. I just kind of feel compelled to do so. I mean I have my own plot, but there's a whole big area that also needs to be taken care of. So, we all need to take a part in that. If I don't come, I feel pretty guilty. [Participant 9]

I always make more effort to attend working bees, just to be a part of the community and involved in it.... I have been away for a while and was not been putting much effort in there, which is bad... and I... I regret that. [Participant 10]

Other benefits and Risks

The majority of the gardeners considered gardening as injury-free, low impact activity that they could do on their own pace. Few senior gardeners reported other benefits that gardening offered such as fighting the human aging process. Gardening made them feel younger. One of them (aged >65 years old) considered gardening the secret behind her youth as she stated:

“this is why I look younger than my daughters! Gardening keeps me happy and young!”
[Participant 6]

On a sidenote, none of the members perceived any risks from their participation in the garden.

4.4.2 Caring for the environment

Importance of green spaces and their sustainability

The majority of participants picked up gardening as a direct cause of living in a household that lacks a green space such as having no or a little backyard. The expression “live in a unit” was commonly repeated by different participants. They noticed a big change in their lifestyle after moving to Sydney and those who already lived in the city found it expensive to afford a house with a proper garden, so they lived in a townhouse unit or an apartment, for example:

In Adelaide, you can really have a house and not move far from the city and we had lots of birds and olive trees and stuff like that. It was lovely. In Sydney we realised that there is no way to have a garden if you want to live in a unit that you can afford [Participant 8]

The urban lifestyle had a big impact on their life, some described it as “a concrete jungle” and pushed them to seek refuge in a green space within the neighbourhood where they found the garden to be “sort of a rural lifestyle in the city.” Green spaces availability and accessibility within their neighbourhood was highly important for participants and allowed them to “be happy” and “escape the city and work stress” alongside the varied health benefits elaborated above. Participants felt that it was important to take care of the environment and were aware of the built-environment’s impact on their health especially in terms of food consumption and environmental factor. They would take good care of the soil quality as they know it will impact their crops and in return their health. They would also think of their food journey before reaching their tables. For example:

I am now really conscious of making sure that I eat my Own produce because I know what is going into the soil and I know there are no chemicals. [Participant 4]

I don’t like the whole idea of things being shipped and trucked and flown over from other countries. I think it is really bad for the environment and not sustainable. [Participant 8]

Taking care of the environment and ensuring a balanced ecosystem was perceived as “*a win-win situation*” for the community, the university, and all the animals within this shared ecosystem. This even spread to an intergenerational thinking and planning as three gardeners considered planting fruitful trees an activity that allowed them to leave something behind for the future generations the same way themselves harvested what their ancestors left for them, as one gardener stated:

You should always plant for the next generation. We reaped the rewards of others, somebody grew for us, we grow for somebody else. [Participant 6]



Figure 4.7 Using organic manure to enrich the soil quality

Sustainable practices

Gardeners reported different ways to protect the environment via adopting sustainable practices in their day to day activities such as 1) consuming local food and encouraging local produce, 2) building shelters for different species especially those endangered such as bees and frogs, 3) collecting food waste and using it for compost and 4) using public transport and active transport methods when possible such as bus, train, bikes or even walking. They also stated different sustainable gardening practices such as prioritising organic agricultural practices to enhance their soil quality and improve their produce (figure 4.7). They avoided using artificial fertilisers or pesticides and replaced them with natural fertilisers such as worm juice. They even used chickens to naturally manure the soil and remove weeds (figure 4.8). Some examples from the interviews are as follow:

When you are growing tomatoes, you have to rotate because otherwise you are drawing too much nitrogen out of the soil and you won't get a good crop the next year. So, I like to give the soil a break. [Participant 8]

Gardeners also showed a high level of awareness about climate change and the damage caused to the environment. During their time at the garden, they tried and experimented different techniques to fight climate change and planted produce in a sustainable way. They trialled different type of crops which were the most resilient to harsh climate conditions. They looked at crops not requiring a lot of resources to maintain, especially when it came to scarce resources such as water. For example, one gardener stated:

I am always experimenting which are the strongest, which ones can I only water once a week and they still keep surviving, which I think is really important in Australia considering we do not have a lot of water all the time. [Participant 8]



Figure 4.8 using the chicken to weed the soil

4.4.3 Experiential learning and skill development

The more time gardeners spent at the garden, the more they learned from it. One gardener stated that being present at the garden watching plants' journeys from seeds taught her patience and realised that effort is always rewarded. During their time at the garden, participants observed its different ecosystems. They observed and learned how different elements of an ecosystem would interact with each other creating a state of balance. They also noticed how human action may disturb the ecosystem's balance. They experienced the benefits of a balanced ecosystem on the environment and even on their harvest season. Moreover, when the balance was broken, gardeners took different initiatives to try and reinstate it. They learned the importance of different elements of the fauna and the flora as well as they saw direct consequences, whether good or bad, of their interference with a specific ecosystem. For example:

We had so many tomatoes but then the rats came and they decided that it was a delicious feast... I ended up planting mint.... I found that the rats don't like mint... you've got to be

careful because I don't think lady bugs like mints. So, if you've put mint in one area, they might not really go to that area very much... [Participant 8]

The majority of the gardeners learned through trying and experimenting and sharing their success stories with other gardeners hence developing their gardening skills and capacities.

The garden was also seen as a learning platform for kids where they got a chance to interact with nature and learn from it. It provided them with a natural space to play and grow. One third of participants reported bringing their kids to the garden as they saw it beneficial for their growth and development. At the garden, the kids need to be aware of their surroundings, use different senses, assess situations and calculate risks. The following comment as an example of this:

They're [the kids] getting a bit of sun, exercise, they'll get stung by stinging nettle... They're not like bubbled in a flat where nothing can harm them. I mean, they got to watch out for bees. I've told them there's snakes here. I'm telling them, all right you got to watch out for these things. So, they get a bit more in tuned with some nature. [Participant 9]

Moreover, gardeners with children used the garden to teach their children different skill sets that can set them up for future stages in life. They reported teaching their kids patience, responsibility and work ethics, for example:

I actually give them a little bit of money if they're working. So, if they're doing weeding I'll give them a little bit of money, as well just to kind of get a bit of a work ethic there as well. [Participant 9]

My mom bought them some plant to teach them to water them on a regular basis and things like that. [Participant 4]

4.4.4 Obstacles and challenges to participation

The majority of the gardeners only visited the garden over the weekend, few would visit during weekdays. There was no specific pattern noticed in garden visit schedules other than the seasonal impact on visits' frequencies, as people visited the garden more often during summer than in winter. On one hand, factors such as work, family, children, lack of support, sickness and even cultural beliefs were reported as barriers for the weekly visits to the garden. On the other hand, having their own plot instead of shared communal ones motivated several gardeners to attend the MQ community garden. The following comments as example of this:

They come during weekdays; I think it's a culture thing. Very cultural thing for Chinese during the weekends. Especially if their kids have the grandchildren [Participant 3]

I think having your own plot is a motivator. Because there are some community gardens where you can't have your own plot. Like they just don't have space [Participant 4]

It is worth mentioning that the majority of gardeners first started gardening because it was an activity that reminded them of past events in their life, such as their childhood or their mother's garden. It is something that they acquired long time ago and feel comfortable doing it, as some gardeners stated:

I liked gardening since I was a little kid. Just getting seeds from the kitchen and just throwing them in the ground. [Participant 9]

Since I was a kid, my mom had a beautiful garden. [Participant 10]

When asked about resources available at the garden, opinions varied. Some gardeners thought that there were not enough resources especially in terms of information and learning material while others considered enough resources being available such as tools. However, many agreed that the garden lacked proper funding. In addition, the immigrants at the garden found language to be an important barrier to their participation in the garden.

Finally, a common theme that came up during the interviews was volunteers' roles at the garden. The MQ garden has a president who volunteers to take care of the garden and a treasurer who volunteers to sort out financial matters. Some gardeners thought that there were no issues at the garden and no major things to change. However, other gardeners reported facing several issues regarding management of the garden such not finding available support at the garden, waiting too long to hear about a request they made about a plot, a prolonged delay time in fixing broken items at the garden and a lack of organisation in the monthly working bees and the casual workshops as some participants stated the following:

I think that support aspect [is missing] and it would be good to know like where we stand with the plots, because we've asked quite a few times. They haven't got back to us. [Participant 4]

We haven't had it fixed yet. [Participant 5]

Chapter 5: Discussion

5.1 Introduction

This chapter discusses the study's findings and make recommendations for improving participation in the Macquarie university community garden, alongside recommendations for future research. This research project conducted a formative evaluation of the Macquarie (MQ) community garden by exploring the participation patterns, including enablers and barriers, and benefits of the participation. It identified the various factors that had an impact on garden participation. This research project consisted of two studies: a cross-sectional survey and semi-structured interviews with the MQ community gardeners, answering the following research questions:

“What are the demographic characteristics, lifestyles and participatory behaviours of the MQ community garden users?”.

“What are the benefits and risks perceived by the MQ community garden participants and how does gardening affect their overall health and wellbeing?”

“What are the barriers and facilitators encountered by the MQ community garden users when accessing and utilising the garden?”

Earlier in this thesis, Chapter 1 developed a socioecological model for the garden (Figure 1.2), alongside an explanation of the garden's microsystem (Figure 1.3). Then, the study explored different lifestyle components within the garden's microsystem based on their contribution to the sustainability dimensions: promoting health, improving the economy and protecting the environment. The corresponding findings were reported in Chapter 4. In this Chapter, I discuss and interpret the results guided by the SEM developed for this study, nesting thoughts on the individuals' level (microsystem), communal level (mesosystem) and then the policy level (Exosystem). Figure 5.1 incorporates this discussion's sections within the SEM.

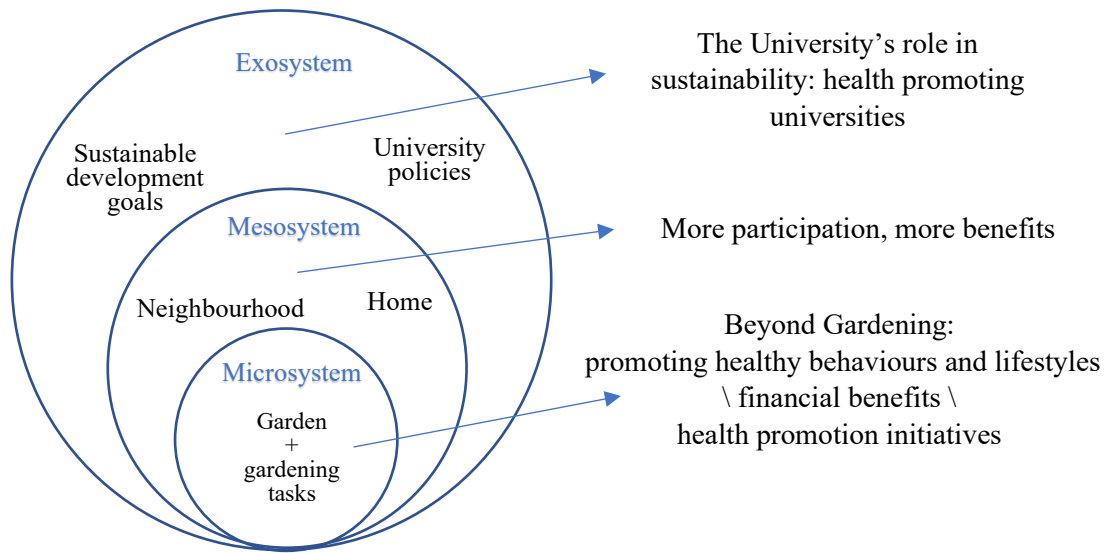


Figure 5.1 A visual presentation linking the discussion to the Socio-ecological model

5.2 Summary of key findings

Varied groups of people participate in the MQ community garden such as MQ students, staff, and local community members. Age categories and gardening experiences varied within the sample and individual lifestyles shaped participation's frequency in the garden. Overall, gardeners identified many benefits that they received from the participation in the garden. Health benefits were strongly present; gardening was found to affect participants health by enhancing their diet, increasing their physical activity and improving their mental health and social wellbeing. Participants thought of gardening as a self-paced activity, thus no risks or injuries has been reported. Those findings were present in both studies. On one hand, several barriers to participation have been identified through the interviews such as work, family, sickness and lack of support at the garden. On the other hand, a 24/7 access and owning your own plot at the garden motivated people to join and participate at the garden.

5.3 Beyond gardening: promoting healthy behaviours and lifestyles

A direct reason for using the garden was to gain access to fresh and healthy produce. Participants enjoyed gardening and took good care of their plots, as they were aware that the quality of their produce directly related to the quality of their plots. The gardeners saw in their harvested produce a healthier choice than what they could obtain from supermarkets, as their produce was fresher and organic. Similar results were found in different studies such as the "LA Sprouts" project by Gatto et al. stating that gardens offer access to fresh fruits and vegetables.³⁰ Also, gardening made participants more aware of what they are consuming and whether they are consuming enough fruits and vegetables. Interestingly, gardeners of the MQ community garden did not report an increased consumption of fruits and vegetables or a change in their diet before and after gardening despite it being strongly present in the literature.^{25, 28, 68, 71} This implies that gardening may not have an impact on fruit and vegetable consumption. However, it is important to note that this project did not measure participants actual fruits and vegetables consumption from a quantity

perspective but rather measured the variety of fruits and vegetables consumed as this has not been previously explored. Finally, all the gardeners grew vegetables in their plots while only 18.8% of the sample grew fruits. However, 37% of the sample scored a good variation in vegetables consumption against 56% who scored a good variation in fruits' consumption. This suggests that gardeners purchased most of their fruits consumed in comparison to vegetables, which in return allowed a varied consumption of fruits.

An important contribution offered by gardening is its potential to increase food literacy in different age categories. In a recent study, Alaimo et al. associated gardening to some aspects of food literacy.¹⁴⁹ Similar results were found in the present study indicating that gardening can help increase food literacy. This includes food and nutrition knowledge and skills by providing an access to fresh fruits and vegetables, teaching children about where their food comes from, increasing their preferences to try new vegetables and fruits, consuming less junk food, increasing both adults' and children's awareness about food waste and its management and preserving the excess produce for future use. However, in order to increase food literacy, it is also important to have a good understanding of the dietary guidelines, factors impacting food choices and how to prepare and cook healthy food. Hence, a combination of cooking and gardening sessions at a local community garden can be beneficial in terms of increasing food literacy.

Less than half (43.8%) of the participants met the physical activity guidelines when measured by the Single Item Physical Activity Questionnaire (SIPAQ) (only measuring leisure time physical activity). People meeting the physical activity guidelines increased by 12.5% when gardener's "total time spent gardening" was counted as a contribution to their weekly physical activity levels. On a side note, the percentage of people meeting the PA guidelines would further increase if their leisure physical activity was summed with their time spent gardening. This study allowed a calculation of gardeners' physical activity level and highlighted gardening contribution to participants physical activity levels despite using a subjective measure to acquire a basic understanding of individuals physical activity. More importantly, the Australian Physical Activity Guidelines recommends an accumulation of a minimum 150 mins of exercise throughout the week at the equivalent of >30 mins per day.¹³⁶ Gardeners, however, spent their time gardening in 1 to 2 visits per week. Hence, they do not accumulate their physical activity levels on a daily basis but rather accumulate it over one or two gardening sessions per week.

So, the question remains in whether gardeners gardening in 1 or 2 sessions per week would still gain the same health benefits compared to individuals who exercise on a daily basis. Earlier this year, Murphy et al.¹⁵⁰ published a meta-analysis including 19 studies (total participants N=1080), comparing the effects of continuous to accumulated exercise on health.¹⁵⁰ They found no difference between the two groups in terms of effects on fitness, blood pressure, lipids, insulin and glucose as opposed to small evidence for changes in body mass and low density lipoproteins cholesterol to accumulated exercise's advantage.¹⁵⁰ Despite these findings, there is still a need for

quantitative research and interventions in terms of gardening and its impact on individuals' physical activity levels, as reported time spent in the garden can be a combination of the actual work, breaks, or even time spent socialising. Tools as accelerometers, pedometers and energy expenditure measures can be used to accurately evaluate this data.

Interestingly, interviews revealed a common concern expressed by gardeners about their future fitness levels and autonomy, as they wish to maintain a good musculature and keep their independence while aging. The majority of the sample (75%) were aged between 36 and 65 years old and 12.5% were above 65 years old. As people get older, injuries and health problem start arising such as sarcopenia,¹⁵¹ osteoporosis¹⁵¹ and osteoarthritis.^{152, 153} Hence, physical activity becomes essential for adults and seniors.¹⁵⁴ Gardening is in fact providing exercise, alongside a social aspect by connecting with other members at the garden, which also fall as a need for the same group of people, since the more a person age, the more they there are at risk of loneliness and isolation.^{155, 156} This makes gardening a promising intervention targeting vulnerable senior populations. This is especially important in developed countries where population demographics are shifting towards an aging population such as Australia,¹⁵⁷ Japan,¹⁵⁸ Italy,¹⁵⁸ Germany.¹⁵⁸

Two thirds of the sample used active transport methods such as walking or biking, however this can be simply due to the proximity of the garden to their households. Nonetheless, this is important when planning gardens in urban areas, as the location plays a major role in participation rates. Furthermore, gardening showed an impact on participants' energy levels and body musculature as they reported feeling more energised after gardening alongside maintaining a good musculature and a good range of motion. This matched the literature where gardening improved gardeners physical health,²⁸ improved fitness level and fought aging outcomes.⁵⁹ However, it is important to note that these studies were qualitative; therefore, there is a need for longitudinal studies in order to draw such conclusions. Yet, this does not deny the fact that gardening has certain impacts on individuals' fitness levels. Bearing in mind that it might not be fighting sarcopenia and increasing muscle mass, gardening can still provide benefits by gently activating blood flow, encouraging recovery, and releasing post-exercise hormones such as endorphins. Future research is needed to explore the hormonal levels post gardening and their similarity to hormonal levels post resistance workout and conditioning. Having said that, such a study would need resources and funding to measure blood samples and hormonal levels. A better alternative would be using psychological tests and surveys to determine post hormonal secretion in the body.

In conclusion, consuming a nutrient rich varied diet; increasing food literacy; increasing physical activity; improving physical health and using active transport all fall under lifestyle behaviours. Gardening can have a significant impact on participants lifestyles, promoting healthier ones which in turn can directly affect people's health. Today, we know that our lifestyles can contribute significantly to our health. For example, unhealthy lifestyle choices and behaviours have been associated with increase of Non-communicable diseases (NCDs) such as cardiovascular

diseases,¹⁵⁹ diabetes,¹⁵⁹ cancers, mental health, obesity¹⁶⁰ (NCD's risk factor) and digestive health.¹⁶¹ Consequently, promoting healthier lifestyles and driving better individual choices is essential. Taking the best advantage of activities such as gardening and incorporating them in local communities is therefore beneficial to promote healthier lifestyles.

5.4 Beyond gardening: financial benefits

None of the participants grew and harvested crops in order to sell them and 75% of the gardeners did not consider their produce to be a source of income. However, more than half of the gardeners considered that harvesting their own produce reduced their weekly costs on fruits and vegetables and produce from the garden was seen as a cheaper alternative to buying it from supermarkets. One of this study's innovations is that it looked at varied financial benefits that participants can get out of gardening. To the best of my knowledge, few studies explored community gardens' financial benefits. The interviews' findings explain the results listed above and it seems that they are due to the fact that gardeners considered their produce to be organic, as they respect and work by organic practices. They compared their produce to organic produce prices in the supermarket. For example, 250g of organic strawberries are retailed at \$6 at Woolworths®, 1 kg of organic tomatoes is retailed at 10\$ and 250g of organic snow peas are retailed at \$12 at the same retailer. One organic cauliflower is retailed at \$12 at Doorstep Organics®. (Prices were checked via the two retailer's official website on the 11 of December 2019). Gardeners reported that planting those crops in their plots reduced their spending on produce from supermarkets, excluding the trip cost, on spot parking and the time required to complete the shopping. However, gardeners paid for their plot, their fertilisers and their crops. Hence, an economic evaluation would be highly beneficial in term of future research to determine whether gardening is reducing weekly costs on fruits, vegetables and herbs by comparing it to the costs of a weekly shopping trip at a local supermarket.

Some gardeners also reported a better control over their income due to gardening. They used to spend weekends at shopping centre, spending their savings, whereas now, they spend their weekend collectively attending their plots. A similar finding was reported in a study which has been done in rural Mali,⁹⁷ where gardening allowed women a better control over income. This might reflect that gardening financial benefits are not limited to socio-economical statuses nor to geographical natures and boundaries but expand to a variety of people, places and countries.

5.5 Beyond gardening: health promotion initiative

Participants reported gardening improved their mental health, as it helped them relax by connecting with nature and escaping daily life stresses. These findings align with the current gardening and mental health literature. In a review about community gardens' benefits, Al Delaimy et al. reported an improvement in participants' mental health.⁸ Similar findings were reported by Wakefield et al.²² and Armstrong et al.²⁹ While mental health benefits were strongly

present in the data, the garden also increased the community's social capital as it encouraged aspects of trust, collective action and collaborative care. It is a platform for socialising, expanding networks and making new connections. Participating in the garden generated both sense of belonging and a sense of community within participants. This is also supported by the literature, as different studies described how the garden helped participants connect with each other,²⁸ increase social capital¹⁶² and build stronger communities.⁵⁹

Gardeners reported caring more about the environment and the ecosystem they live in. The majority chose the garden as they sought access to green spaces within their urban environment to connect with nature. This labelled the garden with a subjective value which in return generated a sense of responsibility towards maintaining it and taking care of its environment. Increased environmental care is a common benefit of community gardens reported within the literature.²⁵ Moreover, gardeners showed a sense of awareness when it came to the built environment around them and how it impacted their lives and health. They also showed an understanding of how ecosystems work and how important is each element of the fauna and the flora in maintaining the ecosystem balance. On a larger scale, this can raise environmental awareness, as it can show the damage resulting from human interference with different ecosystems and its impact on the planet, possibly leading to positive behavioural changes.

One way that gardeners showed care about the environment is by adopting sustainable practices in their gardening activities. Aside from using organic agricultural methods, gardeners encouraged and consumed local produce. This reduces their food miles as well as their carbon footprints. Furthermore, gardeners showed an interest in trying and experimenting with different kind of crops, by testing for example which crops can survive harsh climate conditions such as drought which is a very important in Australia, as the country is experiencing accentuated drought periods,¹⁶³ more frequent natural fires¹⁶³ and water restrictions set by authorities.

Consequently, gardening is positively impacting the health of different age groups by improving their mental health, promoting a sense of community, connecting people together, increasing environmental awareness and promoting sustainable practices. Being accessible to everyone (Community gardens can tailor memberships to the area where it is located in, or have free access for community residents), the garden can reduce socioeconomical inequalities.^{24, 164} It is also putting into practice different sustainable development goals such as SDG 3: Good health and wellbeing; SDG10: Reduce inequalities; SDG 11: Sustainable cities and communities; SDG 13: Climate action, and SDG 15: Life on land. It is proving itself to be a successful initiative to help in achieving the SDGs, hence the importance of using it as a health promotion initiative.

5.6 More participation, more benefits

The MQ community garden is set on a vast piece of land, bigger than the average gardens in the area, for example, Turramurra community garden's area: 787m²; Rhodes community garden's

area: 110 m²; Naremburn community gardens area: 87m². However, the space planning could be improved. Currently, it is divided in 75 plots at ground level. New forms of agriculture such as vertical farming can provide better space management and enhanced utilisation of the land,¹⁶⁵ increasing the garden's capacity and allowing participants to own more than one plot. Gardeners reported suffering from musculoskeletal injuries and considered it a limitation to their participation in the garden. To solve this problem, it is recommended to use elevated plots in the garden. The garden currently has in-ground plots that require the gardener to repetitively bend their back each time they need to weed, mix the ground, or even harvest produce. It also requires them to use agricultural hand tools such as a pitchfork, a shovel or a hoe. On different occasions, those tools can become heavy to lift increasing the stress exerted on the individual's muscles and joint to perform the task. It is important to remember here that 68% of the garden population were aged between 36 and 65 and 12.5% were older than 65 years old, making them at risk of developing musculoskeletal injuries.¹⁶⁶ Elevated beds bring the soil and produce closer to the individual's body, limiting spinal flexions and allowing gardeners to use smaller, lighter and shorter tools reducing loads and their impact on the human musculoskeletal system. Using elevated beds not only reduce the risk of injury of gardeners and make their tasks easier but also widen the access to the garden offering people with disability (e.g. people in a wheelchair) a chance to participate in gardening activities and reaping all its benefits.¹¹⁸ Nonetheless, elevated plots are not risk free, especially in terms of soil quality. Studies revealed that plots were elevated above ground level by using Chromated Copper Arsenate (CCA) treated wood.¹¹³ The CCA treated wood diffused Arsenate, Copper and Chromium to the adjacent soil.¹¹³ The chemicals elements were then found present in plants above their normal average and travelled to human digestive systems by oral ways when consuming the plants' produce.¹¹⁵ Thus it is essential to take the wood factor into consideration and choose a better quality wood to avoid unnecessary health issues.

On a different note, gardeners had different perspectives concerning the resources available at the garden. Some of them reported a lack of resources while the other found them abundant. A clearer understanding was developed when the perception of resources was compared to gardening experience. Gardeners who had been gardening for a while thought of resources as physical materials such as tools required for gardening. While new joiners thought of resources as support and assistance in the garden and reported delays in receiving responses to requests from garden management team. The MQ community garden is currently managed by two individuals; the garden's president (elected by all the gardeners) and the garden's treasurer. As volunteers, it is understandable that the president and the treasurer will not be available on a day-to-day basis answering gardener's requests the same way a full-time employee would be. When any of the people responsible of the garden are unavailable, gardeners lose their support and task's completion is delayed. Hence, a change in the administrative governance of the garden might be beneficial for both gardeners and in-charge volunteers. This can lead to fairer workload

distribution across members and increased support throughout the garden. For example, creating a board committee of few people where each is responsible of a certain task or field of work in the garden might make the work easier. If one of the board members is busy or away, the others can fill its place and tasks will still be done on time. Moreover, further assistance needs to be presented to new joiners until they find their way around the garden and get to know the garden's normal procedures. For example, developing a handbook that can be offered to new gardeners upon joining the garden might help them find their way around independently. Such handbook might contain information on how to use the water supplies, steps to composting, information about worm juice and other garden specific information. Another beneficial initiative would be doing more workshops to deliver and teach gardening skills.

To sum up, gardening has lots of health benefits to offer that can promote healthier lifestyles, fight diseases and increase people's wellbeing. However, it is conditioned by people's participation and their interest in staying in the garden. Individuals will not reap gardening's benefits by participating in one single gardening session but rather by incorporating gardening as a lifestyle activity that is practiced throughout life stages. Hence, it is important to make sure that people joining the garden keep participating in it on the long run. Further research is needed to investigate on how to spark people's interest about gardening in order to successfully promote health and wellbeing.

5.7 The University's role in sustainability: health promoting universities

When it comes to community gardens, the importance of a university and the contribution it can make lay within the resources it has. A difference between a university and a council is that the former has access to more educational knowledge and research resources. This allows universities to form what is called "living labs". A living lab combines the expertise of staff and students and apply their knowledge in real-world context.¹⁶⁷ Let us take soil quality as an example, as gardeners expressed varied concerns about it.^{8,28} A council would need an external party to test the garden's soil quality while a university can test it as part of an agricultural project executed by students within the agricultural department. Same can be applied for innovative technologies or cross-disciplinary research in agricultural planning, seeding, crossing and watering. Students can share their knowledge with the gardeners, teaching them new practices especially in terms of agricultural techniques to face drought's season. This is in particular relevance to Sydney as it has been suffering from severe drought over the last few years.¹⁶³ This will result in a non-academic population well educated about innovative sustainable gardening practices as well as a student generation with hands on experience in their fields. Similar interventions can be done in terms of the garden's ecosystem. The ecosystem at the garden is unbalanced and in constant change. Gardeners are trying to adapt by experimenting on their own. Students from concerned specialised departments can pick up this ecosystem as a university project. They can then present findings, solutions and action plans to re-instate the ecosystem's balance allowing the garden to

flourish in a healthy, controlled way. This can return benefits not only to gardeners who will harvest more efficiently, nor to students who got a chance to work their practical skills, but also to the environment itself that would flourish balanced and protected.

Finally, the university can play a leading role within its community in protecting the environment and promoting sustainable practices by applying sustainable practices on campus, such as collecting the campus green waste, composting it and then sending it for soil use at the garden. This will not only provide the university with a self-sufficient way to manage its waste and reduce waste management costs but will give it a role model in the community in increasing waste management awareness. Hence, it is important to integrate the garden within the university sustainability plan and make use of the garden in a day to day business-as usual model. Such interventions and programs take the university one step closer to achieving the UN Sustainable Development Goals.

Macquarie university is already leading the way in terms of sustainability. In 2013, the university developed its vision for future sustainability and committed to a set of goals, one of which is to develop a vibrant and sustainable campus. The university is taking different initiatives and launching varied programs within three defined focus areas to contribute to achieving the sustainable development goals: 1) Leadership and governance: by implementing the principles of the SDGs through governance structures, day to day operation and decision-making processes. 2) Learning, teaching and research: by teaching students' skills they need to understand and implement the SDGs in their daily life, hence promoting sustainability inside and outside the campus life. Especially in terms of SDG4 "Quality education". Also, many SDGs relate directly to research as they require research-related activities on varied topics such as sustainable agriculture and sustainable consumption. 3) Partnerships and engagement: by strengthening public engagement in achieving SDGs and by playing a role model in policy development and advocacy for sustainable development.

This shift towards sustainability is not only happening in Macquarie university but rather been a global movement since 1990. The World Health Organization launched its "Health Promoting Universities" initiative; a settings-based approach to health promotion that can improve different populations' health and wellbeing such as students, staff and local community members. This movement generated several associations, committees and boards on national and international levels encompassing different universities to collaboratively work on achieving sustainability and ensure a better future for following generations. One of those associations is the "Association of university leaders for a sustainable future", who in 1990, signed the "Talloires declaration", a 10-point action plan to achieve sustainability. More than 500 university presidents and chancellors signed that declaration including 24 Australian universities. Macquarie university, however, did not sign the declaration yet. Signing the Talloires declaration would introduce the MQ university

to an international higher degree network committed to achieve sustainability. This also increase the university accountability over time.

At the end, the higher education sectors' interest is increasing day after day in achieving sustainability and building health promoting universities for future generations. Interventions such as a community garden create a platform for universities to put sustainable practices into action and implement them in a real-world context. To enhance those efforts, universities have the chance to connect with national and international networks all sharing the same vision for the future. This collaborative action underlines universities' commitment to sustainability and increases accountability in the eye of international committees.

5.8 Study's strengths and limitations

This project looked at a community garden from different perspectives, elaborating on varied benefits of using the garden. It included an extensive review of the literature with studies from different countries and regions instead of focusing on one specific country or population. It used a mixed methods approach allowing a better understanding of participants' perspectives and their journey across the garden. Moreover, it approached community gardens from a settings-based perspective (a university one). Universities have an important role to play within achieving the United Nations 2030 agenda for sustainable development. Interest is increasing in this field. Finally, this study looked at different areas poorly reported in previous research such as the impact of gardening on diet's variety and the financial benefits out of community garden. However, several limitations of this study should be acknowledged. The study was conducted at the beginning of winter, which is not ideal for gardening hence slowing the recruitment phase and delaying the project as participants visit the garden less during the winter season. Moreover, most of the data in the survey reporting individuals' fruit and vegetable intake was self-reported, which may influence the reporting of actual food skills capabilities.¹⁶⁸ Furthermore, language was found to be a barrier to the recruitment phase. The MQ garden had a considerable number of non-English speakers, mainly Chinese (N=6). It is assumed that they would have added a richer input to the collected data as they belong to a vulnerable group of people (immigrants in Australia). Especially that the literature about community gardens has only started including data about gardening and its impact on immigrants' health. Hence for future reference, including an interpreter or translator for the interviews as well as a multilingual survey will insure a wider inclusion and richer data collection. Unfortunately, due to budget restrictions, this was not possible for the current study. Finally, the study had a small sample as the garden is a local one and members are not many. Study findings were constrained by the sample size preventing advanced data analysis. Addressing different Universities' community gardens state and nationwide can recruit larger samples and reinforce the research findings.

5.9 Recommendations for the MQ garden

- *There should be changes to the space management in the garden and use of innovative agricultural techniques.*

The garden is built on vast land and contain in-ground plots only. Some gardeners reported their need for more plots. Using different forms of agriculture such as vertical farming would allow the individual to grow more crops in a single plot they have. This will also increase the garden's capacity in accommodating more participants.

- *Ground level beds should be replaced with appropriate elevated beds.*

Many senior gardeners are present at the garden (based on the surveys' results, interviews and as well as researcher observations at the garden). It would be important to consider ways that increase accessibility and make the gardeners work easier such as the use of elevated beds. They render gardeners' tasks easier and allow people with disabilities (e.g. in wheelchair) to participate in the garden. Also, elevated beds bring the soil closer to the gardener's body hence reduce repetitive actions such as bending their back to reach the ground or lifting heavy loads and consequently preventing injury,

- *The gardeners should maintain the use of a shared code-locked gate.*

The garden has a locked gate with a shared code among participants that is offering 24/7 access to the garden as well as keeping the garden well protected against vandalism. This is convenient to access the garden and should be maintained.

- *The gardeners should get together and create a board of members responsible for the garden instead of overloading one individual.*

The garden has one volunteer president responsible for it and for attending the participants needs. There is an overload of tasks required from the person in charge of the garden bearing in mind their personal commitment outside the garden. Creating a board of members for the garden would equally distribute tasks among board members, avoid delays and improve the workflow at the garden.

- *The garden could more actively engage with its new members.*

Several new joiners in the garden reported a lack of support and not knowing how the garden worked. They expressed uncertainty about them staying or leaving the garden. Different procedures to retain those newer members should be set in place such as developing a handbook that covers the garden main procedures.

- *The garden should increase its workshops about essential gardening skills required and increase participation in current workshop "Working bees".*

The garden's "working bees" is a monthly event that aim to take care of the garden communal area. Participation in such events should be agreed on when a new gardener join the garden to ensure that the whole community is coming together at least once per month. For example, a minimum number of participations in "working bees" is required upon signing up to the

garden (e.g. minimum 6 times per year attendance). Moreover, more skill development type of workshops should be initiated to attend the needs of participants.

5.10 Recommendations for future research

- *More research is needed on whether community gardens can serve as a standalone intervention in order to increase food literacy in different populations.*

This study showed that although gardening cover varied aspects of food literacy, uncovered aspects such as understanding dietary guidelines and learning how to cook and prepare healthy meals remain essential. More research is needed on how we can incorporate other components of food literacy (e.g. cooking classes) into gardening activities. Initiatives such as adding nutritional information about planted crops and the best ways to consume them might prove efficient.

- *There is a need for more quantitative research to accurately measure energy expenditures and physical activity levels while gardening.*

The majority of research done in terms of gardening and its impact on individuals' physical activity levels is so far qualitative. In order to calculate whether gardeners are accurately meeting physical activity guidelines, objective monitoring and quantitative research is needed to accurately measure total energy expenditures and gardening activity's intensities. Also, quasi-experimental studies can look at exercise-related hormonal levels pre- and post-gardening.

- *There is a need for economic evaluation studies in terms of financial benefits of community gardens.*

Throughout the literature and in the present study, gardeners reported that growing organic is cheaper than buying from supermarkets. A weekly supermarket shopping trip for organic produce can be costly and also requires time and money for transport. However, gardeners pay for their plots annual fee and all resources. An economic evaluation would give an accurate representation comparing buying organic produce compared to growing them.

- *There is a need for longitudinal studies to assess the impact of gardening on lifestyles and behaviour change.*

Community gardens have potential to impact individuals' lifestyles and promote healthy choices. However more longitudinal studies are required to better explore this change over time.

5.11 Conclusion

Community gardens have been increasingly widespread throughout developed and developing countries. They form a promising strategy for health promotion in order to improve people's health, wellbeing and environment. Macquarie university built a community garden as part of its commitment to building sustainable campuses, however, to this date, the garden has never been evaluated for its benefits. This thesis conducted a formative evaluation of the MQ community garden aiming to explore the garden's demographic characteristics, gardeners' perceived benefits as well as perceived enablers and barriers to the participation in the garden. The findings of this research revealed that the garden has the capacity to contribute in reducing NCD rates as it is leaving a positive impact on gardeners' lifestyles and behaviours through increased consumption of variety of fruits and vegetables, physical activity and food literacy. Also, the participation in the garden can improve gardener's mental health, by increasing social connectedness and reducing social isolation and loneliness. Moreover, the garden showed potential to promote health and contribute in achieving the UN Sustainable Development Goals, especially SDG3, SDG10, SDG11, SDG13 and SDG15. In addition, community gardens can be platforms for universities to show efforts done for achieving sustainability and put sustainable actions into practice. Universities can take part of a global movement to achieve sustainability and build health promoting campuses for future generations, underlining the important role that the higher educational sector has to play in increasing awareness and contributing to the SDGs. Although, the findings of this research highlighted many benefits participating in the community garden, further longitudinal studies are needed to draw causation between participation in the garden and health benefits. Future research can also explore how to spark people's interest in participating in community gardens in order to make the best use of this promising health promotion initiative.

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Appendices

APPENDIX 1: the survey.



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MQ Community Garden survey

In this section you will be asked about your participation in the community gardens.

Q3 How long have you been involved in gardening? (*At any garden*)

- ☐ 0 - 1 year
 - ☐ 2 - 3 years
 - ☐ 4 - 7 years
 - ☐ 8 years +
-

Q4 How long have you been participating in the **MQ community garden**?

_____ Months
_____ Years

Q5 On average, how many times a week do you visit the **MQ community garden**?

- ☐ 1-2 times
 - ☐ 3-4 times
 - ☐ 5 or more times
 - ☐ Nearly everyday
 - ☐ Currently taking a break, not visiting
-

Q6 On average, how much time do you spend in the **MQ community garden**? (*Excluding travel time*)

_____ Minutes
_____ Hours

Q7 Please choose all the activities that you usually perform at **MQ community garden**. (*Choose as many as applicable*)

☐

Weeding

☐

Fertilizing

☐

Harvesting

☐

Seeding

☐

Digging

☐

Watering

☐

Racking up leaves

☐

Other, please specify _____

Q8 What do you usually grow in your plot? (*Choose as many as applicable*)

☐

Vegetables

☐

Herbs

☐

Flowers

☐

Fruits

☐

Other, please specify _____

In this section, you will be asked about your interactions with other people at the MQ community garden. This will help us to understand the role of community gardens in developing networks and social connections.

Q10 In general, do you agree or disagree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Most people in the MQ community garden can be trusted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Most people in the MQ community garden are willing to help me if needed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the MQ community garden, one has to be alert or someone is likely to take advantage of him	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The more time I spend in the garden, the more I get to know and trust the people in it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I like to go
to the
garden
when I
know other
gardeners
are going
to be there

☐ ☐ ☐ ☐ ☐ ☐ ☐

Q11 Since you started at the MQ community garden, have you worked with others to do something for the benefit of the garden?

- ☐ Yes, please specify _____
- ☐ Maybe, please specify _____
- ☐ No

Q12 You mainly go to the MQ community garden to: *(Choose as many as applicable)*

- ☐ Socialise
- ☐ Meet friends
- ☐ Help other people with their plots
- ☐ Take care of your own plot
- ☐ Other, please specify _____

Q13 Please choose from the following:

	Very unlikely	Somewhat unlikely	Neither likely nor unlikely	Somewhat likely	Very likely
If someone went away for a week or more, how likely is it that other gardeners will take care of their plots? (e.g. weeding, watering, harvesting)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If there was a certain problem in the garden (e.g. water shortage, lack of tools), how likely is it that other gardeners will cooperate to try to solve the problem?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q14

How strong is the feeling of togetherness or closeness in MQ community garden? (*1 means feeling very distant and 5 means feeling very close*) (please circle the corresponding number)

Very distant

Very close

1

2

3

4

5

In this section, we would like to know a bit more about what you do with the produce you harvest from your garden.

Q16 What do you do with the crops you harvest from your MQ community garden plot? *(Choose as many as applicable)*

- ☐ Consume it
 - ☐ Share it
 - ☐ Sell it
 - ☐ Exchange it with other gardeners
 - ☐ Other, please specify _____
-

Q17 To what extent do you rely on selling these products as a source of income.

- ☐ Not at all
- ☐ Just a little
- ☐ To some extent
- ☐ A lot

Q18 What do you do with excess produce? *(Choose as many as applicable)*

- ☐ Throw it away
 - ☐ Share it with others
 - ☐ Preserve it (e.g. jam, pickles)
 - ☐ Compost it
 - ☐ Sell it
 - ☐ Store it (e.g. freeze it)
 - ☐ I never have excess produce
-

Q19 In your opinion, does your produce help you reduce your weekly costs on fruits\vegetables?

- ☐ Not at all
- ☐ Just a little
- ☐ To some extent
- ☐ A lot

In this section, you will be asked about your activities in the garden. This will help us to understand the nature of the activities you perform at the garden.

Q21 Do you usually have breaks during your work at the garden?

- ☐ Yes
- ☐ No
- ☐ Sometimes

Q22 For how long?

_____ Minutes
_____ Hours

Q23 How do you usually get from your house (or any other destination you are at) to the MQ community garden?

- ☐ Walking
- ☐ Running, jogging, brisk walking
- ☐ Car\motorbike\scooter\public transport\ ride sharing
- ☐ Push bike\bicycle

Q24 How long does it take you to get from your destination to the garden using the previously chosen method of transport. *(Please specify time in minutes)*

_____ Minutes
_____ Hours

Q25 How do you usually leave the MQ community garden to your house or to any other destination.

- ☐ Push bike\ bicycle
 - ☐ Car\motorbike\scooter\public transport\ ride sharing
 - ☐ Running, jogging, Brisk walking
 - ☐ Walking
-

Q26 How long does it take you to get from your destination to the MQ community garden using the previously chosen method of transport.

_____ Minutes

_____ Hours

Q27 In the past week, how many days have you done a minimum of 30 minutes of physical activity, which was enough to raise your breathing rate. *This may include sport, exercise, brisk walking, cycling (for recreation\for travel). Please do not include housework\ physical activity that may be part of your job.*

- ☐ 0 days per week
- ☐ 1 days per week
- ☐ 2 days per week
- ☐ 3 days per week
- ☐ 4 days per week
- ☐ 5 days per week
- ☐ 6 days per week
- ☐ 7 days per week

In this section, you will be asked about your consumption of certain vegetables and fruits. Think about what you ate over the last 3-6 months when you answer these questions.

What is a serve of vegetables*?

A standard serve is about 75g (100–350kJ) or:

- ½ cup cooked green or orange vegetables (for example, broccoli, spinach, carrots or pumpkin)
- ½ cup cooked dried or canned beans, peas or lentils
- 1 cup green leafy or raw salad vegetables
- ½ cup sweet corn
- ½ medium potato or other starchy vegetables (sweet potato, taro or cassava)
- 1 medium tomato



**With canned varieties, choose those with no added salt*

Q30 Please indicate, how often do you consume the following vegetables: (1 serve = 1\2 cup cauliflower or beans, 1 cup leafy greens, 1 medium potato)

	Never	Less than one per month	1 - 3 per month	Once per week	2-4 per week	5 or more per week
Hot chips cooked at home e.g. oven fries, wedges (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Potato - Boiled, mashed, baked (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pumpkin (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sweet potato (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cauliflower (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Green beans (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spinach (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cabbage or brussels sprouts (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q31 Please indicate, how often do you consume the following vegetables: (1 serve = 1\2 cup broccoli or peas, 1 cup leafy greens, 1 medium tomato)

	Never	Less than one per month	1 - 3 per month	once per week	2-4 per week	5- 6 per week	1 per day	2+ per day
Peas (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broccoli (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carrots (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lettuce (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q32 Please indicate, how often do you consume the following vegetables: (1 serve = 1\2 cup corn or beans, 1 cup mushroom, 1 medium tomato or capsicum)

	Never	Less than one per month	1 - 3 per month	once per week	2-4 per week	5 + per week
Zucchini, eggplant, squash (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capsicum (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Corn, sweetcorn, corn on the cob (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mushrooms (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tomatoes (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Celery, cucumber (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Avocado (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Onion, onion spring, leek (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soybeans, tofu (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
baked beans (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other beans,
lentils e.g.
chickpeas,
split peas (1
serving)



What is a serve of fruit?

A standard serve is about 150g (350kJ) or:

1 medium apple, banana, orange or pear

2 small apricots, kiwi fruits or plums

1 cup diced or canned fruit (no added sugar)

Or only occasionally:

125ml ($\frac{1}{2}$ cup) fruit juice (no added sugar)

30g dried fruit (for example, 4 dried apricot halves,
 $1\frac{1}{2}$ tablespoons of sultanas)



Q34 Please indicate, how often do you consume the following fruits: (1 serve = 1 cup canned fruits, 4 dried apricots or 30g dried fruits)

	never	Less than one per month	Fruit salad (1 serving)	1 - 3 times per month	1 per week	2 - 4 per week	5+ per week
Canned fruit e.g. peaches, two fruits (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fruit salad (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dried fruits e.g. sultanas , dried apricots	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q35 Please indicate, how often do you consume the following fruits: (1 serve = 1 medium apple, orange, or banana)

	Never	Less than one per month	1 - 3 per month	once per week	2-4 per week	5- 6 per week	1 per day	2+ per day
Apple or pear (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Orange, mandarin, grapefruit (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Banana (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q36 Please indicate, how often do you consume the following fruits: (1 serve or 150g = 1/2 cup diced mangoes or pineapple, 2 small peaches, apricots or plums)

	Never	Less than one per month	1 - 3 per month	1 per week	2 -4 per week	5 + per week
Peach, nectarine, plum or apricot (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mango or paw-paw (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pineapple (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grapes, strawberries, blueberries (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Melon e.g. watermelon, rock melon, honeydew melon (1 serving)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q37 Do you regularly eat any other vegetables\ fruits that were not mentioned above? If yes, please list them.

Q38 If any, which of those fruits and/or vegetables, were harvested from your MQ garden? (*Please list them below*)

Q39 Were they all from your own garden plot or did you receive them from another gardener's plot?

- ☐ I planted them all
- ☐ I received them all from another gardener
- ☐ I planted my own and exchanged some of them with another gardener
- ☐ I planted some of them and received the rest from another gardener
- ☐ Other, please specify _____

The following questions are about you. Please choose what describes you best.

Q41 What is your age?

- ☐ 18 - 25 years old
 - ☐ 26 - 35 years old
 - ☐ 36 - 65 years old
 - ☐ 65+ years old
-

Q42 What is your gender?

- ☐ Male
 - ☐ Female
 - ☐ Prefer not to say
-

Q43 Which of the following describes you best:

- ☐ MQ International student
- ☐ MQ domestic student
- ☐ MQ staff
- ☐ Local community member
- ☐ Nonlocal community member
- ☐ Other, please specify _____

Q44 Are you currently

- ☐ Employed - Full time
 - ☐ Employed - Part time
 - ☐ Unemployed
 - ☐ Student
 - ☐ Retired
 - ☐ Not in the workforce
-

Q45 What is the main language you speak at home?

- ☐ English
- ☐ Spanish
- ☐ Chinese
- ☐ Portuguese
- ☐ Arabic
- ☐ French
- ☐ Russian
- ☐ Japanese
- ☐ Hindi
- ☐ Other, please specify _____

Q46 How many people live at your household?

_____ People

Q47 Here, you can add any other comment or feedback you might have about Macquarie University community garden.



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Interview participation form

The second part of this study includes a short face to face interview with a researcher at a place of your convenience (could be at the garden or elsewhere). If you wish to participate in this part,

Please fill the following information:

First name: _____

Last name: _____

Email address: _____

- What is the best daytime telephone number to reach you at?

- What is the best evening telephone number to reach you at?

Please leave any additional information that you would like us to know in the space provided below.

Note: Once completed, please tear this form a part of the survey and present it separately.

APPENDIX 2: Short description of the study for the Newsletter

Hi, all gardeners,

It was lovely meeting you at the last working bee!

For those who were not there, my name is Bachar Skayni and I am a Master of Public Health (Research) student at Macquarie University. My background is in physiotherapy and paramedicine, and I also have training in traditional Chinese medicine and acupuncture.

I am currently working on a research project about the **Macquarie University Community Garden** under the supervision of Dr Rimante Ronto. This project will explore the impacts of participating in a community garden on health and wellbeing along with the role that the community garden plays in your life. This will help us to develop guidelines on how to better sustain the garden, promote it to the community, and make it more enjoyable for everyone.

I am very excited about this project which links my interests in health promotion and caring for our environment.

This project consists of two parts (you are welcome to participate in both or either parts of the study):

- 1) **A survey** which you can fill either online
(press on the following link: [MQ Community Garden](https://mqedu.qualtrics.com/jfe/form/SV_1zA9q3opSJ7k9Hn) or copy & paste the URL below https://mqedu.qualtrics.com/jfe/form/SV_1zA9q3opSJ7k9Hn in your web browser) or paper-based (it will be distributed during working bees). The survey takes only around **15 minutes** of your time.
- 2) **A face-to-face interview** with a researcher which will be conducted at a time and place of your convenience. It is mainly about your experience in the garden, the time you spend there, the things you grow, and other activities that you like doing in the garden.

I would really appreciate if you can help me with this project and share your views and experiences of being a community garden member.

I am looking forward to seeing you all at the MQ community garden!

Bachar Skayni

Bachar.skayni@hdr.mq.edu.au

APPENDIX 3: Survey's invitation email

Dear <First Name>:

I am happy inviting you to participate in our community garden survey created for all our fellow members at Macquarie's university community garden.

The survey is conducted by Bachar Skayni, Student at the faculty of health systems and population and is about your overall experience at the garden.

Your participation in this survey is completely voluntary and all your responses are anonymous. None of the responses will be connected to identifying information.

The survey will take around 15 minutes to complete and your participation is very important and highly appreciated. We would like to hear about each individual experience and aim to promote the garden and make it enjoyable for everyone.

Follow this link to the Survey:

<link>

Or copy and paste the URL below into your internet browser:

<URL>

Follow the link to opt out of future emails:

<Link>

If you have any questions about this survey, or difficulty in accessing the site or completing the survey, please contact Bachar skayni at bachar.skayni@hdr.mq.edu.au

This survey has been approved by Macquarie's University human research and ethics Committee. For more information or complaints you may contact the Committee through the Director, Research Ethics & Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). The survey is being conducted using Qualtrics, a cloud based software that stores data on secure servers in Ireland.

Thank you for your participation,

My best regards,

Bachar Skayni.

APPENDIX 4: Survey consent form



MACQUARIE
University

MQ Community Garden survey

Welcome!

You are invited to participate in an online survey about the Macquarie University (MQ) community garden. This is an MPH research project being conducted by Mr. Bachar Skayni.

What you will be asked to do

Your participation in this survey is voluntary, you can exit the survey at any time without penalty. It should take approximately 15 to 20 minutes to complete and contains five main sections. If you choose to participate in this study, please answer all the questions if you can.

Risks

There are no foreseeable risks involved in participating in this survey, as well as no direct benefits or harms for you. Your responses will help us better understand the MQ community garden and develop guidelines on how to sustain it.

Confidentiality

Your survey answers are anonymous and will be stored in a password protected electronic format at Macquarie University. The survey does not collect identifying information such as your name, email or IP address. No one will be able to identify you and your answers, and no one will know whether or not you participated in this study. No names or identifying information will be included in any publications or presentations based on the survey findings. At the end of the survey, you will be asked if you are interested in participating in a second part of this study which involves an individual interview with a researcher. If you choose to participate, you will be redirected to a separate page where you will be asked to provide contact information such as your phone number and/or email address.

Questions and further information

If you have any questions at any time about this study or the procedures, you may contact the project chief investigator, Dr Rimante Ronto via email rimante.ronto@mq.edu.au. This study obtained ethical approval from the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any aspects of your participation in this research, you may contact the Committee through the Director, Research Ethics & Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome. By answering the following pages, you imply consent to participate and confirm that you have

read and understood the following information. In particular you have noted that:

- You agree to participate in this study.
- You understand that your participation in this research is entirely voluntary and that you are free to withdraw from this research at any time, without comment or penalty;
- You have had any questions answered to your satisfaction and understand that if you have any additional questions you can contact the research team;
- You have been informed that the confidentiality of the information you will provide will be safeguarded, your opinions will be treated as personal information, and your privacy respected;
- You understand that you will be contacted by the researchers following the voluntary provision of your contact details.

APPENDIX 5: The interview guide

Beyond Gardening: Potential and limits of using community garden.

- What are the barriers and/or facilitators encountered by the MQ community garden users when accessing and utilizing the garden?
- What is the perceived benefit of MQ garden and its impact on the users' health and overall wellbeing?

Key topic	Theme	Questions
Introductory question	<ul style="list-style-type: none"> • Garden experience 	<ul style="list-style-type: none"> • Tell me about your first visit to the garden, how did you start gardening? What about the MQ community garden, how did you start gardening there? How often do you visit the garden? (<i>probe: why that often</i>) • Could you please describe what you usually do at the MQ garden?
Benefits		<ul style="list-style-type: none"> • What do you get out of your garden visits? • Could you describe your participation in the working bees?
Risks		<ul style="list-style-type: none"> • Are you aware of or experienced any risks related to your participation in the garden? Please describe. (E.g. soil contamination, physical injuries, sun exposures).
Facilitators		<ul style="list-style-type: none"> • What motivates you to come to the garden? • Is there anything else you would like to see changing/improving/implemented in the garden? • What would make your visit to the garden easier? (<i>e.g. Kid's area, pet area, support, learning workshops, transportation</i>) • What resources are available for you to use at the garden? Any of which you find missing? Do you require any support? (<i>E.g. help in how to grow crops</i>)
Barriers		<ul style="list-style-type: none"> • Based on your experience, what are the factors that might make you postpone or cancel your visit to the garden? (<i>E.g. weather, kids at home, work, lack of knowledge, lack of know-how, lack of funding, not enough material, distance...</i>)
Garden as health promotion tool		<ul style="list-style-type: none"> • Are you aware of any workshops or events that are happening in the garden now or have happened in the past? Have you attended? • What workshops or events would like to see happening?

		<ul style="list-style-type: none"> How do you think MQ staff and students could benefit from participating in the garden? How would you promote the garden if you were talking to MQ staff, students or your neighbour?
FV Consumption	<ul style="list-style-type: none"> Having one gardener in the household impact the FV consumption of the others 	<ul style="list-style-type: none"> Could you tell me whether your diet has changed since you started gardening here? How has it changed? What about for your family
PA (If not answered in the general benefits)	<ul style="list-style-type: none"> Gardening increases PA 	<ul style="list-style-type: none"> How do you usually get to the MQ community garden? What would be the most physically demanding things you do in the garden? What other exercise do you do during your week? What do you think of your overall health and fitness level since you started gardening? (<i>if changed --> how?</i>)
closure		<ul style="list-style-type: none"> Is there anything else you would like to add?

APPENDIX 6: Ethics approval letter

Medicine & Health Sciences Subcommittee
Macquarie University, North Ryde
NSW 2109, Australia



12/08/2019

Dear Dr Ronto,

Reference No: 5201955599785
Project ID: 5559
Title: MQ community garden

Thank you for submitting the above application for ethical review. The Medicine & Health Sciences Subcommittee has considered your application.

I am pleased to advise that ethical approval has been granted for this project to be conducted by Dr Rimante Ronto, and other personnel: Dr Josephine Chau, Mr Bachar Skayni.

This research meets the requirements set out in the National Statement on Ethical Conduct in Human Research 2007, (updated July 2018).

Standard conditions of Approval:

1. Continuing compliance with the requirements of the National Statement, available from the following website: <https://nhmrc.gov.au/about-us/publications/national-statement-ethical-conduct-human-research-2007-updated-2018>.
2. This approval is valid for five (5) years, subject to the submission of annual reports. Please submit your reports on the anniversary of the approval for this protocol (12 August each year for 5 years). You will be sent an automatic reminder email one week from the due date to remind you of your reporting responsibilities.
3. All adverse events, including unforeseen events, which might affect the continued ethical acceptability of the project, must be reported to the subcommittee within 72 hours.
4. All proposed changes to the project and associated documents must be submitted to the subcommittee for review and approval before implementation. Changes can be made via the [Human Research Ethics Management System](#).

The HREC Terms of Reference and Standard Operating Procedures are available from the Research Services website: <https://www.mq.edu.au/research/ethics-integrity-and-policies/ethics/human-ethics>.

It is the responsibility of the Chief Investigator to retain a copy of all documentation related to this project and to forward a copy of this approval letter to all personnel listed on the project.

Should you have any queries regarding your project, please contact the [Faculty Ethics Officer](#).

The Medicine & Health Sciences Subcommittee wishes you every success in your research.

Yours sincerely,

Dr Mark Butlin

Chair, Medicine & Health Sciences Subcommittee

The Faculty Ethics Subcommittees at Macquarie University operate in accordance with the National Statement on Ethical Conduct in Human Research 2007, (updated July 2018), [Section 5.2.22].