Individuals cultivating edible plants on buildings in England

Mina Samangooei
School of Architecture
Faculty of Technology, Design and the Environment
Oxford Brookes University

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Acknowledgements

I would like to start from the beginning. Thank you to my mother Tahereh who supported this adventure, without you this journey would never have happened, and Father Fazu for supporting my ideas. Thank you to Dr Fionn Stevenson and Dr Andrew Lack for beginning this journey with me, and to Dr Paola Sassi for continuing the journey with me: thank you for your friendship and kindness. Thank you to Dr Nicholas Walliman for your support and encouragement. Thank you to all staff and friends at Oxford Brookes University who gave me confidence in my work. Thank you to all my family and friends for your support and patience, especially Simon, Kiaa and Lili.

Let's start a new adventure together!

Abstract

Food production, particularly *local* production, is a key component of sustainable urban environments, given the resilience of the supply and disposal of food are major concerns in cities worldwide. Due to the lack of land for food production in dense urban areas, people have explored possibilities for food production on walls, rooftops, balconies, windowsills and inside buildings. The technology for the integration of food production on buildings is continuously being developed, where plant and building technology have been the main focus. But at present there is a lack of understanding about the users of such technology and how they relate to systems for cultivating edible plants on buildings. This work attempts to fill this gap in understanding, examining a primary research question: "What affects individuals to cultivate edible plants on buildings in England?"

To this end, this research utilizes a two-phase sequential mixed method. In phase 1, a questionnaire was formed to test hypotheses based on the Behaviour Change Wheel (BCW), behaviour theory. In phase 2, semi-structured interviews were undertaken in order to further explore the findings of phase 1. Primary data were collected from 65 participants who completed Surveys in phase 1 of the research, and in phase 2 from 30 interviewees from England who have varying levels of experience of cultivating edible plants and/or cultivating edible plants on buildings.

Findings identified forty-one parameters that affect the behaviour to cultivate edible plants on buildings. These parameters offer a comprehensive framework for understanding what affects users to cultivate edible plants on buildings. They highlight that the following are important for an individual to cultivate edible plants on buildings; cognitive capacity available to implement and maintain the system, knowledge of how and why to cultivate edible plants on buildings, motivation to cultivate edible plants on a building, the outcomes obtained from undertaking the behaviour and the individual's community. These parameters were further conceptually linked with constructs from two behaviour theories (the Theory of Planned Behaviour and BCW), links that lent further validity and theoretical reach to these data. Parameters were also linked to intervention functions and policy categories from BCW in order to explore how they can be addressed, indicating that education, training and modelling are key interventions that can help promote behaviour.

This research offers a framework for understanding the parameters that affect individuals to cultivate edible plants on buildings. This knowledge can be used in the development of technologies for cultivating edible plants on buildings and the implementation of these systems, where the relevant parameters can be established on a case-by-case basis for the target users. This research also contributes new empirical knowledge to the behaviour theories and their application, and offers ideas for practical interventions.

Chapter 1: Introduction

1.1 Introduction

Ecosystem services will play an increasingly important role in the future sustainability of urban environments (Ravetz, 2015), where local food production can be seen as an ecosystem service for urban areas. Due to there being little land in dense urban areas suitable for the integration of green infrastructure or food production, it is important to look at how to integrate plants on buildings. This can include plants on walls, rooftops, balconies, windowsills and inside buildings. This thesis investigates the literature regarding technologies for integrating both edible and inedible plants on buildings, with a focus on building technology with plant technology, and this synthesis indicates that there is little empirical data about the people who use these systems and their relationship with the systems. With this in mind a central aim in this study is to fill this gap in knowledge with a focus on investigating the parameters that affect why people may, or may not, cultivate edible plants on buildings (grow food on and within buildings) using an approach underpinned by behaviour theory. Cultivating edible plants on buildings can be seen as a "behaviour" – an action or actions that someone can undertake and the "parameters" – are the things that may motivate or be a barrier to the motivation of the behaviour.

A comprehensive understanding of this relationship contributes to the development of the technology to cultivate edible plants on buildings. This better understanding of how the user relates to these systems can help inform design, implementation, and maintenance decisions. Ultimately, this knowledge would serve to increase the chance of a system's success in practice.

1.2 The role of cultivating edible plants on buildings

The 20th and 21st century trends towards urbanisation have resulted in more than half of the world's population living in cities. For the first time in human history more now live in dense urban contexts (e.g. Mumbai, India and Shenzhen, China) than rural settings (R. C. Allen, 2009). This trend has been accompanied by a drop in the percentage of the population employed primarily in agricultural production. For example in the USA 80% of people were employed in agriculture in the early 20th century to less than 3% in 2010 (Wenger, 2012). Urban areas rely on external resources to function, including food, water and energy, and this reliance makes cities vulnerable in terms of food security, wherein population density and the relative distance of food production present a risk that people may no longer able to access healthy food easily in the case of disruption of services or natural or man-made disasters (FAO, 1996; Kraas, 2003). In parallel to this, urban areas are global risk areas due to issues with unhealthy urban environments that degrade people's health and quality of life. Increasingly people have become interested to reduce this reliance by re-integrating production of resources in cities, including producing food in cities. Creating healthier places for people and other creatures to inhabit is also on top of the agenda for the future sustainability of cities (WHO, 2014). These initiatives highlight the importance of green spaces and infrastructure (Kirby & Russell, 2015; Newton, Gedge, Early, & Wilson, 2007). For example, the benefits of linked pockets of spaces for wildlife inspired the "My Wild Street" project in Bristol, UK where front gardens in a dense urban street were transformed into havens for wildlife (WT, 2015).

Integrating green spaces into urban areas can also help cities function more efficiently and sustainably by helping the retention of storm water to contribute to sustainable urban drainage (Sheweka & Magdy, 2011), purifying air pollution (Ottele, van Bohemen, & Fraaij, 2010) and shading hard surfaces to help alleviate the urban heat island effect (Mavrogianni et al., 2009). These are positive impacts of nature and food cultivation in urban spaces. Recently, it has been argued that if the public is more involved with food production it will help improve their diets (J. O. Allen, Alaimo, Elam, & Perry, 2008; Benton, 2014; Kortright & Wakefield, 2011; Lovell, 2010; Wakefield, Yeudall, Taron, Reynolds, & Skinner, 2007) and also increase their pro-environmental behaviour (Mayer & Frantz, 2004) such as reducing the food that they waste (Benton, 2014). In the context of cities, this cultivation is referred to as 'urban agriculture', and the U.S. Council of Agriculture, Science and Technology defines this practice as:

> Urban agriculture is "a complex system encompassing a spectrum of interests, from a traditional core of activities associated with production, processing, marketing, distribution, and consumption, to a multiplicity of other benefits and services that are less widely acknowledged and documented. These include recreation and leisure activities, economic vitality and business entrepreneurship, individual health and well-being, community health and well-being, landscape beautification, and environmental restoration and remediation." (Butler & Maronek, 2002, p. 6)

The definition above is illustrated in Figure 1, which is a summary of the benefits urban agriculture can give to cities.

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Figure 1: Diagram from the U.S. Council for Agriculture, Science and Technology representing urban agriculture as a system (Butler & Maronek, 2002, p. 14)

In urban areas, the space required for urban agriculture and green infrastructure compete with transportation infrastructure, as well as commercial, industrial, and residential utilisation. For this reason people are increasingly integrating food production and green spaces within and on buildings (Delor, 2011; Despommier, 2011).

1.3 The significance of understanding what affects individuals to cultivate edible plants on buildings

Vertical farms (Despommier, 2011) and building integrated agriculture (Delor, 2011) explore the idea that spaces within and around buildings can be used to grow food. Spare building surfaces such as rooftops, walls, windowsills and balconies have can be used for food production (cite). A number of cultivation systems that can be used for cultivating food on buildings, have been explored. The technology for integrating edible plants on buildings has been researched with empirical evidence and is generally split into two types: soil-less systems and soil-based systems (Samangooei, Sassi, & Lack, 2016). The technology is well established and progressing but there is a lack of understanding of the user-system relationship. Users are a key component to the success of edible systems as the edible plants need to be planned, maintained, cooked and eaten by the users or other people in the same area. This issue is not as apparent when cultivating inedible plants on buildings, as people are not required to interact with the plants regularly. The objective of this research is to increase the understanding of the relationship that users have with systems for cultivating edible plants on buildings (Figure 2).

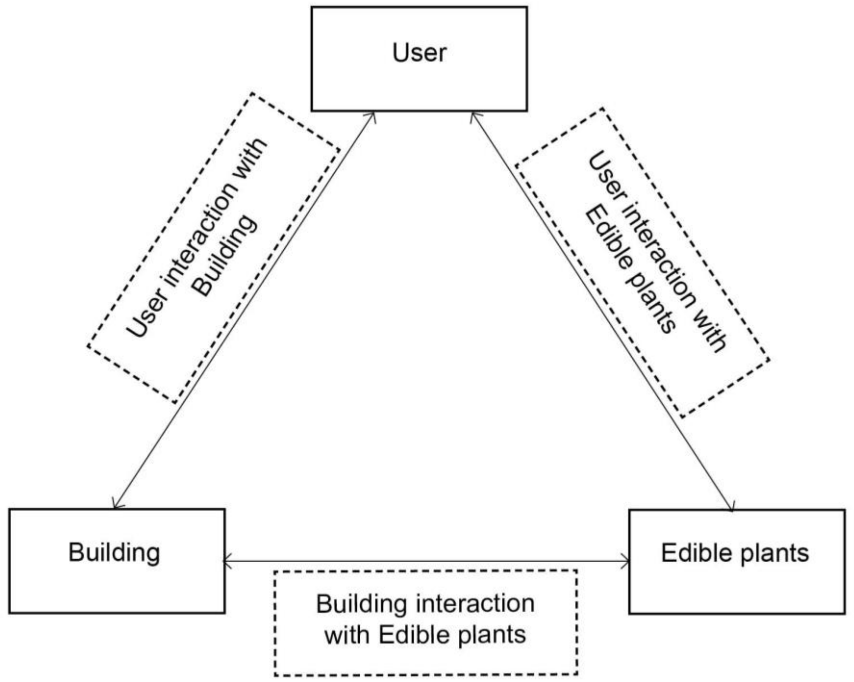

Figure 2: Conceptual framework showing the three elements for cultivating edible plants on buildings

1.4 Main and subsidiary research questions

MAIN RESEARCH QUESTION:

What affects individuals to cultivate edible plants on buildings?

SUBSIDIARY RESEARCH QUESTIONS:

a) Why cultivate edible plants on buildings from a social, economic and environmental point of view?

b) What are the edible plant, user and building parameters that affect the implementation of cultivating edible plants on buildings?

c) What are the categories that affect the behaviour to cultivate edible plants on buildings?

d) What are the parameters that affect the behaviour to cultivate edible plants on buildings?

e) How can behaviour theory inform the understanding of these parameters?

These research questions inform the title of the present work: "Individuals cultivating edible plants on Buildings in England": where the issues discussed above affect towns and cities in England.

1.5 Research approach

The research strategy fulfilled the following requirements in order to answer the research question:

a) Collect primary empirical data from people in England using the indicators from the conceptual framework to form hypotheses,
b) follow a deductive approach by collecting and analysing data that can be used to accept or reject hypotheses,
c) follow an inductive approach by collecting and analysing data that can be used to develop new hypotheses to address the research question.

These requirements fit within a sequential explanatory mixed method combining both quantitative and qualitative research design strategies (Creswell, 2008). Sequential explanatory mixed methods – quantitative data collection and analysis followed by qualitative data collection and analysis, were used to corroborate findings in the study. Quantitative evidence derived from a questionnaire study were collected and analysed in the first stage of the study in order to test hypotheses developed from findings in the literature review (Phase 1). The findings from this analysis informed the second stage of the study wherein qualitative evidence derived from interviews (Phase 2). In doing so, this approach aimed to underpin the findings and generate further theory that was absent from the quantitative study. The quantitative study helped highlight the significant areas that can affect a person's behaviour to cultivate edible plants on buildings. The mixed-methods strategy (Figure 3) helped overcome the weaknesses of quantitative data analysis (Creswell, 2008). In this research, the weakness of the quantitative analysis was that all the questions asked were generated from presumed indicators from the literature review. The qualitative data brought forward new indicators that were not highlighted by the literature.
The intent of this two-phase, sequential mixed methods study was to explore the parameters that affect individuals to cultivating edible plants on buildings. In the first quantitative study phase, hypotheses address the relationship of people with cultivating edible plants on buildings with the aid of people who were already doing so in England and occupants of buildings in England with the potential for cultivating edible plants. In the second qualitative study phase, semi-structured interviews with some participants were undertaken to highlight any indicators that were not considered.

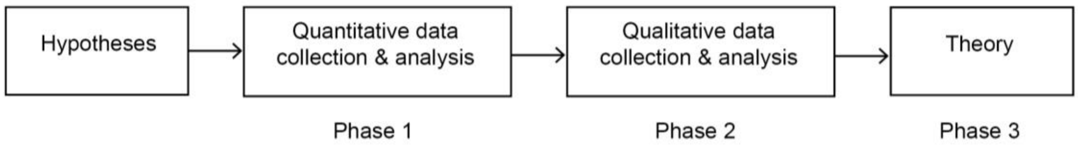

Figure 3: Sequential explanatory mixed methods research design strategy

The study was cross-sectional for both the quantitative data and qualitative data collection. A longitudinal study was not undertaken due to limited resources. Future research could investigate how the parameters that affect individuals to cultivate edible plants on buildings might change before and after undertaking food production on a building.

1.6 Thesis structure

This thesis is comprised of 8 chapters. Following from the Introduction (Chapter 1) Chapters 2 and 3 present a comprehensive literature review. Chapter 2 addresses research question: (a) "Why cultivate edible plants on buildings from a social, economic and environmental point of view?" This chapter consists of a review of the literature relating to why we should cultivate edible plants on buildings from a social, economic and environmental point of view. It starts by investigating why inedible plants are integrated into urban areas and then looks at why edible plants are integrated in urban areas. This led to the question of why people would cultivate edible plants on buildings.

Chapter 3 explores the subsidiary research question: (b) "What are the edible plant, user and building parameters that affect the implementation of cultivating edible plants on buildings?" This chapter provides a critical review of the existing literature regarding the three distinct elements of integrating edible plants with buildings; edible plants (section 3.2), users (section 3.3 where the behaviour theories were identified) and buildings (section 3.4). The issues explored in this chapter identified the gap in empirical knowledge regarding people who use systems for cultivating edible plants on buildings and concluded with the main research question.

Chapter 4 focuses on the methodologies applied to these questions. It details the strategy and design employed to investigate the research questions in terms of how the research was undertaken and how the data was analysed. It shows the conceptual framework of the study and how this has underpinned the research methods chosen. It shows in detail how the questionnaire was developed and the data collection procedure.

Chapter 5 addresses the subsidiary research question (c) "What are the categories that affect the behaviour to cultivate edible plants on buildings?" The chapter presents the results and analysis from the questionnaire data (phase 1) showing the tested hypotheses and other bivariate relationships found related to the research question. The large number of relationships found between pairs of variables were grouped into four categories. To investigate these categories further, they formed four interview questions to be asked in semi-structured interviews. A discussion is included of how appropriate the method used was to answer the research question and any limitations that can be strengthened in the qualitative study. The interview questions were formed using the results.

Chapter 6 addresses the subsidiary research question: (d) "What are the parameters that affect the behaviour to cultivate edible plants on buildings?" The chapter presents the results and analyses of the interview data (phase 2), highlighting the key parameters. The results from phase 1 and phase 2 are brought together to form the parameters that affect the behaviour to cultivate edible plants on buildings, where each parameter is discussed in relation to the research question.

Chapter 7 addresses the subsidiary research question: (e) "How can behaviour theory inform the understanding of these parameters?" The chapter provides a synthesis of the findings by linking the parameters back to two behaviour theories (the Theory of Planned Behaviour and the Behaviour Change Wheel) to assess how the research relates to the theory itself and whether the theory is missing some behavioural indicators. Linking each parameter with the Behaviour Change Wheel provided an initial look at the interventions and policies that could be used to address them.

Chapter 8 presents a comprehensive synthesis of the findings of my studies and provides answers to the main research question: "What affects individuals to cultivate edible plants on buildings in England?" I discuss this original contribution to knowledge in terms of the extant practice and literature, limitations of the findings method and highlight fruitful avenues for further work. This chapter concludes with a discussion of how the results could help the future development of cultivating edible plants on buildings.

Chapter 2: Why cultivate edible plants on buildings from a social, economic and environmental point of view?

2.1 Introduction

This chapter addresses subsidiary research question (a): Why cultivate edible plants on buildings from a social, economic and environmental point of view? The advantages and relevant disadvantages are discussed systematically.

Existing research suggests there are key environmental problems in the built environment; air and noise pollution, the urban heat island effect, drainage of storm water, lack of habitat space for flora and fauna, competition for land due to population growth, reliance on fossil fuels to function, and access to food. These environmental problems have negative effects on mental and physical health and disconnect people from food production. This chapter outlines that the advantages of integrating plants and edible plants within the built environment and on buildings can help address the above environmental and social issues, and that the main disadvantage to cultivating edible plants on buildings is that plants can take up toxins in urban pollution, which can be a health risk.

2.1.1 Background

The increased release of greenhouse gas emissions into the atmosphere since the industrial revolution, through the combustion of fossil fuels, is causing global climate change (IPCC, 2007). The possibility if peak oil is also a concern due to reliance on these fossil fuels (Figure 4) as suggested by ASPO (2010).

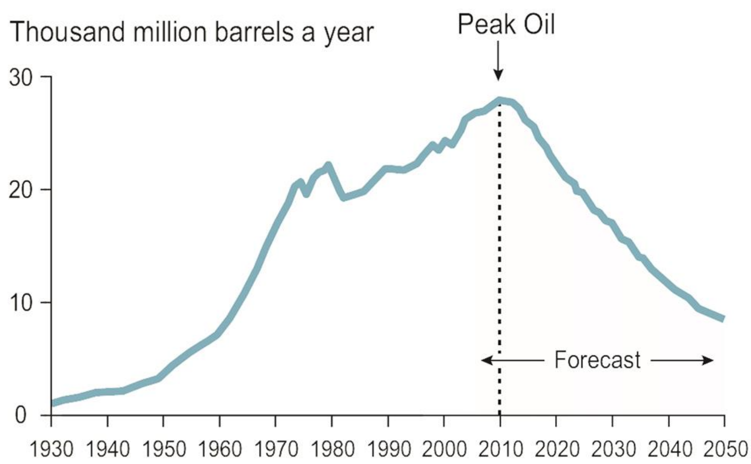

Figure 4: Oil Production predictions (UNEP, 2008)

Buildings are responsible for approximately 40% of total UK GHG emissions (this includes their construction, embodied energy of the materials used and energy used while the buildings are occupied) (CT, 2011). Achieving thermal comfort control in buildings has become more active (mechanised) rather than passive.

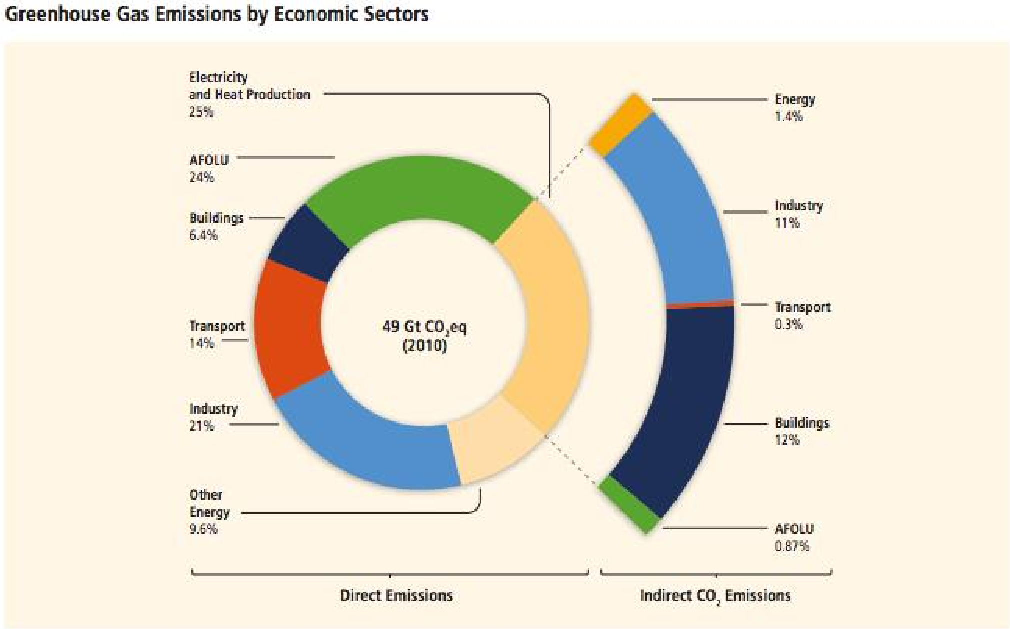

Figure 5: Global Greenhouse Gas Emissions by Economic Sectors (IPCC, 2014)

The current food system (including agricultural practices and transport of food, pesticides and fertilisers) accounts for 13.5% of global GHG emissions (Figure 5) and 20% of GHG emissions in the UK (Audsley et al., 2009). The Green Revolution, after the Second World War, has led to a dependence on fossil fuels for machinery and artificial chemical based fertilisers, pesticides and herbicides to increase agricultural productivity (Rubatzsky & Yamaguchi, 1997). This reliance can threaten food security if access to fossil fuels becomes more difficult.

The UK government aims to achieve 80% emission reductions from 1990 levels by 2050 (CCC, 2008). Ideas such as the Transition Towns Movement say that people need to design their lifestyles in a way that they are less reliant on fossil fuels; a transition from fossil fuel dependency to resilience by increasing local production and trade (Hopkins, 2008). Local food production in dense urban areas would be difficult due to the lack of space at ground level. This research looks at using spare space on buildings' surfaces to cultivate food.

2.2 Integrating vegetation within the built environment

Modern urban areas do not favour integrating vegetation as it generally conflicts with other urban functions, such as keeping roads clear of tree leaves, foundations clear of roots and buildings free from insects and pests, which add to maintenance costs (OCC, 2014). The following section discusses why the integration of vegetation in urban areas is considered important.

2.2.1 Reducing air and noise pollution

Pollution of the earth's biosphere, caused by GHG emissions and other toxins are associated with resource depletion and the destruction of ecosystems and habitats, leading to the extinction of species and creates unhealthy environments for other species (including humans) (Lovelock, 1995). Particulate air pollution causes ill health in humans continuously exposed to it, which is a common problem in towns and cities across the world due to emissions from vehicles (Arden Pope III, 2000). An estimated 24,000 people die prematurely in the UK from the effects of air pollution, showing that air pollution has a significant cost on public health (EAC, 2010; N. Stern, 2007). Emissions containing nitrogen oxides, carbon dioxide and sulphur dioxide cause acid rain which drains soil ecosystems of their vital nutrients such as calcium, potassium and magnesium (AQ, 2012). Plants can absorb large amounts of carbon dioxide, release oxygen and filter airborne particles; therefore they can help improve air quality in urban areas. 'Leaves form a sink for significant quantities of health-damaging particles from the atmosphere' (Ottele et al., 2010, p. 161). Vegetation can also reduce noise pollution and filter contaminates (EPA, 2008), which could leach into water systems (Newton et al., 2007).

2.2.2 Alleviating the urban heat island effect

The built environment consists of vast surfaces that absorb solar energy e.g. buildings and roads and air pollution considered above (Mavrogianni et al., 2009). This combination and lack of vegetation creates a particular microclimate where the temperature is higher than the surrounding rural land, 4^{o}C higher in London during the summer months (Defra, 2007; Hunt, 2004), which is a phenomenon known as the urban heat island effect (Mavrogianni et al., 2009). Plants absorb the sun's energy where '2% is used in photosynthesis, 40% is passed through the leaf and stored in the plant's water system, 30% is transformed into heat (used in transpiration) and only 20% is reflected' (Peck, Callaghan, E., & Bass, 1999, p. 21). Urban spaces mostly have vegetation concentrated in parks and gardens which lower temperatures but only within their vicinity (Alexandri & Jones, 2006). These pools of green spaces do not help lower temperatures within clusters of buildings where people spend most of their time, therefore it is also important to integrate vegetation directly where buildings are (Alexandri & Jones, 2006). Planted areas reduce cooling loads in nearby buildings (Erell, 2008).

2.2.3 Sustainable urban drainage systems (SUDS)

When storm water falls on pervious surfaces, such as soil, it is soaked up and runs down until it reaches groundwater. Some of the water is also soaked up by plant roots and absorbed or put back into the atmosphere through transpiration and evaporation (Figure 6).

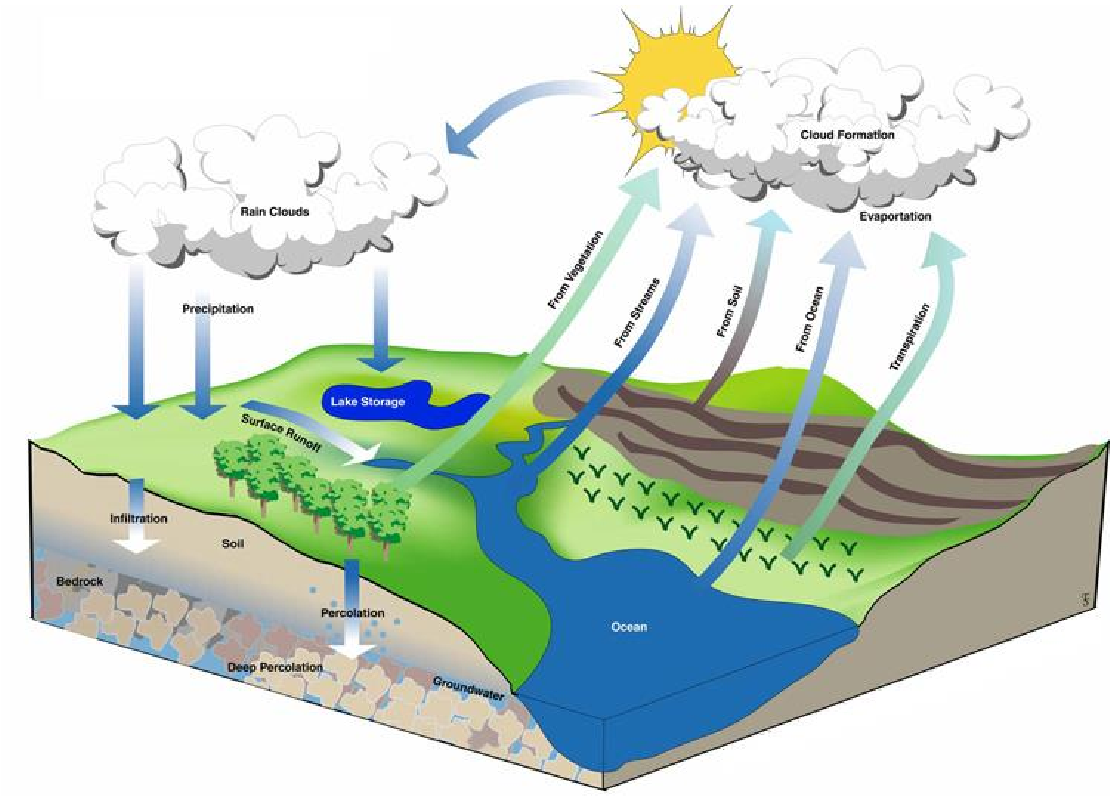

Figure 6: The Water Cycle (LEAF, 2011)

Storm water in towns and cities runs off impervious surfaces (e.g. roads and rooftops) and enters drainage-pipe systems, which carry the water out of the city into a water body. Compared with natural pervious land, which has only 5% surface run-off, built-up areas have 75% surface run-off (Nigel Dunnett & Kingsbury, 2004). Flooding can occur when a drainage system cannot cope with water from a heavy storm (Sheweka & Magdy, 2011). Vegetation in cities acts as temporary water storage that helps drainage systems cope with the rush of water from storms. The more pervious vegetation 'sponges' in cities there are, the less stress there is on drainage systems. In New York City, USA a green infrastructure plan has been developed to alleviate the strain on the city's drainage system and combined sewage overflow (CSO) during heavy rainfall (DEP, 2010).

2.2.4 Increasing habitats for flora and fauna

Since the industrial revolution, much of the UK's wildlife land has been lost or damaged. The pattern has repeated worldwide and currently only 12% of the world's surface is occupied by protected areas and nature reserves (Sassi, 2006). Francis and Lorimer (2011) and Rosenzweig (Rosenzweig, 2003a, 2003b) have shown that the global land area available for preservation and restoration is not enough to prevent the forthcoming and current extinction cascade.

Rosenzweig proposed a 'third strand' of conservation called 'reconciliation ecology', which is 'the modification and diversification of anthropogenic habitats to support a greater range of species, without compromising the land use' (Francis & Lorimer, 2011, p. 1429). Urban areas are very important for wildlife, for example urban gardens, green spaces and even brownfield (derelict) sites have been shown to have high biodiversity, compared to many rural areas, containing rare and protected species (Newton et al., 2007). Pockets of green spaces in urban areas have also shown to provide corridors for flora, fauna and small and medium sized mammals (Angold et al., 2006).

From a social perspective, integrating habitats for wildlife with urban environments may not be favoured if the wildlife enters buildings and causes a nuisance to building occupants. This issue could be solved through design and planning.

2.2.5 Improving Physical and Mental health

Green spaces within the built environment provide amenity space for relaxation, leisure and exercise. This contributes to human mental and physical health. Health is commonly defined as "a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity", i.e. being healthy does not only mean lack of physical or mental illness (Sassi, 2006; WHO, 1946, p. 2). Health can be affected positively and negatively by our surrounding environment, including the built-environment where 70% of deaths are related, not to infectious or parasitic disease, but to environmentally and socially linked aspects of life (Sassi, 2006). On average, people in industrialised countries spend 90% of their lives inside buildings (OECD, 2003). Numerous studies have shown that there are many health benefits when integrating the natural world with human habitats (Newton et al., 2007), for example a study by Ulrich (1984) found that patients in a hospital with a view of a natural setting recovered 3 days faster and needed less care than patients with a view of a brick wall. A study by Lohr et al. (1996) found that productivity of workers can increase with views of green spaces or plants in the office. Psychological benefits of nature have led to the development of horticultural therapies (NA, 2010). Natural environments can also help reduce stress (Simons et al., 1991).

The human desire to connect with other living things, natural systems and processes has been called 'Biophilia' which is defined as "the innate tendency to focus on life and lifelike processes" (E. O. Wilson, 1984, p. 1). 'Biophilic Design' is an architectural design theory that focuses on maximising links between humans and nature within the built environment, rooted in the mental and physical health benefits of contact with nature (Mador, Kellert, & Heerwagen, 2008). The findings in a study by Mayer and Frantz found that there is in fact a link between personal well-being and connectedness to nature (2004). The location, shape, and form of our buildings impinge directly on the smallest details of our daily lives (Shove, 1999). Comfort is defined in the dictionary as a state of physical ease and freedom from pain or constraint (OD, 2011; Sassi, 2006). 'Absolute [comfort] relates not only to thermal comfort, but also to the range of possible comfort determinants including indoor air quality, visual and acoustic conditions, as well as important psychological, cultural and behavioural aspects' (Cole, Brown, & McKay, 2010, pp. 341-342). Green spaces keep environments in towns and cities healthy and comfortable by alleviating pollution and the urban heat island effect. Accessible green spaces also help improve physical health (Cole et al., 2010).

2.2.6 Connection to nature increasing pro-environmental behaviour

Environmental psychology focuses on how features in the environment can influence humans and how humans ("individuals, groups, communities and social entities as large as cultures"), in turn, shape the environment (Halpern & Voiskunskii, 1997). Norberg-Schulz describes this as the genius loci or 'spirit of place' that we feel from specific environments (Norberg-Schulz, 1980, p. 3). Environmental psychologists believe that humans and their environment are a single system and thus cannot be studied separately (Halpern & Voiskunskii, 1997). Some research in environmental psychology focuses on designing and changing the built environment to meet human needs and investigates the links between behaviour and environment (Halpern & Voiskunskii, 1997). Research in environmental psychology has shown an interest in the analysis of the built environment and in recent years there has been a central concern for sustainability and conservation of the environment (Giuliani & Scopelliti, 2009).

Urbanisation and industrialisation has moved humans away from the close contact with nature they had for about 350,000 generations as hunter-gatherers (Mayer & Frantz, 2004). Some past cultures, such as Inuit tribes (Pretty, 2002) and Sufis (Heschong, 1979), saw their communities and habitats as one with the natural world so their practices tried not to harm the natural world, but far more have damaged the natural world (P W. Schultz, Shriver, Tabanico, & Khazian, 2004). Research has shown that there is a positive correlation between implicit connection with nature and concern for the environment (Mayer & Frantz, 2004).

"We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect" (Leopold, 1949, p. viii).

Leopold's argument has been supported by research findings from a study by Mayer and Frantz (2004). The research findings conclude that if humans feel connected to nature they would be less likely to damage it, as damaging nature would be damaging themselves (Mayer & Frantz, 2004). This does not guarantee pro-environmental behaviour as sometimes people are not aware that their actions are damaging nature. Using the example of food production, people may not be aware that buying food produced using industrial methods is harmful to the environment due to chemical fertiliser run-off leading to eutrophication and leaching into groundwater, killing soil microbiology and gradually depleting humus in soils leading to eventual consequences such as desertification (Abbott & Murphy, 2003; Acton & Gregorich, 1995; Bill Mollison, 1988; Steel, 2008; Viljoen, 2005). Soil must be seen as a renewable resource that needs to be managed sustainably in order to help us feed increasing world populations where sustainable soil management can lead to a crop yield increase of 58% (FAO, 2015). Additionally, many people knowingly engage in behaviour that damages them (sometimes they have no other choice as they need food to survive) so they may also knowingly engage in behaviour that damages the environment (Mayer & Frantz, 2004). According to the above ideas of environmental psychology, making food production more visible to humans by integrating it within the built environment makes it part of their everyday lives and they may in turn form a stronger respect for the food that they eat, as they see the work that goes into producing it.

2.3 Integrating food production within the built environment (urban agriculture) at ground level

This section investigates the specific benefits of cultivating edible plants in urban areas. Some of the topics above have been repeated in this context.

2.3.1 Alleviating the environmental impact of food production

Throughout history, food has played a central role in the design of human settlements. Before the industrial revolution, London was a city full of smells of fresh and rotting food with livestock and food markets filling the streets (Steel, 2008). Today, cities present food conveniently, cleanly and neatly to urban dwellers in markets and supermarkets, with little evidence of food production and waste where rotting food is swiftly taken out of sight to avoid pests and the spread of diseases. This way of obtaining food has a negative impact on the environment due to the industrial processes involved; from the farming methods to the packaging and transport to our plates.

> "The present poisoning of the air, water and land can be put an end to only by the fusion of town and country; and only such fusion will change the situation of the masses now languishing in the towns, and enable their excrement to be used for the production of plants instead of for the production of disease" (Marx & Engels, 1876, p. 282).

Marx and Engels refer to the use of excrement to fertilise land rather than the use of chemical fertilisers and pesticides – methods of farming that do not have a negative impact on the environment, showing that people were concerned about the impact of industrial practices even in the 19th Century. As the relationship between cities and the food they survive on remains a major concern, the industrial food system method of obtaining food and disposing of food is being questioned due to its environmental, social and economic impacts (Marx & Engels, 1876; Steel, 2008; Viljoen, 2005). This section discusses how integrating food production (edible plants) within the built environment, can help alleviate the environmental impact of food production by tapping into the waste stream, the reduction of food miles and alleviating the demand for food in urban areas as populations increase (urbanisation).

2.3.1.1 Tapping into the waste stream

Food production within towns and cities can create a nutrient loop, where municipal organic waste can be composted and used as fertiliser, forming a key solution to waste management.

Food waste produced in cities can be used as fertiliser to grow food in cities. The UK is running out of places to put municipal waste, for example some parts of Scotland have no more room for landfill available (Morgan & Stevenson, 2005). This issue has led to governments across the world promoting reducing, reusing and recycling waste (WWF, 2012).

The conventional industrial model is linear (an open-loop system), where resources go in, a product is made, it is used and then becomes waste. Industrial ecology is based on the way natural systems work as closed-loop systems where the waste products of some are beneficial for others, for example the carbon cycle (Figure 7). The industrial ecology concept looks at creating closed-loop systems where waste becomes a resource that is fed back into the system (Figure 8) (Garner & Keoleian, 1995).

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Figure 7: The Carbon Cycle (Stanley, 2002)

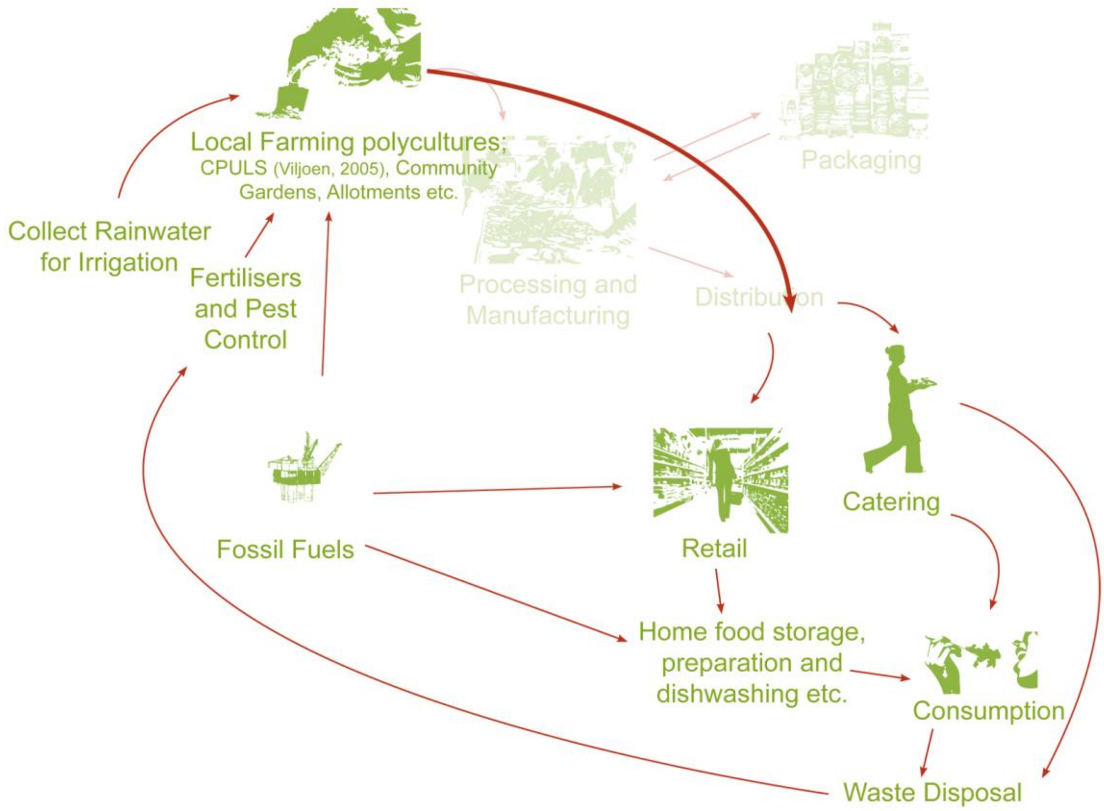

Figure 8: A closed-loop, low GHG emission food system (Source: Author)

Figure 8 shows how a food system can be a closed loop system where the food waste can be composted and used as fertiliser for new food. Local food production can make use of fertiliser created from food waste to mitigate the need for artificial chemical fertilisers, as well as reducing waste that goes into landfill. Urban areas create large amounts of food. This waste can stay within the city and be used as a resource to create food within urban areas. Grard et al. (2015) showed the potential of using urban waste by cultivating edible plants on rooftops using urban green waste from parks and gardens. This highlights the importance of integrating food waste management systems as part of the design of integrating food production within the built environment.

2.3.1.2 The environmental impact of globalisation in relation to food production

Globalisation can be defined as "the accelerated movement of goods, services, capital, people and ideas across national borders" (Little & Green, 2009, p. 166). The globalisation of the food industry has increased transport, packaging and pesticides for preservation, all of which are reliant on fossil fuels (A. Smith et al., 2005). Transport, or 'food miles' accounts for 9% of the food chain's GHG emissions (Defra, 2009b). Food miles create a disconnection between the producer and the consumer, which leads to lack of knowledge and understanding about related environmental, social and economic issues (McClintock, 2010). A social and economic impact of globalisation has been that some farmers have become reliant on trade with international buyers, or global corporations such as some supermarkets, to sustain their business, even at the expense of people in their own country (Paxton, 2011). The 1984-85 Ethiopian famine which claimed over one million lives did not interrupt the export of green beans to UK supermarkets (Athanasiou, 1996; Barton, 2000). The food per capita in Kenya has been declining, yet food exports have been expanding (Gitu, 2006). This reliance on imported food points to the need to increase local trade. In addition, green beans need to be as fresh as possible, therefore need to be air-freighted to the UK, which is 177 times more GHG intensive than shipping (SA, 2007). To help alleviate this, the UK could grow most of its own fresh, seasonal produce and import produce that does not have a short shelf-life. Integrating food production within the built environment can help increase the amount of food available locally. Local food production can help reconnect consumers with the food that they eat, think about where the food they buy comes from and if it is in season, and increase people's respect for the food they eat which in turn can help reduce food waste (Benton, 2014; Defra, 2010b; Lovell, 2010). Libman (2007) found that experiencing food growing, harvesting, sharing, preparing and eating produce may influence young people's food consciousness and eating habits.

2.3.1.3 The environmental impact of urbanisation in relation to food production

Urbanisation is the migration of people from rural settlements to live and work in towns and cities. Cities are reliant on rural areas for providing food for their populations (Keene, 2012; Steel, 2008). Historically cities grew to the size relative to the natural geography that could provide them with food, but innovations in transportation in the 19th century revolutionised this and thus urban sprawl could begin (Steel, 2008. p.90). This has led to cities today relying on a land mass for producing their food many times the physical size of the city itself and its surroundings. Between 1841 and 1901 over 3 million people from rural England and Wales moved to towns and cities (Crouzet, 1982; Long, 2002) in search of work as their communal farming land was taken from them (McClintock, 2010). This pattern has spread globally over the past 100 years, most recently in China and India (Dobbs & Sankhe, 2010). Since mid-2009 the number of people living in urban areas (3.42 billion) has exceeded the number living in rural areas (3.41 billion) (Figure 9) (R. C. Allen, 2009).

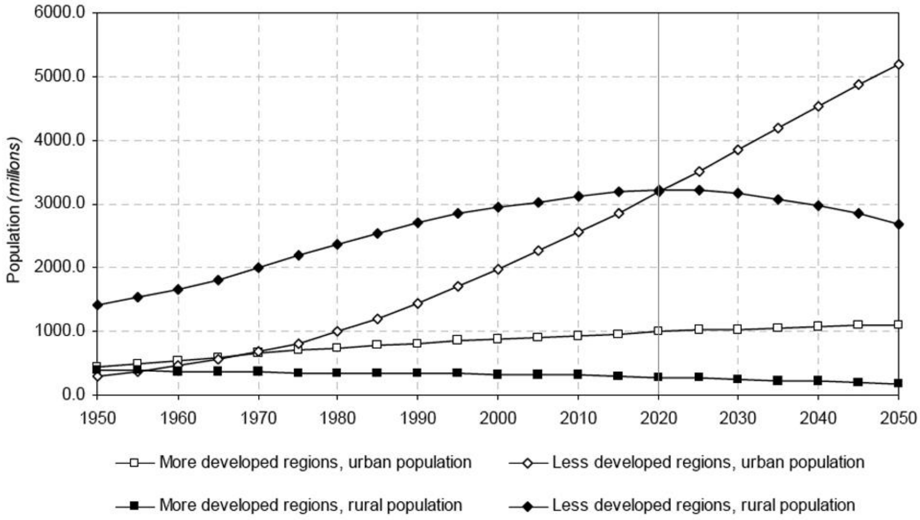

Figure 9: Urban and rural populations of the world 1950-2050 (UN, 2010)

Increasing urbanisation (megacities) is seen as increasing global risk areas for human habitation where cities are "particularly prone to supply crises, social disorganisation, political conflicts and natural disasters" where it is estimated that 57% of the world's total population will live in cities by 2025 (Kraas, 2003, p. 583). Urban food production can help mitigate some of the risks of living in cities by helping alleviate food security, creating opportunities for social interaction within urban communities, and mitigating flooding and pollution.

2.3.2 Integrating food production in urban areas can help alleviate food security and food poverty

"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996, p. 13).

The common elements of food security are food availability, access, affordability (nutrition and quality), safety and resilience (confidence) (Defra, 2006b, 2009b). There are circumstances where 'safe and nutritious' food is available but is not within easy reach of poorer urban communities, who do not have private vehicles, and who live in areas with inadequate public transport (Food Deserts) (Viljoen, 2005). Fresh fruit and vegetables available in local shops are often expensive, thus cheaper processed foods are more frequently purchased which are high in fat, salt and sugar

(Viljoen, 2005). There are issues of food poverty in the UK, even in wealthy cities such as Oxford (Lalor, 2014). Food poverty is defined as the following:

"Food poverty is the inability of individuals and households to obtain an adequate and nutritious diet, often because they cannot afford healthy food or there is a lack of shops in their area that are easy to reach" (FSA, 2014, p. See URL).

Kortright and Wakefield (2011) found that food security is fundamental for the health of people within a community and that growing food can contribute to food security at all income levels due to promoting a nutrient rich diet. Accessibility is not a problem for most in the UK as 97.8% of households are within 15 minutes of a food retailer by public transport (Defra, 2009b). The main barriers in the UK are affordability and resilience where there is low income, lack of education and skills (Defra, 2010a). Local food production helps to address this. Nutrition rich diets increased during the 'dig for victory' campaign in the Second World War, as government initiatives were set up to encourage people to grow their own fruit and vegetables, thus increasing access to fresh produce (Drummond, 1957). This is an example of how local food production can help alleviate concerns about food security. During the same time period 20 million victory gardens were set up in the USA, providing 44% of the country's fresh produce (Kortright & Wakefield, 2011). A more recent example is that of Cuba, who after the collapse of the Soviet Union in the early 1990s suffered a 67% reduction in food supply due to a major decline in foreign trade. The agricultural sector was heavily affected as it imported 48% of fertilisers and 82% of pesticides (Viljoen, 2005). This resulted in a major change in agricultural methods; farmers were forced to cultivate organically and with less machinery. The Cuban government set up initiatives to increase sites for urban food production, as lack of oil during the 90's embargo reduced the capacity for Cuba to import, transport and store food. It is estimated that 90% of the fresh produce eaten in Havana, Cuba and some African cities is produced in and around the city (Kortright & Wakefield, 2011), through growing around buildings, in derelict urban sites and on buildings (balconies, windowsills and rooftops). Urban food production has gained recognition to help alleviate food security for poorer urban dwellers by allowing them to produce their own food, thus becoming less reliant on cash income to buy food and also sell some of the food that they produce to earn an income (Armar-Klemesu, 2000). One study found benefits of rooftop urban agriculture for food security for the dense city of Dhaka, Bangladesh (Islam, 2004). The potential of Skyfarming (also known as vertical farming where hydroponic or aquaponic indoor farms are stacked on top of each other in purpose built towers) has also been looked at to address future food security in high-density urban areas (Germer et al., 2011).

According to the ICFFA "Multifunctional, biodiverse farming systems and localised diversified food systems are essential for ensuring food security in an era of climate change" (ICFFA, 2008).

Integrating food production within the built environment would provide more opportunity to help alleviate food security.

2.3.3 Integrating food production in urban areas can improve physical and mental health

The location of food production may have an impact on our health as the type of food we eat has a significant impact on public health costs (Frey & Barrett, 2007). A third of a balanced diet recommended by the UK government (Figure 10) is fresh fruit and vegetables. Out of the different food types shown, these would be the most successful if grown closer to where people live, as fruit and vegetables have their highest nutrient content at harvest; thereafter, that amount cannot be increased but will decrease during processing, transportation and storage (Garnett, 2006; Rubatzsky & Yamaguchi, 1997). Spinach and asparagus lose 50% of the their vitamin C content 24 hours after being picked, sitting at room temperature (Paxton, 2011). This is the key reason why UK celebrity chefs have been promoting 'growing your own' fruit and vegetables (Jameson, 2011). Starchy foods that provide carbohydrates, such as rice and potatoes, need far less energy and packaging to transport and lose a minimal amount of their nutritional value. Preserving, packaging and processing of food uses ten times the energy needed to grow the crop in the first place (Paxton, 2011).

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Figure 10: The Eat Well Plate (FSA, 2011)

A key question is whether nutrient rich fruit and vegetables can be grown, stored and transported in less energy intensive ways (Garnett, 2006). Local food production integrated within the built environment could help alleviate this issue. According to Table 1, the key nutrients that we need in our diets can be found throughout the year in fruit and vegetables that can be grown naturally in the UK.

Household food growing can increase the overall health and well-being of the gardeners (Kortright & Wakefield, 2011). Wakefield et al. (2007) found in Toronto, Ontario that gardeners perceive that community gardens increase access to food, increase physical health and improve mental health and nutrition. Improved nutrition was also found in a study of community gardens in Michigan (J. O. Allen et al., 2008). Lovell (2010, p. 2516) found that when low-income families grow their own food it can help improve "their sense of empowerment, their understanding of food and nutrition, and their skills in horticulture and gardening". Vertical farming and urban agriculture can help increase the consumption of fresh produce due to increasing its ease of availability and visibility, thus incentivising dietary change (Benton, 2014).

Table 1: Nutritive constituents of fruits and vegetables that have a positive impact on human health and their sources

(Source: Kader *et al.*, 2001)

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2.3.3.1 The health risks of urban agriculture

Food production in urban areas is seen as a possible health risk due to a generally higher exposure to pollutants compared with rural areas (Säumel et al., 2012). Most toxins are collected by plants through the soil rather than from airborne pollutants (St. Lawrence, 1996). Research in this area shows that the pollutants of concern are from vehicle exhausts and tyres, as well as cultivating land that was industrial in the past. A study in Berlin found that high traffic burden increases trace metal content in biomass (St. Lawrence, 1996). Barriers (such as buildings and large rows of vegetation) between the cultivation site and the traffic significantly reduce trace metal content due to blocking airborne pollutants from the vehicles (Säumel et al., 2012). This finding highlights that integrating food production with buildings could help decrease trace metal contamination in food production in urban areas if the building can form a barrier to block airborne pollution. The soil at ground level can be contaminated (Ackerman, Dahlgren, & Xu, 2013) but food production on buildings can use soil in containers that is not contaminated. The accumulation of contaminants over time in rooftop soils is a concern (Ackerman et al., 2013). The importance of growing in containers in urban areas where there may be contaminated soil at ground level was also highlighted by Alloway (2004), who investigated soil contamination in gardens and allotments. It was suggested that soils with lower levels of contamination could be used for food production for types of edible plants that do not accumulate high levels of contaminants. Methods for reducing the contamination of the edible plants from urban pollution is an area that requires further research.

2.3.4 Reconnecting people with food production

Kyrk defined consuming as "the use of goods in the satisfaction of human wants". John Lukacs said that "In the modern world the production of consumption has become more important than the consumption of production" (Campbell, 2005, p. 38 and 36).

Fromm stated that contemporary man has an unlimited hunger for more and more goods (Campbell, 2005). This consumer behaviour is highlighted in the United Kingdom for example when there is a huge amount of expenditure on products before the Christmas period and then a further huge amount of expenditure after the Christmas period, clearly showing that consumption is largely governed by custom and tradition (Campbell, 2005). Markin stated that "when one want is fulfilled, several more usually pop up to take its place" (Campbell, 2005, p. 37). NEF believe that it is possible to fulfil human wants without material goods, but instead with any sense of achievement (NEF, 2009).

> "We want money so that we can have an automobile. In turn we want an automobile because the neighbours have one and we do not wish to feel inferior to them, so we can retain our own self-respect and so we can be loved and respected by others. Usually when a conscious desire is analysed we find that we go behind it, so to speak, to other, more fundamental aims of the individual" (Maslow, 1970, p. 65).

In 1900 in the UK, 40% of people had a job in agriculture and even more worked in agriculture before this (Heinberg, 2007), therefore our work was producing our food to live and at the same time, gave us a sense of achievement as the 'fruits of our labour' were seen. Now only 1% work in agriculture and the new 'fruits of our labour' give us a more environmentally destructive sense of achievement in the form of material goods. Growing one's own produce provides a sense of achievement and gives physical reward in the form of food after hard work and thus could reduce our need to buy material goods and 'consume' less. 'User engagement in positive environmental practice beyond comfort provision, such as turning off electrical appliances, reducing water consumption, limiting waste production… etc., can further help reduce building energy and carbon consumption' (Cole et al., 2010, p. 343), where food habits play a key role. McClintock (2010) discussed how workers have become alienated, de-skilled and lost their understanding of the processes of production due to the separation of manual and intellectual labour, i.e. they do not see the source of the materials etc. in the process so they do not see the possible social and environmental problems with the process.

"As our society becomes technologically more sophisticated it also becomes biologically more ignorant. We no longer know what we eat or drink, or where our wastes are taken" (White, 2002, p. xi). Increased food miles has led to social disconnection and loss in education and understanding of how food is grown (Guerra, 2005; Steel, 2008; Viljoen, 2005). 'The food we eat links us directly to nature' but our mentalities about food have lost this connection (Steel, 2008, p. 51).

A study conducted in Singapore regarding the perceptions and expectations of residents in relation to roof gardens found that as part of the benefits of roof gardens, people felt that they can help promote an interest in nature (Yuen & Hien, 2005). If some of the plants were edible in the roof garden or areas were provided for the cultivation of edible plants, this may also promote an interest in fresh, seasonal food and an understanding of where food comes from. Specht et al. (2015) studied stakeholders considering hydroponic building integrated agriculture in Berlin and concluded that one of the key benefits of this integration highlighted by the stakeholders is the education of people regarding food production and consumption.

This disconnection with food has led to key changes with environmental, social and economic consequences, such as increased consumption of out of season produce (where people now expect to be able to eat produce such as fresh green beans and spinach all year) and large amounts of food waste. 27% of the food sold in the UK is imported; half of all the vegetables and 95% of all the fruit (A. Smith et al., 2005). Ventour (2008) found that one third of the food bought by people in the UK is thrown away, 61% of which was avoidable and could have been used if better stored or managed, and one third of this avoidable waste is untouched food. Only 19% of the food waste is truly unavoidable (such as tea bags and bones). City dwellers may not see the link with the products they consume and 'the natural environment' outside their built environment or the people and energy expenditure embodied in these products. If people were more aware of the efforts involved with food production, they may consume in a more resource efficient and waste minimising way (Benton, 2014). Kortright and Wakefield found that household food growing increased the sustainability of household food sourcing (2011). Education about where food comes from leads to consumers demanding more information from retailers about the products they consume (FLP, 2010), increasing their knowledge of the disconnection from food and the benefits of local, fresh produce (Steel, 2008). The food for life partnership has shown that children who are taught about food production have inspired their parents and grandparents to grow their own food (FLP, 2012). Local food production can cut down the social segregation of food production by re-linking the consumer with the producer and re-establishing a "conscious metabolic relationship between humans and our biophysical environment" (McClintock, 2010). Specht et al. found that reconnecting people with food production is one of the key social advantages of cultivating edible plants on buildings (2014).

Information alone does not change behaviours and needs to be combined with other approaches (Defra, 2005; Demos & theGreenAlliance, 2003). These are explored later in the thesis under motivation and behaviour change. Direct involvement with food production is also important for reconnecting people with nutritious food (Lovell, 2010). Sassi (2006, p. 45) explained that, "Growing one's own food is also invaluable in educating people about the links between humans and their natural environment". Engelhard (2010) found that one of the key benefits of rooftop farming is community engagement with food production, through classes and active community participation in their gardening, giving physical exercise and social cohesion. Michelle Obama started an organic vegetable garden on the South lawn of the White House to educate children about healthy fresh food aiming to cut down diabetes and obesity (Burros, 2009; Reimer, 2011). Food production taking place in an area has also proven to cut anti-social behaviour, for example there was a 51% drop in anti-social behaviour when an allotment was revived in Leigh, Greater Manchester (Landshare, 2011). Integrating food production with the built environment would provide urban dwellers some contact with food production, thus possibly increasing their awareness, respect and education of where their food comes from and how it is grown (Benton, 2014). A study by Defra showed that when people see action on food it can show them what is possible, influence behaviour and normalise behaviour changes (Defra, 2011c). These results were based on the observations from different community food organisations. The literature above shows that humans shape and are shaped by their environment (McClintock, 2010; Shove, 1999). This highlights the importance of food production being very visible when integrated into the built environment and that urban dwellers would gain a deeper connection with food production if they are directly involved with the food growing.

2.3.5 Increasing water security

Fresh water is often used (the 'water footprint') in large quantities to produce many goods including food. Many countries have externalised their water footprint by importing water-intensive goods from elsewhere, which has put pressure on the water resources of the exporting regions. Many exporting regions do not have wise water governance or conservation, which can lead to fresh water depletion and other environmental damage (WFN, 2012). Ancient underground aquifers are being emptied for agricultural irrigation, for example the Ogallala Aquifer in the USA (Terrell & Johnson, 1999). A person's water footprint is not just from the water they use directly; each person's consumption of 'virtual water' or embodied water from other countries, from their consumption of imported goods, is on average 4,645 litres of the world's water every day (Terrell & Johnson, 1999). For example the production of one kilogram of beef requires 16,000 litres of water (Segal & MacMillan, 2009). Local food production alleviates the virtual water from other nations by using local water such as collected rainwater. 73% of the UK's water footprint is from agricultural products (Chapagain & Orr, 2008), therefore food contributes a huge amount to an individual's water footprint. Local food production with resource efficient and waste minimising water usage can help reduce an individual's virtual water footprint.
Some plants demand a lot of water, therefore the use of storm water (rainwater) storage as irrigation, instead of mains water, will add to the sustainable urban drainage infrastructure.

2.3.6 Increasing habitats for flora and fauna

Local food production can increase food that has been produced using biodiverse food production methods and thus increase habitats for flora and fauna in urban areas (Defra, 2010b). Habitats have declined in monocultures as agricultural efficiency has increased. This has created a buffet for pests and diseases, which become resilient to pesticides (ICFFA, 2008; Viljoen, 2005). This 'conventional' method of cultivation depletes soil carbon and decreases the resilience of the crops to an unpredictable climate (Clevely, 2006; SA, 2008). Hundreds of fruit and vegetable varieties, each with their own taste and cultivation requirements have been lost to productivity, contributing to a decline in the variety of species grown and more flavoursome food (FFTS, 2012; HSL, 2012). There are methods of food production that create rich biodiverse habitats. Organic agriculture uses the techniques of conventional agriculture, but with organic fertiliser where the fundamental aim is to create healthy soil, alive with micro-organisms and rich in nutrients that feeds the plants (Clevely, 2006). Since the introduction of industrial agricultural production methods, "official figures have shown that minerals in fruits and vegetables have fallen between 17 and 80%" (SA, 2015). On a large scale, organic agriculture is reliant on machinery powered by fossil fuels or needs a large labour force. Also the fertiliser used can often be processed and sourced from long distances (FAO, 2009). Local food produced organically can tap into local food waste streams for fertiliser, creating a nutrient loop.

Austrian philosopher and scientist Rudolf Steiner developed the biodynamic theory and method of cultivation in 1924, where, similar to organic farming, no artificial chemicals are used (Diver, 1999). Biodynamics takes a more spiritual perspective for cultivation where celestial rhythms are followed, compared with organic agriculture which takes a more ecological perspective (Diver, 1999). One of the fundamental beliefs of biodynamic cultivation is that the food is nutritionally superior and tastes better than food produced by conventional methods (Diver, 1999). However, it is not as accepted as other methods of ecological cultivation because the ideas are seen as esoteric and thus difficult for some communities to implement.

Permaculture is a system of organic farming which is designed to need less energy and labour, creating a more 'permanent agriculture' where there is a focus on the use of edible perennial plants to create a self-sustaining system, rather than the traditional practice of continuously working the land and planting annual crops (Bill Mollison, 1988). Yield is diverse in a permaculture system and would not provide an abundance of annual vegetables for example, but rather a little bit of a lot of things (Figure 11).

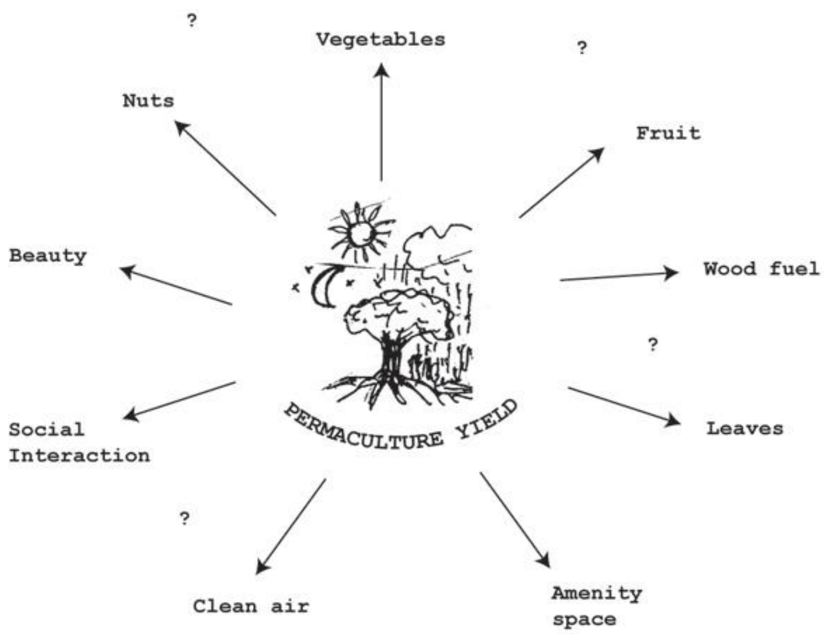

Figure 11: Types of yield (Naturewise, 2008)

A key aim is to use minimum effort for obtaining maximum effect by observing nature (Bill Mollison, 1988), so that once a system has established, the main task would be to harvest, which is ideal for busy city lifestyles. Permaculture systems are based around key design principles (Figure 12) (Bill Mollison, 1988). For example the soil structure is never disturbed in a permaculture garden (i.e. no digging) to maximise soil fertility.

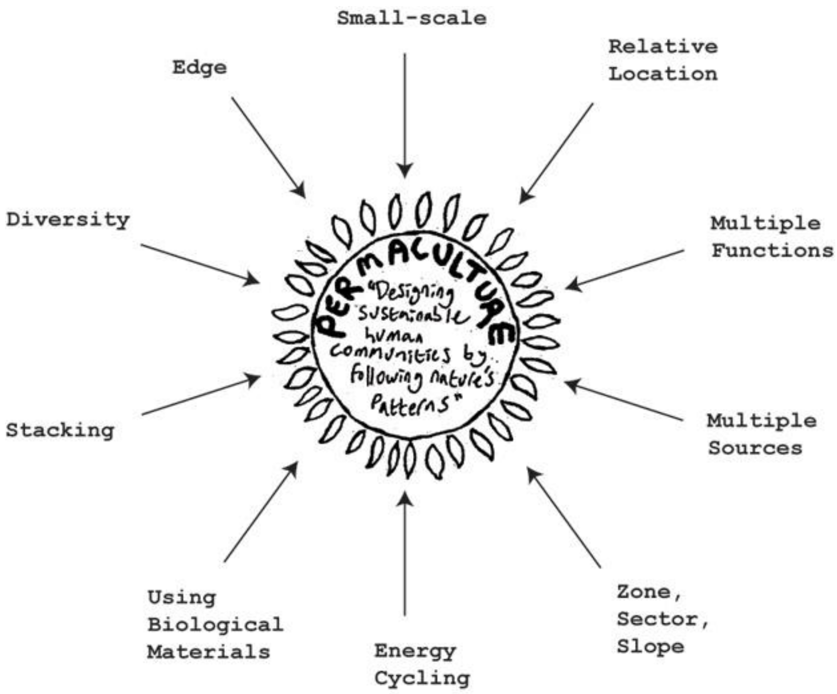

Figure 12: Permaculture Principles
(Barton, 2000; Naturewise, 2008)

Local food production can contribute to plant and soil biodiversity if the above methods are used. Local food production in cities is known as; urban agriculture, urban food growing and urban horticulture. Urban agriculture can provide habitats for urban flora and fauna (Benton, 2014) if the above growing methods are used.

2.3.7 Increasing community cohesion

Growing food within the built environment can help create opportunities for community cohesion (Defra, 2010a), which is important for strengthening local communities and the way people live together in their community. Gardeners in Toronto, Ontario found that gardeners perceived that community gardens promote social health and community cohesion (Wakefield et al., 2007). Social benefits were also highlighted by stakeholders considering hydroponic building integrated agriculture in Berlin (Specht et al., 2015).

2.4 Integrating vegetation directly with buildings

Integrating vegetation directly on buildings is not seen as a necessary feature for an external fabric, especially because plants need water which conflicts with the role of the external fabric to keep water and other elements out. This section outlines how vegetation integrated directly inside and on buildings can in fact play a key role for building performance and occupant satisfaction.

2.4.1 Contributes to energy efficiency in buildings

Historically, humans have lived in buildings that are kept comfortable within contextual expectations, with the aid of mostly passive strategies, which do not have an operational energy demand. Fossil fuels have provided an abundance of cheap energy, which has influenced the design of buildings. Many buildings now need operational energy to function comfortably for the occupants. A highly glazed building can only be comfortable in a desert climate, e.g. in the United Arab Emirates, with the use of air-conditioning; an energy intensive, active, mechanical system powered by electricity generated using fossil fuels.

Energy efficiency in buildings reduces the amount of operational energy needed through passive design strategies such as orientating the building in relation to the sun, wind and site characteristics, insulating the building, designing to help passively cool and ventilate the building and providing appropriate natural light to minimise electrical lighting use (Sassi, 2006). Cole et al. (2010) have shown that passive strategies increase occupant-productivity. Exposure to restorative environments such as gardens helps improve attention with cognitive benefits (Berman, Jonides, & Kaplan, 2008; Berto, 2005). Integrating vegetation directly with buildings can help contribute to cooling, sheltering and shading buildings passively, where plants provide a cooler microclimate and lower the ambient temperature around a building (Sassi, 2006). A study undertaken by Alexandri and Jones (2006) found that covering un-used hard spaces with plants, such as walls and roofs, significantly decreases temperatures in built-up urban areas, and so reduced energy consumption for cooling from 32% to 100%. Green roofs shade the building fabric from heat in the summer by providing thermal mass and can reduce fabric heat loss, although this depends greatly on the amount of water held within the plants and substrate (Newton et al., 2007). Green roofs have been shown to reduce air-conditioning demands by 75% (Liu & Baskaran, 2003). A report undertaken by the City of Portland regarding vegetated roofs and energy conservation found that green roofs help reduce the energy consumption of buildings through reduced cooling demands and heating demands as well as offering other environmental benefits that have been highlighted in this chapter (BES, 2013).

Sanye-Mengual et al. (2014) looked at the embodied energy of implementing a rooftop greenhouse for growing tomatoes hydroponically in comparison to a ground level commercial greenhouse in

Spain. The study found that the environmental impact of rooftop greenhouses are higher due to an increase in materials needed for stability of the greenhouse structure in order to meet building law requirements for safety, but that this increased impact could be balanced by the positive environmental effects on the building, for example rainwater harvesting (Sanye-Mengual et al., 2014). Methods for integrating food production on building could be assessed in relation to the embodied energy of the cultivating systems vs. the benefits it would have to reduce the building's cooling.

2.4.2 Population growth and competition for land

The human population has risen very rapidly over the past 200 years (Figure 13). The more humans there are, the more buildings that are needed to house them. Green spaces and brownfield sites are under great threat in the UK and across the world due to the need for more buildings.

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Figure 13: Population Growth in England, 1801 to 2001 (Jefferies, 2005)

Vegetation integrated on the building fabric can help contribute to increasing vegetation in urban areas, for example 16% of the surface area in the City of London is flat roofs, many of which have potential for becoming vegetated (Newton et al., 2007). Numerous vertical surfaces also have the potential to be cultivated.

2.4.3 Urban Heat Island Effect (UHI)

Vegetation integrated directly with buildings (such as on walls and roofs) will reduce a building's impact on the UHI, therefore the more vegetation integrated directly with buildings, the greater this impact (Newton et al., 2007). This is especially important in high-density urban areas.

2.4.4 Sustainable Urban Drainage (SUD)

Rooftops make up on average 40-50% of impervious surfaces in urban areas (Nigel Dunnett & Kingsbury, 2004). Green roofs add a pervious sponge to rooftops and also filter the water before entering a drainage system (Nigel Dunnett & Kingsbury, 2004). Green roofs can play a key role in a city's sustainable urban drainage strategy (Ackerman et al., 2013). Green roofs can also help reduce pollutant run off into city sewage systems (Ackerman et al., 2013), but in some cases depending on the growing medium and how long it has been on the roof, green roofs can also leach contaminants into runoff (Ackerman et al., 2013; Jarlett, 2013).

2.4.5 Plant species biodiversity

Francis and Lorimer (2011) have identified that buildings could be part of reconciliation ecology where living (green) roofs and walls are some of the key strategies for achieving reconciliation ecology in towns and cities. Between 2004-5 Dunnett et al. (2008) recorded 35 colonising plant species on a single experimental living roof in Sheffield, UK, with greatest abundance and diversity of colonists being found on sections of the roof with a substrate depth of 100mm, highlighting that an extensive green roof with a soil depth of 100mm can help support plant biodiversity. Integrating vegetation into the built environment and with buildings can promote plant species biodiversity.

2.4.6 Protecting the external fabric of a building

The fabric of buildings is continuously exposed to ultraviolet light and temperature changes which cause weathering (GRC, 2010). Plants can shade the external fabric of a building from weathering, increasing the lifespan, which has economic advantages (GRC, 2010; Newton et al., 2007).

2.4.7 Reduces noise pollution

There are many external noises (such as traffic and rain on a metal roof) in the built environment that can affect comfort levels for building occupants. A green roof can reduce sound levels in a building by 8dB or more compared with a conventional roof due to the growing medium, the plants and trapped air within the system (GRC, 2010; Newton et al., 2007).

2.5 Integrating edible plants directly with buildings

It has been outlined above that there are numerous advantages when integrating food production within the built environment, but there are some obstacles to achieving this integration at ground level. There is limited land in urban areas for food production as land is in demand for other purposes such as buildings. It can be more difficult for people to access pockets of land for food production as they may be far from where they live or work e.g. allotments in urban areas are often not conveniently close by for someone to be able to make quick trips on the way to somewhere or during their breaks. This section outlines how food production integrated directly with buildings that are used for other purposes could help mitigate these obstacles. Those buildings that are designed solely for food production will not be looked at in this research, such as large warehouses, where it is possible to grow hydroponically using artificial light (Kozai, 2007).

2.5.1 Population growth and competition for land

Current attempts to increase spaces for local food production in towns and cities are facing difficulties as populations are increasingly rising (Capital Growth, 2009). Housing shortages are putting land under pressure (Steel, 2008, p. 46). The UK government has a target of building three million new homes by 2020 (DCLG, 2007). Theoretical proposals for ecological and low energy developments often look at the land around the buildings for food production such as community allotments and commercial gardens (DCLG, 2008). However, in densely populated areas competition for land is severe. Demand for allotment plots across the UK has increased; a 13,000 waiting list in 1996 to 100,000 in 2008 (Hope & Ellis, 2009). 14 acres of garden space (South Central Farms) which fed 350 families in Los Angeles, USA were demolished in 2006 for development (McClintock, 2010). Strategies for integrating food production with the built environment could help alleviate this conflict. Could the new development integrate the gardens on the buildings? Rooftops, balconies, windows, walls etc. could be used for food production.
S –mall P –lot IN –tensive (SPIN) farming is the use of organic techniques and business planning to intensively cultivate plots smaller than 4046.8 sqm (an acre): for example a half an acre plot can gross $50,000+ over a year (SPIN, 2012). SPIN farming focuses on low-tech cultivation for commercial purposes, on small disused plots integrated within towns and cities (SPIN, 2012). This creates opportunities for more people to become farmers as the land is affordable and there is no need for large expenditure on equipment. SPIN farming provides farmers a business concept, marketing advice, financial benchmarks and a detailed day-to-day workflow, which helps guide people who are new to farming (SPIN, 2012). This method of cultivation is extremely valuable for a country, such as the UK, where the farming population is ageing, land is expensive and starting up costs are high (SPIN, 2012). This method of farming could also be used on disused surfaces on buildings such as rooftops with sufficient structural capacity.

2.5.2 Easy Access

Permaculturalists see cultivation as an integrated part of human habitats to reduce the energy expenditure on food production (i.e. the promotion of lazy gardening where we do not need to go out of our way to cultivate food), where there is a symbiotic relationship between dwellings and the land. Mollison (1979) talked about the importance of designing buildings with easily accessible areas for food production, for example balconies, trellises and rooftops where occupants living in flats can also cultivate food. Denny (2009) showed that a tomato grown in an allotment plot in England had twice as many emissions than a tomato from Southern European regions bought in a local shop in England due to the trips taken with a private car to the allotment, although if not using a car, urban tomato growing could reduce tomato related emissions by 44%. This highlights that local food production should be close to where the gardener lives. People in industrialised countries spend an average of 90% of their lives inside buildings (OECD, 2003). Spaces for food production directly integrated with buildings would be very close to the occupants so they would not need to spend much time or emissions to travel there. The convenience of cultivating directly where you live or work means that the cultivating can take place during breaks or when passing by so that the cultivator does not have to allocate large portions of the time to cultivating.

2.5.3 Visibility

The discussions above about the education of food production highlighted the importance of the visibility of food production for urban dwellers who are disconnected with how food is produced. Barracks Lane community garden is an example of a community garden in Oxford, UK, which provides invaluable knowledge of food cultivation within an urban context (Figure 14). The site is behind private gardens in a residential area.

Figure 14: Barracks Lane Community Garden built on the site of a disused car park, Oxford, UK (Source: Author)

OxGrow is another example of a community garden. It was set up by university students, on a disused university college playing field. The local community joined forces with the students and created an international edible food garden in Summer 2011, including crops such as Chinese Pak Choi and Quinoa grain from South America. Both these community gardens are in sites where they are not visible by the general public. This makes it difficult to spread the benefits gained from these gardens to a wider (unconverted) audience. Food production directly integrated with buildings can be highly visible to all the building occupants, which can subconsciously increase their awareness of food production and in turn create more resource efficient and waste minimising consumption habits.

2.6 Conclusion

This chapter has systematically identified why people would cultivate edible plants on buildings. The integration of vegetation within the built environment alleviates pollution and the urban heat island effect as well as contributing to sustainable urban drainage, habitats for flora and fauna and health. Along with these benefits, if the vegetation is edible it alleviates the negative impacts of globalisation and urbanisation, food security, food poverty, food waste and the water footprint of food. It also contributes to resource efficient and waste minimising consumerism through directly reconnecting people with food growing, education, health through increased nutrition and exercise and increasing community cohesion. Integrating vegetation directly with buildings (i.e. on the building fabric or inside a building) can contribute to the energy efficiency of a building, protects the external fabric and reduces noise pollution. Integrating *edible* vegetation directly with buildings lessens competition for land for local food production, provides a short distance to growing spaces and contributes to reconnecting city dwellers with food production by increasing the visibility and proximity of food production.

This research has established the worth of cultivating edible plants on buildings. The next chapter investigates how this can be achieved by looking at the three main elements of these systems; edible plants, buildings and users. Existing case studies are explored to assess the successes and failures of these systems.

Chapter 3: The three elements for integrating edible plants with buildings: edible plants, buildings and users

3.1 Introduction

When cultivating edible plants at ground level, the main elements that shape success of the undertaking are the edible plants, qualities of the ground and the person cultivating the plants (the user). Similarly, three distinct elements are involved when integrating edible plants with buildings (edible plants, users (the individuals growing and eating the produce) and buildings). These are shown in the conceptual framework below (Figure 15).

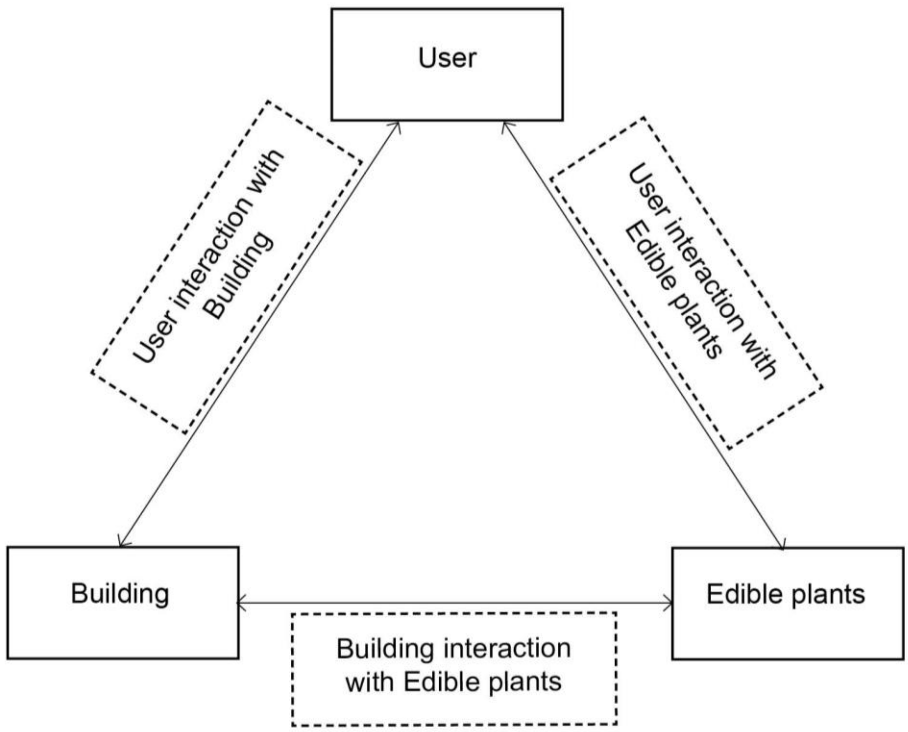

Figure 15: Conceptual framework showing the three elements for cultivating edible plants on buildings

The first element involves the edible plants themselves, and what they need to thrive (the edible plants parameters). The second element involves the users and how they interact with the system (the user parameters). Finally, the third element is the opportunities a building offers for integrating edible plants (the building parameters). These parameters were integrated into a conceptual framework diagram, where the focus is on investigating how the elements interact with one other. This chapter undertakes a literature review of the edible plant, user and building parameters and highlights that there is a gap in knowledge regarding how the user interacts with the edible plants integrated with buildings.

3.2 Edible plant parameters

Edible plant parameters are the conditions needed to grow edible plants and are discussed in the following sections. This section aims to highlight the edible plant parameters that would need to be considered in the context of cultivating edible plants on a building.

3.2.1 Growing medium

Plants grow naturally in soil but buildings do not usually have soil on them. This section looks at how plants use soil to grow, in order to begin to understand how soil put on a building could maintain good conditions for healthy plant growth.

A soil's chemical, physical and biological environment are all interrelated and are important for soil fertility in the context of plant growth.

3.2.1.1 Soil Physical Environment:

An understanding of the composition of soil will help when deciding what type of soil to use in containers (a green roof can be seen as a large container) on buildings. Figure 16 shows the composition of a soil ideal for plant growth (a fertile soil or loam). The arrows indicate that the percentage of water and air can vary widely and that they are negatively related (i.e. an increase in one is associated with a decrease in the other) (Hillel, 1982).

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Figure 16: A schematic composition (by volume) of a medium textured soil considered optimal for plant growth (Hillel, 1982)

The width and depth of growing medium available for the plant to grow is important as there needs to be sufficient depth for the plant roots. 30cm is sufficient depth for all annual vegetables and most dwarf fruit trees (Guerra, 2005). Many leaf greens can grow in just 10cm deep soils (Guerra, 2005).

3.2.1.2 Soil Chemical Environment:

An understanding of the soil chemical environment is important when cultivating on buildings in order to maintain conditions in the soil that the edible plants can thrive in. Soil pH is also important for plant growth as well as soil temperature. If suitable nutrients are added to any growing medium then plants will be able to grow, which is the principle behind hydroponic growing systems (where plants are grown in a water solution or growing medium that is not soil). Modern agriculture practices can grow crops on poor soil by using artificial fertilisers and pesticides. However, this approach has led to contamination of environments due to the leaching of excess nutrients (Abbott & Murphy, 2003). Even the addition of unmanaged external organic nutrients can devastate an environment, for example peat is used widely for gardening, however the mining of peat can destroy important ecosystems (Guerra, 2005). This shows that, in order to reduce the environmental impact of systems for cultivating edible plants on buildings, it is important to consider how the resources for maintaining a soil's chemical environment are sourced and how these resources leave the building to mitigate contamination.

3.2.1.3 Soil Biological Environment:

An understanding of the soil biological environment is important when cultivating on buildings in order to maintain conditions in the soil that the edible plants can thrive in. A soil's biological environment helps regulate the chemical and physical environment (Abbott & Murphy, 2003; Bot & Benites, 2005).

Agricultural practices take advantage of soils with high biological, chemical and physical fertility that have become fertile naturally over time. These soils do not stay fertile forever if the balance of the soil's physical, chemical and biological environment is not maintained. When one crop is continuously farmed on an area of fertile land, the soil eventually becomes drained of the nutrients needed for that plant; the soil's biological environment changes, and is no longer suitable for that plant without some input such as irrigation, fertilisers, pesticides and tillage (if the soil becomes compacted). The principle behind organic, biodynamic and permacultural cultivation is to maintain soil biological fertility (Clevely, 2006; Diver, 1999; Bill Mollison, 1988). Organic and biodynamic cultivation uses heavy machinery or traditionally human/animal labour to maintain the soil habitat. Permaculture looks at minimising human input into a growing system by using plants to maintain the soil habitat (i.e. observing what happens in natural systems such as forests). The difference between vegetation in a natural forest and vegetation in permacultural systems is that the vegetation is mostly edible (for example the concept of an edible forest) and that there are no large trees, which makes a big difference ecologically.

Soil organic matter is how plants can continually obtain nutrients in the soil food web (Figure 17). Soil organic matter consists of two main fractions; the active organic matter which is the soil biota (living organisms) including micro-organisms as well as readily decomposable soil organic matter and the stable organic matter which is referred to as humus (Bot & Benites, 2005).

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Figure 17: Soil food web (Ingham, 2000)

Table 2: Functions of soil living organisms (Ingham, 2000)

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Table 2 highlights the importance of having a range of living organisms present in a growing medium to perform different functions in order to sustain a healthy environment for plant growth at ground level and on buildings. This complexity aids a variety of functions to help plants grow well including; nutrient cycling, nutrient retention, structure, infiltration and water retention, disease suppression, good decomposition rates and degradation of pollutants (Ingham, 2000). An imbalance in these different soil living organisms can create a bad environment for plant growth (e.g. pests and disease, lack of oxygen etc.):

- The organisms need to be fed well. The organisms eat readily decomposable soil organic matter (e.g. dead animals, plants and plant roots). In an edible system, plant matter is taken away by being eaten by humans, unlike in a natural system where it would be returned to plants via animal faeces and left over parts of the plant. This layer of readily decomposable organic matter on the surface of the soil protects the surface of the soil from wind erosion and damage by raindrops as well as retaining moisture. Organic farming systems use a mulch of dead plants to feed the soil biota, which then feed the plants and build up humus in the soil.

- Changes in the soil physical environment such as salinity, toxicity and extremes in soil pH can kill soil biota (Bot & Benites, 2005). Adding lime or fertiliser can cause this imbalance.

- Digging (tilling, ploughing) the soil can disturb the organisms by exposing them to conditions they cannot survive in. For this reason, many organic agriculture practices have developed no-dig systems (Bot & Benites, 2005; Bill Mollison, 1988).

- Pesticides and fungicides can kill some soil biota, which can also create an imbalance.

- When one organism becomes dominant, causing an issue for the others, then natural predators for that organism could be introduced. For example slugs can become dominant in vegetable gardens in the UK, so natural predators such as nematodes can be added to reduce the slug numbers. Nematodes can also be used for vine weevils that eat plant roots.

3.2.1.4 Nutrients

An understanding of the nutrients that plants need and how to source them is important when cultivating on buildings in order to maintain conditions in the soil that the edible plants can thrive in.

As discussed above, the conventional agricultural practice of adding artificial fertilisers and pesticides to soils is causing environmental issues (Tilman, Cassman, Matson, Naylor, & Polasky, 2002). Artificial fertilisers also release GHGs such as nitrous oxide, which is 310 times more powerful than carbon dioxide, accounting to 60% of agriculture GHG emissions (Stanley, 2002; Viljoen, 2005). The same problems will occur when using fertilisers and pesticides within the built environment, therefore methods of food production without the need for these chemicals should be explored. In a natural environment the nutrients that plants would need (Table 3) come from water and soil.

Table 3: Nutrients needed by plants (NCA, 2011)

Primary Macronutrients:	Secondary Macronutrients:	Micronutrients:
Nitrogen (N) Phosphorous (P) Potassium (K)	Magnesium (mg) Calcium (Ca) Sulphur (S)	Iron (Fe) Manganese (Mn) Zinc (Zn) Copper (Cu) Boron (B) Molybdenum (Mo) Cobalt (Co) Chlorine (Cl)

In some permaculture and organic no-tillage systems, fertilisation is only needed annually through mulching (Figure 18) using compost and nutrient-rich perennial plants. This is possible because the soil is rich in micro-organisms and soil biota that have not been disturbed and can help break down the mulch, providing accessible nutrients to the plants. Research has shown that plants grown in organic soils contain more nutrients compared with plants grown in conventional agricultural systems (G. Irwin, 2012) due to soil organic matter helping plants absorb more nutrients (Bot & Benites, 2005).

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Figure 18: An example of mulch build-up to suppress weeds rather than digging them up, which would disturb the soil structure and biota (Whitefield, 1993)

Cultivating on buildings is essentially cultivating in containers (at different scales). Growing mediums in containers can have soil organic matter with a self-sustaining soil food web if managed using organic cultivation methods. Mulching can be part of this management in order to add nutrients to the growing medium. Companion planting is also a method that can help alleviate the need for artificial fertilisation, for example some plants can fix nitrogen into the soil, which other plants may need (Bill Mollison, 1988). Plants can also help deter pests from one another, attract pollinating insects and prevent diseases and weeds (Guerra, 2005).

Compost added to soil annually is an organic method of adding nutrients to a soil. When growing in small containers, these could be filled with compost and repotted annually. Pure compost cannot be used as a growing medium in larger containers where repotting is not easy, as the nutrients will eventually deplete and the soil composition will break down (due to the lack of other elements that help the soil structure as discussed in section 3.2.1.1 above) reducing the air gaps for the roots to access, so management of the soil organic matter in larger containers helps the growing medium supply nutrients to the plants in the long term.

Grard et al. (2015) showed the potential of using urban waste such as compost, made from green waste from parks and gardens and coffee grounds, for growing in containers in urban areas and on rooftops in Paris.

3.2.1.5 Yield when cultivating edible plants on buildings in soil

The yield or productivity achieved can be important for the grower when cultivating edible plants, as the aim is to eat the plants. How much can be grown on buildings? An allotment of 250m^2 (NSALG, 2015) was traditionally sized to produce the annual vegetable needs of a family of four (62.5m^2 per person where 1m^2 produces 1.6% of a person's annual vegetable intake).

This area of growing space is very difficult to achieve in high density developments where maximising the number of units is given priority over private open space (e.g. balcony, garden etc.) if there are no specific requirements by the councils (local authorities). Design for London recommends that 1-2 person dwellings should have a minimum of 5m^2 of private open space. This area could produce 8% of a person's annual vegetable intake or 4% each for two people if using the productivity levels on allotments. Design for London also recommends an additional 1m^2 for each person added, and that balconies should have a minimum depth and width of 1500mm (DfL, 2010). Different councils have different recommendations for private open space, i.e. amenity space, for dwellings. For example Barnet Council recommends 40-85m^2 for family housing and 5m^2 per habitable room in flats (GLA, 2006). If 40-85m^2 is halved to give space for amenity this could produce 8%-17% of each family member's annual vegetable intake for a family of four people. Most councils have minimum requirements of private open space for family units only and do not give a minimum requirement for flats. A typical balcony space for flats in the UK is about 2-3m^2 (Figure 19). If we subtract, 1m^2 for access this could produce 1.6%-3.2% of a person's annual vegetable intake.

Figure 19: A balcony garden on a typical balcony space, UK (Fennel&Fern, 2012)

Crest Nicholson and Bioregional Quintain, the developers of the 'One Brighton' flats in Brighton, UK gave over 450m² of private open space to the development in the form of communal terraces, gardens and sky gardens and a further 128m² of roof-top allotments (BioRegionalQuintain, 2006). They also followed the guide of 1.5m² of private open space per bed space (or per person) (minimum of 3m² per dwelling) and 1m² of communal space per bed space and all balconies were installed with small planters (designed for herbs). The allotments were allocated in the form of 1.5m² raised beds (one per dwelling). This gives one resident the space to grow about 2.4% (1.5 x 1.6) of their annual vegetable intake.

Mark Ridsdill Smith, the founder of an Internet based resource for learning about small-scale container growing the 'Vertical Veg Club', started a blog about his own balcony and windowsill edible garden in London. The space that he had was "9 foot x 6 foot (5m²) north-west facing balcony, 5 south facing window sills, 3 north facing window sills, and a small patch of concrete outside the front door" (Fennel&Fern, 2012b). Taking the patch of concrete as 3m by 1m (3 m²), minus 1m² of the balcony for walking space and a total of 26 planters that are 1m by 0.15m (3.9m²) make the total growing space about 11m², where he aimed to grow vegetables for his family (2 adults at the time) all year (Figure 20 and 21).

Figure 20: Ridsdill Smith's 9 foot by 6 foot north west facing balcony and 3 north facing windowsills (Fennel&Fern, 2012b)

Figure 21: Ridsdill Smith's 5 south facing windowsills and patch of concrete. NOTE: The plants are blocking some glazing area which would reduce the natural light entering the building. This may be beneficial on a south facing and west facing façade during the summer period to reduce over heating but north facing windows would want to maximise light entering through them (Fennel&Fern, 2012b)

From May to October 2010 he grew 66kg worth of vegetables in this space (Ridsdill Smith, 2010) and from May to October 2011 he grew 69kg, which he calculated to be valued at £452 worth of produce using prices from the UK's lowest price supermarkets (Ridsdill Smith, 2011). This is about 69 tonnes/hectare.

If on average two people spend £80 per week (about £20 per week on fresh vegetables if they are eating the recommended 25% of fresh vegetables (FSA, 2011)) (£2600 per year) on their food shopping, this means Ridsdill Smith was able to grow about 17% of the annual diet of two people (or 68% of their annual vegetable intake) in 11m² of containers (assuming that he did not grow anything the rest of the year), thus showing that 5.5m² per person is sufficient to grow 68% of their annual vegetable intake if growing with the growing methods used by Ridsdill Smith (each 1m² creating 12% of one person's annual vegetable intake). If the One Brighton allotment plot holders used Ridsdill Smith's growing methods, they could in theory grow 18% of one person's annual vegetable intake in their 1.5m² planter, instead of the previously calculated 2.4% which uses traditional growing methods used in allotments. If this measurement were to be used when designing housing with the aim to achieve 68% of the household's annual vegetable intake then a two bedroom, four person flat would need 22m² (5.5 x 4) of growing space allocated to grow 68% of the annual vegetable intake for that household. It may be possible to spread out 11m² (34% of their annual vegetable intake) along accessible windowsill external planters, a typical balcony space and some planters fixed to wall space accessible from the windows and balcony. Ridsdill Smith (2010) said that his most productive plants had been tomatoes, salads, herbs, runner beans and courgettes. He used some of the following techniques to achieve more from a small space: plant "fast-growing crops that produce a harvest quickly, inter-planting fast-growing crops between slower-growing plants, and planning container combinations such as early potatoes followed by a later crop in June in the same pot" (Fennel&Fern, 2012b). He said planning what to grow in each container is key to achieving higher yields from a small amount of space (Figure 22) (Ridsdill Smith, 2015).

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Pot 1			First Early potatoes			Runner beans				Kale		
Pot 2		Mange tout peas					Courgette			Rocket		
Pot 3		Pak Choi (under cover)			Tomatoes					Mooli		
Pot 4		Carrots				French beans				Swiss chard Bright Lights		

Figure 22: Example of a year round planting plan for four pots. NOTE: Dates refer to transplant dates – seeds should be started two to four weeks earlier (Ridsdill Smith, 2015)

Growing medium nutrients and soil microbiology are also important to increase yields, where Ridsdill Smith recommended using compost from a wormery and also mixing in fresh compost, fertiliser or matured manure between each crop (Ridsdill Smith, 2015). The methods used by Ridsdill Smith and other micro-generation technologies (RUAF, 2003) for maximising yields in container gardening is an opportunity for further research where a knowledge base can be brought together and different technologies can be used depending on the context and the gardeners.

3.2.1.6 Growing medium used for growing plants on buildings

Saturated soil can weigh 1463kg or more per cubic metre, which can cause structural issues when cultivating on buildings (Myers, 2016), so lighter growing mediums have been developed for cultivating on buildings. Further research is needed in order to assess the performance of these lightweight soils for edible plants (Ackerman et al., 2013). Table 4 shows different building integrated vegetation systems and the growing mediums used.

Table 4: Building integrated vegetation systems

Name of System	Growing Medium	Fertilisation and frequency (if edible plants)
ANS green wall (ANS, 2012)	Green waste and pumice stone	Soluble fertiliser (organic or chemical), everyday.
Amytis Living Wall (Amytis, 2012)	Expanded clay and mineral rock	Soluble fertiliser (organic or chemical), everyday.
Biotecture (Biotecture, 2012)	Mineral fibre (rockwool) - expanded and layered basalt rock	Soluble fertiliser (organic or chemical), everyday.
Den Ouden	Rockwool	Soluble fertiliser (organic or chemical), everyday.
Tree box Easiwall (Treebox, 2012)	Green roof substrate mixture (typically crushed rubble, compost and medium clay soil).	Soluble fertiliser (organic or chemical), in general every 2 months.

Verti-garden (VertiGarden, 2012)	Compost with slow release fertiliser	Soluble fertiliser (organic or chemical), replace the growing medium annually.
Frosts vertiscapes (Frosts, 2012)	Compost/soil mix	Soluble fertiliser (organic or chemical), everyday.
Vydro substrate (Huntsman, 2012)	Chemically inert hydrophilic foam which can retain a lot of water	Soluble fertiliser (organic or chemical), everyday.
Paradise Park Children's Centre Living wall (Dawson, 2006)	Rockwool	Soluble fertiliser (organic or chemical), everyday.
Patrick Blanc living wall system (Lee, 2011)	Polyamide felt	Soluble fertiliser (organic or chemical), everyday.
Mobilane LivePanel (Mobilane, 2012)	Rockwool	Soluble fertiliser (organic or chemical), everyday.
Green living technologies Green Wall System	Compost (mixed with GLT Biosoil)*	After one year (Pirro, 2012) (depending on types of plants) add soluble organic fertiliser or tea from the biosoil fermentation via the irrigation system (G. Irwin, 2010a) (in general every 2 months) or replace the entire growing medium every year.
ELT living wall system (ELT, 2011)	Compost and coconut coir - A mixture of organic and inorganic materials to culture micro-organisms beneficial to plant performance	Soluble fertiliser (organic or chemical), in general every 2 months.
Minigarden (Minigarden, 2012)	Potting compost	Soluble fertiliser (organic or chemical), add more growing medium when it reduces down.

Woolly Pocket (Woollypocket, 2012)	Potting compost	Soluble fertiliser (organic or chemical), add more growing medium when it reduces down.
Bin Fen greenwall system (Binfen, 2012)	Potting compost	Soluble fertiliser (organic or chemical), add more growing medium when it reduces down.
Habitile (Habitile, 2012)	Potting compost	Soluble fertiliser (organic or chemical), add more growing medium when it reduces down.

*GLT biosoil is created using a patented fermentation process (McNelly, 2007) that uses chicken dung and other bio-solids to create a compost mix that is rich in Nitrogen, Potassium and Phosphorous (Irwin, 2010b). GLT biosoil contains a wide variety of living soil organisms (including mycorrhizae) and organic humates (mined humic substances (Pettit, 2012)) which help plants grow and increases the taste, nutritional quality and density (G. Irwin, 2012). Mined humic substances (humates) are carbon containing minerals, such as Leonardites. These are concentrated in humic and fulvic acids and when added to soil, they can perform the role of a humus rich soil and stimulate the development of soil organic matter. Adding humates can be a quick fix solution to adding organic matter to make a soil more fertile for plant growth, however humates are a finite resource that take thousands of years to form (Pettit, 2012). Humates would not need to be continuously added if the cycle of organic matter in the soil is sustained.

3.2.1.7 Hydroponic and Aquaponic (soil-less) Systems vs. soil-based systems:

Most of the systems above are hydroponic systems, which means they do not use soil as a growing medium. Some hydroponic systems use the growing medium as a structure for the plant roots and the irrigation as a source of nutrients making the system much lighter than soil based systems. Hydroponic systems can be used for cultivating edible plants on buildings to create commercially viable food production in urban settings as they can be four times more productive per square metre compared with growing in soil (Jenkins, Keeffe, & Hall, 2015; Muro, Diaz, Goni, & Lamsfus, 1997). A possible yield for hydroponics on rooftop systems is calculated to be 184 tonnes/hectare (Astee & Kishnani, 2010) which is three times as much as the 69 tonnes/hectare using Ridsdill Smith's growing methods in containers with soil on buildings discussed in section 3.2.1.5 above.
Hydroponic systems have been used by NASA in space stations (Greenfortune, 2011). The Science Barge in New York, is a hydroponics urban agriculture prototype (Nelkin & Linsley, 2009). The hydroponics on the barge are powered by photovoltaic panels (1.25 kW) with a solar tracker (70-

80% of the power), micro-wind turbines and a diesel generator powered by waste vegetable oil (Nelkin & Linsley, 2009). The goal is to make the barge self-sufficient but the main barrier to achieving this is finding a sustainable source of nutrients (Buttery, Leach, Miller, & Reynolds, 2008).

Further advantages of hydroponics in comparison to growing in soil organically are 1/ that you can control exactly how much nutrients the plants need to grow, so they are often very healthy plants (Nelkin & Linsley, 2009); 2/ that you are able to control the climate; 3/ that you can control pests (Germer et al., 2011) and 4/ hydroponic systems require four times less water for the same yield (Astee & Kishnani, 2010).

The disadvantage of hydroponic systems in comparison to growing in soil organically is that they are reliant on an energy input to pump water and nutrients to the plants, making the system energy intensive unless it uses renewable energy, which in itself carries an embodied energy premium. Kim et al. (2009, p. 256) say that 'beneficial phytochemicals are often more concentrated in plants that have experienced stress than in plants that are pampered' thus indicating that hydroponic plants need very precise management in order to be nutritionally compatible or nutritionally superior to soil grown plants (Hayden, 2006). In addition, hydroponic systems commonly use chemical fertiliser to provide a precise application of nutrients to the plants (G. Irwin, 2012a), and will not use urban waste streams as a source of nutrients but need to source mined nutrients from external sources (nutrient liquor from vermiculture (G. Wilson, 2002) and aquaponics can be a possible solution to this issue). Hydroponic systems are not highly beneficial for increasing habitats for flora and fauna (Cornucopia, 2015) and diseases can sometimes develop from the build up of dominant microbes and root rot due to lack of air in the water solution that is pumped around the system (G. Irwin, 2012a). The pH and temperature of the water are also very important for the success of hydroponic systems (G. Irwin, 2012a) and hydroponic systems can be much more expensive to start up and maintain compared with organic soil growing (James, 2013). Further research is needed to investigate the possibility of using water-soluble organic fertiliser in a hydroponic system in order to make use of urban waste streams for sourcing nutrients for the plants. A study in Australia looked at using nutrient liquor from vermiculture as a nutrient source for a hydroponic system, where the worms broke down food waste from restaurants (G. Wilson, 2002). The nutrient content of organic solutions can vary so it is not as simple as using an inorganic chemical solution, but they can be adjusted with the addition of rock dust or other soluble organic materials (G. Wilson, 2002).

Aquaponics is a hydroponics system that uses organic waste produced by tanked fish (most commonly tilapia) as the only source of nutrients for the plants rather than importing nutrients. Aquaponics is a possible way of farming fish sustainably and creating a symbiotic relationship between growing food and producing fish (Buttery et al., 2008). 'A major concern in aquaponic systems is the removal of ammonia, a metabolic waste product excreted through the gills of fish.

Ammonia will accumulate and reach toxic levels unless it is removed by the process of nitrification (referred to more generally as biofiltration)' which is performed by some bacteria lining the tanks (Rakocy, Masser, & Losordo, 2006, p. 6). The pH values of the tank need to be maintained to keep this bacteria functioning well. Aquaponics are a possible solution to the imported nutrient issues of hydroponic systems depending on how the fish feed is sourced, but water is heavy negating the lightweight benefit of growing hydroponically on buildings, so if the structural capacity of a roof is not sufficient, the tanks would need to be located at ground level and the water pumped up to where the plants are growing.

Table 5 provides a summary of the findings above, highlighting that low-tech soil based systems cover most of the advantages of integrating edible plants with buildings, set out in Chapter 2.

Table 5: Summary of edible plant growing systems within the built environment

	Soil based system	Home-made hydroponic system	Manufactured hydroponic system	Aquaponics
Set-up cost	Low	Low	High	High
Maintenance cost	Low	Depends on cost of time of person maintaining it and cost of fertiliser	Mostly high but depends on cost of time of person maintaining it and cost of fertiliser	Mostly high but depends on cost of time of person maintaining it and cost of fertiliser
Resources needed to build system (embodied energy)	Can be easily accessible and use reclaimed materials	Can use reclaimed materials	Mostly specialist, can be made from recycled materials	Mostly specialist, can be made from recycled materials
The system can thrive even if completely neglected	Yes	No	No	No
Electricity needed	No	Yes (can be from a renewable source but this raises costs or could be hand	Yes (can be from a renewable source but this raises costs)	Yes (can be from a renewable source but this raises

		watered but this raises maintenance time to every day (JIGOHG, 2012))		costs)
Pest and disease resilience	High	Low	Low	Low
Time needed	Varies depending on type of plants (annual or perennial)	Daily checks of system.	Daily checks of system.	Daily checks of system.
Weight	Heavy	Light	Light	Medium
Yield vs. time needed	Medium	High	High	High
Can use urban waste as a source of nutrients	Yes	Yes	Yes with specialist monitoring.	Yes with specialist monitoring.
Helps alleviate UHI	Yes if outside	Yes if outside	Yes if outside	Yes if outside
Contributes to SUD	Yes if outside	Yes if water collected is rainwater	Yes if water collected is rainwater	Yes if water collected is rainwater
Contributes to alleviating air pollution	Yes if outside	Yes if outside	Yes if outside	Yes if outside
Resilience to mild vandalism	High	Low	Low	Low
Specialist knowledge of type of system for success	No	Yes	Yes	Yes
Contribution to habitats for flora and fauna	Yes	Medium if outside	Medium if outside	Medium if outside

Key (for resource efficiency and waste minimisation):	Excellent	Ok	Poor

A research study looking at planning food production in cities explained that soil-based agriculture may not be the best method for cities and on buildings due to contaminated land in urban areas and the weight of soil for retrospectively adding food production on existing buildings (Jenkins et al., 2015). Jenkins et al. (2015) also argued that more food needs to be grown in the future due to increases in world population and that soil-less methods are a solution to this problem as they are four times more productive than conventional soil-based agriculture. The study did not look at the impact of biodiversity benefits from these soil-less systems and the interaction the average urban dweller would have with these systems (in order to increase their education of where food comes from, how to reduce food waste, how to increase healthy eating (Benton, 2014) etc. discussed in Chapter 2). Table 5 shows that due to the time and expertise requirements for soil-less systems, they would need to be maintained by people who have the knowledge to use them. The average urban dweller may not have the interest/time/knowledge to cultivate using soil-less systems, so if most urban dwellers are to be reconnected with food production (see Chapter 2, section 2.3.4) then soil-based solutions may be important for urban agriculture, at ground level and on buildings. Hydroponic methods can reconnect the average urban dweller indirectly with food production by meeting the growers and buying the locally grown hydroponic crops (for those who can afford it) (Specht et al., 2014; Specht et al., 2015). Soil-based methods can also provide more affordable produce as they are cheaper to set up (James, 2013). One of the challenges and key issues highlighted by stakeholders regarding integrating high-tech solutions for food production on buildings is the social exclusivity that may occur and lack of social inclusion and public involvement with the food production, which is invaluable for reconnecting people with food production (Specht et al., 2015). A low-tech system of food production gives someone who is not an expert of a specific growing technology or someone who is not technologically minded, the opportunity to grow food. A low-tech system is also more resilient to neglect if soil is used as a growing medium as it can establish a soil food web that sustains itself (up to a certain degree in food systems where nutrients are continuously being taken away). Low-tech systems need weekly input and high-tech systems need daily amounts of input during a peak growing season if the user would like to grow annuals, which tend to yield more desirable produce, such as common vegetables found in supermarkets (Richards, 2008). A low-tech, perennial system can require very little input (annual maintenance and harvesting) once the system has established (Bill Mollison, 1988). Low-tech and High-tech methods of growing can be imagined as being on opposite ends of the scale, where growing systems for cultivating edible plants on buildings can sit somewhere on this scale. The type of growing system chosen will depend on the needs of the grower (user) and the constraints of the site (Samangooei et al., 2016).

3.2.2 Climate

Temperature

Different plant species favour varying temperature ranges which differ during the day and the night. Vegetables can be loosely grouped according to climatic preference, such as cool season and warm season crops (Rubatzsky et al, 1997, p.64).
Climatic temperature also affects the temperature of the soil, which influences water and nutrient absorption by plants, root development, soil microbial activity, seed germination and crusting and hardening of soil (Bot & Benites, 2005). The temperature of a growing medium may be positively affected if it is on a building, for example if the building fabric is not thermally efficient. Heat loss from the building may help keep the soil temperatures up, so there may be fewer problems with frost when cultivating on a building.

Humidity

Relative humidity is an important factor for plant growth as it has a strong influence on transpiration (Rubatzsky et al, 1997, p.66), thus the amount of irrigation needed. If humidity is too high it increases the risk of disease and insect infestation. When cultivating on buildings, the humidity levels required by the edible plants may not be compatible with the humidity requirements of the building's occupants. This needs to be considered when designing internal spaces for cultivating edible plants.

Wind

Wind speeds can greatly damage plants, thus an understanding of the wind tolerance of different plant species is important. Keeping the soil covered with vegetation, mulches, crop residues etc. helps to protect the soil and the plants from various climatic conditions (Bot & Benites, 2005). Building surfaces can have more wind and higher wind speeds than ground level due to increased height and exposure, which can be more difficult for plants to grow. The windier conditions can be alleviated with perforated barriers (or other plants) to slow down the wind.

3.2.3 Light

Light is required for photosynthesis. Different plants prefer varying amounts of light intensity and duration. Orientation is a good indicator of light intensity. The duration of the relative light period for flowering is called photoperiodism (Rubatzsky et al, 1997, p.70). Some plants develop and reproduce normally when there are short periods of light (short-day plants) and others prefer long periods (long-day plants). For some plants the flowering response is not affected by the photoperiod (day-neutral plants).

Light can be a problem when cultivating on a building as the surface that is cultivated could be overshadowed by other buildings due to orientation. The amount of light a surface receives should be assessed and appropriate plants chosen that can tolerate the light conditions. A light and shade analysis was undertaken for the roofs and facades of a part of Manchester's existing urban blocks in order to avoid the use of artificial lighting for soil-less (hydroponic) systems for cultivating on buildings to reduce the energy consumption of these systems and increase their integration within urban settings (Jenkins et al., 2015).

3.2.4 Irrigation and Drainage

The amount of water a plant will need depends on the type of growing system and the microclimate it sits in, which can vary growth and transpiration and evaporation from the growing medium. A growing medium rich in stable organic matter (humus) is more resilient in times of drought compared with a lifeless growing medium such as rockwool, as the organic matter can retain more water (Bot & Benites, 2005). The plants grown in the ground can tap into water deeper in the soil in times of drought. Plants grown in containers tend to suffer more in times of drought, due to the lack of a reservoir of water to tap into, and the growing medium being more exposed to climatic conditions. A growing medium should also give scope for water to be able to drain out of soil so that the plant roots do not become too wet and waterlogged.

Designs for planters with water reservoirs have been developed to reduce the frequency of irrigating a container garden, making them more resilient to neglect by the grower (Germain, Gregoire, Hautecoeur, Ayalon, & Bergeron, 2008) (Figure 23). This could be useful when cultivating edible plants on a building as sometimes occupants are away. These planter reservoirs can be linked together with a rainwater storage tank, so when the water levels go down in the reservoir, it is automatically filled up by water in the storage tank (Germain et al., 2008). This system would work with a float valve in a control planter. Linking the system to a rainwater tank means that during times of drought, the plants will have access to stored rainwater. The duration of access to water depends on the size of the tank and the length of the drought.

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Figure 23: Planter with a water reservoir (Germain et al., 2008)

There are also gravity-fed drip irrigation systems, where the drips can also be directly linked to a rainwater tank. Some systems can gradually drip feed the plants over several weeks, which means the systems are less reliant on manual irrigation. There are also irrigation systems that use pumps that need a source of electricity to work.

3.2.5 Maintenance

Planting systems that humans intend to cultivate, need varying levels of maintenance depending on the type of growing system, type of plants grown, productivity requirements, aesthetic requirements and other requirements specific to the user that would require maintenance. Annuals tend to need more maintenance than perennial crops. Depending on the soil quality and method of cultivation, some plants may need frequent fertilisation. The management of the edible plant parameters above will affect the level of maintenance needed.

3.2.6 Summary of plant parameters

The research above identified the key parameters that edible plants require to grow:

- Growing medium and Nutrients
- Climate

- Light
- Irrigation and Drainage
- Maintenance

These parameters can come from different sources (natural or artificial), which have an influence on the advantages of cultivating in urban areas and also on how the user is required to interact with the edible plants. For example, a system with perennial edibles growing in soil requires a different way for the user to interact with the system, compared to a hydroponic system with annual edibles. An understanding of the 'user interaction' with plants is necessary to inform the design of different cultivation systems. The following section investigates the user parameters in relation to cultivating edible plants on buildings.

3.3 The User

This section looks at the interaction the user (the people who would use the system e.g. the building occupants) has with edible plants integrated with buildings. Are systems for cultivating food on buildings designed for the commercial growing of food only, or can they also be for the building occupants to use and engage with? The occupants of a building are not primarily in the building to grow food, they use the building for a particular reason (e.g. to work), therefore systems for integrating edible plants with buildings need to be something the occupants can engage with, without much effort. The systems may be used while the occupant is taking a break or en-route to another location within the building, but these are only guesses as to when the occupant might use the system. In this section, several theories will be explored to begin to understand the user: why we do or do not undertake a behaviour, how behaviours could be changed, and maximising physical usability of the system for the user (ergonomics and perceptual psychology's affordance theory).

3.3.1 Behaviour Theories

This section looks at cultivating edible plants (food) on a building as a behaviour; someone would either choose to undertake it, or not to undertake it. This section has conducted a review of theories that aim to see how behaviours can be changed (through motivation, persuasion and other elements). The elements of behaviour theories help begin to understand the parameters that affect someone's behaviour to cultivate edible plants on buildings. This review has found models and theories from the field of psychology that focus on individuals and their behaviours, as well as how behaviour itself relates to social and environmental context.

3.3.1.1 Maslow's Hierarchy of Needs

This section looks at Maslow's theory of human motivation, which helps begin to understand what would motivate people to undertake the behaviour of cultivating food on buildings. Maslow's theory of human motivation looks at the hierarchy of basic needs (Maslow, 1970). These needs are as follows:

1. Firstly **physiological needs** need to be met so the body functions well. Food plays a key part in this first basic need. Highlighting straightaway the importance of a sustainable food supply.
2. Secondly once our physiological needs are relatively satisfied we have a **safety need**; "security; stability; dependency; protection; freedom from fear; anxiety and chaos; need for structure; order, law and limits; strength in the protector; and so on" (page 18).
3. The **belongingness and love need** comes next once we feel well and safe.
4. Once we feel like we belong to a person or group and feel loved by them, then comes the **esteem need**; to have self-esteem and esteem of others.
5. Even when all the above needs are met, we may still often develop the **self-actualisation need**; to be doing what you feel you can do.

The order that these needs have been written is what is found to be most common, however many people do not necessarily follow that order. For example, some people feel self-esteem is more important than loving and being loved (Maslow, 1970). Also sometimes when a need has been satisfied for a long time it becomes under-evaluated, for example people who have not experienced chronic hunger often underestimate the value of food and do not eat a balanced diet (Maslow, 1970).

Motivation theory should take into account the context or environment that each human is in, as this affects what motivates him or her (Maslow, 1970). Most people in the UK have never suffered chronic hunger; therefore they would not even imagine this being an issue that would affect them or that their food habits result in chronic hunger for others around the world. Supermarkets provide the UK with food day and night; therefore it is unthinkable that there would be any food security problems. This shows that education, in order to change perception about food production, and the threats related to this issue (affecting both the physiological need, safety need and self-actualisation need), is a key motivator for changing a person's food habits in the UK. Food resilience and security is a key motivator that guides environmentally concerned groups such as Transition Towns who aim to be resilient from such threats. Transition Town groups in the UK are developing local food networks that are independent from large-scale commercial food production. People also exchange skills in their transition group so they are prepared for the future;

to grow their own food for example. The aim of transition resilience is not just survival, but to keep the standard of life in the 21st Century without reliance on a fossil fuel economy (Hopkins, 2008).

What motivates people to grow their own food?

The results of a survey about food growing in UK schools (1302 institutions) has shown that the main motivator for food growing is educating children, parents and the community about the environment and where food comes from (80%), followed by teaching about nutrition (Nelson, Martin, Nicholas, Easton, & Featherstone, 2011). Table 6 shows some of the key motivators and barriers for people to grow their own food from the literature. Food security was the top reason people grew their own food in a survey undertaken in Texas, USA (Wildcraft, 2012). These indicators were used to guide the research methodology.

Table 6: Motivations and barriers for people to grow their own food from existing literature

Motivations	Barriers
Learning about the environment (Buckman, 2009; Hopkins, 2008; Hujber, 2008; Nelson et al., 2011)	Lack of space (Buckman, 2009; Nelson et al., 2011)
Learning about how to grow food (Hopkins, 2008; Nelson et al., 2011)	Lack of time (Buckman, 2009; Gerber, 2011; Nelson et al., 2011)
Skills and knowledge (Buckman, 2009; Hopkins, 2008; Nelson et al., 2011)	Perceived lack of skills and knowledge (Buckman, 2009; Gerber, 2011; Nelson et al., 2011)
Personal interest and enjoyment (Hujber, 2008; Nelson et al., 2011)	Lack of interest (Buckman, 2009; Nelson et al., 2011)
Exercise (Hujber, 2008; Nelson et al., 2011)	Physically unable (Kortright & Wakefield, 2011)
Grow unique crops that you cannot buy (Hujber, 2008)	Concerns about contaminated soil (Buckman, 2009; Hujber, 2008)
Save money (Buckman, 2009; Hujber, 2008; Wildcraft, 2012)	Cost of establishing garden (Hujber, 2008)
Eating nutrient rich, fresh food (Gerber, 2011; Hujber, 2008; Nelson et al., 2011)	Concerns about air pollution (Hujber, 2008)
Community cohesion (Gerber, 2011; Hujber, 2008)	Not supported by others (attitude of others) (Nelson et al., 2011)

Sharing tasks with others (Hujber, 2008)	Lack of group help (Nelson et al., 2011)
Chemical avoidance and food safety (Buckman, 2009; Hopkins, 2008; Hujber, 2008; Wildcraft, 2012)	Lack of easily accessible resources (Nelson et al., 2011)
Family influence (Buckman, 2009; Nelson et al., 2011)	Social identification against a healthy lifestyle* (Gerber, 2011)
Food security (Hopkins, 2008; Hujber, 2008; Wildcraft, 2012)	Disaster from pests etc. (Gerber, 2011)
Cooking (Hujber, 2008)	Legal and policy barriers (Hujber, 2008)
Aesthetics (Gerber, 2011)	Vandalism and theft (Hujber, 2008)
	Health and Safety (Nelson et al., 2011)
	Attitude and awareness (perceived benefits) (Hujber, 2008)
	Ownership of space (Hujber, 2008)

*Some people do not see themselves as 'salad' eaters.

The importance of visibility of roof gardens for leisure was highlighted in a study in Singapore looking at the perceptions and expectations of residents in relation to roof gardens (Yuen & Hien, 2005). Seeing the roof gardens was important for the residence to motivate them to use them more (Yuen & Hien, 2005). This study shows that visibility of a growing space on a building could be an important motivator for people to use the growing space. This study also found that sense of purpose was important for the residents as a motivator to use the roof gardens (Figure 24) (Yuen & Hien, 2005). Integrating areas for residents to cultivate and/or harvest edible plants could be an additional purpose (motivator) for using a roof garden.

Reason for visit	Households with visit to roof garden (n = 58) (%)	Household living near roof garden (n = 43)[a] (%)	Household living away from roof garden (n = 15)[a] (%)
To take the children out	29.3	32.6	20
To get some exercise	20.7	27.9	0
Because friends were visiting	13.8	18.5	0
To find peace and quietness	12.1	7	26.7
To enjoy the company of others	8.6	7	13.3
To get out of the house	6.9	2.3	20
Other reasons e.g. to smoke, happen to be there	6.9	4.7	13.3
Do not know	1.7	0	6.7

[a] n includes only households who had visited roof gardens.

Figure 24: Reasons for visiting a roof garden, Singapore (Yuen & Hien, 2005)

The findings above show that some research has been undertaken regarding why people would or would not cultivate their own food, but there is a lack of research that has looked at why people would or would not cultivate edible plants on buildings.

3.3.1.2 The principles of persuasion

Persuasion and motivation are two different things. Persuasion comes from the world outside us (a person persuading another person to undertake a behaviour). Motivation comes from within us (a person becomes interested or enthusiastic or has a reason to undertake a behaviour). Persuasion can often lead to motivation.
Cialdini has developed principles of persuasion that appeal to "deeply rooted human drives and needs" taken from five decades of research by behavioural scientists, where experiments showed that certain interactions persuade people to comply/concede/change (Cialdini, 2001, p. 74).

Liking

People are more likely to be persuaded by someone that they like and that they know likes them. An example of this is hosting a party to sell some products in your own home with friends, relatives and neighbours. Frenzen and Davis (1990) found that the guests' fondness of their host had a significant impact on their purchase decisions. Cialdini (2001) has shown that praise increases affection which in turn increases the power of persuasion, for example managers who praise their staff. Attractiveness also leads to liking which leads to persuasion; good looking people find it easier to persuade people (Cialdini & Goldstein, 2002). Finding similarities with someone can lead them to liking you (or liking each other), which leads to persuasion. In the case of cultivating edible plants on buildings, the *liking* principle highlights the importance of those who are advertising the systems to be liked by the people they are trying to persuade.

Reciprocation

This principle is based on the idea that people are likely to repay favours or gifts, so doing something kind for someone may persuade them to do something in return for you (Cialdini & Goldstein, 2002). This principle highlights the effectiveness of social gardening as people can do favours for each other ,which may persuade them to garden.

Social proof (Social norms of behaviour)

"Social creatures that they are, human beings rely heavily on the people around them for cues on how to think, feel and act" (Cialdini, 2001, p. 75). Numerous studies have confirmed this intuition of human nature (Cialdini, 2001; Cialdini & Goldstein, 2002). In the case of cultivating edible plants on buildings, if people see others doing it and it looks like something good to do, this may encourage them to do it themselves.

"Norms are standards or rules that tell members of a group or society how they should behave" (Shwartz, 2012, p. 16). Social norms are those things that are perceived acceptable by the people around you; for example most vehicle drivers accept riding a bicycle on the streets of Oxford, UK but they may not be as accepting in other cities where this is not a social norm. The term 'norm' has two meanings a) what people commonly do (descriptive norm or social proof as above) and b) what people commonly approve and disapprove (injunctive norm) (Cialdini, Reno, & Kallgren, 1990; Kallgren, Reno, & Cialdini, 2000). There have been decades of debate as to whether social norms guide behaviour. Research has shown that social norms encourage and guide "action in direct and meaningful ways" (P. W. Schultz, Nolan, Cialdini, Golstein, & Griskevicius, 2007, p. 429). Cialdini et al. (1990) said that this impact can only be identified by researchers if they a) separate descriptive norms and inductive norms and b) focus the participants attention on the type of norm being studied (Cialdini et al., 1990; Kallgren et al., 2000). Normative information can backfire and lead to the opposite action to what the messenger wanted if the descriptive norm is used on its own (Cialdini, 2003). For example an advert aimed at reducing littering shows someone littering in an already littered environment (descriptive norm), with a person crying when this happens (injunctive norm); this is also saying the message "many people are littering" (Cialdini, 2003). Research has shown that the advert would be more successful if it showed someone littering in a litter free environment with a person crying when the littering occurs; no litter shows that littering is not commonly accepted in this environment (Cialdini, 2003). According to the descriptive norm and injunctive norm, if people commonly see food production within their built environment they may also be encouraged to do it, as they see that it is commonly done and that it is accepted. For example in a rural community there are a lot of home vegetable gardens (a descriptive norm) and there is a Country Fair with prizes for the best produce, which communicates that vegetable growing is valued by others (an injunctive norm) (Koger & Du Nann Winter, 2010). This example shows how descriptive and injunctive norms can work in parallel (Koger & Du Nann Winter, 2010). This highlights the importance of the visibility of food production when integrating such systems.

Commitment and consistency

Liking is something needed for persuasion but people also need to be committed to what you want them to do. Research has shown that once people commit to something they do not tend to change their mind (Cialdini, 2001). For example a restaurant manager had 30% of people who reserved tables not show up and not inform them, but when he requested that the receptionist ask the question "Will you let us know if you cannot come?" to obtain an answer, instead of simply stating "Please let us know if you cannot come" without receiving an answer, the no-show-no-call rate dropped to 10% because people felt obliged to stick to their given answer (Cialdini & Goldstein, 2002). In the case of food production, if people are given a planter that is their responsibility and asked "Will you keep this planter looking green so it looks good for the campus?" they may be encouraged to keep to their promise. A person interested in the environment may keep a planter healthy in order to be consistent with their beliefs about the environment. If they are busy they may decide to plant perennial herbs that are green throughout the year and low maintenance or inform the organiser that they have given up using the planter.

Scarcity

Research has shown that when something is hard to get or in limited supply it is more desirable (Cialdini, 2001; Cialdini & Goldstein, 2002). Scarcity applies to products, opportunity and information (Cialdini & Goldstein, 2002). In the case of food production within the built environment, if people are given a window of opportunity to sign up to a planter or given time frames for planting, they may be persuaded to undertake the activity. They also may be persuaded to cultivate food if certain foods that they can grow were not available in shops.

Authority

Research has shown that the opinion of an expert can persuade people about a topic, issue etc. (Cialdini, 2001). In the case of food production, if an expert in gardening tells people that it is possible to grow a good amount of food in a small space they may be persuaded to do it.

The above principles highlight the importance of information, management and communication of a group of people who are producing food together in a space. This can be undertaken by creating a group on a social networking website, a blog or sending a newsletter to people involved in the gardening to keep them informed and updated. Using all the above principles in the methods of communication can persuade the gardeners to continue gardening. For example, informing them of the deadlines of planting in the seasons (scarcity principle) and showing them what others are doing (social proof principle). It is not evident from the principles of persuasion that design can help persuade people to use the systems, but it is clear that designing to accommodate a group of gardeners to create social interaction is important for persuasion.

3.3.1.3 The Theory of Reasoned Action and Theory of Planned Behaviour

"Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour...psychological tendency refers to a state that is internal to the person, and evaluating refers to all classes of evaluative responding, whether overt or covert, cognitive, affective, or behavioural" (Eagley & Chaiken, 1993, p. 1).

Attitudes sit on a positive/negative scale (Shwartz, 2012). There has been much debate as to whether attitudes can predict behaviour (Eagley & Chaiken, 1993). If people have a positive attitude toward a behaviour, one would think that it might have some kind of influence over whether they undertake that behaviour. In 1955, Herbert Blumer, a prominent sociologist criticised the idea that attitudes influence behaviour, followed by Irwin Deutscher in 1966 and Alan Wicker in 1969 (amongst others) (Eagley & Chaiken, 1993). In reaction to this view about the impact of attitudes on behaviour, social scientists started to find positive correlations between attitude and behaviour (Eagley & Chaiken, 1993). Research has shown that attitude could directly predict behaviour (Bentler & Speckhart, 1981).

Ajzen and Fishbein "have argued that a person's attitude toward an object (attitude object e.g. attitude toward a religion) influences the overall pattern of his responses to the object, but that it need not predict any given action" (Ajzen & Fishbein, 1977, p. 888). This analysis showed that a single action (behaviour) is determined by an intention to undertake that behaviour and a person's intention is guided by their attitude toward performing the behaviour and their subjective norm (Ajzen, 2005; Ajzen & Fishbein, 1977). This does not include behaviours that are conditioned, reinforced or habitual (Booth-Butterfield, 2010). The mental event of an attitude is transformed by an intention (aim or plan) into a behaviour (R P. Bagozzi, Baumgartner, & Yi, 1989). The definition of an intention is a person's commitment, plan, or decision to undertake an action or achieve a goal (Eagley & Chaiken, 1993). An intention is formed by a motivational process guided by attitude (and other thoughts shown in Figure 15). Ajzen and Fishbein's research showed that a single act can be predicted by behaviour, only if there is a high correlation between intention and behaviour (1977), if the attitudes and behaviours are compatible (correspondent) (Eagley & Chaiken, 1993) and if the time interval is short enough to make sure that intentions have not changed (Conner & Armitage, 1998). Compatibility can be looked at in terms of matching the types of attitude with the types of behaviour. For example positive attitudes towards a religion show a high correlation to undertake

general behaviours for that religion (Eagley & Chaiken, 1993). Ajzen and Fishbein developed the idea of compatibility more precisely by saying that each attitude and behaviour has four elements: "the *action*, the *target* at which the action is directed, the *context* in which the action is performed, and the *time* at which it is performed" (1977), so the specificity and generality of the attitude and behaviour should be analysed against these four elements. This is known as the principle of compatibility (Ajzen, 2005; Eagley & Chaiken, 1993). It is similar to the contiguity hypothesis in Guttman's facet theory (Ajzen, 2005). In the case of this thesis the elements are: growing (action), food (target), on a building that they occupy (context), during their spare time or breaks (time). The attitude is their attitude toward undertaking all these specific elements. This is called a single-act criterion as all the actions have been specified (Ajzen & Fishbein, 1977).
The Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) is concerned with what causes purely volitional (wilful) behaviour (Ajzen, 2005). According to TRA, intentions are determined by two things, the individual's attitude toward the behaviour (personal influence) and the individual's perception of social pressure related to undertaking the behaviour (social influence) (Ajzen, 2005). Attitude includes a person's evaluations of the outcomes of a certain behaviour, as well as an estimation of the likelihood of this outcome, so according to Kaiser et al. factual knowledge is a necessary precondition for any attitude (1999). The social influence is called a subjective norm as it is what the individual perceives to be normative or standard in their social setting. Research has shown that attitude toward the behaviour and subjective norms are guided by the beliefs the individual has (Figure 25) (Ajzen, 2005), for example women who have stronger beliefs about breast-feeding are more likely to breastfeed (Manstead, Proffitt, & Smart, 1983). "Beliefs are ideas about how true it is that things are related in particular ways" (Shwartz, 2012, p. 16). Attitude is guided by salient beliefs about the behaviour (Conner & Armitage, 1998). Subjective norm is guided by the normative beliefs (Kaiser et al., 1999).

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Figure 25: Theory of Reasoned Action (Ajzen, 2005)

TRA deals with purely volitional behaviour. Not all behaviour is purely under volitional control, for example trying to quit smoking (Ajzen, 2005). The intention (motivation) to undertake that action can be very strong and guided by attitude towards that behaviour and subjective norms, however there may be barriers such as the lack of opportunities or resources (these are control factors to undertaking behaviour) (Ajzen, 2005).

Internal control factors are:

- Information, skills and abilities the person lacks (these problems can be overcome)
- Emotions and compulsions (these problems cannot always be overcome)

External control factors:

- Opportunity
- Dependence on others (incomplete control over behavioural goals)

The Theory of Planned Behaviour (TPB) has been developed to deal with the problem of behaviour that is stopped by personal deficiencies and/or external obstacles. TPB is an extension of the TRA. As with TRA the central factor is the intention (motivation) leading to the behaviour (Figure 26). An additional determinant has been added; perceived behavioural control, PBC (perceived ease or difficulty in performing the behaviour) guided by the control beliefs (from past experiences and anticipated obstacles) of the individual. Eagley and Chaiken say that perceived behavioural control is similar to Bandura’s concept of self-efficacy: a person’s belief as to whether they can successfully undertake a behaviour (1993). Ajzen argues that PBC is synonymous with self-efficacy (Conner & Armitage, 1998). This view has been challenged by many research projects that have shown that there is a distinction between PBC and self-efficacy (Conner & Armitage, 1998). TPB comes with the assumption that perception of control upon a behaviour reflects actual control with some accuracy (Kaiser et al., 1999).

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Figure 26: Theory of Planned Behaviour (Ajzen, 1985, 2005)

TPB is saying that an individual will undertake a behaviour if: their attitude towards it is favourable, if they think that important people would approve of it and if they believe they have the resources and opportunities needed to undertake the behaviour.

TPB is a widely used "expectancy value model of attitude-behaviour relationships" which has shown successful at predicting some behaviours (Conner & Armitage, 1998). Although there are some details within TPB that are yet to be confirmed, since its conception, TPB has been validated by many research studies. TPB has been useful in predicting ecological behaviour (Kaiser et al., 1999). For example Phillips and Rowley found that people have every intention (guided by attitude and subjective norms) to reduce or compost food waste, in order to reduce food waste sent to landfill, but due to busy lives and practical barriers (such as rats when composting in a garden) it is not always possible (perceived behavioural control) (2011). They found that large-scale government interventions can help reduce food waste sent to landfill by separating food waste collections with other bin collections, as households would then simply put all their food waste in a separate bin to be collected. This gives people an easy opportunity and the right resources to stop food waste entering landfill.

According to this theory, in the case of food production, an individual is more likely to perform the behaviour of growing their own food if:

- Their attitude towards it is strong enough (i.e. they really believe that growing their own food benefits themselves and others, including the environment);

- If important people think it's good that they are doing it (for example if their manager and colleagues support the act of tending to their garden during work hours e.g. lunch breaks or if parents support their children using a part of their garden for vegetables);
- If they believe that they have the opportunity to access the equipment and skills for growing food.

The problems with attitude and subjective norm highlight the importance of education and change in perception of individuals and communities of food related issues. The perceived behavioural control highlights the need for teaching food growing skills and providing the space and time to grow food. This research addresses the issue of space and time, giving people places to grow food within the built environments so that it is easy to access.

3.3.1.4 Variants and adding to the Theory of Planned Behaviour

Bagozzi et al. argue that attitudes, subjective norms and perceived behavioural control "fail to consider how intentions become energised" (R. P. Bagozzi, Gurhan-Canli, & Priester, 2002, p. 80). Bagozzi et al. propose that "desires provide the motivational impetus for intentions" (R. P. Bagozzi et al., 2002, p. 81), so attitudes, subjective norms and perceived behavioural control form behavioural desires, and then influence intentions. Bagozzi et al. also say that the TPB does not address the topic of setting a goal; a behaviour is undertaken to achieve a goal (R. P. Bagozzi et al., 2002). Producing edible plants that have been cultivated on a building is a conscious goal. According to Bagozzi et al., conscious goals arise in three ways (R. P. Bagozzi & Dholakia, 1999);

1. Goals forced on people where they are obliged to work towards a goal.
2. People have goals formed automatically that are activated unconsciously but pursued consciously, for example they receive an unexpected award and their goal is to celebrate this by going to a restaurant with friends.
3. Goals arising from reasoned reaction to external stimuli or internal stimuli.

The goal to produce edible plants that have been cultivated on a building may arise from number 1 or number 3 above. Due to this currently being something novel that not many people are undertaking, it is less likely that the goal to cultivate on a building would arise from number 1, where the people around have created an obligation towards this goal. It is more likely that the goal would arise from number 3 from; external stimuli such as seeing others cultivate on a building or internal stimuli, such as concluding that cultivating edible plants on a building is the solution to their lack of space at ground level. External and internal stimuli can be influenced by behavioural beliefs, normative beliefs and control beliefs from TPB.

Research has shown that past behaviour could be a good predictor of future behaviour, where past behaviour could act as a source of information to undertake the future behaviour (Conner & Armitage, 1998). This highlights the importance of investigating past behaviour in the case studies for the research. Past behaviour feeds into attitudes, subjective norms and perceived behavioural control.

Moral norms could provide a useful addition to the TPB by directly informing intention (Conner & Armitage, 1998). Moral norms are whether the person feels the behaviour is morally correct or incorrect and would help predict behaviours that have a moral or ethical element (Conner & Armitage, 1998). Moral norms are influenced by societal values. Personal norms can also be an addition to the TPB which are formed by an individual's personal values, for example eating healthy food is not affected by moral norms but may be affected by personal norms if the individual regards themselves as a healthy eater (Conner & Armitage, 1998). Values in general are what we think of as important to us in life (Shwartz, 2012). Norms are affected (accepted or rejected) by our values (Shwartz, 2012). Values also guide attitudes as they are the basis of our evaluations of entities (Shwartz, 2012). The Value-Belief-Norm (VBN) Theory proposes that norm based actions start from personal values, then beliefs that these values are threatened and then beliefs that taking personal action can help, alleviate this threat (P. C. Stern, Dietz, Abel, Guagnano, & Kalof, 1999). In the case of the behaviour of cultivating edible plants on buildings, a person could highly value growing food for various reasons, they could believe that their ability to grow food in a city is threatened due to lack of space and then believe that growing food on a building can be a solution to this. The person's value has guided their beliefs about the behaviour of cultivating edible plants on buildings and in turn this guides their attitude towards the behaviour. Beliefs can guide the transition from value to attitude; a person could value growing food, believe that there is plenty of room to grow food at ground level in cities, so their attitude towards cultivating on a building could be less positive.

Research has shown that self-identity could also provide an addition to the TPB, so it is important to investigate self identity in the case studies (Conner & Armitage, 1998). For example a study related to consuming organic vegetables found that self-identity independently predicted intention (Conner & Armitage, 1998).

The beliefs of the affects of performing a behaviour may also influence intention (affective beliefs). The affective beliefs of undertaking food production on a building should be explored in the case studies (Conner & Armitage, 1998).

People form intentions to undertake behaviours but they do not always do what they intend to do. Gollwitzer and Brandstatter say that there is a difference between goal intention "I intend to achieve x" and implementation intentions "I intend to perform goal-directed behaviour y when I encounter situation z" (P. M. Gollwitzer & Brandstatter, 1997, p. 186). This forms a two stage process where; the first stage considering all the elements of performing a goal and then forming the intention (same as the TPB), and the second stage is forming a plan to implement the goal, the implementation intention (Conner & Armitage, 1998). Gollwitzer and Brandstatter's research found that forming an implementation intention (specifying the when, where and how of achieving a goal (P. M. Gollwitzer, 1999)) made the behaviour much more likely (P. M. Gollwitzer & Brandstatter, 1997, p. 186). An implementation intention is more likely to be formed if the person has the answers to the "when, where and how" of the intended goal; level of perceived behavioural control or self-efficacy and level of conscientiousness have been "found to moderate implementation intention effects" (P.M. Gollwitzer & G., 2013, p. 1044).

Figure 27 below shows a revised diagram of the Theory of Planned Behaviour with the above additions added.

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Figure 27: Additions to the Theory of Planned Behaviour (original in red) (Ajzen, 1985, 2005; R. P. Bagozzi et al., 2002; Conner & Armitage, 1998; P. M. Gollwitzer & Brandstatter, 1997; P. C. Stern et al., 1999)

3.3.1.5 Diffusion of innovation theory

The diffusion of innovation (DOI) theory, or Diffusion of innovations, was developed by Everett. M. Rogers in 1962 (Robinson, 2009; Rogers, 2003). The aim of the theory is to give some explanation as to how innovations (behaviour, object, or idea that is new to people) are taken on board by or diffuse through populations. In the case of this research, the innovation is the behaviour to cultivate edible plants on buildings. DOI theory has been used in many different fields including public health, communication, marketing and agriculture; used for understanding the target population and the factors that influence their rate of adoption of an innovation (BU, 2013). DOI theory offers four insights into the process of successfully implementing an innovation into a population (Robinson, 2009).

A. The qualities that determine the success and spread of an innovation (Robinson, 2009):

1. *Relative advantage* - This is the degree to which an innovation is perceived (by a particular group of people) as better than the idea that it supersedes and is measured in terms that are important to those particular users (e.g. economic advantage, social prestige, convenience, satisfaction etc.). In other words, it matters a great deal whether an individual perceives the innovation to be advantageous; "the greater the perceived relative advantage, the more rapid its rate of adoption will be" (Rogers, 2003, p.15). In the case of cultivating food on buildings; is this perceived as convenient etc. in comparison to growing at ground level in a garden?

2. *Compatibility* - This "is the degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of potential adopters" (Rogers, 2003, p.15). An idea that is incompatible with the majority values and experiences will be far slower to adopt. How compatible is cultivating food on buildings with people's values, past experiences and needs?

3. *Complexity (also known as simplicity and ease of use)* - This "is the degree to which an innovation is perceived as difficult to understand and use" (Rogers, 2003, p.16). If an innovation is perceived as complicated, then it is slower to adopt. The simpler a system for cultivating food on buildings is perceived, the more easily it's adopted.

4. *Trialability* - This "is the degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003, p.16). If an innovation can be tried first then it represents less uncertainty and is more likely to be adopted (Robinson, 2009). People could be offered to

see an existing system for cultivating food on buildings, which may encourage them to adopt their own system.

4. *Observability* - This "is the degree to which the results of an innovation are visible to others" (Rogers, 2003, p.16). Innovations are easier to adopt if people can see the results easily. If other people can also see the results, they are more likely to enquire about it (innovation evaluation information (Rogers, 2003, p.16)) and maybe adopt it themselves. This highlights the importance of the visibility of systems of cultivating food within an urban setting. The more people see the food production and the success of these systems, the more likely it is that they will also try it.

B. Re-invention

Every innovation needs to give way to improvement as it diffuses through a population and meets different groups of people with different needs. Continuous improvement is important for the success of any innovation.

C. Understanding the needs of different user segments (Adopter Categorisation)

According to the DOI theory, any population or social network can be split into five different segments or ideal types (the adopter categories) (Figure 28), based on their tendency to adopt a given innovation (Robinson, 2009). These idea types are "concepts based on observations of reality that are designed to make comparisons possible" and "exceptions to the ideal types can be found" (Rogers, 2003, p.282). Each ideal type has its own attitude towards a particular innovation. The aim is to work with each segment in a particular way to spread an innovation rather than trying to shift people into a different segment. It is important to emphasise that people can fall into different segments depending on the innovation.

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Figure 28: The five segments, Adopter categorisation on the basis of innovativeness (Source: Robinson, 2009)

Innovators: Venturesome

Innovators are interested in new ideas, want to be the first to try them and are willing to take risks (BU, 2013). They are the innovators themselves, developing new ideas.

Innovations can be made appealing to an innovator by providing support and publicity for their own ideas and inviting them to become partners in the innovation (Robinson, 2009). Innovators create links with their circle of innovators.

Early Adopters: Respect

Early adopters have good links with local social networks (Rogers, 2003). They are aware that there is a need for change in many areas and are comfortable with adopting new ideas. They have a high degree of opinion leadership; people in their social network respect their opinions on innovations (Rogers, 2003). Innovations can be made appealing to early adopters by offering them trials (Robinson, 2009) of the innovation and manuals and information on how to take on the innovation (BU, 2013).

Early Majority: Deliberate

The early majority like to adopt an idea before the average person, however they are rarely opinion leaders but rather opinion leader followers (they deliberate for some time and look for evidence that the innovation works well before adopting it (Rogers, 2003)). "Be not the first by which the new is tried, nor the last to lay the old aside" (Rogers, 2003, p. 284) is a good quote that describes how the early majority think. Success stories are a good way to appeal to the early majority (BU, 2013).

Late Majority: Skeptical

The late majority adopt an idea after the average person. Adoption of an innovation may be due to pressure from peers and/or an economic necessity (Rogers, 2003). Evidence that many people in their social circle and beyond that have adopted the innovation successfully will make the innovation appealing to the late majority (BU, 2013); promoting social norms rather than product benefits (Robinson, 2009).

Laggards: Traditional

The point of reference for laggards is what has been done in the past, so adopting an innovation is difficult for them and is a lengthy process (BU, 2013). An innovation needs to be made familiar to them over time. Statistics can help convince laggards as well as pressure from peers in their social network (Robinson, 2009).

D. The importance of peer-peer conversations and peer networks

Impersonal marketing methods, such as advertising and media stories, are good for spreading information, but conversations between people are key to adopting an innovation (Robinson, 2009). This is due to the adoption of innovations to be seen as risky and people are uncertain about them, so when they talk to their peers (people who they personally know and trust) about the innovation and see that it is successful by their peers, then it will show them how the innovation is working in their reality and thus reduce the fear of adopting it themselves (Robinson, 2009). This can be linked with social proof (Cialdini, 2001) and subjective norms (Ajzen & Fishbein, 1977) above.

Early adopters and innovators do no need peer-peer conversations to adopt an innovation. They are the people the early majority and late majority are looking to for reassurance about the innovation. They are the Opinion Leaders and can spread their opinion of an innovation via social networks (Rogers, 2003).

Criticisms and Limitations of the DOI Theory

DOI theory has been mainly developed for adopting innovations or new behaviours rather than preventing a behaviour (BU, 2013). It also does not take into account the resources (or lack of) that people have (BU, 2013).

The theory has a pro-innovation bias; the implication that an innovation should be diffused throughout a social system and as rapidly as possible (Rogers, 2003). To overcome this, re-invention and/or rejection should be seen as part of the diffusion process. The DOI theory can have an individual-blame bias and take the side of the innovator rather than the individuals (Rogers, 2003). It should be acknowledged that the system the individual is part of could be the main problem, rather than the individual themselves.

The recall problem in DOI theory may lead to inaccuracies regarding when an innovation was adopted, as respondents may not remember (Rogers, 2003). There is also an issue of equality as socioeconomic gaps are often widened with the adoption of a new innovation (Rogers, 2003).

3.3.1.6 4Es Behaviour Change Model

Research through Defra has developed the '4Es' model for behaviour change showing the importance of **encouraging**, **enabling** and **engaging** people, as well as showing them good **examples** that have worked (Figure 29) (Defra, 2006a). These are clearly linked with TPB discussed above and the BCW discussed below.

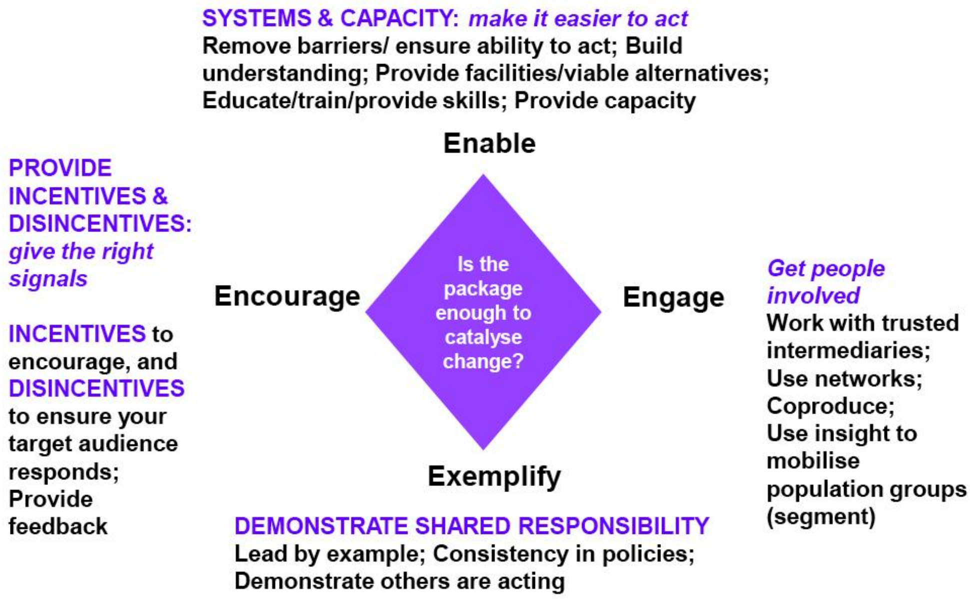

Figure 29: The '4Es' model for behaviour change (Defra, 2011a)

Using the example of the success of separating household food waste by having a food waste bin shows how the 4Es can work. The separate food bins both encourage and enable people to easily stop their food waste going into the landfill bin as the food waste bin is next to the landfill bin, so they do not need to go out of their way to separate food waste. The separate bins also engage people with the food waste issue as they see the proportion of their waste that is just food, which is on average one third of the waste in a household's bin in the UK (Phillips and Rowley, 2011). Defra's research has also looked at how people can be motivated in relation to resource saving strategies and their willingness to change (Defra, 2008). The research concluded that specific groups need to be targeted differently; for example sceptics need to be encouraged to act and concerned consumers need to be enabled and engaged (Defra, 2008), which is what Maslow's motivation theory also highlighted (Maslow, 1970).

The 4Es model will be used in this research to develop sustainable systems for integrating food production with the built environment:

1. **Enabling** the user to use the systems. This will focus on designing systems that are easy to use.

2. **Encouraging** people to use the systems is also part of usability, as the more usable and useful the systems are, the more encouraged they will be to use them. Reaping the benefits and results from the systems will also encourage the user to continue using the systems. This goes back to the sense of achievement the user would gain, which would give them further motivation to use the system (see Chapter 2, section 2.3.4).

3. **Engaging** people to get involved with using the systems highlights the importance of their visibility. The systems need to be highly visible to a large audience to provoke interest.

4. **Exemplifying** the systems using education to show other examples of similar, successful systems.

These have formed four social parameters for the systems. Figure 30 shows an example of using the 4Es model to promote "Energy Efficiency in the Home". This has been used to create a behaviour goal of "Eat more seasonal/local/regional/national food" (Figure 31).

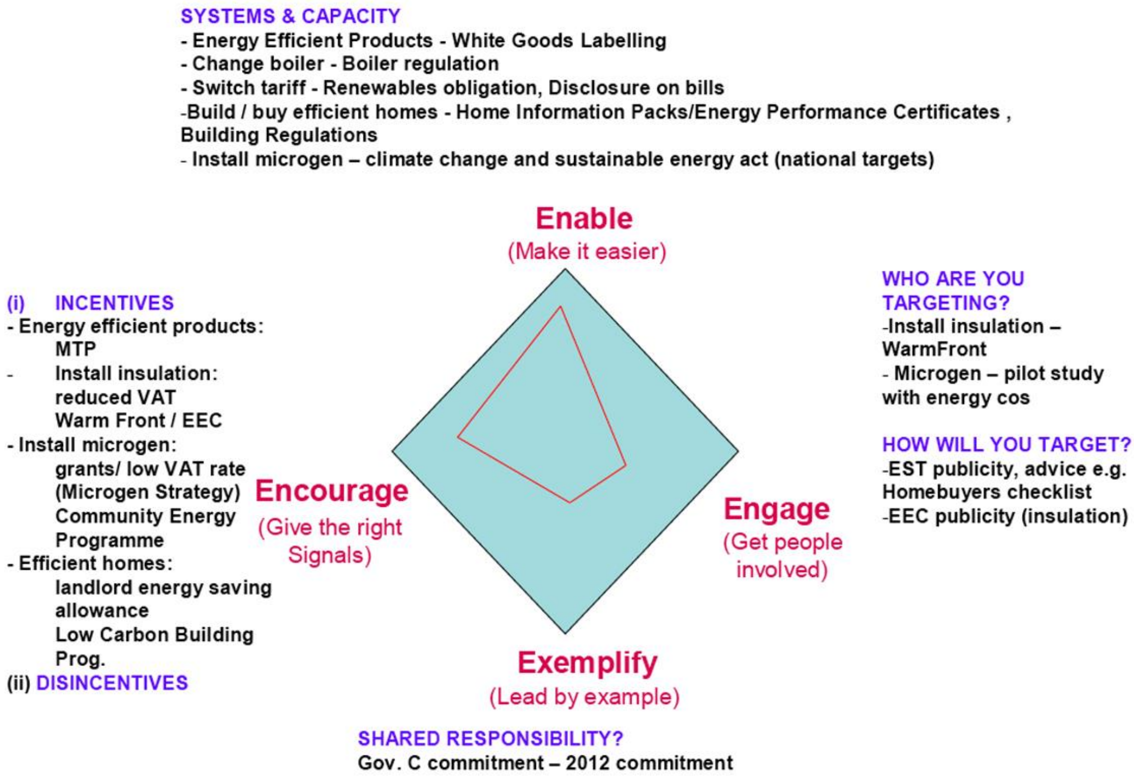

Figure 30: Behaviour Goal - Energy Efficiency in the Home (Defra, 2011a)

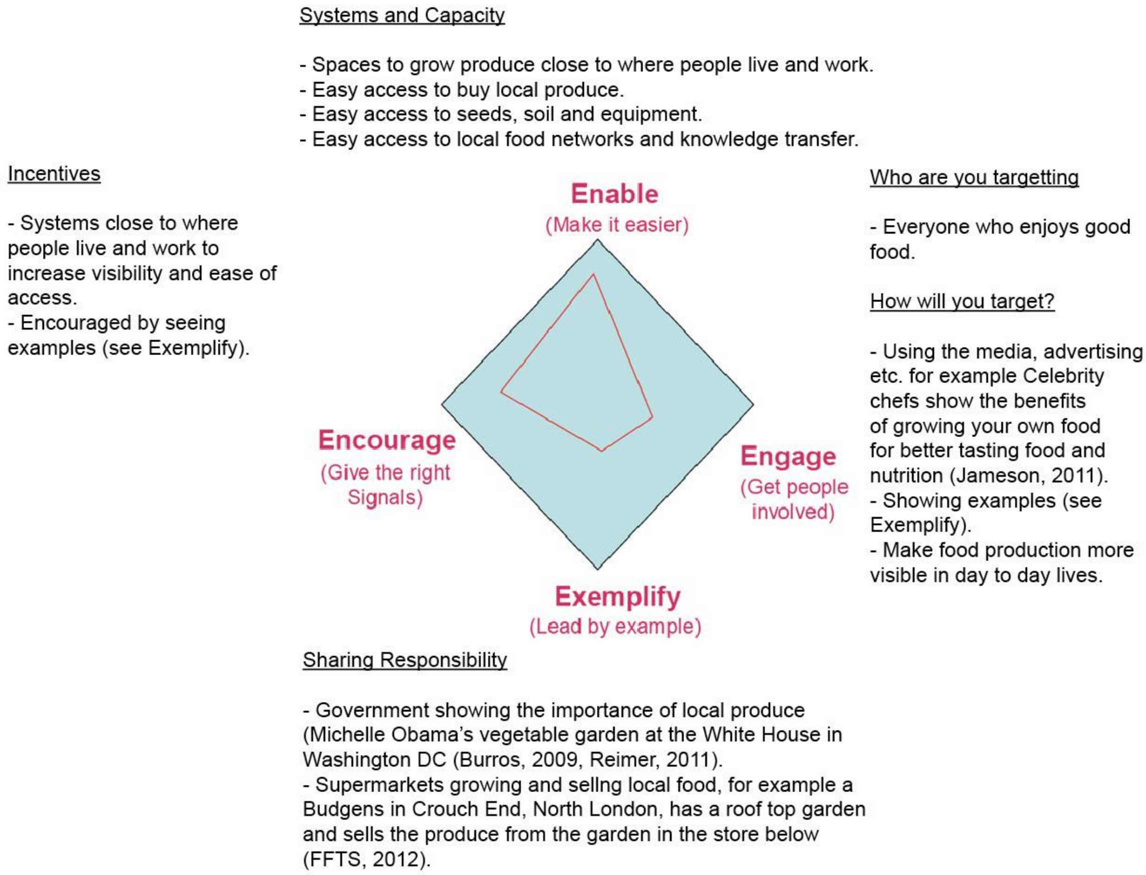

Figure 31: Behaviour Goal - Eat more seasonal/local/regional/national food (Defra, 2011 and Author)

The 4Es diamond is not a complete assessment but it helps to identify gaps in policy and is a structured approach for looking at how behaviour could be influenced (Defra, 2006a). The 4Es model highlights the importance of food production being visible to a wide audience to exemplify, encourage and engage.

3.3.1.7 Behaviour Change Wheel

An evaluation was undertaken in 2011 of the large number of frameworks for behaviour change interventions, in order to address all parameters that could influence behaviour, as it is clear from the assessment above that there is not one framework for behaviour change interventions that addresses all the influences (Michie, van Stralen, & West, 2011). Michie *et al.* say that the Theory of Planned Behaviour does "not address the important roles of impulsivity, habit, self-control, associative learning, and emotional processing" (Michie et al., 2011, p. 2). Their evaluation led to the development of the Behaviour Change Wheel (BCW) (Figure 32), which aims to address the inconsistencies in frameworks for behaviour change interventions and sources of behaviour.

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Figure 32: Behaviour Change Wheel (Source: Michie *et al,* 2011)

The COM-B behaviour system (Figure 33) was put at the heart of the wheel; capability, opportunity and motivation:

- **Capability**: "individual's psychological and physical capacity to engage in the activity concerned. It includes having the necessary knowledge and skills" (Michie et al., 2011, p. 5). Psychological capability can be affected by mental health problems and also by levels of cognitive capacity, which is the volume of information in the brain at any given moment (Halford, Cowan, & Andrews, 2007).
- **Motivation**: "defined as all those brain processes that energise and direct behaviour, not just goals and conscious decision-making. It includes habitual processes, emotional responding, as well as analytical decision-making" (Michie et al., 2011, p. 5). Automatic motivations (desires, emotional responses, habits and psychological states) happen sub-consciously and reflective motivation is the values, beliefs and attitudes of a person towards the behaviour.
- **Opportunity**: "defined as all the factors that lie outside the individual that make the behaviour possible or prompt it" (Michie et al., 2011, p. 5). Social opportunities are the subjective norms related to that behaviour, and physical opportunity is the behaviour control.

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Figure 33: The COM-B system - a framework for understanding behaviour (Michie et al., 2011)

The BCW was developed by undertaking a systematic literature review search of 1,267 journal articles written by experts in behaviour change, where 19 existing behaviour change frameworks were discovered (Michie et al., 2011). The following things became apparent as a result of this review (Michie et al., 2011):

- The wording of interventions needs to be described more precisely due to confusion in everyday language, for example ‘education’ can include ‘training’ in everyday language.

- A distinction needs to be made between interventions (actions to change behaviour) and policies (actions that enable or support interventions). Policies can only influence behaviour through the interventions that they enable or support.

- Any given intervention could perform more than one behaviour change function. The policies are treated as non-overlapping categories.

Figure 34 explains the definitions of the interventions and policies. Figure 35 and 36 show how the components in the wheel are linked together. The 4Es diamond discussed above incorporates some of the interventions in the Behaviour Change Wheel, showing similarities in behaviour change theories (Defra, 2011).

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Figure 34: Definitions of interventions and policies (Michie et al., 2011)

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Figure 35: Links between the components of the 'COM-B' model of behaviour and the intervention functions (Michie et al., 2011)

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Figure 36: Links between policy categories and intervention functions (Michie et al., 2011)

The methodology undertaken to form the BCW has meant that the framework brings together much of the thinking related to behaviour change and aims to resolve the limitations of past frameworks. Michie *et al.* have acknowledged that there are infinite ways of classifying interventions and the BCW will no doubt be superseded, but it is currently a coherent framework for behaviour change, which can prevent policy makers and designers from overlooking important options related to implementing behaviour change (2011). The components of the BCW can form part of the indicators for the development of the methodology of this study. These indicators will be part of the conceptual framework of this study.

3.3.2 Ergonomics and Affordance Theory

This section looks at Ergonomics and Affordance Theory in relation to cultivating edible plants on buildings. This research is related to the physical opportunity and psychological and physical capability (perceived behavioural control) from the research above. Ergonomics and affordance theory are an important part of helping systems/products become usable with the aim to maximise the physical comfort of the user, so the below factors can help inform the questions asked in the research methodology.

3.3.2.1 Ergonomics

In 1900 in the UK, almost 40% of the population farmed compared to the current proportion of less than 1% (Heinberg, 2007), resulting in physical agricultural work becoming factory work with machinery. Human jobs became more and more integrated with technology, especially during the Second World War, where for the first time human sciences and technology where systematically co-ordinated (Dul, 2001). Concerns about human health when using these technologies led to the birth of a field called ‘Ergonomics’ where the goal is to decrease musculoskeletal discomfort and increase work productivity, efficiency and comfort (Meriano & Latella, 2008). Ergonomists take into account the physical and psychological limitations of humans. They aim to design safe, healthy, comfortable and efficient situations in the workplace and in everyday life (Dul, 2001). How can systems for integrating edible plants on buildings be safe, healthy, efficient and comfortable for the user?

Ergonomic factors when designing include; body postures and movement, environmental factors (noise, illumination etc.), information and operation (information gained visually or through other senses, controls, relation between displays and control) and work organisation (appropriate tasks, interesting jobs). The affordance theory is a branch of the ergonomics factor of information and operation, which will be looked at in more detail below.

The ergonomic factors are listed below as a checklist for designing systems for edible plants with buildings. These factors are based on the 1:1 interaction of the user with a system and are based on the work of Dul (2001). The common sense of the user working in a garden scenario is not included in these factors, for example wearing appropriate headgear on a hot day.

Body Postures and Movement

Biomechanical Background:

- The system should be within easy reach to avoid strain.
- The system should not require twisting the trunk to avoid straining the back.

Anthropometric Background:

- Take account of differences in body size. Would a person in a wheelchair be able to reach some planters for example?

Posture:

- Ensure that the posture is comfortable when attending to different parts of the system, for example mulching the planters.

Movement:

Any movements such as lifting, carrying, pulling and pushing need to be designed carefully to ensure minimal mechanical stress on the user.

- It must be possible to hold the load close to the body.

- It must be possible to hold the load with two hands using an appropriate area to grip.
- The trunk should not need to be twisted.
- Foot and leg room must be adequate to allow for a stable position.
- A heavy load must have several areas to grip for more than one person to help.

Environmental Factors

- The environmental noise levels when using the system should be considered to avoid annoyance and ear impairment. This needs to be below 80 decibels on average, as exposed to anything higher than this for prolonged periods will damage hearing.

- The systems need to be in an area with appropriate lighting to avoid strain.

- Appropriate climatic conditions, air temperature and humidity. The users need to be well protected from high air velocity, for example working in a roof garden.

Information and Operation

Controls:

- Any mechanical controls should be well within reach.

Relationship between information and operation:

- The method of control should respond logically to the user's expectations, for example an irrigation tap should be easy to turn on. This is about making the dialogue between the user and system clear, meeting the user's expectations and a more usable system. This dialogue is also known as affordance, which will be explored in more detail below.

3.3.2.2 An affordance based approach to design

The concept of affordance has come from Gibson's ideas of an ecological approach to perceptual psychology (Gibson, 1979). Perceptual psychology focuses on how the mind processes and represents information (Mandler, 1985). It also looks at the way animals perceive their surroundings in the 'real' world (Millican & Holt, 2010). Gibson's definition of affordance is as follows:

"The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. The verb to *afford* is found in the dictionary, but the noun *affordance* is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment" (Gibson, 1979) p.127.

Gibson claims that animals can perceive 'opportunities for action', e.g. a chair can afford sitting on, standing on etc. and he calls these opportunities for action *affordances* (Pols, 2011). An action is something you intentionally do directly e.g. the action performed when switching the light on is moving your hand, not switching the light on (Pols, 2011). The concept of affordance can be explained more clearly by using an example:

"If a terrestrial surface is nearly horizontal (instead of slanted), nearly flat (instead of convex or concave), and sufficiently extended (relative to the size of the animal) and if its substance is rigid (relative to the weight of the animal), then the surface *affords* support" (Gibson, 1979, p. 128). The example above given by Gibson is not true for all animals as some animals can find convex or concave surfaces 'afford' support. The example implies that the same environment will have different affordances for different animals and also that affordances are continuously changing as the animal itself changes. For example the affordance of a window would be different for children than for adults.

Norman took the idea of affordances a step further by giving guidelines as to what 'everyday' objects should and should not afford, to maximise their usability (addressing all the usability attributes discussed above) (Norman, 1988). Norman's work on cognitive psychology has helped guide Apple Macintosh Designs (AppleComputerInc, 1995). He highlighted that affordances can be positive or negative (Maier, Fadel, & Battisto, 2009). An example given by Norman (1988) is that of the door handle (Figure 37).

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Figure 37: Door handles affording pushing or pulling (Source: Norman, 1988 and (Simpson, 2008)

The door on the left with the horizontal door handle only opens when it is pushed, yet the handle 'affords' pulling, as humans intuitively grab it and pull (Figure 37). The words 'PUSH' have been written on the handle on the right to help overcome this design failure. However if the door did not have a handle in the first place, there would be no possibility for pulling, thus one would automatically push the door open (Figure 38). This highlights that affordances are intuitive (intuition is tacit knowledge). Gibson termed intuition as 'direct perception' (Geilo-Perczak & Karwowski, 2003), so intuition is needed for affordances to be perceived. Usabilityfirst.com explains an affordance as "a situation where an object's sensory characteristics intuitively imply its functionality and use" (Usabilityfirst, 2012).

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Figure 38: Door push plates for pushing (Simpson, 2008)

Gaver stated that Gibson focused mainly on visual affordances, but there are also affordances from the other senses such as touching and hearing; the perceived 'opportunities for action' when touching and hearing (Gaver, 1991). For example, one can feel when a pan is hot, which affords the action of cooking and hear the sound of a door latch, which affords the action of opening.
Gibson (1979) asks the question 'Can an ecological approach to the psychology of perception and behaviour provide a theoretical basis for architecture and design?' More recently, Maier *et al.* (2009) state it can provide a theoretical basis by applying the concept of affordance to the design of objects and in particular to the 'domain of architecture'. They give an example of affordances in the context of architecture:

> "Windows afford the transmission of light, and hence illumination of the interior environment as well as a view of the exterior environment. Operable windows may afford the exchange of air, and in extreme cases even defenestration."

In the case of cultivating edible plants on buildings, a window could also afford aromas, food, air filtration and coolth from plants. For optimum food production, the existing affordances of the building system should be considered at all stages and not compromised, for example the plants should not affect the illumination needed in the interior environment. Interestingly, 'an affordance indicates the potential for a behaviour, but not the actual occurrence of that behaviour' (Maier et al., 2009). A window system that also integrates food production affords food growing but not the act of cooking or eating.

3.3.3 Summary

This section explored several theories in order to understand the user parameters in relation to cultivating edible plants on buildings. Looking at motivation theory and existing research on the motivations and barriers for growing food using different studies, highlighted the barriers to motivation that could be investigated further. The Behaviour Change Wheel has highlighted user parameters that can be investigated further (elements from other behaviour theories have been included to show how they fit within the BCW);

Opportunity
Physical:
Control beliefs (Enablement, Environmental restructuring)
Social:
Normative beliefs (Communication/marketing and Modelling, Enablement, Persuasion, Environmental/social planning, Regulation, Legislation)
Diffusion of Innovation

Capability
Physical:
Control beliefs (Enablement, Environmental restructuring)
Psychological:
Control Beliefs (Knowledge, Training and Guidelines, Enablement)

Motivation
Reflective:
Moral and personal norms
Affective and behavioural beliefs (Persuasion, Incentivisation)
Automatic:
Personal identity
Past behaviour

Table 7 shows how the motivations and barriers to growing your own food found in the existing literature, is linked with the user parameters from the Behaviour Change Wheel. These were used to guide the questions asked in the research methodology in order to find the parameters that affect individuals to cultivate edible plants on buildings

Table 7: Table showing how the motivations and barriers of people growing their own food found from the existing literature is linked with the user parameters from the Behaviour Change Wheel

User Parameters from The Behaviour Change Wheel	Motivations	Barriers
Opportunity - Physical	Exercise (Hujber, 2008; Nelson et al., 2011)	Lack of space (Buckman, 2009; Nelson et al., 2011)
		Concerns about contaminated soil (Buckman, 2009; Hujber, 2008)
		Lack of easily accessible resources (Nelson et al., 2011)
		Disaster from pests etc. (Gerber, 2011)
		Vandalism and theft (Hujber, 2008)
		Ownership of space (Hujber, 2008)
Opportunity - Social	Community (Gerber, 2011; Hujber, 2008)	Not supported by others (Nelson et al., 2011)
	Family influence (Buckman, 2009; Nelson et al., 2011)	Social identification against a healthy lifestyle* (Gerber, 2011)
	Sharing tasks with others (Hujber, 2008)	Lack of group help (Nelson et al., 2011)
		Legal and policy barriers (Hujber, 2008)
Capability – Physical		Lack of time (Buckman, 2009; Gerber, 2011; Nelson et al., 2011)
		Physically unable (Kortright & Wakefield, 2011)

		Cost of establishing garden (Hujber, 2008)
		Health and Safety (Nelson et al., 2011)
Capability – Psychological	Learn about how to grow food (Hopkins, 2008; Nelson et al., 2011)	Attitude and awareness (Hujber, 2008)
	Skills and knowledge (Buckman, 2009; Hopkins, 2008; Nelson et al., 2011)	Perceived lack of skills and knowledge (Buckman, 2009; Gerber, 2011; Nelson et al., 2011)
	Learning about the environment (Buckman, 2009; Hopkins, 2008; Hujber, 2008; Nelson et al., 2011)	Getting dirty and squeamish about insects
Motivation - Reflective	Personal interest and enjoyment (Hujber, 2008; Nelson et al., 2011)	Lack of interest (Buckman, 2009; Nelson et al., 2011)
	Grow unique crops that you cannot buy (Hujber, 2008)	Concerns about air pollution (Hujber, 2008)
	Save Money (Buckman, 2009; Hujber, 2008; Wildcraft, 2012)	
	Eating nutrient rich, fresh food (Gerber, 2011; Hujber, 2008; Nelson et al., 2011)	
	Chemical avoidance and food safety (Buckman, 2009; Hopkins, 2008; Hujber, 2008; Wildcraft, 2012)	
	Cooking (Hujber, 2008)	
	Aesthetics (Gerber, 2011)	
	Food security (Hopkins, 2008; Hujber, 2008; Wildcraft, 2012)	

3.4 Building parameters

This section explores the building as a food production system, looking at the opportunities a building can offer for producing food, the key considerations when integrating food production with buildings, and case studies that are analysed against these considerations. It is found that most of the technical issues related to building parameters integrated with edible plant parameters have been resolved, but there is a gap in knowledge regarding the user parameters that would affect someone to cultivate edible plants on a building.

3.3.1 Considerations for planting edible vegetation on buildings

The considerations for cultivating edible plants on buildings have been identified below, underpinned by the edible plant parameters and user considerations investigated above.

Safe Access

Firstly, safe access to the building surface for cultivation needs to be confirmed (see user considerations above; Physical Opportunity and Physical and Psychological Capability). If there is no access for people, then they are not able to maintain or harvest the plants. Any building surface can be accessed using external machinery such as a cherry picker or a hanging platform (for annual window cleaning for example), but these are not practical for daily access to the plants by users.

Structural capacity

The structural capacity will identify how much extra loading could be added to the surface and the depth and type of growing medium that is possible to use due to the structural limitations (see plant parameters section 3.2.1.6 above for types of growing medium for cultivating on buildings).

Building surface microclimate

The location of the site will affect the microclimate of the building fabric (see plant parameters section 3.2.2 above).

Orientation

Orientation is a key factor for light (see plant parameters section 3.2.3). The vertical sky component (VSC) indicates the amount of skylight falling on a wall or window. The VSC is affected by surrounding buildings and is a good indicator of light availability. The daylight factor is a good indicator of quality of light in internal spaces.

Angle of building surface

The angle of the building surface needs to be identified to examine how the plants could grow and which types of plants would be most suitable for the conditions available and the user parameters.

Location of plant roots and growing medium depth

The structural capacity and the plant types identified in the steps above will determine whether the plant roots can be on the building surface or at ground level. The type of structure, area and depth available for the plants to grow is critical when choosing suitable species; for example root vegetables and fruit trees need much more depth than salad leaves (Nigel Dunnett & Kingsbury, 2004). See section 3.2.1.1 above.

Materials and waterproofing

Particular attention must be paid to ensuring durable waterproofing of roof surfaces and protection against root penetration, particularly as they will be inaccessible under the soils and planting (see section 3.2.4 above about drainage). The materials used for holding plants next to a building fabric should be resistant to moisture, hold water and stop roots from penetrating the main weather-tight element of the fabric (Nigel Dunnett & Kingsbury, 2004). The sustainability (embodied energy and ecological impact) of the materials used should also be considered. The waterproofing and root resistant materials tend to have a high-embodied energy and ecological impact as they are made from non-renewable resources (Felton & Crawford, 2014), which opens an area for further research regarding reducing the ecological impact of these materials.

Irrigation

Plants could either be irrigated with water from the mains system, collected rainwater or greywater (depending on the quality) (see section 3.2.4 above). Stored rainwater can be a form of irrigation with zero embodied energy if no energy is needed to transport it (i.e. if plants are gravity-fed with stored rainwater on the roof or there is a manual pump system). The rainwater storage capacity should be sized according to the garden's needs in times of drought (Richards, 2008). The drainage of water needs to be considered to protect the building fabric.

Organic (renewable) compost/fertiliser

On-site composting can help reduce organic waste leaving the site and in-turn provide a fertiliser for the food growing system (Whitefield, 1993) (see section 3.2.1.4 above regarding nutrients).

Storage

Storage is important when cultivating edible plants, for easy access to tools and equipment (Bennett, 2001).

Internal space for propagating seedlings

Some space is needed inside to nurture plants from seed before they are ready to go outside. This can help extend the growing season of edible plants (Bennett, 2001).

Table 8 shows all of the considerations above in a table that can be used to assess current systems (cases studies) for cultivating edible plants on the fabric of buildings.

Table 8: The considerations for cultivating edible plants on the fabric of buildings

Consideration	**Has this been considered (in relation to resource efficiency and waste minimisation) and implemented?**
Safe access	Yes / No
Structural capacity	
Building surface microclimate	
Orientation	
Angle of building surface	
Location of plant roots and growing medium depth	
Materials and waterproofing	
Irrigation and Drainage	
Organic (renewable) compost/fertiliser	
Storage	
Internal space for propagating plants	

3.3.2 The opportunities for food production a building can offer

Building surfaces, internal and external, provide a range of opportunities for planting edible vegetation. These are shown in Figure 39. All of these building elements are common to most existing buildings but are not an element of all existing buildings. The diagram highlights that access is a key consideration for roof spaces and wall surfaces being classified as usable for food production. The importance of ease of access was also highlighted in a study of people's perceptions and expectations of roof gardens in Singapore (Yuen & Hien, 2005).

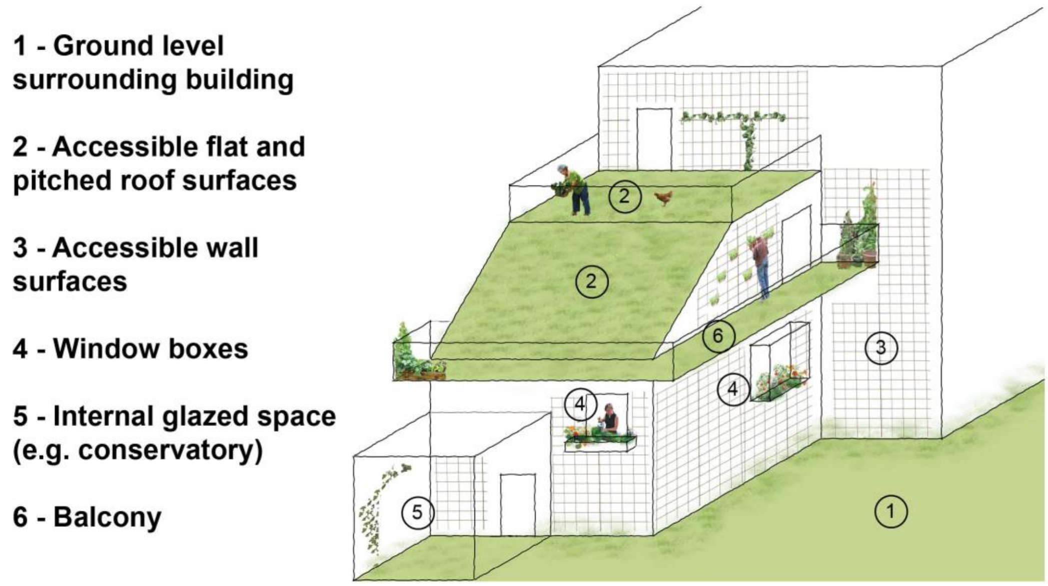

Figure 39: Diagram showing typical building elements that could be used for edible planting (Source: Author)

1. Ground level surrounding building

Buildings can have space at ground level for installing planters or planting directly into the ground. Edible plants can be trained to grow up walls.

2. Accessible flat and pitched roof surfaces

Many existing rooftops are designed with no easy access, mainly because they are not structurally designed for live loads (people). These types of rooftops would not be suitable for food production as people are not able to access the edible plants easily for planting, maintenance and harvesting. Rooftops that can be accessed easily could provide a potential space for producing food.

Rooftops can be designed as green roofs (also known as living roofs, brown roofs or vegetated roofs) with inedible and edible vegetation. Green roofs can be either extensive or intensive (Nigel

Dunnett & Kingsbury, 2004). Extensive green roofs are commonly planted with low maintenance perennials such as succulents or wild flowers, do not have a deep growing medium (usually less than 20cm deep) and cannot be easily accessed. Intensive green roofs have deep soils, are designed to be accessed and are usually landscaped similar to ground level (Nigel Dunnett & Kingsbury, 2004). Intensive green roofs are more likely to be suitable for edible planting as they are usually designed to be accessed easily and can take larger loads.

3. Accessible wall surfaces

Living wall or green wall systems have been developed to add vegetation to external and internal walls. These are commonly panel systems where the growing medium (different growing mediums identified in section 3.2.1.6) sits within a panel that is fixed to the wall. Living wall manufacturers have shown that edible plants can be planted on their living walls depending on the growing medium depth required.

4. Window boxes

Window boxes are planters that are fixed to the building near a windowsill. They can be internal or external. Depending on the strength of the fixing and space available, they can be any depth or size.

5. Internal glazed space

Internal glazed spaces such as conservatories and atriums can provide very good microclimates for tender crops, such as tomatoes, which are harder to grow outside in the UK (BHCC, 2011). Plants can be grown inside containers.

6. Balcony

Edible plants can be grown in containers on balconies. Climbing edibles can be trained to grow up the building wall that is linked with the balcony to provide more space.

3.3.3 Case studies of edible planting on buildings

Using the investigation above regarding the opportunities for cultivation that buildings can offer, this section shows some case studies for different planting systems. Some are purpose built for planting and some have been retrofitted. The case studies have been introduced and analysed against the considerations above in a summary table at the end of this section (Table 10).

3.3.3.1 Roof systems

RISC Roof Garden, Reading, UK - Retrofit field green roof system

The roof garden of Reading International Solidarity Centre (Figure 40) was constructed on an existing concrete and steel frame building in Reading town centre and was initially planted in 2002. Built in the 1960s, the flat roof structure is a series of 180mm steel joists, resting on reinforced concrete piers spanning 6 metres wide, thus the capacity for extra weight is substantial (Richards, 2008).

The construction build up consists of a petroleum based waterproof layer to seal the roofs, covered with stirling board to spread the load evenly (Figure 41) (RISC, 2009). The hard landscaping was constructed using a combination of reused, renewable (natural) and reclaimed materials; such as old bricks, woodchip and cordwood from the waste in the timber industry, and willow and hazel for the fencing and raised beds. Labour costs were minimised with the help of volunteers during construction.

Figure 40: RISC Roof Garden, Reading (Source: RISC, 2009)

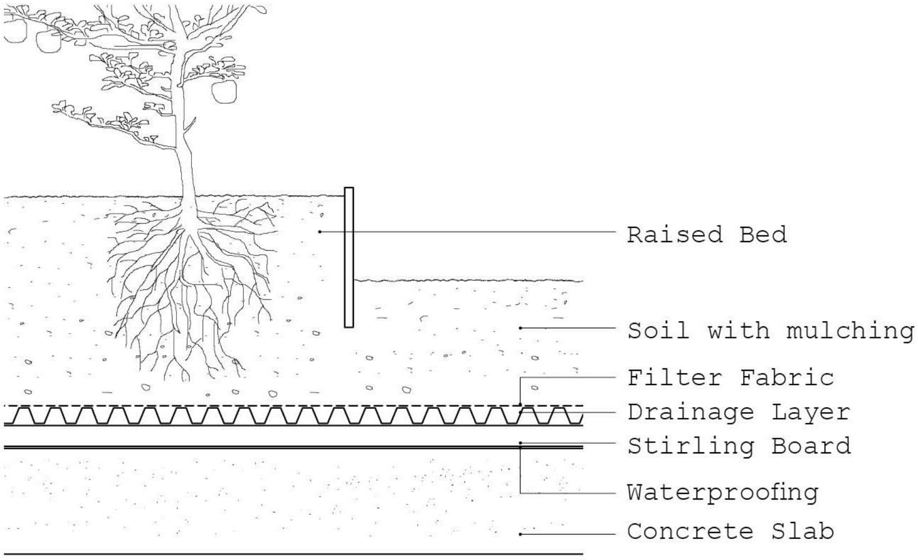

Figure 41: Detail of RISC Roof Garden Construction at 1:20 (Source: Author)

Table 10 in the summary below shows that RISC roof garden performs very well against the building considerations discussed above for cultivation of edible plants, apart from the use of a high-embodied energy waterproofing material.

Trent University, Ontario, Canada - Retrofit field green roof system

The flat roof of the concrete Environmental Sciences building at Trent University, Ontario, Canada has been turned into a roof garden planted with edible crops since 1996 (Figure 42) (Blyth & Menagh, 2006). The garden was initially used as a site for monitoring the effects of air pollution on agricultural crops grown in urban areas (Blyth & Menagh, 2006). It is now used as a learning space where student volunteers develop gardening skills and grow food for local groups. Each year, one student is elected as a coordinator for the garden. A student levy funds the students' wages and cost of supplies (Moss, 2011).

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Figure 42: Trent University Roof Garden, Ontario, Canada (Moss, 2011)

The green roof sits on a concrete slab roof structure. A layer of synthetic rubber waterproofing has been applied on top of the concrete with a mixture of soil and crushed brick on top of the waterproofing.

Table 10 in the summary below shows that the Trent University roof garden performs very well against the building considerations discussed above, apart from the use of a high-embodied energy waterproofing material.

Food from the Sky Roof Garden - Retrofit container system

Food from the Sky (FFTS) (Figure 43) is a community roof garden that uses Permaculture food cultivation methods that focuses on the education of food production, addressing issues such as food security, deep biodiversity, resilience and make change from within the food industry. It is the rooftop of Thornton's Budgens supermarket in Crouch End, North London. FFTS aims to show how supermarkets can run more sustainable practices by growing food locally and selling it. The organisers of FFTS run educational workshops for individuals, groups, organisations and the Budgens supermarket's team members (FFTS, 2012).

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Figure 43: Food from the Sky roof garden (Borgobello, 2011) (FFTS, 2011a)

The plants are grown in 350 reclaimed plastic recycling boxes (25cm by 15cm) that are no longer used by the local authority (FFTS, 2011c).

Table 10 in the summary below shows that the Budgens roof garden performs very well against the building considerations discussed above.

The Edible Campus Garden, McGill University, Montreal, Canada

The Edible Campus at McGill University was set up by the school of architecture and local NGOs Santropol Roulant and Alternatives (Figure 44). The garden grows annual plants between March and October. It is replanted every growing season.

Figure 44: The Edible Campus, McGill University, Montreal, Canada (MU, 2007)

The garden was both at ground level (a bare, paved over concrete plaza) and rooftop level (MU, 2007). The rooftop section is an underutilised concrete frame terrace (MU, 2007). The garden is a container garden system both at ground level and rooftop level. The containers are fitted with a reservoir at the bottom for increased drought resilience (Figure 45).

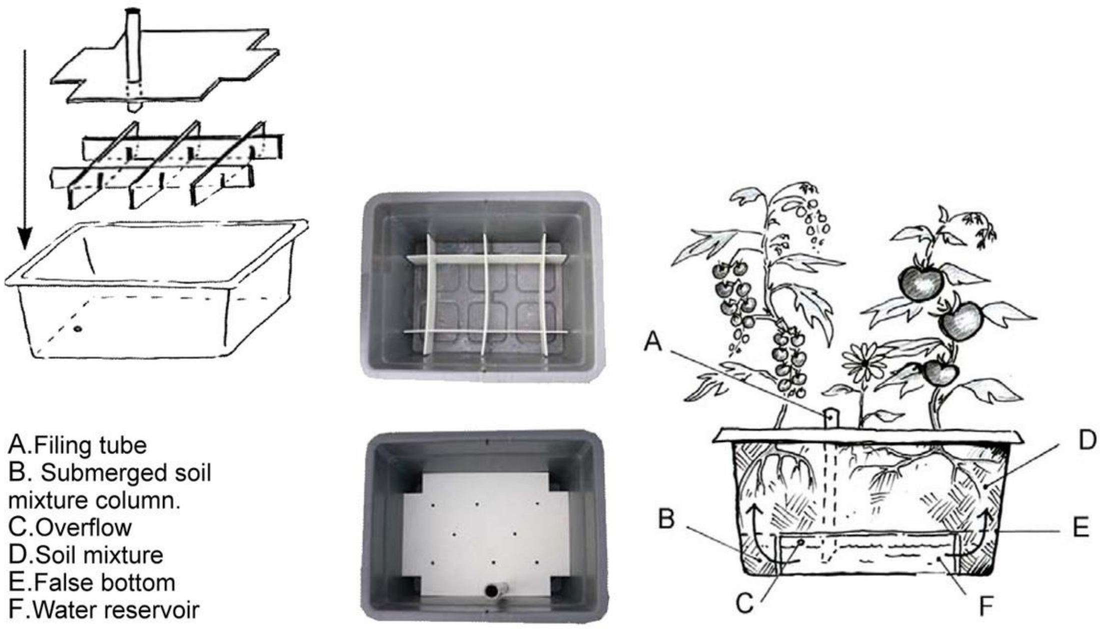

Figure 45: Reservoir container system (MU, 2007)

The garden is 93m² with a total of 30m² of containers (123 containers) (MU, 2007). Compost is used as the growing medium inside the containers. Edible annual crops where planted in the container garden (Table 9) during the growing season 26th May 2007 - 23rd October 2007. They grew about 64 tonnes/hectare, which is similar to Ridsdill Smith's productivity level in his containers.

Table 9: Annual crops grown in 2007 and productivity (MU, 2007)

Crop type	Total harvest (kg)
Arugula	0.62
Basil	10.51
Bok Choy	2.60
Broccoli	0.30
Cantaloup	3.00
Celery	9.50
Cherry Tomatoes	15.90
Chives	0.09
Cilantro	0.02
Cucumbers	27.04
Dill	0.10
Edible flowers	0.97
Eggplant	0.90
Green beans	11.45
Green Peppers	10.06
Ground Cherries	7.32
Lettuce	9.55
Leeks	7.20
Mint	0.29
Onions	0.60
Parsley	0.74
Squash	2.30
Swiss Chard	5.62
Thai Basil	1.35
Tomatoes	48.85
Total	**176.90**

Container systems are a very good example of how food production can be integrated flexibly into the built environment. The containers can be relocated if needed. In this case study, the containers were all stored on the terrace outside of the growing season. Due to the transient nature of the containers and the planting of annuals, the project needs a dedicated group of people to be successful every year.

Table 10 in the summary below shows that the edible campus roof garden performs very well against the building considerations discussed above. The irrigation system is resilient to drought and some neglect due to the reservoir system.

3.3.3.2 Wall systems

Paradise Park Children's Centre, London - Purpose built panel system

Paradise Park is located in Islington, North London, designed by DSDHA (Saunt, 2007). The children's centre benefits from a self-seeded green roof (covered with a layer of rubble) and a hydroponic living wall system (Figure 46), which was the first large-scale green wall in the UK (Long, 2006). Although not designed as an edible system, there were some strawberries and herbs planted on this wall. The edible plants planted higher up on the wall would be difficult to access.

Figure 46: Paradise Park Children's Centre, London (Source: Author)

Construction:

The living wall system is constructed using metal panels containing black filter foam and a rock wool growing medium (Pearce, 2009), fixed back to a waterproofed block work wall (Figure 47).

The tops of the walls are capped by a preformed polyester-powder-coated aluminium coping (Dawson, 2006).

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Figure 47: Detail of living wall at Paradise Park (Source: Dawson, 2006)

Table 10 in the summary below shows that the Paradise Park living wall does not perform greatly against the building considerations discussed above. The main problems were: the higher parts of the wall cannot be accessed easily for regular maintenance (which is problematic for an edible garden), the materials are waterproof and root-proof but have a high embodied energy, the irrigation system is reliant on electricity to function and the fertiliser is from a non-renewable source. These problems are also present in other green wall systems, where some could be resolved at the design stage.

Urban Farming Food Chain, Skid Row Housing Trust's 'The Rainbow' Green Wall, Los Angeles, USA - Retrofit panel system

GLT wall systems (introduced in section 3.2.1.6 above) with edible plants ($70m^2$) have been installed on four different sites in and around downtown Los Angeles, USA (GR, 2008). The green wall systems are mounted on buildings or concrete walls, or are freestanding in parking areas.
The owners of the four sites are The Weingart Center; The Rainbow Apartments (in partnership with the Yankee Apartments); The Los Angeles Regional Food Bank (Figure 48) and the Miguel Contreras Learning Complex.

Figure 48: The Los Angeles Regional Food Bank Edible Wall

This food chain has been replicated in other cities in the USA such as New York, Rochester, Detroit and Las Vegas. All the systems are funded and developed by Green Living Technologies. This section will concentrate on the Green Living Technologies, green wall system (GR, 2008).

The green wall is a panel system made from stainless steel for exterior systems (Figure 49). The company uses aluminium for interior systems. The panels slot into a steel frame bolted on a wall or freestanding.

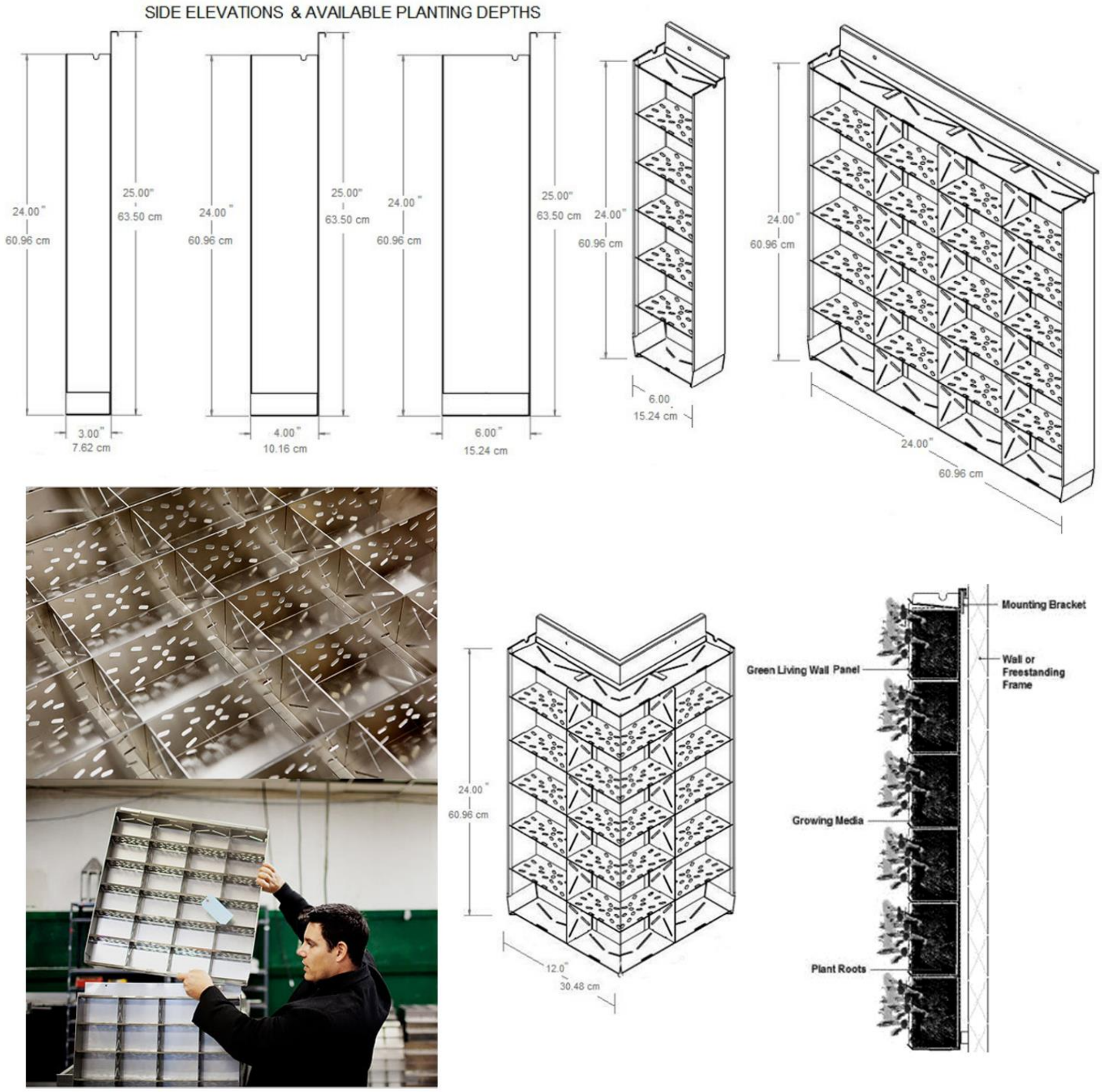

Figure 49: Green Living Technologies, Green Wall System

Table 10 from the summary below shows that the GLT living wall performs well (much better than the Paradise park living wall system) against the building considerations discussed above. The areas that could be improved are the use of lower embodied energy materials and an irrigation system that does not need electricity and is resilient when neglected. This is an example of how there are design solutions to the problems of the Paradise park living wall.

Bosco Verticale (Vertical Forest)

The residential tower is designed by Stefano Boeri Architects with a forest as the façade (Figure 50). "Bosco Verticale [is a] device for the environmental survival of contemporary European cities," says Stefano Boeri (Borgobello, 2011). The towers are 110 and 76 metres tall (Borgobello, 2011).

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Figure 50: The vertical forests as they would look once the trees have matured (Borgobello, 2011)

The trees sit in 1 metre deep concrete planters, which merge into the reinforced concrete structure of the tower.
Table 10 in the summary below shows that the Bosco Vertical performs well against the building considerations discussed above. The areas that could be improved are the use of lower embodied energy materials, highlighting again the need for further research in this area.

3.3.4 Summary

This section explored the building as a food production system, looking at the opportunities a building can offer for producing food, the key considerations when integrating food production with buildings, and case studies that are analysed against these considerations.

Table 10: The considerations for cultivating edible plants on the fabric of buildings

Consideration	**Has this been considered and implemented?**							
	RISC Roof Garden, Reading, UK	**Trent University, Ontario, Canada**	**Food From The Sky, Roof Garden, North London, UK**	**McGill University, Montreal, Canada**	**Paradise Park Green Wall, London, UK**	**GLT Green Wall, Los Angeles, USA**	**Bosco Verticale, Vertical Planters, Milan, Italy**	**Total score for all case studies:**
Safe access	Yes	Yes	Yes	Yes	No	Yes	Yes	86%
Structural capacity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%
Building surface microclimate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%
Orientation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%
Angle of building surface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%
Location of plant roots and growing medium depth	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%
Materials and waterproofing	Partly	Partly	Yes	Partly	Partly	No	Partly	50%
Irrigation and Drainage	Yes	Yes	Yes	Yes	No	No	No	57%
Organic (renewable) compost/fertiliser	Yes	Yes	Yes	Yes	No	Yes	Yes	86%
Storage	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%
Internal space for propagating plants	Yes	Yes	Yes	No	No	No	Yes	57%

Table 10 shows the main issues found from the case studies regarding the building parameters. It is clear from the sample of case studies that all types of systems for cultivating plants on buildings have not been able to resolve the issue of using materials with low environmental impact. The table also shows that green roof systems are generally able to use low environmental impact irrigation and drainage systems compared to vertical systems. All case studies were able to implement storage for their growing systems as due to their nature of being integrated on a building, the building occupants can allocate a space in the building for storage. It is found that there are design solutions to most of the issues above apart from the use of low-embodied energy materials.

The case studies show that from a technical point of view, it is possible to cultivate edible plants on buildings. If most of the technical issues can be resolved, then why are more people not cultivating edible plants on buildings? What are the parameters that affect people to cultivate edible plants on buildings? A study by Hui regarding green roof urban farming in high-density urban cities mentioned re-engaging the community to participate and be part of the urban harvest (Hui, 2011), but what are the parameters that would affect this engagement? Behaviour theories and the edible plant and building parameters looked at in this chapter can provide a framework for investigating these questions.

3.5 Conclusion

This chapter has investigated the plant, user and building parameters in relation to cultivating edible plants on buildings. A review of the literature indicated there is a lack of understanding of the user parameters in relation to the edible plant and building parameters. The relationships that need further investigation are shown in the conceptual framework (Figure 51).

As such, this chapter has also investigated interactions between these three elements: buildings' interactions with edible plants, users' interaction with a building and users' interaction with the edible plants. The conceptual framework shows in bold arrows the relationships that need further investigation; namely, the user parameters affecting the interaction of edible plants with buildings, the building parameters affecting the user interacting with edible plants and the edible plant parameters affecting the user interacting with a building. These relationship are not as critical for the success of inedible plants integrated with buildings as there is less user involvement with these systems (e.g. a green roof with inedible plants does not need to be easily accessible and can be left to grow with minimal maintenance). The user needs to interact with the edible system, where the Behaviour Change Wheel showed that the user needs to be motivated, capable and have the opportunity to undertake the behaviour of using the system (maintaining, harvesting, and eating).

The conceptual framework also shows the parameters that affect these relationships, which were formed from findings in this chapter. These user parameters require further investigation, as they are from a literature that focused on cultivating edible plants at ground level rather than on buildings. There is a lack of knowledge of the parameters that affect the behaviour to cultivate edible plants on buildings. To inform the existing research base, this thesis pursues a main research question: "What affects individuals to cultivate edible plants on buildings?"

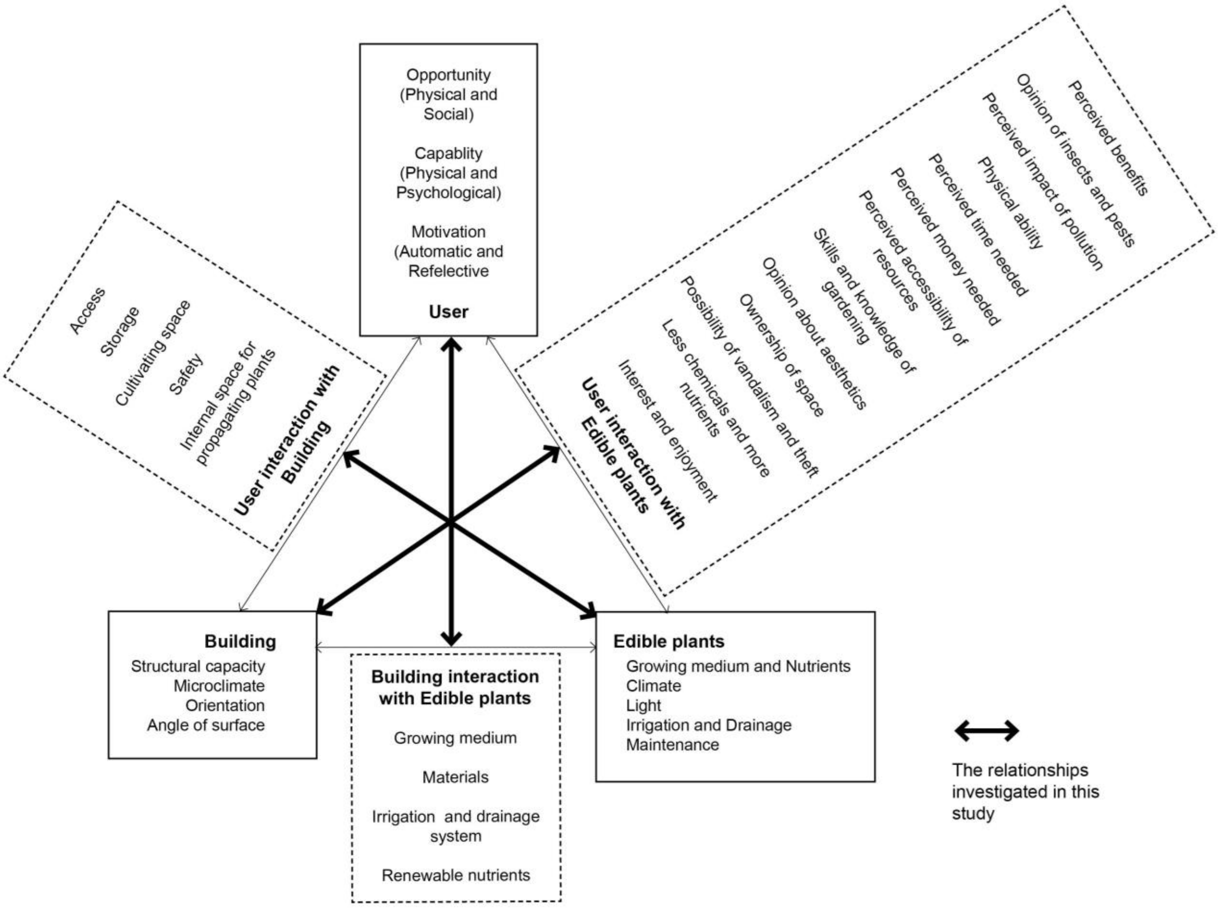


Figure 51: Conceptual framework showing the three main elements for cultivating edible plants on buildings and their relationships, as well as the parameters that guided the research methodology

The research findings can provide a better understanding of the parameters related to users of systems for cultivating edible plants on buildings. A better understanding of the parameters that affect people to cultivate edible plants on building can underpin further developments and guide the design of systems for cultivating edible plants on buildings. For example, such an understanding can inform the development of an assessment tool to evaluate the potential for cultivating edible plants on existing buildings, similar to assessing the energy performance of a building. The findings of this research could provide a framework for assessing the occupant of a building (user parameters), in addition to assessing the building and edible plant parameters.

The indicators in Figure 51 underpin the research methodology.

Chapter 4: Methodology

4.1 Introduction

This chapter explains the research strategy, research design and methodology of this study. The quantitative (phase 1) and qualitative (phase 2) methodologies and process are detailed and the rationale for employing these approaches are explained. It closes with a synthesis of these data (phase 3). In the first phase, a questionnaire was developed based on the indicators in the conceptual framework (Figure 51). A pilot study was undertaken to test the questionnaire and methods of analysis. Hypotheses were developed based on the Behaviour Change Wheel, behaviour theory and relationships found in the pilot study data. The ethical considerations, validity and reliability of the research methodology are also discussed.

Chapter 2 highlighted that cultivating edible plants on buildings can be a useful contribution towards the future sustainability of cities. Chapter 3 showed that there is a significant amount of research and knowledge regarding the interaction between edible plants with buildings and edible plants with the user, but there is a gap in knowledge regarding the interaction of the three main elements with each other and the edible plants, user and building parameters (the relationships shown in the bold arrows in the conceptual framework Figure 51). This formed the research questions regarding investigating what affects individuals to cultivate edible plants on buildings and my synthesis of these data (phase 3).

4.1.1 Main and subsidiary research questions

MAIN RESEARCH QUESTION:

What affects individuals to cultivate edible plants on buildings?

SUBSIDIARY RESEARCH QUESTIONS:

a) Why cultivate edible plants on buildings from a social, economic and environmental point of view?

b) What are the edible plant, user and building parameters that affect the implementation of cultivating edible plants on buildings?

c) What are the categories that affect the behaviour to cultivate edible plants on buildings?

d) What are the parameters that affect the behaviour to cultivate edible plants on buildings?

e) How can behaviour theory inform the understanding of these parameters?

4.2 Research paradigms, research strategy and research design

4.2.1 The research paradigm

The methodology indicates "a philosophical stance of worldview that underlies and informs a style of research." (Sapsford, 2006, p.175).

To summarise, this research sits within the social science discipline, taking a critical realist approach from Bhaskar (1975) and pragmatist approach to the research question with the research design based on mixed methods. A pragmatist would support using whatever philosophical or methodological approach that works best to answer the research questions (Robson, 2011) and has a close relationship to critical realism.
This study is considered to be social science research as it is dealing with individual/groups of people and their views about a particular topic area (cultivating edible plants on buildings). Social science research is the systematic investigation of a material or source in the social world.

4.2.2 The research strategy

The research strategy fulfilled the following requirements in order to answer the research question:

a) Collect primary empirical data from people in England using the indicators from the conceptual framework to form hypotheses;
b) Follow a deductive approach by collecting and analysing data that can be used to accept or reject hypotheses;
c) Follow an inductive approach by collecting and analysing data that can be used to develop new hypotheses to address the research question.

These requirements fit within a sequential explanatory mixed methods (quantitative and qualitative) research design strategy (Creswell, 2008). Sequential explanatory mixed methods was used to corroborate findings in the study. The quantitative data (from a questionnaire) were collected and analysed first in order to test hypotheses developed from findings in the literature review (Phase 1). The findings from this analysis were used to collect qualitative data (from interviews) (Phase 2), which would help underpin the findings and generate further theory that may have not been highlighted by the quantitative study. This strategy helps overcome the weaknesses of quantitative data analysis using the strengths of qualitative analysis (Figure 52) (Creswell, 2008). In this research, the weakness of the quantitative analysis was that all the questions asked are generated from presumed indicators from the literature review. The qualitative data can bring forward new indicators that were not highlighted by the literature.

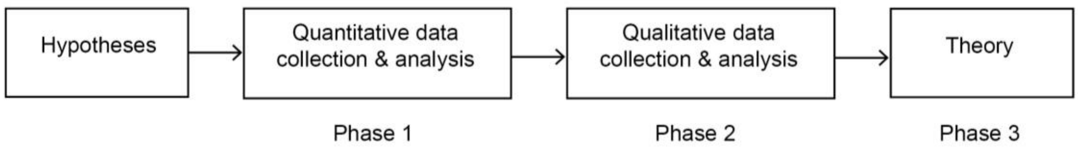


Figure 52: Sequential explanatory mixed methods research design strategy (Source: Author)

4.2.3 Research design

The study was cross-sectional for both the quantitative data and qualitative data collection. A longitudinal study was not undertaken due to limited resources. Future research could investigate how the parameters that affect individuals to cultivate edible plants on buildings might change before and after undertaking food production on a building.

4.3 Data Collection Methods

The data collection methods used were questionnaires to obtain quantitative data (Phase 1) and 1:1 semi-structured interviews to obtain qualitative data in order to form a better understanding of the quantitative results (Phase 2). An experiment was not appropriate for answering this research question as the question is aimed at what is happening in reality, which would not be possible to accurately simulate in an experiment, as there are too many variables. There are no official statistics in the literature that would help answer the research question in depth, as the research question focuses on people's experiences "out there" in real-life situations.

4.3.1 Phase 1 - The questionnaire (quantitative study)

The questionnaire (Appendix D) was developed using the indicators from the literature review that have been shown in the conceptual framework.

The indicators shown in the conceptual framework have been explored in the questionnaire using mostly Ordinal (rated) variables (questions). There are also nominal (including dichotomous) and interval (ratio) variables. One open-ended question was asked in the questionnaire in order to give all respondents the opportunity to write about their

experience/opinion of cultivating edible plants on buildings. Further open-ended questions were asked in phase 2 of this research study.
The participants to complete the questionnaire were selected using the selection criteria explained in section 4.4 below. A deductive approach was initially undertaken where the hypotheses were tested using the data. The data was also analysed using an inductive approach, where the relationships of all combinations of pairs of variables were investigated and significant relationships directly related to the research question were highlighted. These relationships were then brought together under categories that were used to form the key open questions for the qualitative phase of the study.

4.3.2 Phase 2 - The 1:1 semi-structured interviews (qualitative study)

"Experiments, official statistics and survey data may simply be inappropriate to some of the tasks of social science. For instance, they exclude the observation of behaviour in everyday situations. Hence, while quantification may *sometimes* be useful, it can conceal as well as reveal basic social processes." (Silverman, 2000, p. 7).

In phase 2, some respondents were selected from the survey and asked further questions in the form of semi-structured interview questions that were formed from the conclusions in phase 1 in order to obtain a better understanding of the findings from the quantitative data analysis (Robson, 2011; Silverman, 2000). Semi-structured interviews allowed participants to start a conversation about their experiences, as well as to answer some key questions to guide the conversation towards answering the research question. A semi-structured interview has questions to start the conversation and prompts to make sure all the information needed is obtained from the conversation (Robson, 2011).
The selection process for those interviewed depended on the number of respondents who said that they would be interested to take part in a 1:1 interview. Some interviewees were contacted through recommendation by other interviewees.

4.3.3 Phase 3 - Combining the findings from phases 1 and 2

The findings from the quantitative study and qualitative study were brought together in phase 3 in order to form answers to the research question.

4.4 Data Collection Process

This section focuses on how the primary data were collected and how the participants were chosen for questionnaires and interviews.

4.4.1 Case selection

The selection process of whom to question was guided by characteristics, underpinned by the edible plant, user and building parameters, in order to achieve a cross-sectional sample across the population. The characteristics looked at were:

- Close proximity to normal planting space at ground level e.g. a garden, where they live or work. Asking people with gardens about cultivating edible plants on buildings gave the perspective of someone who has ground level space available.
- Possibility of easy access to potential growing space on a building that they use often, where they live or work. Asking people who use a building with the potential for cultivating edible plants on it, gave their perspective on the idea to cultivate on their building and why they are/are not doing it.
- People who do not own their homes in order to have the perspective of people who may be in a building for a temporary period.
- Owners of homes/buildings in order to give the perspective of landlords and/or people who are living somewhere long term.
- People who are/are not already cultivating at ground level and/or on buildings, gave the perspective of people with/without the knowledge/experience.
- People who are cultivating on walls/roofs/balconies/ground level in order to give the perspective of people cultivating in different places on and around buildings.
- People who are cultivating using different growing systems on buildings in order to give the perspective of people using different growing systems.

With the above characteristics as guidance, a range of cases were targeted for both questionnaires and interviews with the categories as follows:

a) Individuals living in rented and owned flats who may want to grow edible plants/are cultivating edible plants
b) Individuals living in rented and owned houses with small gardens who may want to grow edible plants/are cultivating edible plants

c) Individuals who may want to grow edible plants at their workplace/are cultivating edible plants at their workplace
d) Individuals cultivating at ground level
e) Communities cultivating at ground level
f) Urban growers who sell their produce and are cultivating at ground level
g) Individuals cultivating on a building
h) Communities cultivating on a building
i) Urban growers who sell their produce and are cultivating on a building

4.4.2 Population and Sampling frame

The people questioned were based in England (Oxford, Reading, London and Brighton). The sampling amount was different for each category due to numbers available, for example there are many allotments in England but not many gardens on walls (Table 11). Table 12 explains the sampling for each category and the numbers from each. This research did not aim to generalise or predict from the whole sample population, but is interested in different opinions, approaches and attitudes, therefore a representative number from each sector according to size was not needed.

Table 11: Matrix of the cases and type of cultivation system

Case Type	Type of cultivating system			
a) Individuals living in rented and owned flats who may want to grow edible plants/are cultivating edible plants	n/a	n/a	n/a	n/a
b) Individuals living in rented and owned houses who may want to grow edible plants/are cultivating edible plants	n/a	n/a	n/a	n/a
c) Individuals who may want to grow edible plants at their	n/a	n/a	n/a	n/a

workplace/are cultivating edible plants at their workplace				
d) Individuals cultivating at ground level	Allotments	-	-	-
e) Communities cultivating at ground level	Old derelict site	Council grounds	Private grounds	Solid surface such as paving
f) Urban growers who sell their produce and are cultivating at ground level	Old derelict site	Council grounds	Private grounds	Solid surface such as paving
g) Individuals cultivating on a building	Roof	Wall	Balcony	Windowsill/glazed internal space
h) Communities cultivating on a building	Roof	Wall	Balcony	Windowsill/glazed internal space
i) Urban growers who sell their produce and are cultivating on a building	Roof	Wall	Balcony	Windowsill/glazed internal space

Table 12: Sampling of the case and growing system matrix

Case Type	Sampling method
a) Individuals living in rented and owned flats who may want to grow edible plants/are cultivating edible plants	(1) All flats that have the opportunity to grow edible plants on the building could be part of the sample but there are too many. The flats questioned had balconies and an accessible flat roof. 2 blocks of flats chosen were in Oxford (a small city/town). It was planned to have one in London, however due to access limitations, this was not possible.

b) Individuals living in rented and owned houses who may want to grow edible plants/are cultivating edible plants	(2) Most houses in England have the opportunity for edible plants production, as they have front or back gardens so again they cannot all be part of the sample. They were chosen based on the house type. They were all in Oxford. A road of terraced houses was chosen and a road of semi-detached houses.			
c) Individuals who may want to grow edible plants at their workplace/are cultivating edible plants at their workplace	(3) Many office buildings have the opportunity to grow edible plants on so they could not all be part of the sample. The office buildings questioned had the opportunity to grow edible plants on an accessible flat roof or an accessible south/east/west facing wall. 2 office buildings in Oxford were chosen.			
d) Individuals cultivating at ground level in an allotment	(4) There are many allotments in England. 2 allotments in Oxford were chosen.			
e) Communities cultivating at ground level	(5) 2 community gardens on a **derelict site** were chosen. 1 in Oxford and 1 in London.	(6) 2 community gardens on **council grounds** were chosen in London.	(7) 2 community gardens on **private grounds** were chosen in London.	(8) 2 community gardens on a **solid surface** were chosen in London.
f) Urban growers who sell their produce and are cultivating at ground level	(9) 2 cases on a **derelict site** were chosen in London.	(10) 2 cases on **council grounds** were chosen in London.	(11) 2 cases on **private grounds** were chosen in London.	(12) 2 cases on a **solid surface** were chosen in London.
g) Individuals cultivating on a building	(13) 2 cases on a **roof** were chosen. 1 in Brighton	(14) 2 cases on a **wall** were chosen in London.	(15) 2 cases on a **balcony** were chosen in London.	(16) 2 cases on a **windowsill/glazed internal space** were chosen in Oxford.

	and 1 in London.			
h) Communities cultivating on a building	(17) 2 cases on a **roof** were chosen. 1 in Reading and 1 in London.	(18) 2 cases on a **wall** were chosen in London.	(19) 2 cases on a **balcony** were chosen in London.	(20) 2 cases on a **windowsill/glazed internal space** were chosen in London.
i) Urban growers who sell their produce and are cultivating on a building	(21) 2 cases on a **roof** were chosen in London.	(22) 2 cases on a **wall** were chosen in London.		

The samples were chosen according to Table 12. The case matrix with growing systems is used to ensure that the sample is including people who are cultivating in different types of systems (Table 12). It is shown in Table 12 that there are 22 case and growing system combinations in total. Two cases were targeted for each of these 22, which means a total of 44 cases. For a-c, about 50 flyers (Appendix C) were handed out through letter boxes (a possibility of 300 respondents for categories a-c). For d-i, there were electronic posters sent, meaning the sample size was unpredictable as it may have been everyone who was within that case's organisation, e.g. the number of people involved in a community roof garden.
65 participants completed the questionnaire. 35 participants said yes to taking part in an 1:1 interview. 21 participants who completed the questionnaire were interviewed. Four interview participants were contacted for an interview due to their experience with urban agriculture (3 who grow on buildings) and 5 interview participants were recommended by other interviewees.

4.4.3 Fieldwork Procedure

Self-completion questionnaires were used to collect data from each person. These were then followed by semi-structured interviews, with a few participants from each case, to gain a more in-depth understanding about their behaviour and experiences. The questions asked where based on the indicators in the conceptual framework (Figure 51) and findings in the literature review. Self-completion questionnaires are a cost-effective and efficient method of obtaining large amounts of data (Bryman, 2012). The questions are closed-ended and kept short so that they are easy to follow. The wording of the questions must also be accurate to minimise misinterpretation by the respondent. The questionnaire was tested in a small, initial pilot study (see section 4.10 in this chapter) to test the time it takes to complete, the clarity of the questions, and the analysis method.

Fieldwork phase 1 - Questionnaires

Participants were asked to complete a questionnaire related to their experience of cultivating edible plants in general and cultivating edible plants on buildings. It was estimated that the questionnaire would take 20 minutes to complete. There was one questionnaire designed (Appendix D) for all 3 types of participants from the different categories above. The 3 types of participants were:

1. People who may or may not be cultivating edible plants.
2. People who are cultivating edible plants in a garden, allotment etc. (i.e. not on a building but at ground level).
3. People who are cultivating edible plants on a building.

The questionnaire was split into 3 different categories in order to ask questions appropriate for the types of people above.

A. About you – Asking general questions about the person's background and their ideas about gardening. People who do not grow edible plants were asked to complete all the questions in this section (about why they do not garden) and then skip to section C.
B. About growing edible plants – People who do grow edible plants were asked to skip to this section and then move onto section C.
C. About the buildings that you occupy most days e.g. your flat block, your house, your office building etc. All participants were required to complete this section.

All participants were asked at the end of the questionnaire if they would be interested to take part in a 1:1 interview and asked to write down their contact details.

Fieldwork phase 2 - Semi-structured Interviews

Some participants from each category were interviewed 1:1 to obtain a deeper understanding of their cultivating experience. The duration of the interviews was approximately 1 hour. The interviews were carried out near the participant's garden or their home/workplace if they do not have a garden. The interviews were voice recorded with participants' permission. The location was in a quiet location to minimise background noise.

The interview questions were open-ended questions, generated from the analysis of the quantitative data, that allow the interviewee to talk about their experiences in more depth compared to the questionnaire. Their answers prompted further questions from the interviewer.

Sequence of events for the fieldwork:

STAGES FOR APPROACHING THE FOLLOWING PEOPLE:

a) Individuals living in flats who may want to grow edible plants/are cultivating edible plants
b) Individuals living in rented houses with small gardens with small gardens who may want to grow edible plants/are cultivating edible plants
c) Individuals who may want to grow edible plants at their workplace/are cultivating edible plants at their workplace

Stage 1:

Select two blocks of flats, two roads of housing, and two office blocks in Oxford with the potential to grow edible plants on and around the building.

Stage 2:

Put a copy of an advertisement flyer (Flyer 1) (Appendix C) that catches their interest, and a participant information sheet (participant information sheet 1) (Appendix A) in each letter box. Provide a link to the online questionnaire asking them to email or call the researcher if they would like a hard copy of the questionnaire. In the case of the office block, ask the person at reception if they could email or hand out the flyer and participant information sheet to people who work in the office.

Stage 3:

If they ask for a hard copy, put it into their post box or in the case of the office block, give it to reception with the details of the employee.

STAGES FOR APPROACHING THE FOLLOWING PEOPLE (as the email address of their organisation is available online):

d) Individuals cultivating at ground level in an allotment
e) Communities cultivating at ground level
f) Urban growers who sell their produce and were cultivating at ground level
g) Individuals cultivating on a building
h) Communities cultivating on a building
i) Urban growers who sell their produce and were cultivating on a building

Stage 4:

Select the sample of cases. Find the main contact email address for each case using their webpage details, blog details or Facebook (social media) page.

Stage 5:

Email the main contact (Flyer 2) (Appendix C) explaining the research and if they think members of their organisation might be willing to fill out a questionnaire for the study with the attached participant information sheet 1 (Appendix A).

Stage 6:

If they were happy to take part, ask the main contact if they were willing to forward the questionnaire advertisement email (Flyer 3) (Appendix C) to members of their organisation with recommendation. If they were not, ask them how they would prefer the questionnaire to be given to members of their organisation.

Stage 7:

Email a copy of the email cover letter (Flyer 3) (Appendix C), with a link to the online participant information sheet (participant information sheet 1) (Appendix A) and online questionnaire to the main contact for them to forward to members in their organisation.

INTERVIEWS:

Stage 8:

After quantitative analysis of the questionnaires, select some of the participants who said that they would be willing to take part in a 1:1 interview.

Stage 9:

Contact these participants via their preferred method of contact given at the end of their questionnaire, to arrange a time and date for the interview, with a copy of the consent form (Appendix B) and participant information sheet (participant information sheet 2) (Appendix A) for them to have a look at.

Stage 10:

Take a copy of the consent form for the participants to sign before their questionnaire.

4.5 Ethical considerations

Undertaking research requires trustworthiness, sincerity and fairness towards the research itself and those involved in the research study. All participants were given a participant information sheet (Appendix A) and were informed that the data would be kept confidential and that they would be kept anonymous. They were all warned that due to the size of the sample, they may be able to be identified but they would not be directly named anywhere in the research documentation. All interview participants were asked to sign a consent form before the interview (Appendix B). No vulnerable groups have participated in this research. Vulnerable groups in this research context were; children and young people under 16, people with mental health problems, learning disabilities and cognitive impairments, and prisoners (Robson, 2011). There were no direct risks to the researcher when conducting this research. As the interviews were taking place in participants' gardens/homes/places of work then the researcher was accompanied by a chaperone if the interview took place after dark or inside a private home. This research project has been approved by the Oxford Brookes Research Ethics Committee.

4.6 Validity and reliability

4.6.1 Validity

The data have been electronically recorded and all interviews have been audio-taped, with transcriptions. There was a clear path or route to trace that shows how the data interpretation, conclusions and theory have been reached (Robson, 2011). Silverman's constant comparative method has been used to analyse the collected data, where there has been a constant comparison of data results. For example where someone has indicated concerns about cultivating edible plants on a roof-top due to structural limitations, the rest of the data was sifted through to see if there were similar concerns by other people. Anomalies or deviant cases were actively sought out (Silverman, 2000). Each deviant case was looked at in order to find out why they were different. This is one of the roles of the interview process after the questionnaires.

4.6.2 Reliability

The participants were informed of the purpose of the study in the participant information sheet and they were also asked to answer the questions truthfully and to the best of their knowledge. The questions were formed in a way that did not add any bias. The nature and aim of the study may form a bias from the beginning, as participants knew that the study is investigating why more people are not cultivating edible plants on buildings.

All transcriptions included pauses and overlaps, as these may be crucial to how the data are interpreted.

4.7 Data processing and analysis

4.7.1 Quantitative data analysis

The quantitative data from the questionnaires were collated in an electronic format for analysis in Chapters 5 (Phase 1) and 6 (Phase 2). Statistical Package for Social Science (SPSS) software was used to analyse the quantitative data collected from the questionnaires. The questionnaire generated interval/ratio, ordinal, nominal and dichotomous variables. Simple regression and other methods of bivariate analysis were used to assess the relationships and differences between two variables, looking mainly at correlations in order to give an idea of the key areas that affect people to cultivate edible plants on buildings. Different combinations of variables require different methods of bivariate analysis; contingency tables, Pearson's r, Spearman's rho, chi-square, Cramér's V and Phi (Bryman, 2012; P. Smith, 2011).

Univariate analysis

Univariate analysis such as frequency tables, diagrams and measures of central tendency were used to see the general results for individual variables. Measures of dispersion were used to assess the interval/ratio variables. Univariate analysis is an important first step to assist the understanding of more complex analyses. The univariate analysis was useful to see the range of people who took part in the questionnaire, for example if there was a good spread of age groups, home ownership etc.

Bivariate analysis

Simple regression was used to examine the statistical relationship between two interval/ratio variables, one variable being the cause (the independent variable x) and one the effect (the dependent variable y) (P. Smith, 2011). For example, could the independent variable "age" cause change in the dependent variable "minutes it takes to walk to your garden from where you live"? Scatter plots and the line of best fit were used to show the general trend between two interval variables (if any).

A matrix of correlation coefficients was made using Pearson's r for two interval variables and Kendall's tau was used for Interval/Ordinal and Ordinal/Ordinal variables (Bryman, 2012).

Cross tabulations (contingency tables) were drawn for Nominal/Nominal and Nominal/Ordinal variables in order to see whether two variables have a relationship (De Vaus, 2002).

The first stage of bivariate analysis was deductive and was used to confirm or reject the hypotheses formed from findings in the literature review. The second stage of bivariate analysis was inductive, where the relationships between all the combinations of pairs of variables were investigated in order to draw out relationships that were not hypothesised from the literature review. The relationships found were combined into four categories that affect the behaviour to cultivate edible plants on buildings (subsidiary research question c).

4.7.2 Qualitative data analysis

The four categories that affect the behaviour to cultivate edible plants on buildings were formed into four open questions to ask in semi-structured interviews. Transcriptions of the audio-recorded interviews were undertaken and entered into NVIVO software for analysis in Chapter 6 (Phase 2). Content analysis with initial coding of themes in the text was undertaken guided by the research question. Content analysis is a quantitative analysis of the transcripts (Robson, 2011). Content analysis is a useful initial step for the analysis but is limited, as it is simply looking at the frequency of words, phrases and themes coded in the text. For example, the frequency that people talked about time being an issue, when cultivating, in the interviews.

Thematic analysis was used to compare different experiences, meanings etc. from the cases (Robson, 2011). The codes from the content analysis where combined using thematic analysis. The codes and themes generated were guided by the conceptual framework and used to form a better understanding and add to the findings in Chapter 5 (Phase 1). This analysis formed the parameters that affect the behaviour to cultivate edible plants on buildings (subsidiary research question d).

4.8 Significance of research

The significance of cultivating edible plants on buildings has been highlighted in the literature. Using the sequential explanatory mixed methods approach, data was collected in two phases (quantitative data collection using a survey and then qualitative data collection using 1:1 semi-structured interviews), in order to fill the gap in knowledge regarding the parameters that affect individuals to cultivate edible plants on buildings in England. This knowledge is crucial for anyone who plans to design and implement usable systems for cultivating edible plants on buildings.

4.9 Limitations of research

One limit of the study is that it has just focused on England rather than looking at the global situation due to limited time and resources. Looking at a global context could bring some more answers to the research question.

Findings have been extrapolated from the cases rather than concluding with general findings common with a large survey; it has been demonstrated how "the analysis relates to things beyond the material at hand" (Alasuutari, 1995; Silverman, 2000, p. 136), in this case how the analysis answers the research question.

4.10 Pilot Study

A small pilot study was conducted to test the length of the questionnaire and the accuracy of the questions. The questionnaire was given to a friend and a family member to complete. They had a varying range of IT and English language skills. One took 10 minutes to complete the questionnaire and one took 30 minutes; the latter being the person with less IT and English language skills. Both responses helped to clarify the questions further. Secondly, 12 responses were collected using an online questionnaire. The data was inserted into SPSS software for statistical analysis. The pilot study was conducted to test the developed questionnaire and methods of analysis for the questionnaire.

4.10.1 The Hypotheses

The hypotheses were formed using the different elements of the Behaviour Change Wheel from the literature review and relationships found in the pilot study. In the pilot study, the relationships between all the combinations of variables were assessed, as well as the combination of variables in the above hypotheses. This is important as some variables may have a relationship relevant to the research question, but were not hypothesised. A relational theory diagram (Figure 53) was used to show the relationships between variables found in the pilot study in a diagrammatic form.

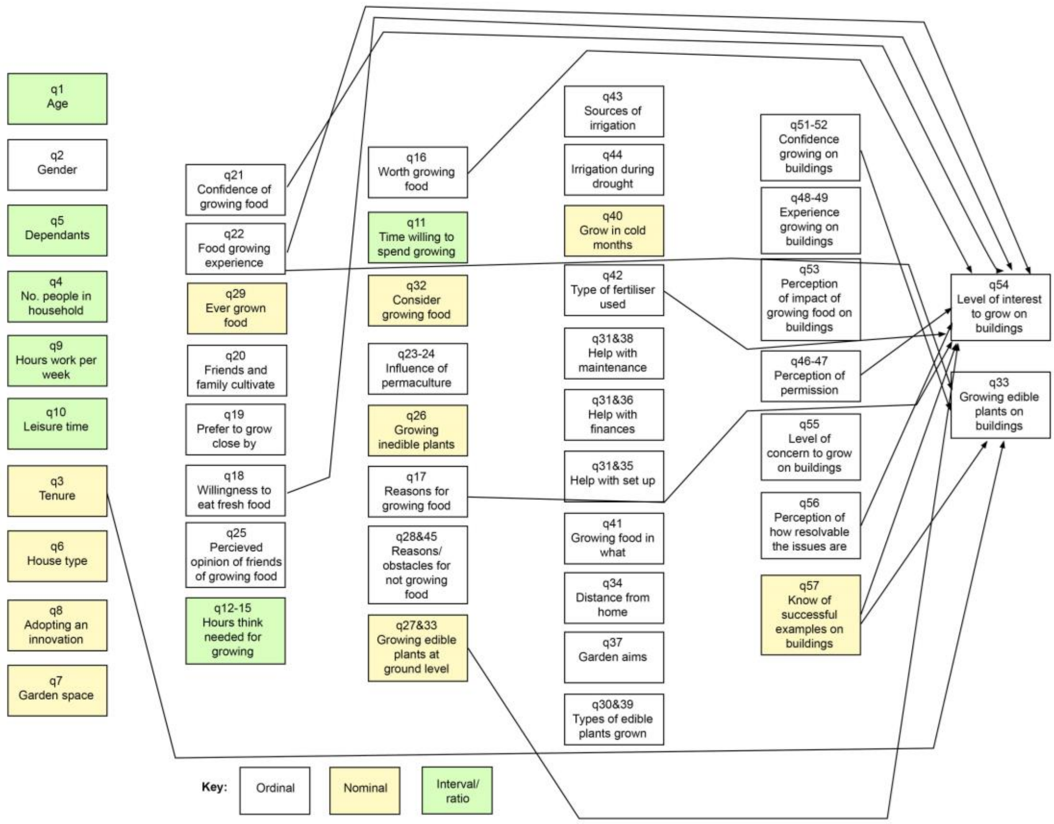


Figure 53: Relational theory diagram (hypothesised relationships shown with arrows)

__Opportunity__

Physical:

Control beliefs (Enablement, Environmental restructuring)

1. People who do not have space to grow edible plants at ground level are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

2. People who are in rented houses are less likely to grow edible plants on buildings. *Ordinal and Ordinal (More than two)*

3. People who think that they have permission to grow edible plants on a building are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

Social:

Normative beliefs (Communication/marketing and Modelling, Enablement, Persuasion, Environmental/social planning, Regulation, Legislation)

4. People who know successful examples of growing edible plants on buildings are more likely to say that they would grow edible plants on buildings. *Nominal and Ordinal*

5. People who know successful examples of growing edible plants on buildings are more likely to be growing edible plants on buildings. *Ordinal and Ordinal (More than two)*

Diffusion of Innovation

6. People who are innovators or early adopters (diffusion of innovation theory) are more likely to agree that it is possible to cultivate edible plants on buildings. *Nominal and Ordinal*

<u>**Capability**</u>

Physical:

Control beliefs (Enablement, Environmental restructuring)

7. People who think that growing edible plants does not need to be hard work are more likely to be interested to grow edible plants on buildings. *Scale (More than two) and Ordinal*

8. People who prefer to grow edible plants close to where they live or work would be more interested to grow edible plants on buildings. *Nominal and Ordinal*

Psychological:

Control Beliefs (Knowledge, Training and Guidelines, Enablement)

9. People who are experienced with growing edible plants are more likely to be interested to grow edible plants on buildings. *Ordinal and Ordinal*

10. People who are experienced with growing edible plants are more likely to be growing edible plants on buildings. *Ordinal and Ordinal*

11. People who feel that regulations regarding growing edible plants on buildings would encourage them to grow edible plants on buildings are more likely to be interested to grow edible plants on buildings. *Nominal*

12. People who feel that council encouragement regarding growing edible plants on buildings would encourage them to grow edible plants on buildings are more likely to be interested to grow edible plants on buildings. *Nominal*

13. People who feel that the issues of growing edible plants on buildings can be resolved are more likely to be interested to grow edible plants on buildings. *Ordinal and Ordinal*

14. People with more confidence of growing edible plants are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

<u>Motivation</u>

Reflective:

Moral and personal norms

15. People who feel that it is worth growing even just a small amount of edible plants are more likely to be interested to grow edible plants on buildings. *Nominal and Ordinal*

16. People who feel that growing edible plants on buildings helps alleviate social and environmental issues (discussed in Chapters 2 and 3) are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

17. People who are interested in growing edible plants generally would also be interested to grow edible plants on buildings. *Ordinal and Ordinal*

18. People who are interested to grow edible plants on buildings are more likely to be growing edible plants on buildings. *Ordinal and Ordinal (More than two)*

19. People who grow edible plants on buildings are more likely to not try avoiding using chemical fertilisers. *Ordinal (More than two) and Ordinal*

20. People who agree with a lot of the reasons for growing edible plants (see Chapter 2) are more likely to be growing edible plants on buildings. *Ordinal (More than two) and Ordinal (More than two)*

Affective and behavioural beliefs (Persuasion, Incentivisation)

21. People who are likely to eat the fresh produce listed are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

22. People who are currently growing edible plants are more likely to be interested to grow edible plants on buildings. *Nominal and Ordinal*

Automatic:
Personal identity

23. People who are confident to grow edible plants on buildings are more likely to be growing edible plants on buildings. *Ordinal and Ordinal (More than two)*

Past behaviour

24. People who have more experience with growing edible plants are more likely to be growing edible plants on buildings. *Ordinal and Ordinal (More than two)*

The analysis from the pilot study highlighted some changes that needed to be made in the survey questionnaire in order to make the analysis clearer in SPSS. These changes are explained below:

1. It is best to ask everyone about their opinions regarding the use of chemical fertilisers and mains water, growing food in colder months, and their preference on what to grow rather than just asking those who are currently growing edible plants.

2. It is useful and clearer in the analysis to find out whether people would grow edible plants on buildings (Dichotomous), as well as asking how interested they would be (Ordinal).

3. Ask all participants questions related to the research question, not just those who are cultivating edible plants.

Summary of pilot study:

The testing of relationships has showed some interesting correlations that helped towards answering the research question. The sample of the pilot study is too small to be able to draw some findings from this study and accept or reject the hypotheses. However, the pilot study has been a successful exercise for testing the process of analysis and also helping revise the survey questionnaire further in order to aid the analysis process.

4.11 Conclusion

This chapter gave a detailed explanation of the thesis methodology. In it, a sequential explanatory mixed methods approach of a survey was outlined, in order to test hypotheses and relationships between all the variables to form the categories that affect the behaviour to cultivate edible plants on buildings (Phase 1), followed by a series of 1:1 semi-structured interviews which developed understanding of the research questions (phase 2). The final stage of the research consolidates what was learned by bringing together the findings from both phases (phase 3).

Results derived from the pilot questionnaire helped highlight which questions needed more clarification and made sure that the questionnaire did not take too long to complete. The pilot study also helped test the data analysis process and showed that the relationships between all pairs of variables, relevant to the research question, should be tested in order to investigate relationships that were not hypothesised.

It was also discussed how the methods used are ethical, valid and reliable. The methodology has provided an underpinning for the fieldwork and analysis in Chapters 5 and 6. The following chapters show the application of the research methods and in turn address the research questions.

Chapter 5 – Phase 1: Quantitative analysis to find the categories that affect the behaviour to cultivate edible plants on buildings

5.1 Introduction

This chapter aims to answer the subsidiary research question c) What are the categories that affect the behaviour to cultivate edible plants on buildings? To do so, 65 participants in total completed the survey data (phase 1 of this research study). The data are analysed using univariate analysis of variance in order to characterise the individuals who completed the questionnaires. This is followed by bivariate analysis in two stages; stage 1 (deductive), during which hypotheses are accepted or rejected depending on the strength of the relationships of the relevant variables, and stage 2 (inductive), where the relationship between every combination of two variables is explored, highlighting any relationships relevant to the main research question (What affects individuals to cultivate edible plants on buildings?) that that were not hypothesised. 276 significant relationships are found, which are brought together into four key categories: parameters related to community, parameters related to personal psychology, physical parameters and parameters related to knowledge. These categories are investigated further in Chapter 6 - the qualitative phase of this research (phase 2), where each category formed four open questions to start conversation in semi-structured interviews.

5.2 Univariate analysis of the quantitative data

Figure 54 below shows univariate results of the variables related to the profiles of the interviewees, showing a summary of the participants in order to give an idea of the socio-economic spread of people who took part.

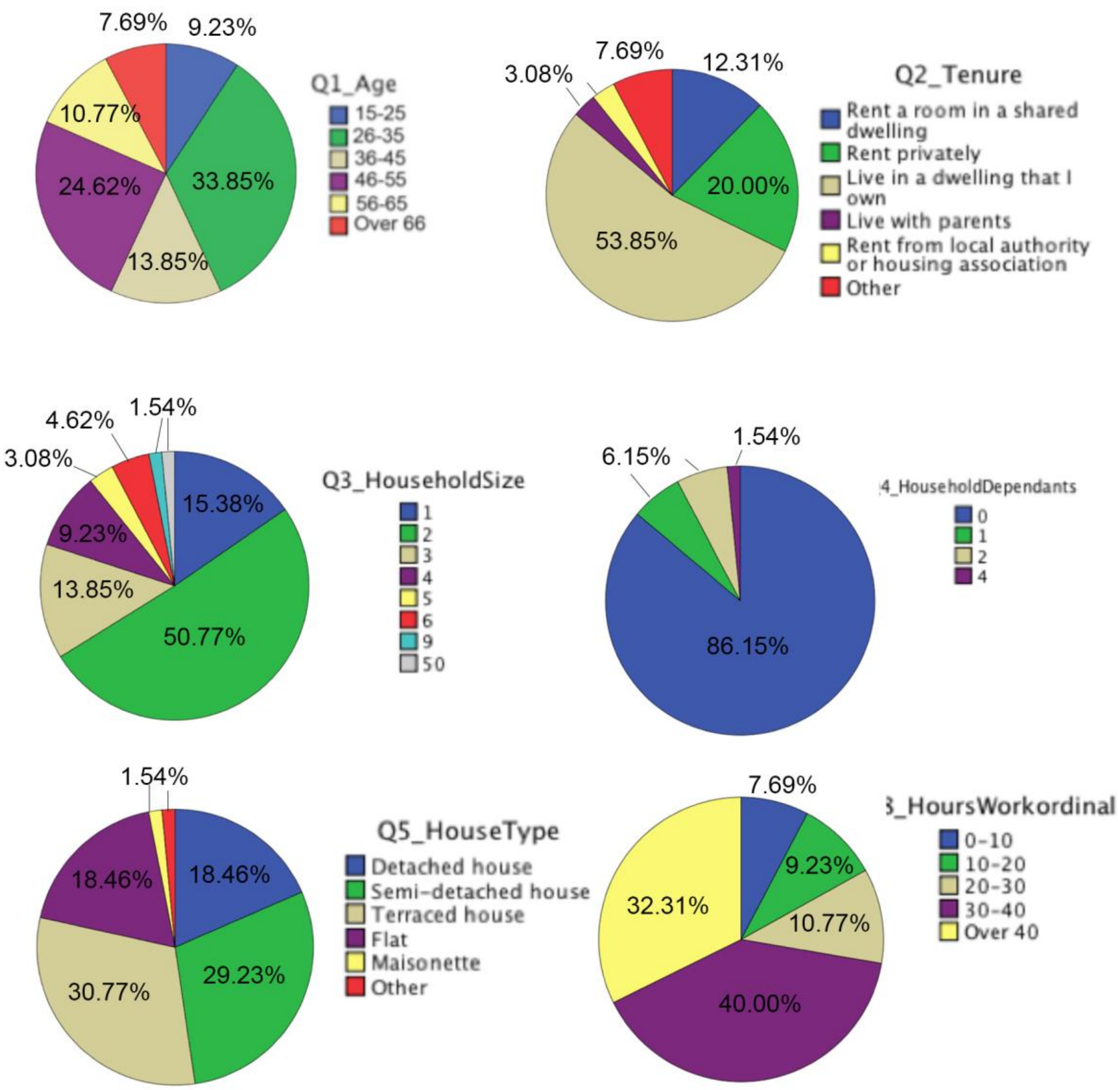


Figure 54: Pie charts showing the profiles of people related to age, tenure, household size, household dependant, house type and hours worked per week

The following points summarise what the pie charts in Figure 54 show:

- There is an anomaly in the household size, where someone answered '50'.
- There was a good age range of participants with a good spread of younger and older people.
- Just over half of people own their home, which may correlate with cultivating their own food as they feel settled enough for the long-term investment of setting up an edible garden.

- Half of the participants had a household size of 2 people, which indicates that this data does not represent opinions of people with larger households.

- Most participants had 0 dependants, which indicates that this data does not represent opinions of families with dependants.

- Most people live in houses, which could indicate that they are more likely to have space at ground level for cultivation.

- 75% of people work more than 30 hours per week so their time is filled with other things, which could make them feel like they do not have enough time to cultivate food.

Figure 55 shows that most interview participants were cultivating on buildings if we consider cultivating on internal windowsills and internal glazed spaces as cultivating on buildings. Figure 56 shows that if we exclude internal windowsills and internal glazed spaces, then there was about an equal number of participants who are and are not cultivating edible plants on buildings, which shows that there was a good balance of participants to give answers for the questionnaire.

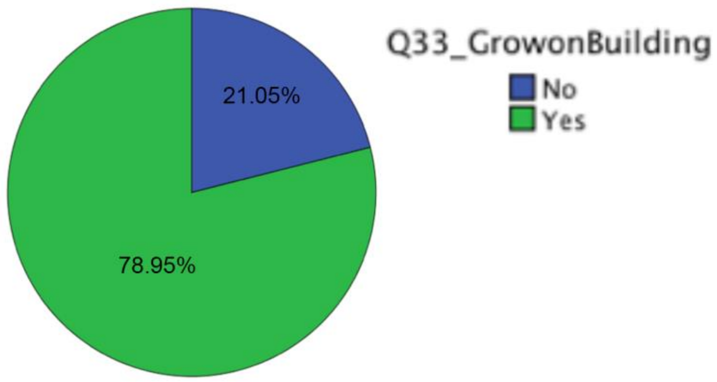


Figure 55: Pie chart showing the number of interview participants who are cultivating edible plants on a building including internal windowsills and internal glazed spaces

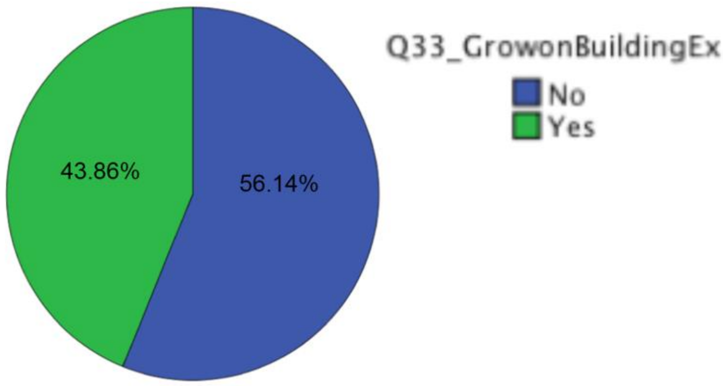


Figure 56: Pie chart showing the number of interview participants who are cultivating edible plants on a building excluding internal windowsills and internal glazed spaces

Figure 57 shows that there was a good variation in levels of experience of cultivating food amongst the questionnaire participants. Figure 58 shows that most people agreed that they would grow food for environmental reasons, indicating that most interview participants understand that there are environmental benefits to individuals cultivating food. Figure 59 shows that most people agreed that cultivating edible plants on buildings can help social, economic and environmental sustainability, indicating that most interview participants are aware of this benefit. The people who disagreed in Figure 58 also tended to disagree in Figure 59, which indicates that education about the benefits of cultivating edible plants on buildings could help increase the understanding of why to undertake the behaviour.

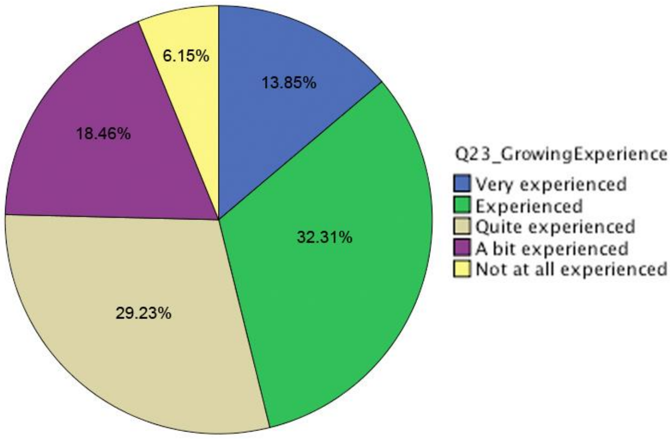


Figure 57: Pie chart showing the number of interview participants who have experience of cultivating edible plants

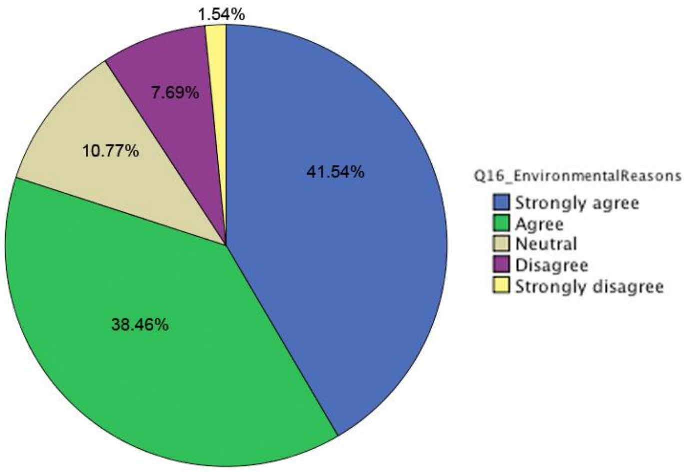


Figure 58: Pie chart showing the number of interview participants who would grow food for environmental reasons

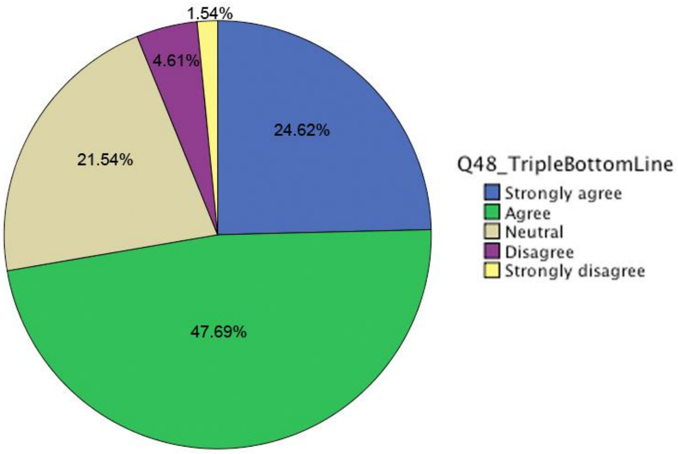


Figure 59: Pie chart showing the number of interview participants who have knowledge of the sustainability benefits of cultivating edible plants on buildings

5.3 Bivariate analysis of the quantitative data

Cross-tabulations and correlation coefficients were used as methods of bivariate analysis. Chi-square test of significance was undertaken, but was not valid due to the sample size (Appendix E).

5.3.1 Cross-tabulations

The data was looked at using cross-tabulations. Table 13 is a cross-tabulation of the location of where edible plants are grown vs. tenure. This relationship was explored in order to see whether tenure has any effect on where edible plants are grown. It shows the following:

- Most participants who grow in an allotment, live in a dwelling that they own. This may be because people who own their home feel more confident that they will stay where they are living for a long enough period of time to commit to an allotment plot. This could be applied to cultivating edible plants on buildings; people may not be cultivating edible plants on a building that they are renting because they do not feel settled enough.

- Most participants who grow in the ground at home, live in a dwelling that they own. This may be for the same reasoning above.

Table 14 is a cross-tabulation of the location of where edible plants are grown vs. house type. This relationship was explored in order to see whether house type has an effect on where edible plants are grown.

- Most people who are growing in the ground at home live in houses. This is most likely due to the fact that most houses in England have garden space.

- Most people who are growing on a balcony are living in a flat. This is due to the fact that most houses in England do not have balconies and a lot of flats in England only have some kind of balcony space.

This cross tabulation brings forward some questions about where people grow, and if one growing location affects them growing in another. For example, do people who grow on a balcony also grow on windowsills? Do people who grow in the ground at home also grow in allotments? Do people who grow a little food grow it everywhere? These are looked at below using bivariate analysis under the physical category.

Table 13: Cross tabulation of the tenure of interview participants against where they are cultivating edible plants

		Q2_Tenure						Total
Q33_Where are you growing edible plants?		Rent a room in a shared dwelling	Rent privately	Live in a dwelling that I own	Live with parents	Rent from local authority or housing association	Other	
Q33_Allotment	A lot	0	0	12	0	1	1	14
	Occasionally	0	1	0	0	0	1	2
	Rarely	1	1	0	0	0	0	2
	Never	5	7	22	1	1	3	39
Total		6	9	34	1	2	5	57
Q33_CommunalGarden	A lot	1	0	1	0	1	1	4
	Occasionally	3	1	1	0	0	0	5
	Rarely	1	1	0	0	0	1	3
	Never	1	7	32	1	1	3	45
Total		6	9	34	1	2	5	57
Q33_GroundHome	A lot	1	4	20	0	0	2	27
	Occasionally	1	1	7	1	1	2	13
	Rarely	0	0	1	0	0	0	1
	Never	4	4	6	0	1	1	16
Total		6	9	34	1	2	5	57
Q33_WallHome	A lot	0	1	1	0	0	0	2
	Occasionally	1	1	2	0	0	2	6
	Rarely	0	1	5	0	0	1	7
	Never	5	6	26	1	2	2	42
Total		6	9	34	1	2	5	57
Q33_InternalSillHome	A lot	1	4	4	0	1	1	11
	Occasionally	2	1	13	0	0	2	18
	Rarely	1	1	4	1	0	1	8
	Never	2	3	13	0	1	1	20
Total		6	9	34	1	2	5	57
Q33_ExternalSillHome	Occasionally	2	0	2	0	0	0	4
	Rarely	0	1	3	0	0	1	5
	Never	4	8	29	1	2	4	48
Total		6	9	34	1	2	5	57
Q33_BalconyHome	A lot	0	1	2	0	1	0	4
	Occasionally	0	0	0	0	0	1	1
	Rarely	0	1	0	0	0	0	1
	Never	6	7	32	1	1	4	51
Total		6	9	34	1	2	5	57
Q33_RoofHome	A lot	0	0	1	0	0	0	1
	Occasionally	0	1	0	0	0	0	1
	Never	6	8	33	1	2	5	55
Total		6	9	34	1	2	5	57
Q33_InternalGlazedHome	A lot	0	1	5	0	0	0	6
	Occasionally	1	0	7	1	0	2	11
	Rarely	1	0	3	0	0	1	5
	Never	4	8	19	0	2	2	35
Total		6	9	34	1	2	5	57
Q33_GroundWork	A lot	1	0	2	0	1	1	5
	Occasionally	1	0	0	0	0	0	1
	Never	4	9	32	1	1	4	51
Total		6	9	34	1	2	5	57
Q33_WallWork	A lot	1	0	0	0	1	1	3
	Never	5	9	34	1	1	4	54
Total		6	9	34	1	2	5	57
Q33_InternalSillWork	A lot	0	0	0	0	1	0	1
	Occasionally	0	0	2	0	0	0	2
	Rarely	0	1	0	0	0	0	1
	Never	6	8	32	1	1	5	53
Total		6	9	34	1	2	5	57
Q33_ExternalSillWork	A lot	0	0	0	0	1	0	1
	Rarely	0	1	0	0	0	0	1
	Never	6	8	34	1	1	5	55
Total		6	9	34	1	2	5	57
Q33_BalconyWork	A lot	0	0	1	0	0	0	1
	Never	6	9	33	1	2	5	56
Total		6	9	34	1	2	5	57
Q33_RoofWork	A lot	0	1	0	0	0	0	1
	Occasionally	0	1	0	0	0	0	1
	Rarely	0	0	1	0	0	0	1
	Never	6	7	33	1	2	5	54
Total		6	9	34	1	2	5	57
Q33_InsideGlazedWork	A lot	1	0	0	0	0	0	1
	Occasionally	0	0	2	0	0	0	2
	Never	5	9	32	1	2	5	54
Total		6	9	34	1	2	5	57

Table 14: Cross tabulation of the house type of interview participants against where they are cultivating food

		Q5_HouseType						Total
Q33_Where are you growing edible plants?		Detached house	Semi-detached house	Terraced house	Flat	Maisonette	Other	
Q33_Allotment	A lot	6	5	3	0	0	0	14
	Occasionally	0	1	0	1	0	0	2
	Rarely	0	0	2	0	0	0	2
	Never	5	11	13	8	1	1	39
Total		11	17	18	9	1	1	57
Q33_CommunalGarden	A lot	0	0	0	3	0	1	4
	Occasionally	0	2	2	1	0	0	5
	Rarely	0	1	1	0	1	0	3
	Never	11	14	15	5	0	0	45
Total		11	17	18	9	1	1	57
Q33_GroundHome	A lot	7	9	9	1	0	1	27
	Occasionally	3	5	4	0	1	0	13
	Rarely	1	0	0	0	0	0	1
	Never	0	3	5	8	0	0	16
Total		11	17	18	9	1	1	57
Q33_WallHome	A lot	0	1	1	0	0	0	2
	Occasionally	1	2	2	0	0	1	6
	Rarely	2	3	2	0	0	0	7
	Never	8	11	13	9	1	0	42
Total		11	17	18	9	1	1	57
Q33_InternalSillHome	A lot	2	3	1	5	0	0	11
	Occasionally	5	5	6	1	0	1	18
	Rarely	3	3	2	0	0	0	8
	Never	1	6	9	3	1	0	20
Total		11	17	18	9	1	1	57
Q33_ExternalSillHome	Occasionally	0	2	2	0	0	0	4
	Rarely	3	1	0	1	0	0	5
	Never	8	14	16	8	1	1	48
Total		11	17	18	9	1	1	57
Q33_BalconyHome	A lot	0	0	1	3	0	0	4
	Occasionally	0	0	0	1	0	0	1
	Rarely	0	0	0	1	0	0	1
	Never	11	17	17	4	1	1	51
Total		11	17	18	9	1	1	57
Q33_RoofHome	A lot	0	0	1	0	0	0	1
	Occasionally	0	0	0	1	0	0	1
	Never	11	17	17	8	1	1	55
Total		11	17	18	9	1	1	57
Q33_InternalGlazedHome	A lot	2	1	3	0	0	0	6
	Occasionally	1	6	3	0	0	1	11
	Rarely	2	1	2	0	0	0	5
	Never	6	9	10	9	1	0	35
Total		11	17	18	9	1	1	57
Q33_GroundWork	A lot	1	1	0	2	0	1	5
	Occasionally	0	0	1	0	0	0	1
	Never	10	16	17	7	1	0	51
Total		11	17	18	9	1	1	57
Q33_WallWork	A lot	0	1	0	1	0	1	3
	Never	11	16	18	8	1	0	54
Total		11	17	18	9	1	1	57
Q33_InternalSillWork	A lot	0	0	0	1	0	0	1
	Occasionally	0	0	2	0	0	0	2
	Rarely	0	0	0	1	0	0	1
	Never	11	17	16	7	1	1	53
Total		11	17	18	9	1	1	57
Q33_ExternalSillWork	A lot	0	0	0	1	0	0	1
	Rarely	0	0	0	1	0	0	1
	Never	11	17	18	7	1	1	55
Total		11	17	18	9	1	1	57
Q33_BalconyWork	A lot	0	0	1	0	0	0	1
	Never	11	17	17	9	1	1	56
Total		11	17	18	9	1	1	57
Q33_RoofWork	A lot	0	0	0	1	0	0	1
	Occasionally	0	0	1	0	0	0	1
	Rarely	0	0	1	0	0	0	1
	Never	11	17	16	8	1	1	54
Total		11	17	18	9	1	1	57
Q33_InsideGlazedWork	A lot	0	1	0	0	0	0	1
	Occasionally	0	0	1	1	0	0	2
	Never	11	16	17	8	1	1	54
Total		11	17	18	9	1	1	57

5.3.2 Correlation Coefficients to test hypotheses and relationships between variables

Bivariate analysis of the data was undertaken in order to investigate any relationships between the variables. All the variables were assessed against each other by looking at their correlation coefficients. Appendix F shows the correlations found in relation to the research question. Only medium strength (>0.3) and high strength (>0.5) correlations are listed. Most correlations listed are tested at two-tailed significance where most are significant at 0.01 (two asterisk **) and a few are at a 0.05 (one asterisk *). Pearson's r was used for interval/interval and interval/dichotomous pairs and Kendall's tau_b is used for ordinal/ordinal, interval/ordinal, dichotomous/ordinal and dichotomous/dichotomous.

5.3.2.1 Testing the hypotheses

The hypotheses proposed in Chapter 4 were tested (supported or not supported) by the bivariate analysis above. These are shown below with the related correlation. Correlations from Appendix F, which have supported a hypothesis, have been shown. The findings that are indicated by each hypothesis are summarised.

Opportunity

Physical:

Control beliefs (Enablement, Environmental restructuring)

1. NOT SUPPORTED People who do not have space to grow edible plants at ground level are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

2. NOT SUPPORTED People who are in rented houses are less likely to grow edible plants on buildings. *Ordinal and Ordinal (More than two)*

3. SUPPORTED (correlation 273) People who think that they have permission to grow edible plants on a building are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

   This finding indicates that permission from a person's **community** can be important for them to undertake the behaviour to cultivate edible plants on buildings. In the case of permission, the community is the building owner/landlord.

Social:

Normative beliefs (Communication/marketing and Modelling, Enablement, Persuasion, Environmental/social planning, Regulation, Legislation)

4. SUPPORTED (correlation 271) People who know successful examples of growing edible plants on buildings are more likely to say that they would grow edible plants on buildings. *Nominal and Ordinal*

5. SUPPORTED (cross tabulation 262) People who know successful examples of growing edible plants on buildings are more likely to be growing edible plants on buildings. *Ordinal and Ordinal (More than two)*

   These findings indicate that a person's **knowledge** of cultivating edible plants on buildings is increased when they see examples and see others doing it (**community**), which would increase their chances of undertaking the behaviour.

Diffusion of Innovation

6. SUPPORTED – (Correlation 23) People who are innovators or early adopters (diffusion of innovation theory) are more likely to agree that it is possible to cultivate edible plants on buildings. *Nominal and Ordinal*

   This finding indicates that a person's views about innovations (**psychological**) can affect whether they would undertake the innovate idea of cultivating on a building.

<u>**Capability**</u>

Physical:

Control beliefs (Enablement, Environmental restructuring)

7. SUPPORTED (cross tabulation 263) People who think that growing edible plants does not need to be hard work are more likely to be interested to grow edible plants on buildings. *Scale (More than two) and Ordinal*

   This finding indicates that a person's views about the level of difficulty (**physical and psychological difficulty**) to undertake a behaviour will affect whether they undertake it.

8. NOT SUPPORTED People who prefer to grow edible plants close to where they live or work would be more interested to grow edible plants on buildings. *Nominal and Ordinal*

Psychological:

Control Beliefs (Knowledge, Training and Guidelines, Enablement)

9. NOT SUPPORTED People who are experienced with growing edible plants are more likely to be interested to grow edible plants on buildings. *Ordinal and Ordinal*

10. NOT SUPPORTED People who are experienced with growing edible plants are more likely to be growing edible plants on buildings. *Ordinal and Ordinal*

11. SUPPORTED (correlation 274) People who feel that regulations regarding growing edible plants on buildings would encourage them to grow edible plants on buildings are more likely to be interested to grow edible plants on buildings. *Nominal*

    This finding indicates that a behaviour that has guidance by some form of regulation is more likely to be undertaken. Regulations are designed for groups of people (at all scales from local communities to nationally), so this finding shows that the way people see a behaviour amongst their **community** is important.

12. SUPPORTED (correlation 274) People who feel that council encouragement regarding growing edible plants on buildings would encourage them to grow edible plants on buildings are more likely to be interested to grow edible plants on buildings. *Nominal*

    This finding indicates that a behaviour that has guidance by the heads of a **community** (in this case the council) is more likely to be undertaken.

13. SUPPORTED (correlation 247) People who feel that the issues of growing edible plants on buildings can be resolved are more likely to be interested to grow edible plants on buildings. *Ordinal and Ordinal*

    This finding indicates that if people feel that they have the **knowledge and physical** ability to resolve issues attached to a behaviour, they are more likely to undertake that behaviour.

14. NOT SUPPORTED People with more confidence of growing edible plants are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

Motivation

Reflective:

Moral and personal norms

15. SUPPORTED (correlation 264) People who feel that it is worth growing even just a small amount of edible plants are more likely to be interested to grow edible plants on buildings. *Nominal and Ordinal*

    This finding indicates that if there are **physical** limitations on space when cultivating edible plants on a building and the grower does not have large productivity targets, then they are more likely to be interested to grow on small areas of a building such as windowsills and balconies.

16. SUPPORTED (correlation 232) People who feel that growing edible plants on buildings helps alleviate social and environmental issues (discussed in Chapters 2 and 3) are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

    This finding indicates that people who have a positive **psychology** and **knowledge** towards the benefits of cultivating edible plants on buildings, are more likely to undertake the behaviour.

17. SUPPORTED (correlation 46) People who are interested in growing edible plants would also be interested to grow edible plants on buildings. *Ordinal and Ordinal*

    This finding indicates that people who have a positive **psychology** (interest) towards cultivating edible plants on buildings, are more likely to undertake the behaviour.

18. SUPPORTED (cross tabulation 260) People who are interested to grow edible plants on buildings are more likely to be growing edible plants on buildings. *Ordinal and Ordinal (More than two)*

    This finding indicates that people who have an interest (**psychology**) towards cultivating edible plants on buildings, are more likely to undertake the behaviour.

19. NOT SUPPORTED People who grow edible plants on buildings are more likely to not try avoiding using chemical fertilisers. *Ordinal (More than two) and Ordinal*

20. SUPPORTED (cross tabulation 262 and correlation 276 in Appendix G) People who agree with a lot of the reasons for growing edible plants (see Chapter 2) are more likely to be growing edible plants on buildings. *Ordinal (More than two) and Ordinal (More than two)*

This finding indicates that people who have a positive reasoning (**psychology and knowledge**) towards cultivating edible plants on buildings, are more likely to undertake the behaviour.

Affective and behavioural beliefs (Persuasion, Incentivisation)

21. SUPPORTED (correlation 53) People who are likely to eat the fresh produce listed (See Appendix D, question 17 in the questionnaire) are more likely to be interested to grow edible plants on buildings. *Ordinal (More than two) and Ordinal*

This finding indicates that what people **physically** eat (their diet) may have an impact on whether they would cultivate edible plants.

22. SUPPORTED (correlation 99) People who are currently growing edible plants are more likely to be interested to grow edible plants on buildings. *Nominal and Ordinal*

This finding indicates that people who already have the **knowledge, psychology and physical** ability to cultivate edible plants are more likely to cultivate edible plants on buildings.

Automatic:

Personal identity

23. SUPPORTED (correlation 224) People who are confident to grow edible plants on buildings are more likely to be growing edible plants on buildings. *Ordinal and Ordinal (More than two)*

This finding suggests that people who have a **positive psychology** due to confidence towards cultivating edible plants on buildings are more likely to undertake the behaviour. This confidence may come from **knowledge** of how to undertake the behaviour.

Past behaviour

24. NOT SUPPORTED People who have more experience with growing edible plants are more likely to be growing edible plants on buildings. *Ordinal and Ordinal (More than two)*

In summary, this testing shows that the hypothesised relationships using the behaviour indicators from the behaviour theory in Chapter 3 were useful in order to understand the key areas that can affect someone's behaviour to cultivate edible plants on buildings. The supported hypotheses can be summarised under four key categories. These are the categories that would affect the behaviour to cultivate edible plants on buildings:

A: Community

A person's local and wider community would affect their behaviour to cultivate edible plants on buildings.
The hypotheses (3, 11 and 12) propose that a feeling of support from others can be important for a person to undertake the behaviour of cultivating edible plants on buildings. Hypotheses 4 and 5 propose that seeing examples of the behaviour in one's community can be important for a person to undertake the behaviour of cultivating edible plants on buildings.

B: Personal psychology

A person's thoughts about the behaviour and psychological state would affect their behaviour to cultivate edible plants on buildings.
The hypotheses (6, 17, 18 and 22) propose that the level of interest someone has for the behaviour would affect whether they would undertake the behaviour. Hypothesis 15, 16 and 20 show the importance of how a person values the behaviour of cultivating edible plants on buildings. Hypothesis 21 shows that it is important for someone to like eating fresh produce in order to undertake the behaviour of cultivating edible plants on buildings.

C: Physical

A person's physical abilities and environment would affect their behaviour to cultivate edible plants on buildings.
The hypothesis 7 proposes that a person's opinion about the level of hard work needed to cultivate on buildings would affect whether they undertake the behaviour. Hypothesis 15 suggests that people who have low productivity targets are more likely to grow food even if the physical space

that they have available is small. Hypothesis 13 suggests that people will undertake the behaviour if they feel that they have the physical abilities that can solve an issue related to cultivating edible plants on buildings.

D: Knowledge

The hypothesis relating to a person's experience of cultivating edible plants were not supported in relation to cultivating edible plants on buildings, showing that the data does not show that knowledge of cultivating edible plants would help someone cultivate edible plants on a building. A person's knowledge about cultivating edible plants on buildings would affect whether they would undertake the behaviour.

The hypotheses 16 and 20 propose that a person's knowledge of the benefits of cultivating edible plants on buildings would affect whether they undertake the behaviour. Hypotheses 4 and 5 propose that knowledge of successful examples can encourage undertaking the behaviour. Hypothesis 13 proposes that a person's knowledge of the resolvability of the issues related to cultivating edible plants on buildings would affect whether they undertake the behaviour. Hypothesis 23 proposes that a person's confidence of cultivating edible plants would affect whether they undertake the behaviour to cultivate edible plants on buildings.

5.3.2.2 Analysis of the bivariate relationships found

All correlation coefficients for pairs of variables were looked at. The significant relationships found (shown in Appendix F) that are directly related to cultivating edible plants on buildings, were linked with the four key areas that affect behaviour found above.

All (276) correlations that are directly relevant to cultivating edible plants on buildings are indicated with the four key areas that are relevant using the letters A. B. C. and D. Table 15 shows the number of correlations linked with each key area.

Table 15: Showing the number of correlations found that link with each key area

Key Area	Number of relationships found
A - Community	76
B – Personal Psychology	148
C – Physical	97
D - Knowledge	174

It is clear from the table above, that all four of these areas play an important role in affecting a person's behaviour to cultivate edible plants on buildings. The table highlights the importance of personal psychology and knowledge when it comes to undertaking this behaviour. How do these key areas affect someone's behaviour to cultivate edible plants on buildings? All the correlation coefficients found were looked at in more detail in order to investigate the parameters that affect the behaviour to cultivate edible plants on buildings under each key area. These are discussed below. There is insufficient data in order to understand the reasoning behind the findings below, so it is an area that needs further exploration. For example, how can community affect the behaviour to cultivate edible plants on buildings? The categories below are investigated further in Phase 2 (qualitative interviews) of this research project.

A – Community

The following parameters related to community have been found from the correlation coefficients:

- **Cultivating within a community of gardeners** can help people to cultivate on buildings:

  - Cultivating in a community garden and cultivating on a wall at work had a positive correlation of 0.438**.
  - Cultivating in a communal garden had a positive correlation with cultivating inedible (0.348**) and edible plants (0.476**) on a roof.
  - Cultivating edible plants on a roof has a positive correlation with growing your own food to be part of a community (0.319**) and share tasks with others (0.309**).

- People who cultivate in community gardens are likely to have **awareness of environmental social and economic issues,** which could increase their likelihood to cultivate on a building. This is shown by the positive correlations between cultivating in a community garden and a garden aim being to raise awareness of social, environmental and economic issues related to sustainability and climate change (0.490**), a garden aim being to add to the biodiversity of an area (0.329**) and agreeing that growing edible plants on buildings can help towards a more social, economic and environmental future for everyone (0.337**).

- **Financial help** has been available for people who agree that they would grow food to be part of a community and share tasks with others (see Table 16 below).

Table 16: Correlation between variables 'Council Paid for Garden' and 'Grant Paid for Garden' with 'Cultivating edible plants for being part of a community and sharing tasks with others' (Ordinal)

Variable	Variable type	Q16_Being Part of a community	Q16_Sharing tasks with others
Q36_PayCouncil	Ordinal	**0.435****	**0.424****
Q36_PayGrant	Ordinal	**0.415****	**0.365****

- People who cultivate in communal gardens are more likely to have **help with maintaining** their garden (see Table 17). This help with maintenance can also be valuable for cultivating edible plants on buildings.

Table 17: Correlation between variables regarding who helps maintain the garden with 'Cultivating edible plants for being part of a community' (Ordinal)

Variable	Variable type	Q33_Cultivating in a Communal garden
Q37_FriendsHelp	Ordinal	0.396**
Q37_CommunityHelp	Ordinal	0.755**
Q37_CityHelp	Ordinal	0.714**
Q37_NationalHelp	Ordinal	0.561**
Q37_InternationalHelp	Ordinal	0.476**

- Some people think cultivating edible plants on buildings is good for **reconnecting people with food production**. This is linked to community as reconnecting people can also be seen as reconnecting communities with food production.

- Cultivating in communal gardens has a positive correlation with **training** (0.368**) as a garden aim. Training could be important to help people cultivate edible plants on buildings.

B – Personal Psychology

- Participants' **thoughts about taking on innovations** are something that could affect their behaviour to cultivate edible plants on buildings. There is some indication of this in the data where there was a positive correlation between early adopters and agreeing that if permitted, it is possible to cultivate edible plants on the building of their place of work (0.301**).

- Participants' thoughts about the **aesthetics of cultivating edible plants on buildings** could affect them undertaking the behaviour. There is some indication of this in the data where there was a positive correlation between people who have cultivated edible plants on walls and agreeing that cultivating edible plants on buildings can help cities become more beautiful (0.322**).

- Participants' thoughts about the **benefits of cultivating edible plants on buildings** could affect them undertaking the behaviour. There is some indication of this in the data where there was a positive correlation between people who have cultivated edible plants on roofs and agreeing that cultivating edible plants on buildings can help shade buildings (0.322**), increase biodiversity in cities (0.307**), increase people's physical health (0.332**) and can help towards a more social, economic and environmental future for everyone (0.301**).

- Participants' thoughts about the **amount of food that is worth cultivating** could affect their behaviour to cultivate edible plants on buildings. There is some indication of this in the data where there was a positive correlation between people who have grown edible plants on a wall and think it is worth growing smaller amounts of their annual diet (0.436**).

- Participants' level of **interest of cultivating edible plants** could affect their behaviour to cultivate edible plants on buildings. There is some indication of this in the data where there was a positive correlation between people who have grown edible plants on a roof and people who are interested to grow food on buildings (0.372**).

- Participants' **enjoyment of eating fresh fruit and vegetables** could affect their interest of cultivating edible plants on buildings (Hypothesis 18 supported by correlation 260 in Appendix F).

- Participants' level of **confidence and experience to cultivate edible plants** on buildings could affect them undertaking the behaviour. There is some indication of this from the correlations between the variables in Table 18.

Table 18: Correlation between variables regarding confidence cultivating on buildings and whether they have cultivated on different parts of a building (Ordinal)

Variable	Variable type	Q44_ Edible on Roof	Q44_ Edible on Wall	Q44_ Edible on Internal sill	Q44_ Edible on External sill	Q44_ Edible on Balcony	Q44_ Edible in glazed space
Q46_ConfidenceInedibleOnBuilding	Ordinal	0.354**					
Q47_ConfidenceEdibleOnBuilding	Ordinal	0.380**	0.314**	0.331**	0.375**		0.339**

- Participants' thoughts about the **negative consequences of cultivating edible plants on buildings** could affect them undertaking the behaviour. Participants who grow on balconies and windowsills were less likely to agree that they would be concerned about insects and pests being attracted to the building (balconies -0.326**, inedible external sill -0.320**, edible external sill -0.306**). It is not clear if this is because they do not mind insects and pests, or that insects and pests are not attracted to their building.

C – Physical

- Participants' **availability of space at ground level for cultivation** could affect their behaviour to cultivate edible plants on buildings.

  The table below (Table 19) gives an idea of how the location people are cultivating in, affects the other locations that they cultivate in. For example there is a negative correlation of -0.428** between cultivating in the ground at home and cultivating on a balcony at home, which could be due to the lack of availability of ground level space to cultivate for people who have balconies. This relationship was put under category B (Personal Psychology) due to a person's attitude towards cultivating on a building when they have/have not got space at ground level and C (Physical) due to the physical availability of space.

  The table (Table 20) also shows that there are significant positive correlations between cultivating on a balcony and internal and external windowsills, which shows that when someone is cultivating in a particular type of space on a building, they are more likely to cultivate in other similar places on a building. These relationships were put under category

B (Personal Psychology) due to their attitude towards cultivating on a building once they have started cultivating somewhere on a building, C (Physical) due to the physical availability of the tools for this particular type of cultivation, and D (Knowledge) due to having the skills to cultivate in a particular type of space on a building.

Tables 19 and 20: The tables above show the significant correlations (* at 0.05 level and **at 0.01 level (2-tailed)) found between the variables from Question 33 "You are growing edible plants…" (Ordinal)

Variable	Variable type	Q33_ Allotment	Q33_ Community garden	Q33_ Ground Home	Q33_ Wall Home	Q33_ Internal Sill Home	Q33_ External Sill Home	Q33_ Balcony Home	Q33_ Roof Home
Q33_GroundHome	Ordinal							-0.428**	
Q33_BalconyHome	Ordinal			-0.428**					
Q33_GroundWork	Ordinal		0.538**						
Q33_WallWork	Ordinal		0.438**						
Q33_InternalSillWork	Ordinal							0.337**	
Q33_ExternalSillWork	Ordinal							0.535**	
Q33_InsideGlazedWork	Ordinal						0.360**		
Q33_Other	Ordinal		0.357**						

Variable	Variable type	Q33_ Internal Glazed Home	Q33_ Ground Work	Q33_ Wall Work	Q33_ Internal Sill Work	Q33_ External Sill Work	Q33_ Balcony Work	Q33_ Roof Work	Q33_ Internal Glazed Space Work
Q33_CommunalGarden	Ordinal		0.538**	0.486**					
Q33_ExternalSillHome	Ordinal								0.360**
Q33_BalconyHome	Ordinal				0.337**	0.535**			
Q33_GroundWork	Ordinal			0.695**					0.438**
Q33_WallWork	Ordinal		0.695**			0.388*			0.307*
Q33_InternalSillWork	Ordinal					0.689**			
Q33_ExternalSillWork	Ordinal			0.388**	0.689**				
Q33_InsideGlazedWork	Ordinal		0.438**	0.307*					

- **Expense** could affect some participants undertaking the behaviour to cultivate edible plants on buildings. As shown above, financial help towards cultivating edible plants has helped participants who like to cultivate within a community setting.

- Participants' **view of the level of difficulty** involved in cultivating edible plants could affect them undertaking the behaviour to cultivate edible plants on buildings. Participants who cultivate in allotments, were more likely to disagree that cultivating food does not have to be hard work (-0.323**). Participants who cultivate in the ground at home were more likely to agree that cultivating edible plants does not have to be hard work (0.332**). This may be due to allotment growing perceived as hard work due to the effort taken to travel to the growing space compared to growing in the ground at work.

- The level of **help available to set up and maintain a garden on a building** can affect participants undertaking the behaviour. This may be physical help and/or help by providing knowledge on how to undertake the behaviour. This is indicated in the data with significant relationships found between variables of cultivating on buildings spaces and help with set up and maintenance. For example, cultivating on a wall at work has a positive correlation with set up by a company (0.373**), and cultivating edible plants on a roof has a positive correlation with community help (0.527**).

D – Knowledge

- Participants' **knowledge about the benefits of cultivating edible plants on buildings** could affect whether they undertake the behaviour. This is indicated by the findings of participants' views of the benefits of cultivating edible plants on buildings (shown above under personal psychology). Participants who agree that cultivating edible plants on buildings is beneficial to the triple bottom line of sustainable development are more likely to be cultivating food on a wall at work, (0.311*) indicating that knowledge of the benefits of cultivating edible plants on buildings can have an impact on whether someone undertakes the behaviour.

- Participants' **knowledge about how to cultivate edible plants on buildings** could affect whether they undertake the behaviour. This is indicated by the relationship found between people who have cultivated buildings and their level of interest and confidence to cultivate edible plants on buildings. For example, the data showed a positive correlation between people who have cultivated edible plants on a roof and their interest (0.372**) and confidence (0.380**) to cultivate on buildings.

- Participants' **knowledge of successful examples could affect** their behaviour to cultivate edible plants on buildings. This is indicated where the data showed a significant relationship between people who know successful examples of cultivating edible plants on buildings, and people who said they would grow edible plants on buildings (0.428**), and also between people who would be interested to cultivate edible plants on buildings (-0.314**).

In summary, the deductive bivariate analysis, used to confirm and reject the hypothesis, was useful to find four key categories that affect the behaviour to cultivate edible plants on buildings. The inductive analysis of relationships between all variable combinations was useful to further underpin the four key areas and also begin to highlight some parameters that affect individuals to cultivate edible plants on buildings.

5.3.3 Analysis of people typologies

The above findings give an idea of the type of people who may be more likely to cultivate edible plants on buildings. This section will use these findings to form people typologies. Looking at people typologies will contribute two things: 1. Whether fitting into a certain person typology has some effect on the behaviour to cultivate edible plants on buildings; 2. Give an idea of any biases in the data due to most participants being a certain type of person.

The following people typologies were formed using the quantitative data, where a variable was created in SPSS for each person typology. The people typology variable was dichotomous where a participant was either 1 (yes, they are that typology) or 0 (no, they are not that typology).

1. Very environmentally aware people (score less than 71) vs. a little environmentally aware people.

An exploration of the person typology of "Very environmentally conscious participants" was created by creating a new variable. The data in the variable was created using a scoring system to assess how environmentally conscious each questionnaire participant is. The score was given by adding up the results for Question 16 "You would grow food for…", Question 18 "In your opinion, when growing edible plants…", Question 48 "You think that if people grow edible plants on buildings, it…". The lower the score, the more environmentally conscious a participant is. All participants with a score of less than 71 were given the code 1 (Very environmentally conscious) and scores of 71 and above were given code 0 (A bit environmentally conscious). Relationships were explored between this new variable - person typology "Very environmentally conscious participants".

2. People who easily adopt innovations (score less than 3) vs. people who do not easily adopt innovations.

The variables in question 7 ("When it comes to adopting an idea or innovation for a good cause, which describes you best below?") were used to create the data for this person typology variable. Anyone who scores less than 3 (i.e. selected options 1 or 2) is considered to easily adopt innovations.

3. People who are busy (spend a lot of their time working) (score greater than 3) vs. people who are less busy working.

The variables in question 8 ("On average, how many hours do you work per week?") were used to create the data for this person typology variable. Anyone who scores greater than 3 (i.e. work more than 30 hours per week) are considered to be busy people.

4. People who have a high combination of confidence and experience of cultivating edible plants (score less than 6) vs. people who have a low combination of confidence and experience.

The variables in question 22 ("How confident are you when it comes to cultivating edible plants?") and question 23 ("How experienced are you when it comes to cultivating edible plants?") were used to create the data for this person typology variable. Anyone who scores less than 6 is considered to have a high combination of confidence and experience cultivating edible plants.

5. People who are confident to grow inedible and edible plants on a building (score less than 6) vs. people who are not confident to grow inedible and edible plants on a building.

The variables in question 46 ("How confident are you when it comes to cultivating inedible plants on buildings?") and question 47 ("How confident are you when it comes to cultivating edible plants on buildings?") were used to create the data for this person typology variable. Anyone who scores less than 6 is considered to have a high combination of confidence and experience cultivating edible plants on buildings.

6. People who think there are a lot of benefits to cultivating edible plants of buildings (score less than 20) vs. people that think there are a little.

The variables in question 48 ("You think that if people grow edible plants on buildings, it…(list of benefits)") were used to create the data for this person typology variable. Anyone who scores less than 20 (i.e. selected options agreed for most of the benefits) is considered to think there are a lot of benefits to cultivating edible plants on buildings.

7. There is no variable that asked about income, so the tenure variable has been used as an indication of wealth. This is not accurate, as these people may have a low income but live in a home that they own or privately rent.

The variables in question 2 ("What type of tenure is your current residence?") were used to create the data for this person typology variable. Anyone who selected options 2 and 3 (i.e. own or privately rent their dwelling) is considered to be wealthier than other participants.

Table 21: The number of participants under each person typology

Person Typology	Number of participants (total 65 participants)
1. Very environmentally aware	28
2. Easily adopt innovations	36
3. Busy people	**47**
4. Confident and experienced cultivating edible plants	37
5. Confident and experienced cultivating inedible and edible plants on buildings	27
6. Think there are a lot of benefits to cultivating edible plants on buildings	34
7. People who own or privately rent their home	**48**

Table 21 shows that there are mostly an equal number of people out of the 65 participants for each person typology. This shows that there was a good mix of people typology in the population sample who took part in the questionnaire. For example, there was not a large bias in the results due to everyone who took part being very environmentally conscious. The numbers highlighted in bold are the people typologies that were not close to equal, showing that a large proportion of participants are busy people and a large proportion of participants own or privately rent their homes. This shows a limitation in the sample population, especially regarding information from people from poorer backgrounds. The significant correlations found between people typologies and other variables in relation to the research question are the following (see Appendix G). They have been put under the four key categories.

A - Community

(1) People who are **environmentally conscious** are more likely to use a community garden a lot and cultivate in the ground at work (correlation -0.338**).

(4) People who are **experienced and confident growing edible plants** are more likely to agree that they grow edible plants for community cohesion (-0.316**) and for sharing tasks with others (-0.368**).

B – Personal Psychology

(1) Being **environmentally conscious** is more likely to increase a person's level of interest to undertake the behaviour to cultivate edible plants on buildings (correlation -0.511**).

(1) People who are **environmentally conscious** are more likely to agree that they would cultivate edible plants on a building (0.305*).

(6) Thinking that **there are many benefits to cultivating edible plants on buildings** is more likely to increase a person's level of interest to undertake the behaviour to cultivate edible plants on buildings (-0.492**).

(6) Thinking that **there are many benefits to cultivating edible plants on buildings** is more likely to increase a person's likelihood of agreeing that they would undertake the behaviour to cultivate edible plants on buildings (0.324**).

C – Physical

(2) People who **easily adopt innovations** are more likely to say lack of physical ability is a barrier to having an edible garden (0.390**).

(6) Thinking that **there are many benefits to cultivating edible plants on buildings** is more likely to affect a person's opinion about the level of productivity achievable in physically small spaces on buildings (these people disagree that you cannot grow much on buildings) (0.420**).

D – Knowledge

(1) People who are **environmentally conscious** are more likely to agree with the benefits of cultivating edible plants on buildings (shade buildings (-0.569**), biodiversity (-0.678**), reconnecting people with food production (-0.582**), increasing access to fresh food (-0.548**), help make cities more beautiful (-0.591**), good for mental (-0.580**) and physical health (-0.571**)), and agree that it is possible to resolve the issues of undertaking the behaviour to cultivate edible plants on buildings (-0.326**).

(4) People who are **experienced and confident growing edible plants** are more likely to agree with the benefits of cultivating edible plants on buildings (biodiversity (-0.470**), reconnecting people with food production (-0.368**), increasing access to fresh food (-0.340**), help make cities more beautiful (-0.421**), good for mental (-0.406**) and physical health (-0.374**)).

(6) People who think that **there are many benefits to cultivating edible plants on buildings** are more likely to agree that it is possible to resolve the issues of cultivating edible plants on buildings (-0.469**), and are more likely to know of successful examples of cultivating edible plants on buildings (0.373**).

The findings above show that the following three people typologies have some affect on a person's behaviour to cultivate edible plants on buildings:

- People who are very environmentally conscious
- People who are experienced and confident cultivating edible plants
- People who think there are many benefits to cultivating edible plants on buildings

The data does not show any variable relationships that show specific barriers for the above groups of people. People who would agree that their inability to grow much on buildings is a concern for them, are more likely to NOT think there are many benefits to cultivating edible plants on buildings (0.420**). 11 people who ARE NOT very environmentally conscious are not interested to cultivate edible plants on buildings. 10 people who DO NOT think there are many benefits to cultivating edible plants on buildings are not interested to cultivate edible plants on buildings. 9 people who ARE NOT experienced and confident cultivating edible plants on buildings are not interested to cultivate edible plants on building. These people could be persuaded by giving them knowledge of how and why to cultivate edible plants on buildings.
When undertaking interviews, it is important to interview a range of people from the above three people typologies.

5.4 Summary of findings

The analysis above relied on quantitative data derived from the survey responses of 65 participants, and found four key areas that affect a person's behaviour to cultivate edible plants on buildings; Community, Personal Psychology, Physical and Knowledge. Specific parameters that affect the behaviour to cultivate edible plants on buildings were found under each of these areas using the correlation coefficients linking pairs of variables. These four key areas were investigated in more depth using four open questions in 1:1 semi-structured interviews, as further discussed in Chapter 6. A greater understanding of the parameters that affect the behaviour to cultivate edible plants on buildings can be reached by combining the results for the quantitative data analyses with those from the qualitative data analyses.

The semi-structured interview questions derived from phase 1 of the research are:

1. What are the physical aspects for you related to growing edible plants on buildings? How do you feel these physical aspects affect your motivation to grow edible plants on buildings?

Prompts: Any physical restriction? Things that enabled you? Help with costs? Services to help? Restrictions? Incentivisation?

2. What are your personal views about growing edible plants on buildings? How do you feel these views have affected your motivation to grow edible plants on buildings?
   Prompts: Morally normal? Personally normal? Consequences? Beliefs of the affects of growing food on buildings? What do you think of the behaviour? Personal identity? Regulation? Legislation? Persuasion? Motivation?

3. How do you feel that your knowledge would affect your motivation to grow edible plants on buildings?
   Prompts: Education? Training? Guidelines? Past Behaviour?

4. How do you feel that the community around you has affected your motivation to grow edible plants on buildings?
   Prompts: Your community of people?, The media?, Other people set an example?

5.5 Conclusion

In this chapter, quantitative analysis of participant questionnaires was undertaken (Phase 1). Single variables were assessed in relation to the main research question, "What affects individuals to cultivate edible plants on buildings?" Bivariate analysis was undertaken to find relationships between pairs of variables. Strong correlations were found between 276 pairs of variables that were relevant to the main research question. These correlations were split into four keys categories (Physical, Personal Psychology, Personal Knowledge and Community), which answered subsidiary research question c). These results indicated the importance of parameters related to; physical elements (such as space, access and physical ability), the personal thoughts of individuals about the behaviour, the knowledge of individuals about the behaviour and how the individuals' community might affect them undertaking the behaviour. Four open questions were formed related to the four key areas in order to investigate them further using semi-structured interviews (Phase 2).

Personal typologies were explored and new variables were created for person typology with bivariate analysis undertaken for each person typology with all the other variables. The typologies that relate to a greater likelihood to cultivate edible plants on buildings were; People who are very environmentally conscious, people who are experienced and confident cultivating edible plants, people who are confident cultivating edible plants on buildings and people who think there are many benefits to cultivating edible plants on buildings. These typologies were considered when selecting interview participants in order to achieve a good range of people who were interviewed.

Chapter 6 – Synthesis of Phases 1 and 2: Identifying the parameters that affect the behaviour to cultivate edible plants on buildings

6.1 Introduction

In the previous chapter, four key categories that affect the behaviour to cultivate edible plants on buildings were identified. These categories were further investigated with the use of interviews. This chapter consists of the selection process of interviewees and a content and thematic analysis of their responses with the aim of finding the parameters that affect the behaviour to cultivate edible plants on buildings (subsidiary research question d). The parameters found are discussed and underpinned by the results from the quantitative data where relevant. The found parameters were added to the theoretical framework diagram, illustrating how the theoretical model progressed throughout this research study.

6.2 Interview and Analysis process

30 people were interviewed in total. Out of the 35 participants who said yes to being interviewed in the questionnaire, 21 were interviewed in the end, four interview participants were contacted for an interview due to their experience with urban agriculture (three who grow on buildings), and five interview participants were recommended by other interviewees. Table 22 shows the personal profile of each interviewee. It shows a range of people from different living situations, time spent working, experience cultivating edible plants, and environmental awareness. Most people grew some kind of edible plants (including herb bushes and fruit trees) so the number of people not cultivating anything was limited, however there was a good balance between the number of people who consider themselves experienced with cultivating food vs. those who consider themselves not experienced (1 = Very Experienced and 5 = Not Experienced).

Table 22: Showing the range of different people who were interviewed by order of when they were interviewed

Participant No.	How were they contacted?	City	House Type	Tenure	Age	Dependants	Growing food for personal use	Growing food for commercial use	Experience growing food	Growing/grown food on a building	Average hours work per week	Person Typology - Very Environmentally Concious if score less than 71	Person Typology - People who are experienced and confident growing edible plants if score less than 6	Person Typology - People who are confident cultivating edible plants on buildings if score less than 6	Person Typology - People who think there are many benefits to cultivating edible plants on buildings if score less than 20
1	Met at a conference	London	Flat					yes		yes					
2	Questionnaire	London	Terraced house	Owner	46-55	0	yes		1	yes	30	46(Yes)	2(Yes)	2(Yes)	10(Yes)
3	Questionnaire	London	Terraced house	Parents	26-35	0	no	yes	4	yes	60	42(Yes)	8(Yes)	6(No)	10(Yes)
4	Questionnaire	London	Flat	Rent council	36-45	0	Yes		1	yes	20	37(Yes)	2(Yes)	2(Yes)	9(Yes)
5	Questionnaire	Oxford	Semi-detached house	Owner	46-55	0	yes		2	no	0	95(No)	3(Yes)	8(No)	27(No)
6	Questionnaire	Oxford	Terraced House	Owner	46-55	2	yes		3	no	40				
7	Questionnaire	Oxford	Terraced house	Owner	26-35	0	yes		2	yes	40	57(Yes)	4(Yes)	2(Yes)	12(Yes)
8	Questionnaire	Oxford	Terraced house	Owner	46-55	0	yes		4	yes	37	71(No)	7(No)	8(No)	22(No)
9	Questionnaire	Oxford	Detached house	Owner	46-55	0	yes		2	no	42	62(Yes)	4(Yes)	6(No)	13(Yes)
10	Questionnaire	Oxford	Terraced house	Rent privately	36-45	0	yes		4	no	38	80(No)	7(No)	8(No)	30(No)
11	Questionnaire	Oxford	Flat	Rent privately	26-35	0	yes		3	no	60	59(Yes)	5(Yes)	6(No)	20(No)
12	Met in an allotment	Oxford	House				yes			no					
13	Questionnaire	Oxford	Terraced house	Owner	46-55	0	yes		2	no	40	81(No)	4(Yes)	5(Yes)	17(Yes)
14	Questionnaire	Oxford	Flat	Rent privately	26-35	0	yes		3	yes	38	75(No)	5(Yes)	3(Yes)	20(No)
15	Questionnaire	Oxford	Detached house	Owner	46-55	0	yes		1	no	40	76(No)	2(Yes)	4(Yes)	20(No)

16	Questionnaire	Oxford	Terraced house	Rent share	26-35	0	yes		2	yes	60	41(Yes)	3(Yes)	4(Yes)	11(Yes)
17	Questionnaire	Oxford	Detached house	Owner	Over 66	0	yes		3	no	0	107(No)	6(No)	4(Yes)	29(No)
18	Questionnaire	London	Terraced house	Owner	56-65	0	yes		4	yes	80	78(No)	7(No)	6(No)	19(Yes)
19	Questionnaire	Oxford	Flat	Rent privately	26-35	1	yes		5	no	50	101(No)	10(No)	8(No)	25(No)
20	Questionnaire	Devon	Semi-detached house	Owner	46-55	0	yes		1	no	50	70(Yes)	2(Yes)	2(Yes)	13(Yes)
21	Questionnaire	Oxford	Semi-detached house	Rent privately	46-55	2	yes		4	no	37	64(Yes)	8(No)	10(No)	18(Yes)
22	Expert and experience	Reading					yes			yes					
23	Recommended by participant	Oxford	House				yes			no					
24	Questionnaire	London	Flat	Rent share	26-35	0	yes		2	yes	45	36(Yes)	4(Yes)	2(Yes)	9(Yes)
25	Recommended by participant	Oxford	House				no			yes					
26	Recommended by participant	London	Flat				yes			yes					
27	Recommended by participant	London					yes			no					
28	Expert and experience	Brighton					yes			yes					
29	Questionnaire	Oxford	Detached house	Owner	56-65	0	yes		4	no	37.5	77(No)	8(No)	4(Yes)	21(No)
30	Recommended by participant	Oxford	House							no					

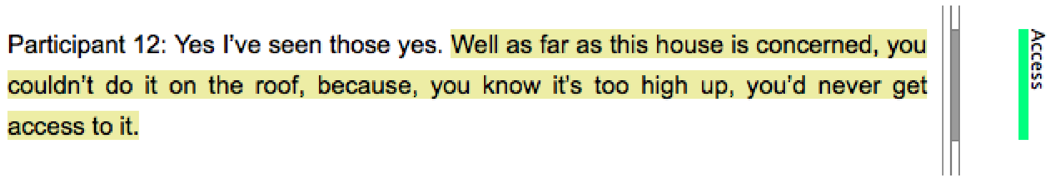
Notes for table:

The last four columns aim to demonstrate that there was a good range of person typologies (from the questionnaire data, Chapter 5, Phase 1 of this research study) from the people interviewed.

The interviews were transcribed (sample shown in Appendix H) and imported into Nvivo software for analysis. The steps of the analysis were as follows:

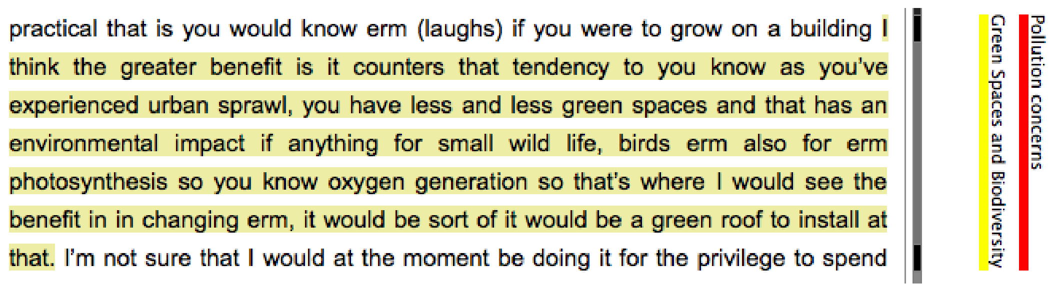
Step 1: Create the four categories (Physical, Community, Personal Psychology and Knowledge) developed in Phase 1 of this research study as main nodes (parent nodes) in Nvivo.

Step 2: Read through the transcripts and highlight sentences/paragraphs that are relevant to answering the research question "What are the parameters that affect the behaviour to cultivate edible plants on buildings?". Give these sentences/paragraphs nodes related to the research question and put these nodes under the relevant parent node. Below is an example where a sentence was coded as "Access":


Participant 12: Yes I've seen those yes. Well as far as this house is concerned, you couldn't do it on the roof, because, you know it's too high up, you'd never get access to it.

This created "Access" as a node. Whenever another sentence/paragraph was related to "Access" this was also coded under "Access". "Access" was put under the parent node "Physical".

Sometimes sentences/paragraphs were coded under more than one node as there are several things talked about. Below is an example where one paragraph is coded under the nodes "Pollution Concerns" (parent node personal psychology) and "Green Spaces and Biodiversity" (parent node Physical):


practical that is you would know erm (laughs) if you were to grow on a building I think the greater benefit is it counters that tendency to you know as you've experienced urban sprawl, you have less and less green spaces and that has an environmental impact if anything for small wild life, birds erm also for erm photosynthesis so you know oxygen generation so that's where I would see the benefit in in changing erm, it would be sort of it would be a green roof to install at that. I'm not sure that I would at the moment be doing it for the privilege to spend

During the process of working through the transcripts, some nodes were combined and reworded where appropriate.

Step 3: Read through all the transcripts a second time and check if anything was missed and if more coding or rewording of nodes is needed.

In this step it was found that most of the transcripts that were initially read through required some more coding under later nodes that were created when reading through all the transcripts in step 1. This showed that these nodes are also relevant to what other people said.

Step 4: Begin to combine nodes that are similar to each other in order to make the findings more concise using thematic analysis, where patterns in the nodes were identified (see Appendix I). Create new parent nodes if relevant. In this case a new parent node called "Economic Sustainability" was created as the node "Money" had developed many sub-nodes in the "Physical" parent node, which made it substantial enough to be its own category.

6.3 Results and Discussion

The results from the analysis above in Nvivo are shown in Appendix J and summarised in Table 23 below. In Table 23, the parameters have been split into two locations: 1. Cultivating food on buildings; 2. Cultivating food in urban areas. The parameters have also been split into 5 categories (Physical parameters, Personal Psychology, Knowledge, Community and Economic). The 5th category – Economic was brought out from the Physical Parameters category, as it was highlighted as a key issue from the qualitative data analysis. Although Community and Economic are not directly linked with the cultivating edible plants on buildings parameters, they are a key component of cultivating edible plants on buildings, as they are directly linked with cultivating edible plants in general in urban areas. The parameters are listed by order of most sourced by each participant. Table 23 has columns that show which parameters were found in the literature review, phase 1 analysis and phase 2 analysis and the parameters that were found only in the phase 2 analysis, highlighting the value of a sequential explanatory mixed methods approach in order to explore the findings from quantitative analysis further with qualitative research.

The "parameters that affect the behaviour to cultivate edible plants on buildings" are referred to as "parameters" for short from this point in the writing. Each parameter can both aid motivation to undertake the behaviour to cultivate edible plants on buildings, or can be a barrier to cultivating edible plants on buildings. For example, the parameter "Time needed" would be a motivator for someone who has a lot of spare time, but a barrier to someone who does not have much spare time. Where relevant, parameters can be both perceived and actual. For example "Access to irrigation" can be both perceived access to irrigation and actual access to irrigation.

Table 23 shows that 41 parameters were found in total; 14 parameters directly related to cultivating edible plants on buildings and 27 related to cultivating edible plants in general in urban areas. The table also shows that 18 parameters were found as a result of this research (i.e. they were not present in the literature review), 8 of which were parameters directly related to buildings.

Table 23: Showing the parameters that were found in the literature review, phase 1 analysis and phase 2 analysis and the parameters that were found only in the phase 2 analysis

Parameter found in literature review and Phase 2 Analysis	Parameter found in Phase 1 analysis	Parameter found only in Phase 2 analysis
Cultivating edible plants on buildings		
Cultivating on Buildings – Physical (BP)		
	BP1. Space requirements for productivity aims, storage and propagation (26 participants)	
BP2. Access to irrigation (24 participants)		
BP3. Access to plants (23 participants)		
		BP4. The availability of other space (space that is not on a building) for cultivation (21 participants).
BP5. Access to suitable growing medium type and depth (20 participants)		
BP6. Climate around building impacting cultivation (20 participants)		
BP7. Angle of a building surface impacting on cultivation (9 participants)		
Cultivating on Buildings - Personal Psychology (BPP)		
		BPP1. Opinion of using spare space on buildings (20 participants)
BPP2. Perceived safety		

cultivating on a building (14 participants)		
		BPP3. Beliefs about new building technologies (6 participants)
Cultivating on Buildings – Knowledge (BK)		
		BK1. Knowledge of building structure (19 participants)
	BK2. Knowledge of existing examples of cultivating edible plants on buildings (17 participants)	
		BK3. Knowledge of building construction (15 participants)
	BK4. Knowledge of benefits of cultivating on buildings (5 participants)	
Cultivating edible plants in urban areas in general		
Cultivating in Urban Area – Physical (UP)		
UP1. Time (24 participants)	Also found in Phase 1	
UP2. Resources and facilities (20 participants)		
UP3. Aesthetically pleasing space to enjoy (20 participants)	Also found in Phase 1	
UP4. Ownership of space (19 participants)		
UP5. Climate of UK (15 participants)		
		UP6. Transient lifestyle (11 participants)

		UP7. Proximity to growing space (11 participants)
UP8. Physical and mental health (11 participants)		
UP9. Possibility of vandalism and theft (8 participants)		
		UP10. Visibility of space (5 participants)
Cultivating in Urban Area – Personal Psychology (UPP)		
UPP1. Interest, enjoyment, opinions, ideas and aims (29 participants)	Also found in Phase 1	
	UPP2. Value growing food – knowledge of benefits (25 participants)	
UPP3. Believing that food grown by themselves has fewer chemicals, is nutrient rich and flavoursome (18 participants)	The "flavoursome" part was also found in Phase 1 under Personal Psychology (people who like to eat fresh fruit and vegetables).	
		UPP4. Value of crop vs. value of space (13 participants)
		UPP5. Commitment and determination (11 participants)
UPP6. Urban pollution contamination (6 participants)		
		UPP7. Supporting organic food growing businesses (5 participants)
Cultivating in Urban Area – Knowledge (UK)		

UK1. Gardening skills and confidence (24 participants)	Also found in Phase 1	
		UK2. Project management and communication skills (16 participants)
		UK3. Cooking skills and healthy food literacy (12 participants)
Cultivating in Urban Area – Community (UC)		
UC1. Community cohesion, engagement and socialising (25 participants)		
UC2. Share ideas, inspire, give reassurance (24 participants)		
UC3. Help and support from others (24 participants)		
UC4. Perceived attitude and judgement of others (23 participants)		
		UC5. Nuisance to others (5 participants)
Cultivating in Urban Area – Economic (UE)		
UE1. Expense (18 participants)	Also found in Phase 1	
		UE2. Financial incentives (12 participants)

In sections 6.3.1 and 6.3.2 below, each parameter has been discussed in more detail. Where relevant, each parameter found from the interview analysis has been underpinned by results from the quantitative data analysis (Chapter 5). Chapter 7 will link each parameter back to the behavioural theory from the literature review. Under each parameter, it has been suggested how the parameter could be addressed, which are based on findings and theory introduced in Chapter 3 (literature review). Section 6.3.3 introduces some example scenarios of how the parameters can be used for the development, design and implementation of a project to cultivate edible plants on buildings.

6.3.1 Cultivating edible plants on Buildings

Physical Parameters (BP)

BP1. Sufficient space on building for productivity aims, storage and propagation

Some people feel that the small space available on a balcony or a windowsill is not large enough to be able to grow a good amount of food for the effort put in. This would also be an issue when cultivating edible plants at ground level in a small space. Interview participant 4 said "I mean you can produce a lot in a very small space", but what could be "a lot" to this participant might not be a lot to another. "A good amount" grown also depends on the type of edible plants that are grown, for example it can be possible to grow "a good amount" of herbs like rosemary and thyme in a 5 litre container in order to add a lot of flavour every day to meals. One interviewee (participant 11) said, "you get a lot of useful herbs but you do not actually have to give much space up for the amount of flavour that you get from them". The question "What size space is needed to grow a 'good' amount of food on a building?" requires further research but the findings in this research can provide some insight to answering this question.

The solutions to this parameter depend on each individual grower and their opinion of the 'worth' of the amount of food they are able to grow in a certain space, as well as other parameters such as knowledge and time, explained further below. Correlation 246 from analysis in phase 1 showed that people who are concerned that it is not possible to grow much on buildings are less likely to be interested to cultivate on buildings. Question 15 from the questionnaire helps illustrate this 'worth' (Figure 60).

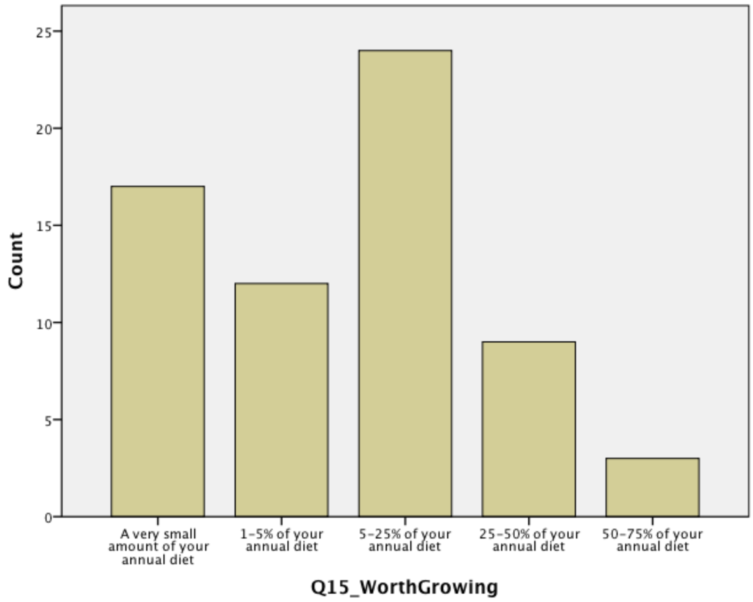


Figure 60: Answer to Question 15 – "You think it is worth growing your own food if it contributes to…"

Annual diet in question 15 is a person's total annual food intake (including meat, wheat etc.). 17 out of 65 people thought that it is worth growing even a very small amount of food, 12 people thought that it is worth growing only 1-5% of your annual diet, and 24 people thought that it is worth growing 5-25% of your annual diet, thus 53 out of 65 people think it is worth growing less than 25% of their annual diet. This shows that more than half of the sample thought that it is worth growing their own food if it contributes to less than 25% of their annual diet, which can be achievable on a standard sized balcony in the UK or a small roof top space depending on what they grow and what they like to eat. According to the UK Government's 'Eat Well Plate' (FSA, 2011), 33% of a balanced diet should be fruit and vegetables (let's say 25% fresh vegetables and 8% fresh fruit). The vegetable intake may be higher for vegetarians and would be higher for vegans. Assuming that the 33% is correct for all the participants, this suggests that 17 out of 65 people think it is worth growing a very small amount of this 25% of fresh vegetables, 12 people think it is worth growing 4%-20% of their annual fresh vegetable intake, and 24 people think that it is worth growing your own food if you grow 20%-100% (average 60%) of your annual fresh vegetable intake. Thus repeating the findings above in this context means that 29 (17 + 12) out 65 people think it is worth growing your own food if it contributes to less than 20% of their annual vegetable intake, and the rest think it is worth growing your own food if you can grow more than 20% of your annual vegetable intake. In practice, according to the One Brighton caretaker who was interviewed in phase 2 of this research study, there is a waiting list for the 1.5m^2 allotment raised beds and a small turnaround of plot holders, which shows that allocating small spaces for cultivating can be successful.

Figure 61 from the questionnaire in phase 1 of this research study shows that 28 out of 65 people agree that they are concerned that it is not possible to grow much on buildings.

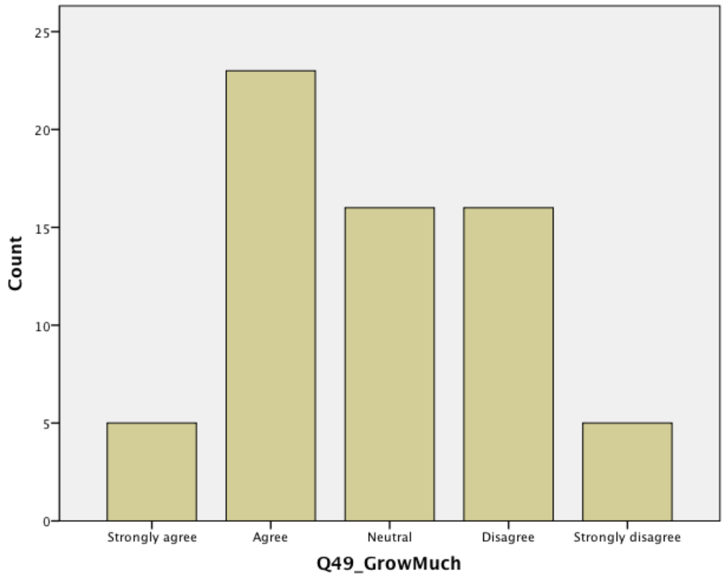


Figure 61: Question 49 "What would be your concerns regarding growing edible plants on buildings?" answers for "Cannot grow much"

In Chapter 3, section 3.2.1.5, it was calculated that using Ridsdill Smith's method of cultivating food in containers using soil, it is possible to cultivate 68% of one person's annual vegetable intake in 5.5m² of space. The data from the questionnaires in phase 1 show that 68% is acceptable for 53 out of 65 participants, showing that 5.5m² per person could be "a good amount of space" for most people to cultivate their own food in soil. Of course, due to the high population density in urban areas this would be difficult to achieve. Table 24 is a guide for the amount of space to provide for cultivating X% of a person's annual vegetable intake in soil.

Table 24: Amount of space needed to grow X% of a person's annual vegetable intake using Ridsdill Smith's methods (soil in containers)

Percentage of one person's annual vegetable intake	20%	40%	60%	80%	100%
Area required to cultivate that amount of vegetables using Ridsdill Smith's cultivation method	1.6m²	3.2m²	4.9m²	6.5m²	8.1m²
Area required to cultivate that amount of vegetables using hydroponics	0.6m²	1.1m²	1.6m²	2.2m²	2.7m²

The amount of floor space required to cultivate X% can be reduced by stacking containers. Cultivating hydroponically rather than in soil can also reduce space requirements, as hydroponic or soil-less methods of cultivation can be 3 times more productive per square metre (see chapter 3, section 3.2.1.7). This may be more difficult to achieve than soil-based systems as cultivating in soil-less systems requires specialist **knowledge** (UK1), can be **costly** (James, 2013) to set up and maintain (UE1), and requires regular **time** (UP1) to plan and maintain. If the productivity aims are high vs. the space available, then soil-less methods may be a good solution depending on the other parameters above.

Ridsdill Smith's vertical gardening experience shows that **knowledge** of how to grow in smaller spaces is important to achieve higher yields. **Time** available to plan it and the **proximity** of the growing space to where the grower is most of the time are also key parameters, and are an important part of achieving the high productivity using Ridsdill Smith's methods.

BP2. Access to irrigation on the building space and drainage

This concern is generally in two parts; the concern of not having easy access to water for irrigating plants if they were to cultivate edible plants on a building (e.g. interview participant 10 commented about "the ability to get services up there if it requires water.") and the concern of drainage of water away from the external skin of the building to prevent any water damage to the building and the plants (this concern also overlaps with the general knowledge of building construction parameter BK3). Interview participant 26 said "I look at the drains because if you put water through any soil it picks up a load of silt, bits of soil particles and over a year if you're not careful it will block up the drain hole so I always find out where drain holes are so to make sure I can manage the outflow." 24 out of 30 interviewees talked about access to water for irrigation and/or good drainage needed on buildings.

This parameter could be addressed through carefully considered design, planning and maintenance when deciding to implement an area to cultivate edible plants on buildings, where an easily accessible source of water should be installed and a drainage plan has been implemented during the installation. All water entering the containers (large (a green roof seen as a large container) or small) should be able to drain out of the container and away from the building fabric into guttering and downpipes. All current and future users of the space should be introduced to how water is accessed and how it is drained away, and made aware of which drains to keep clear. This indicates towards the development of a user manual for all areas for cultivating edible plants on buildings, which would most likely include other parameters that will be discussed further below. A user manual can be kept with the building documents and passed on to future users (tenants or owners) of the building when other users move on.

The above solution relates to other parameters that would affect the behaviour to cultivate edible plants on buildings; "carefully considered design, planning and maintenance" may not be an option for someone who does not have the **knowledge of building construction** (parameter BK3) to be able to do this, and does not have the **financial resources** (parameter UE1) to hire someone who does have this knowledge. People who do not have the building knowledge to design and plan would need help starting up (**help and support from others** parameter UC3) the area that they would like to cultivate on a building from someone who has this knowledge. These parameters are discussed further below.

BP3. Access to the plants is a concern for people, as the external surfaces of a building are not generally easily accessible, thus ease of access to the plants is a parameter.

It is important to have easy access to an edible garden as the plants need to be harvested and watered regularly, and also the growing medium may need to be refreshed, which means annually getting heavy bags of compost to the garden for example. Interview participant 17 stated "Unless I had a bit of shared garden but then you'd be going up and down stairs to water it and deal with it so don't know what would physically restrict me. I think it would be watering and carting stuff around."

Question 49 (multiple choice) in the questionnaire asked people "What would be your concerns regarding cultivating edible plants on buildings?". 38 out of 65 people agreed that it would be "too difficult to access" (Figure 62).

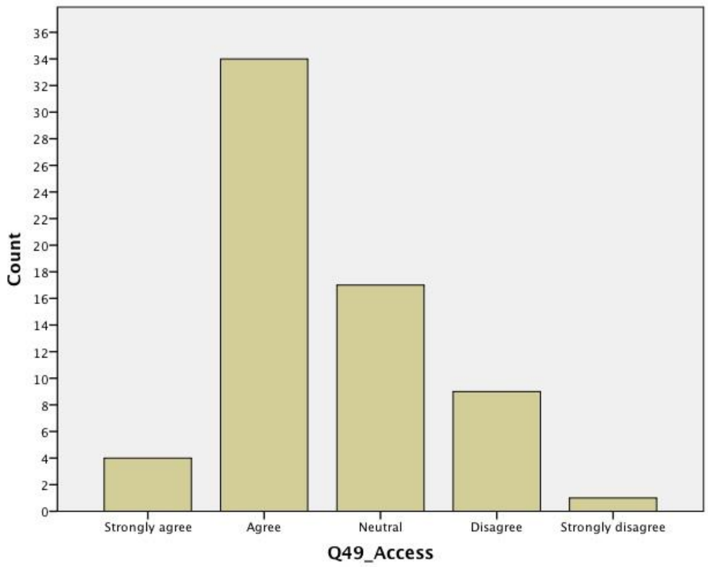


Figure 62: Question 49 "What would be your concerns regarding growing edible plants on buildings?" answers for "Too difficult to access"

If the access to a building surface where there is an edible garden is not as straight forward as access to any other used area of the building then it would not be suitable. The method of access needs to be safe and as inclusive as possible to different types of users, such as wheelchair users (this also overlaps with **"physical and mental health"** parameter UP8), which is another practical parameter that would affect the behaviour to cultivate edible plants on buildings and cultivating edible plants in general.

The parameter of access to the plants could be addressed through carefully considered design and planning when deciding to implement an area to cultivate edible plants on a building. For example, if a rooftop is located as an area to cultivate edible plants, it should be accessible via a staircase and/or a lift (especially if it is more than 3 storeys high). Users should not have to go up more than 3 flights of stairs without a lift for at least part of the journey. This is best practice in order to reduce the physical exertion needed to access the space and increases the sustainability of the space, as easy access means more people are likely to access the space, thus if the users of the garden move on, the new users are more likely to continue using it.

There is also another element to access and this is the perceived ease of access rather than just the physical ease of access. This relates to **proximity** (parameter UP7) and **visibility** (parameter UP10), as the closer the space is perceived to be by the users, the more accessible it could be perceived to be. For example, a garden that can be seen from where a user is inside the building or the garden is on a route where the user usually passes through may mean that the user perceives that they can access it easily. This may be because people are subconsciously keeping an eye on it and go out occasionally to do some kind of maintenance. If the garden is up 3 flights of stairs/lift where the user cannot see it regularly from where they usually are in the building and/or they do not pass through it regularly, then they may be less inclined to go up to use the garden. This is underpinned by the behaviour theory in Chapter 3 where the importance of visibility is highlighted in; Cialdini's principles of persuasion under 'Social proof' (Cialdini, 2001), 'Observability' under the diffusion of innovation theory (Robinson, 2009), and 'Engaging' under the 4Es Behaviour Change Model (Defra, 2006a). Perceived ease of access may not be a barrier to all users, for example people who grow food in an allotment know that it is a bit more difficult to access compared to cultivating food in their back garden, however for other reasons (interest, and/or other parameters) they are committed to taking the journey to their allotment. **Commitment and determination** (parameter UPP5) is also another parameter that would affect the behaviour to cultivate edible plants on buildings, where the commitment of the user would mean whether or not a roof top garden that is not perceived to be easily accessible is actually accessed.

It could be said that, for the reasons discussed above, in order to motivate more people to grow edible plants, ideally all spaces on a building that are to be designed to grow edible plants should be designed to be directly next to where the building occupants are. For example, office windows attached to a roof terrace, but this may not be good for other reasons; people may prefer to have more ornamental plants in a garden they can see regularly (**aesthetics of a place** (parameter UP3) and/or it may not be as **safe from theft or vandalism** (parameter UP9) if a lot of other people can see and access the garden regularly and/or people may not want to be overlooked by others when they are working in their edible garden (therapeutic linked with knowledge of benefits (parameter UPP2)). **Financial resources** (parameter UE1) available also play a key role to making a building surface accessible, as it can be expensive to add stairs, lifts, platforms etc. In summary, perceived ease of access should not be put as a priority to solve when designing an edible garden on a building if it may compromise other parameters that affect the behaviour of cultivating edible plants on buildings, but physical ease of access should be carefully considered as a priority.

BP4. The availability of other space (space that is not on a building) for cultivation.

The findings of the research suggest that if the only space available for cultivation is on a building, then people are more likely to consider cultivating on a building, but they are more likely to first utilise space for cultivation that is not on a building. This is due to the increased risks and perceived complications and difficulties of cultivating edible plants on a building compared to spaces at ground level. For example interview participant 25 said, "there's a sense in which that growing them on buildings is just doing the same thing as you might do in a vegetable patch only more complicated so why would I expose myself to that extra complication?". This highlights that cultivating edible plants on buildings is seen as a last resort for cultivation space, thus would be mostly suited to dense urban areas where suitable spare ground level space would be difficult to find. For example interview participant 23 said, "I can see if you're talking about a lot of city buildings where you have not got outside land" and interview participant 15 said, "in the context of my house at the moment, it's you know, there is plenty of space to use before I use the building". This again brings forth the question "What size space is needed to grow a 'good' amount of food on a building?".

If people have space to grow at ground level then they may be more likely to utilise that space first before cultivating on their building, as it is generally perceived as less complicated to cultivate at ground level compared to cultivating on a building. The following findings from Phase 1 and Phase 2 of the data analysis underpin this parameter. Table 25 shows that 6 people grow some edible plants on their balcony at home and all of these people do not grow in the ground at home. The table also shows that 41 people grow edible plants in the ground at home and none of these people grow on a balcony at home.

Table 25: Crosstabulation showing people who grow edible plants on a balcony at home compared to people who grow edible plants in the ground at home

Q33_BalconyHome * Q33_GroundHome Crosstabulation

Count

		Q33_GroundHome				Total
		A lot	Occasionally	Rarely	Never	
Q33_BalconyHome	A lot	0	0	0	4	4
	Occasionally	0	0	0	1	1
	Rarely	0	0	0	1	1
	Never	27	13	1	10	51
Total		27	13	1	16	57

Correlation 91 (people who grow on a balcony at home are less likely to grow in the ground at home and more likely to grow in an internal and external window sill at work) is an example

showing the utilisation of a balcony in comparison to cultivating at ground level. Finally, 15 out of the 30 interview participants said that the availability of somewhere to grow at ground level is a reason why they would not grow on a building, and 6 participants who are growing on a building said that they do not have space at ground level to cultivate.
This parameter highlights that the cultivation of edible plants on buildings is suitable when there is not space at ground level available to cultivate, such as in urban areas with a high density of buildings.

BP5. The availability of an appropriate growing medium (depth, size, type, nutrients source and microbiology) is a parameter.

Different types of plants can grow in varying depths and sizes of containers and various soil types and conditions, for example some edible plants are able to grow well in a soil that does not have many nutrients, where as other edible plant need to grow in a soil rich with nutrients in order to grow well (e.g. tomatoes) (see Chapter 3, section 3.2.1.4). Interview participant 14 said "there may be more efficient planters that we could use, we've got these recycling boxes which are in fact deeper than they need to be and maybe don't take up much area. We could do with things that are bigger and shallower."
This has been listed as a parameter specifically related to cultivating edible plants on buildings, as cultivating on buildings is essentially cultivating in containers, which can be very different compared with cultivating in the ground which generally has a much larger soil volume and depth.
This could be addressed through careful design, planning and maintenance when implementing an area to cultivate edible plants on a building. The size and depth (volume) of the containers where the growing medium will sit in, need to be appropriate to the edible plants that want to be cultivated. Most vegetables can grow well in a 300mm deep container but width also needs to be looked at, as not all vegetables can grow in narrow containers (Guerra, 2005). For most vegetables, a good volume of growing medium is needed for the roots to be able to spread. There are also a lot of edible plants that can grow well in small volumes of soil (Guerra, 2005). If it is possible during the design process, a larger volume of growing medium (for example in the form of a raised bed) should be implemented in order to accommodate most types of edible plants that a user may choose to grow. This will also help with the development of microbiology in the soil and when adding nutrients to the soil, as mulch could be used for larger areas of growing medium in order to replenish the nutrients rather than refreshing the entire soil in the pot with new compost. As was discussed in the literature review in Chapter 3, good soil microbiology helps plant roots access nutrients in a growing medium. Although a well-balanced soil microbiology can help plants grow well, it can sometimes become detrimental to the plants if the soil has an imbalance in microbiology, for example the development of vine weevils which would eat the plant roots (linked

with gardening skills and confidence parameter UK1). There are solutions to imbalances in soil microbiology, for example by adding a predator of vine weevils, however this requires **knowledge of gardening** (parameter UK1) and the **commitment** (parameter UPP5) and **time** (parameter UP1) to research any issues that are come across.

Again as above, this solution of larger volumes of growing medium relates to other parameters; "carefully considered design, planning and maintenance" may not be an option for someone who does not have the **knowledge** of how to grow edible plants in containers (parameter UK1) and/or does not have the **financial resources** (parameter UE1) to hire someone who does have this knowledge, and to pay for the larger volume of growing medium needed.

BP6. Specific climatic problems on a building (wind, exposure, temperature, frost, orientation and shade) are parameters.

Building surfaces that are high up tend to be more exposed to wind and sun. Interview participant 15 expressed that "the orientation of the house is probably errrr the worst orientation it could be for catching light." They also tend to have greater fluctuations in temperature. This can greatly damage plants and therefore affect the productivity of edible plants. Some plants are more tolerant to these climatic problems than others (Bot & Benites, 2005), but it is best to alleviate these problems in a garden so that a user can have a greater option of edible plants that they can grow. Figure 63 shows that 33 out of 65 people agreed that it would be too windy for the plants on buildings.

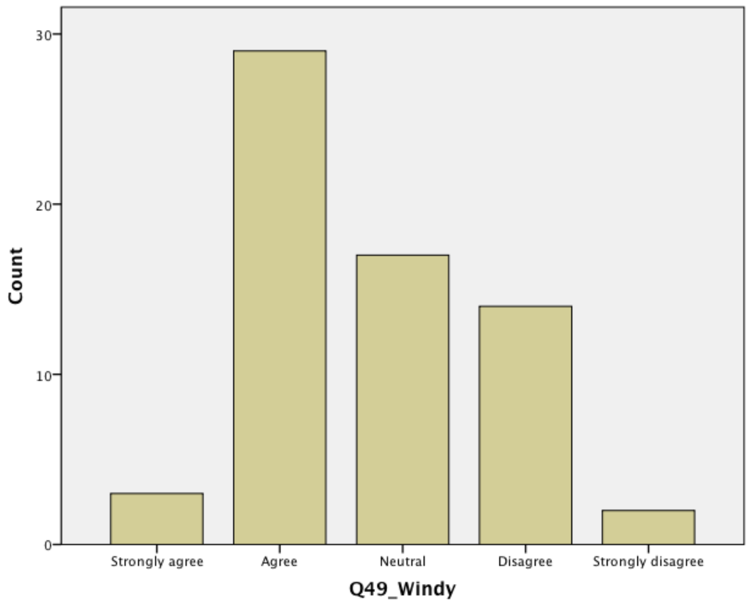


Figure 63: Question 49 "What would be your concerns regarding growing edible plants on buildings?" answers for "Too windy for the plants"

Table 26 shows that out of the 30 people who consider themselves experienced at cultivating edible plants, 17 people agreed and 9 people were neutral about it being too windy for the plants on buildings. 8 experienced people disagreed that it would be too windy for plants.

Table 26: Cross tabulation between Question 23 "How experienced are you when it comes to growing edible plants?" and Question 49 "What would be your concerns regarding growing edible plants on buildings?" answers for "Too windy for the plants"

Q23_GrowingExperience * Q49_Windy Crosstabulation

Count

		Q49_Windy					
		Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
Q23_GrowingExperience	Very experienced	1	6	2	0	0	9
	Experienced	1	9	7	3	1	21
	Quite experienced	1	8	5	5	0	19
	A bit experienced	0	5	3	4	0	12
	Not at all experienced	0	1	0	2	1	4
Total		3	29	17	14	2	65

Climatic problems can be addressed through careful design, planning and maintenance when implementing an area to cultivate edible plants on a building. Wind damage can be a problem due to the height of buildings and can be alleviated using perforated barriers to slow it down (RHS, 2016). Temperature fluctuations could also be alleviated with the use of shading devices, taller plants to add shade and regular watering during times of low precipitation. If the orientation of a building site results in a lot of shade, edible plants that are shade tolerant could be grown. In general the conditions should be assessed and the appropriate edible plants for those conditions should be chosen.

Again as above, these solutions relate to other parameters; "carefully considered design, planning and maintenance" may not be an option for someone who does not have the **knowledge** (parameter UK1) of how to solve these climatic problems and/or does not have the **financial resources** (parameter UE1) to hire someone who does have this knowledge, and to pay for the materials needed to solve these issues.

BP7. The angle of a building surface is a parameter.

If someone had no flat surface to grow on a building (e.g. a balcony, spare floor space or a flat roof) they may have a pitched roof or wall that could be utilised, but they see the angle of the surface as a barrier. Interview participant 20 said "my house has a very steep pitched roof so it's not really, the house isn't suitable so I have a little green roof on my porch and another one on my garden shed." There are various types of systems that would create the possibility to cultivate plants on a wall or a pitched roof, however these systems are not easily available to most people, as they do not know they exist or how they work (**knowledge of construction** (parameter BK3)) and/or they do not have the **financial resources** (parameter UE1) to pay for these systems. Many of these systems have not been designed for edible plants, so **easy access** (parameter BP2) has not been considered as part of their designs.

Personal Psychological Parameters (BPP)

BPP1. A person's opinion about making use of spare building space

15 out of 30 interviewees mentioned that it is a good idea to make use of disused building space. Interview participant 9 said "I really like the idea that you use spaces that aren't otherwise used. I mean what's the point of having a dead roof that's just you know complete waste isn't it?" 11 out of 30 interviewees felt that there are also different ways of using spare building space such as green roofs for biodiversity or adding solar panels. Interview participant 5 said "I sort of mentioned the alternatives that are currently attractive which is the roof space covered with solar heating or solar cells which give me direct payback." If someone thinks that it is not a good idea to use spare building space to cultivate plants then they are less likely to be motivated to undertake this behaviour. It may be more relevant in the context of the building to use the spare building space in other ways. Every site will be different and have different potential users, therefore the most appropriate solution for a space should be chosen. If there is a need or drive by the building occupants to cultivate food (or need for an activity that gives health benefits, community cohesion and environmental benefits) and there is no ground space available, then spare building space is more likely to be considered for cultivating edible plants. This relates back to parameter BP4 – the availability of other space for cultivation.

BPP2. The perceived safety of cultivating edible plants on buildings

A person will not choose to cultivate in a space that they feel is unsafe to access (parameter BP2) and/or stand in because they fear falling off the building. Interview participant 28 commented "unfortunately the wasps also come erm and it can be a bit of a you know you're running around on top of a roof being chased by a horde of bees and wasps."

Question 49 (multiple choice) in the questionnaire asked people "What would be your concerns regarding growing edible plants on buildings?". 23 out of 65 people agreed that falling off the building would be a concern for them (Figure 64).

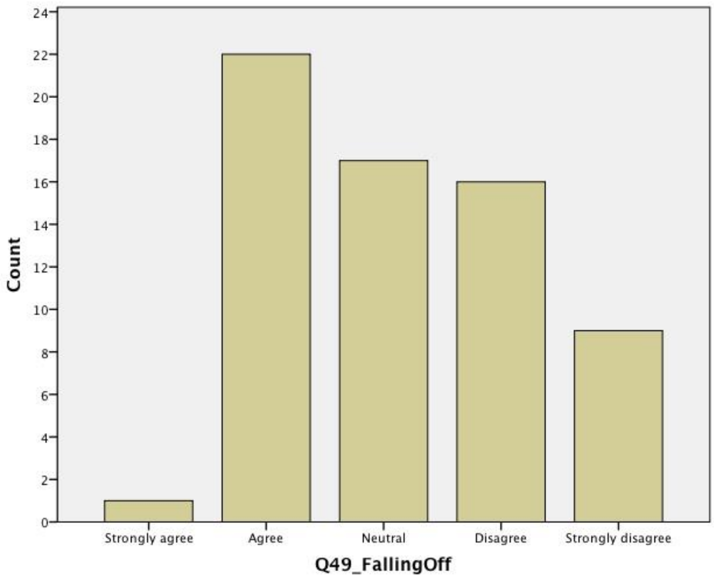


Figure 64: Question 49 "What would be your concerns regarding growing edible plants on buildings?" answers for "Falling off the building"

This parameter could be addressed as part of carefully considered design and planning using building regulations safety guidelines (e.g. appropriate balustrading, staircases, fire exits etc.) when deciding to implement an area to cultivate edible plants on buildings. People would be more likely to use the space if they feel that it is safe to use.

BPP3. The technical beliefs of a person in relation to cultivating edible plants on buildings

Some people believe that highly technical solutions would work better for buildings due to aesthetics (parameter UP3), structural issues (parameter BK1) and productivity (parameter BP1) in comparison with low-tech solutions which may be heavier (due to the use of soil as a growing medium rather than the lighter soil-less systems such as hydroponics) and less productive in comparison (see Chapter 3, section 3.2.1.7). Interview participant 19 said "I just I'm not sure where building technology is on this but but I'm just not sure that the old fashioned plant pot is terribly great."

If a person's technical belief is more inclined towards high-tech solutions then they may be less likely to cultivate food on buildings if they have financial restrictions (parameter UE1) and/or lack knowledge on how to cultivate with and/or implement these high tech systems (parameter UK1). This parameter should be something to investigate for each project and user, as one user may prefer to implement a hydroponic micro-generation solution rather than a soil based system as they have strong beliefs, interests and curiosity in technology (RUAF, 2003).

Knowledge Parameters (BK)

BK1. Knowledge of building structure

If someone has the knowledge of building structures, they would have more confidence regarding the loading capacity of a proposed area of a building considered for cultivating food. Interview participant 13 said "I wouldn't know the structural kind of principle information about how to make it safe and I think a lot of people you know would feel very uncomfortable about those kinds of things so they don't try."

Question 49 (multiple choice) in the questionnaire asked people "What would be your concerns regarding growing edible plants on buildings?". 33 out of 65 people agreed that the weight of the soil would be a concern for them (Figure 65).

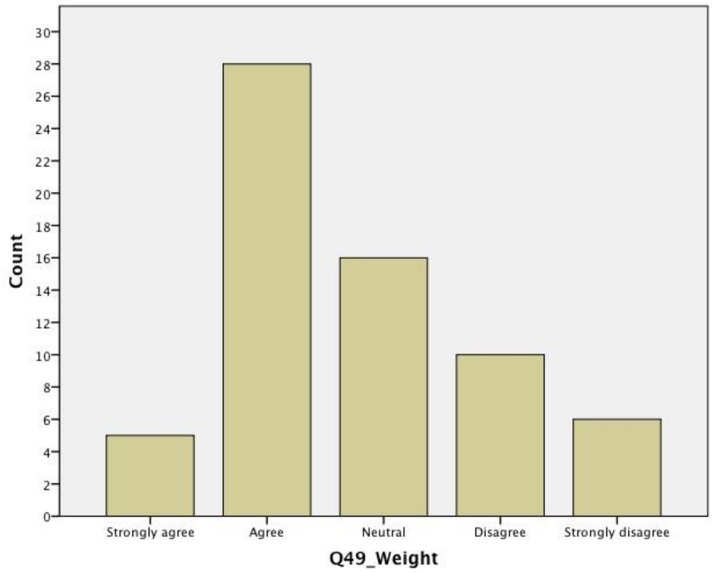


Figure 65: Question 49 "What would be your concerns regarding growing edible plants on buildings?" answers for "The weight of the soil"

This links with the parameter of knowledge of buildings affecting cultivating edible plants on buildings, which is discussed further below. A person who has **knowledge** of building construction (parameter BK3) and confidence in this **knowledge** would be more confident about structural issues when adding extra load to a roof for example.

This can be addressed through careful design, planning and maintenance when implementing an area to cultivate edible plants on a building. People who do not have the **building knowledge** to design and plan, would need help starting up (help and support parameter UC3) the area that they would like to cultivate on a building, with consultation from a person who has **knowledge of building structure** and **construction** (parameter BK3) to advise how much loading can be added. This links with the parameter of financial resources, as someone may not have the **financial resources** (parameter UE1) to pay for this advice and help.

BK2. Knowledge of existing examples of cultivating edible plants on buildings

People who are aware of existing examples of cultivating edible plants on buildings in the same context as the building space that they have available, are more likely to be encouraged to also cultivate on their building, as they have seen that it can work. Interview participant 15 said, "I'm pretty sure for my neighbourhood there is an element that if someone did it and did it successfully, they may motivate others to do it." 10 out of 30 interviewees talked about knowing examples of cultivating edible plants on buildings, where 8 of these 10 people are cultivating edible plants on a building themselves. Real examples of an idea help people see that it can work. This is underpinned by the behaviour theory in Chapter 3 where the importance of examples is highlighted in; Cialdini's principles of persuasion under 'Social proof' (Cialdini, 2001), 'Observability' under the diffusion of innovation theory (Robinson, 2009) and 'Exemplifying' under the 4Es Behaviour Change Model (Defra, 2006a). This was also confirmed in Phase 1 of the research analysis where hypothesis 4 and 5 were confirmed by correlations between pairs of variables in the data.

This parameter could be addressed by showing people successful examples of cultivating edible plants on buildings. Horticultural retailers could show people successful examples in stores. Building owners, who are cultivating edible plants on buildings, could show their projects in local and national media and on the Internet.

BK3. Knowledge of building construction

If someone has the knowledge of building construction, they would have more confidence regarding how the construction detailing would work for cultivating edible plants on buildings and its impact on the building fabric. Interview participant 27 said "I'm not sure about the physical aspects like the actual building and things like that, obviously that would affect things like soil, growth."

Any type of plant cultivated on the fabric of a building is a concern to most people, as plant roots can damage buildings. Plants also need water to survive so when cultivating plants on the fabric of a building, the plants need to be irrigated, which is also a concern as water is being applied to the fabric of a building. Question 49 (multiple choice) in the questionnaire asked people "What would be your concerns regarding growing edible plants on buildings?". 19 out of 65 people agreed that the plant roots damaging the building would be a concern for them (Figure 66).

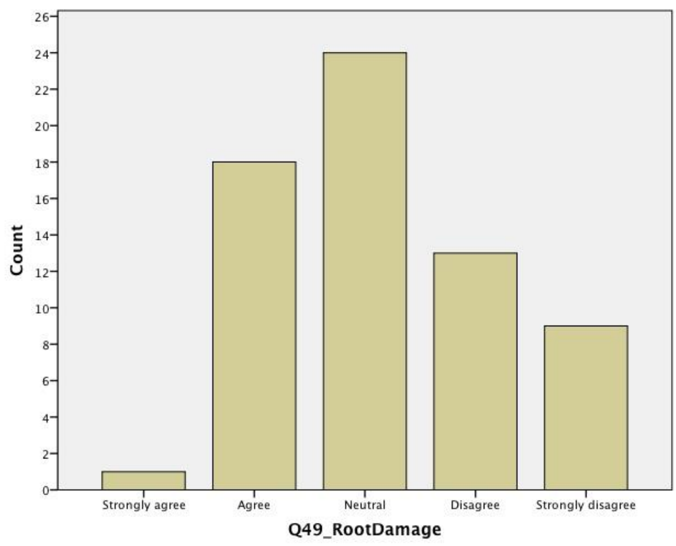


Figure 66: Question 49 "What would be your concerns regarding growing edible plants on buildings?" answers for "The plant roots would damage the building"

This parameter can be alleviated through careful design, planning and maintenance when implementing an area to cultivate edible plants on a building. Again, if the person does not have the **building knowledge** or the **financial resources** (parameter UE1) to pay for help with start up (help and support parameter UC3) from someone with this knowledge, then this would be a barrier to them cultivating edible plants on buildings.

BK4. Knowledge of the benefits of cultivating food on buildings

People who know about the benefits of cultivating edible plants on buildings are more likely to have a positive attitude towards the behaviour, and thus are more likely to undertake the behaviour of cultivating edible plants on buildings, or consider it if they do not have other space for cultivation. Interview participant 22 commented "you know at the very least then it helps to you know reduce the environmental impact of your building by absorbing storm water, helping to create biodiversity, helping to keep you know the urban area cool so you know it works on all kinds of levels."

Univariate analysis of the data from the questionnaire in phase 1 gave an indication of this parameter (see Figures 58 and 59). Bivariate analysis of the data showed that there are correlations between people who think there are benefits to cultivating food on buildings and whether they would cultivate on a building and their interest to cultivate on a building (Table 27). The table shows that people who think cultivating edible plants on buildings is good;

- for biodiversity,
- reconnecting people with food,

- helping make cities more beautiful,
- mental health and
- the triple bottom line of (economic, social and environmental) sustainability,

are more likely to agree that they would cultivate edible plants on a building and agree that they would be interested to cultivate edible plants on a building.

Table 27: Correlations between a person's perceived benefits of cultivating food on buildings and whether they would cultivate and are interested to cultivate on buildings (Ordinal)

Variable	Q53_WouldGrowOnBuildings	Q54_InterestGrowOnBuildings
Variable type	Dichotomous	Ordinal
Q48_Help developing countries become less reliant on External Markets		0.399**
Q48_Shade Buildings		0.350**
Q48_Biodivesity	-0.426**	0.602**
Q48_Reconnecting people with food production	-0.412**	0.487**
Q48_Access to Fresh Food		0.469**
Q48_ Help make cities more beautiful	-0.315**	0.507**
Q48_Mental health	-0.357**	0.498**
Q48_Physical Health		0.507**
Q48_Sustainability triple bottom line	-0.332*	0.549**

This parameter can be addressed by increasing people's knowledge of the benefits of cultivating edible plants on buildings through access to information on why it is good to do it. Horticultural retailers, e.g. garden centres, could provide this information. National government could encourage showing example projects and their benefits on media, such as television.

6.3.2 Cultivating in urban areas

Physical Parameters (UP)

UP1. The time needed for cultivating food

Most people who live in urban areas undertake jobs/activities that do not involve cultivating food so they would need to allocate time for cultivating food on top of the other things that they do. Interview participant 11 stated, "It's about the amount of time it can take because I've got an allotment that I struggle to work and that time can be quite a big time commitment."

The findings in this research suggest that time is one of the key reasons as to why people are not cultivating edible on buildings (and cultivating edible plants in general). This finding was also highlighted in the questionnaire data analysis in phase 1 of this research study. Figure 67 shows that out of the 8 people who are not growing anything edible (including herb bushes and fruit trees in a garden), 7 people agree that they do not grow anything due to lack of time. Figure 68 shows that out of the 57 people who are growing something (even just a herb bush or fruit tree in their garden), 49 people agree that lack of time would be a barrier.

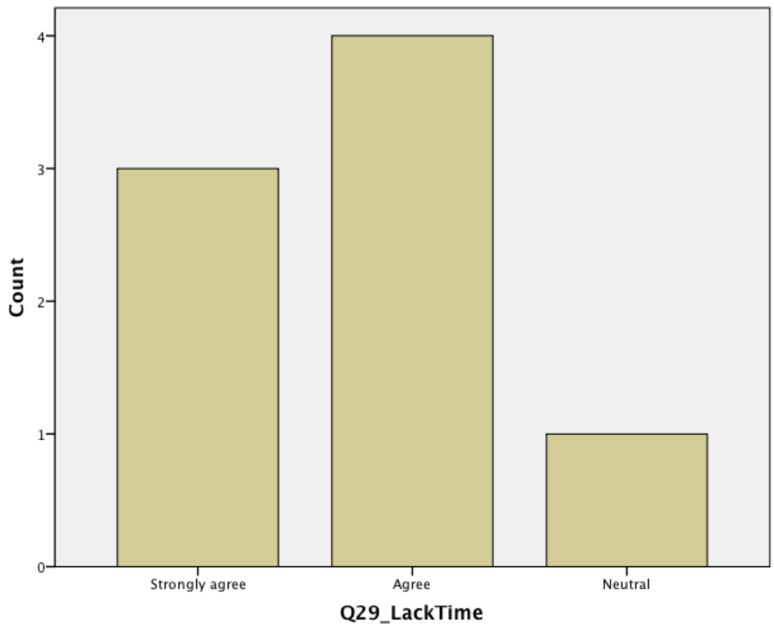


Figure 67: People who aren't growing anything agree that lack of time is a barrier Question 29 "Why aren't you growing your own food?"

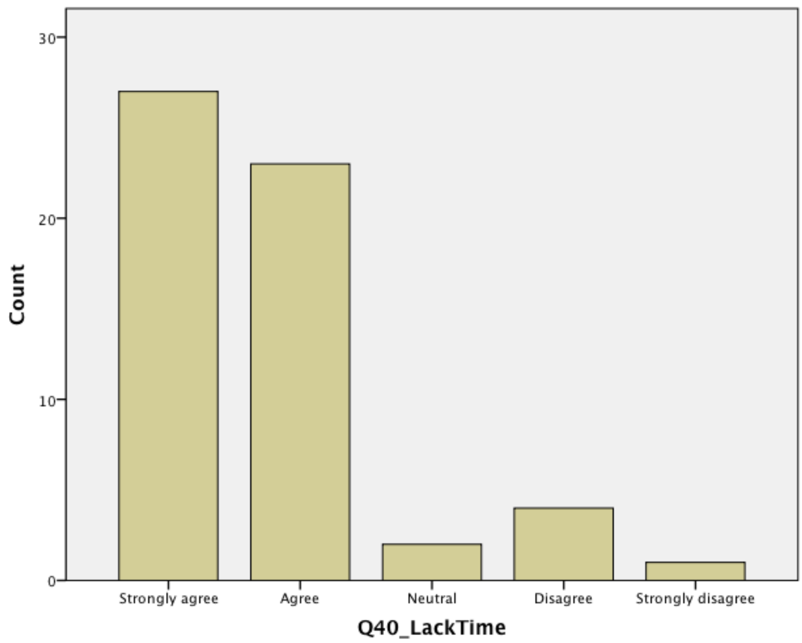


Figure 68: People who are growing something (could be just herb bushes or fruit trees in their garden) agree that lack of time would be a barrier Question 40 "What obstacles would have prevented your edible garden(s) from being set up?"

This parameter can be addressed through; increasing **knowledge** of cultivating (parameter UK1), as this can give people the knowledge of things that need little maintenance time to cultivate, and **knowledge of building construction** (parameter BK4), as this can decrease the time needed to set up an edible garden on a building.

UP2. Access to resources and facilities

It is important to have easy access to the resources needed for maintaining a garden such as tools. Interview participant 16 said "The additional thing would be taking plants errr supplies to the roof would then be a problem, if there are heavy lots of soil and equipment that could be a real problem to get up stairs." This also overlaps with **easy access to plants** (parameter BP2), as there are some resources that need to be sourced externally such as getting compost to the space. It is also important to have easy access to the facilities needed for maintaining a garden, such as toilets and somewhere to wash tools and hands etc. This is especially important if the building is not the occupants' dwelling/home.

Figure 69 shows that out of the 8 of 65 people who are not growing anything edible (including herb bushes and fruit trees in a garden), 1 person agrees that they do not grow anything due to lack of access to resources and facilities. Figure 70 shows that out of the 57 people who are growing something (even just a herb bush or fruit tree in their garden), 18 people agree that lack of access to resources and facilities would be a barrier.

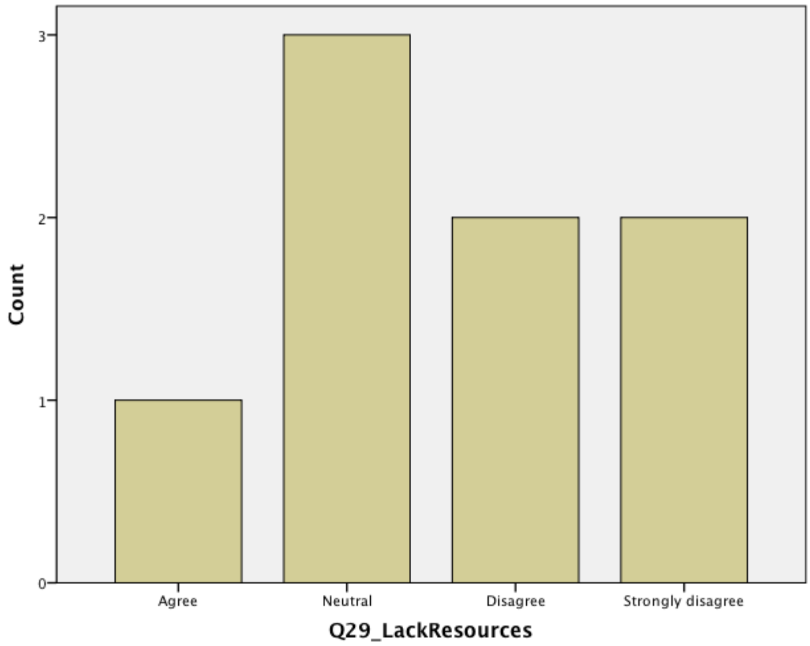


Figure 69: People who aren't growing anything agree that lack of resources is a barrier Question 29 "Why aren't you growing your own food?"

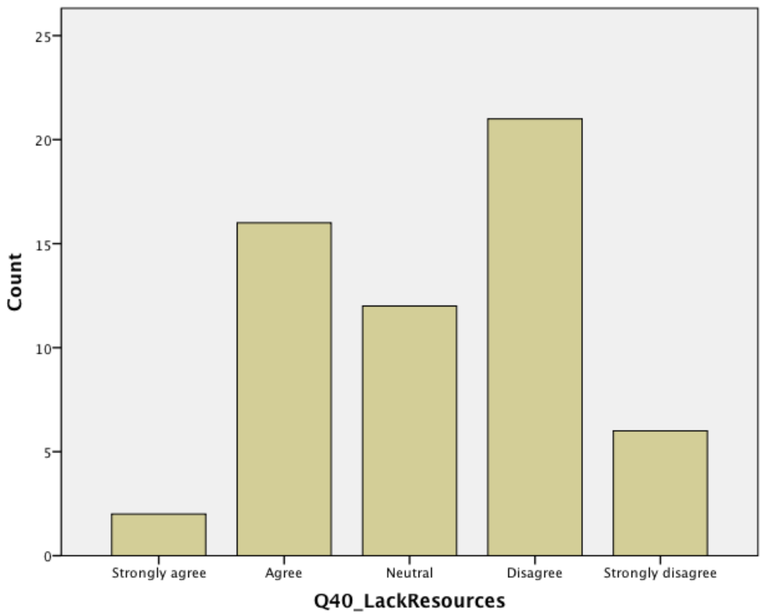


Figure 70: People who are growing something (could be just herb bushes or fruit trees in their garden) agree that lack of resources would be a barrier Question 40 "What obstacles would have prevented your edible garden(s) from being set up?"

This parameter can be addressed through careful design, planning and maintenance when implementing an area to cultivate edible plants on a building. Again, if the person does not have the **gardening knowledge** (parameter UK1) or the **financial resources** (parameter UE1) to pay for help with start up (help and support parameter UC3) from someone with this knowledge then this would be a barrier to them cultivating edible plants on buildings.

UP3. Whether the space is an aesthetically pleasing space that is enjoyable to be in

The findings in phase 2 (interviews) of this research study suggest that people would like a place for cultivating edible plants to also be an enjoyable place to spend time in and be beautiful (i.e. to also act as an amenity space). Interview participant 9 said "seating, because there's something about being able to sit and enjoy it as well and depending on the sort of levels that things are at I got, whilst I'm fine doing most things then suddenly I think oooh I've got to be careful and sit down and just for people to enjoy while they're doing it as well does matter." In the case of cultivating on buildings for example, some people do not see a rooftop as a place they would want to spend time in.

This can be addressed through consultation, with the people who would be using the cultivation space, regarding their ideas for the aesthetic of the space.

UP4. Ownership of space and permission

The ownership of spaces and permission can be restrictions as to whether someone would cultivate in a space. Interview participant 29 remarked, "I mean bearing in mind that the building is not owned by the company, it's rented so anything you do would have to be constrained by what the landlord has in the terms and conditions." They may give permission but this could be a long process of negotiation (for example, permission was granted to the author to cultivate on a roof terrace at Oxford Brookes University after a lengthy process of negotiation), which may not be possible to undertake due to other parameters such as time, commitment and determination, transiency etc. Table 28 shows that 34 out of the 57 people who are growing some kind of edible plant (including herb bushes and fruit trees) are owners of their homes and 17 people are renting.

Table 28: Cross tabulation between Question 2 "What kind of tenure is your current residence?" and Question 28 "Are you currently growing any edible plants (including herbs and fruit trees)?"

Q28_GrowingEdible * Q2_Tenure Crosstabulation

Count

		Q2_Tenure						
		Rent a room in a shared dwelling	Rent privately	Live in a dwelling that I own	Live with parents	Rent from local authority or housing association	Other	Total
Q28_GrowingEdible	No	2	4	1	1	0	0	8
	Yes	6	9	34	1	2	5	57
Total		8	13	35	2	2	5	65

UP5. Climate

15 out of the 30 interviewees felt that the climate in the UK can be difficult for cultivating the plants that they would like to cultivate throughout the year or during the colder months. Interview

participant 8 said "Too cold at the moment so get energy to do is still difficult for me, it has to be convenient, especially in the winter." There were also comments about it being unpleasant to cultivate during the colder months. This could be addressed through increasing knowledge about what can be grown in the UK climate. The issue of unpleasantness in the colder months could be resolved by showing how people cultivate comfortably in the colder months.

UP6. The level of transiency of a person's lifestyle

11 out of 30 interviewees talked about transiency being an issue for them in relation to cultivating edible plants. Interview participant 2 stated, "I went abroad for a while and I had a job in Hampshire for a while which meant I wasn't living here permanently." People can move home annually (maybe due to their job situation or their tenancy situation etc.) thus they may not feel settled enough somewhere to cultivate anything. Setting up the garden, planning the planting etc. takes effort to organise, so if people are unsure how long they are staying in a place then they are less likely to invest time and effort in a cultivation space. Dennett and Stillwell have linked population transiency in the UK with age, where they found that 16-29 year olds are the least stable and older age groups are the more stable (Dennett & Stillwell, 2008). They also found that urban areas exhibit more transiency and said, "in London this is partially due to the younger migrant age structure" (Dennett & Stillwell, 2008, p. 40).

Table 29 from the questionnaire data analysis (phase 1 of this research study) shows that out of the 57 people who are growing something, 53 are at least 26 years old and 22 are at least 46 years old.

Table 29: Cross tabulation between Question 1 "What is your age?" and Question 28 "Are you currently growing any edible plants (including herbs and fruit trees)?"

Q1_Age * Q28_GrowingEdible Crosstabulation

Count

		Q28_GrowingEdible		
		No	Yes	Total
Q1_Age	20	2	4	6
	30	3	19	22
	40	2	7	9
	50	1	15	16
	60	0	7	7
	70	0	5	5
Total		8	57	65

At the design stage, it could be considered how plants and containers could be moved if the occupant were to move house, but it is unpredictable whether it would be possible to move everything to the new location. Knowledge of cultivation could address this parameter by showing the types of plants that are easy and cheap to grow and grow quickly, for example salads. This was demonstrated by the student vegetable diaries, where it was shown how to grow fast growing edibles on internal windowsills in student halls of residence in Oxford, UK (Wilkins, 2012).

UP7. The proximity of the growing space to where a person spends a lot of their time

Having a growing space close to where you spend a lot of your time means that you do not need to make a lot of effort to get to the growing space, so you are able to tend to the plants for short periods of time (as a break from other work for example). Interview participant 7 said, "In my office there's a balcony area which when I first joined the office it just had a few plant pots on it and erm it just seemed ideal to fill it up with edible plants so it was kind of convenient." The research findings suggest that proximity of the growing space is an important factor for people. Figure 71 shows that 60 out of 65 people would prefer to cultivate edible plants close to where they spend most of their time. 38 out of the 57 people who are cultivating edible plants grow them 0 miles from their home.

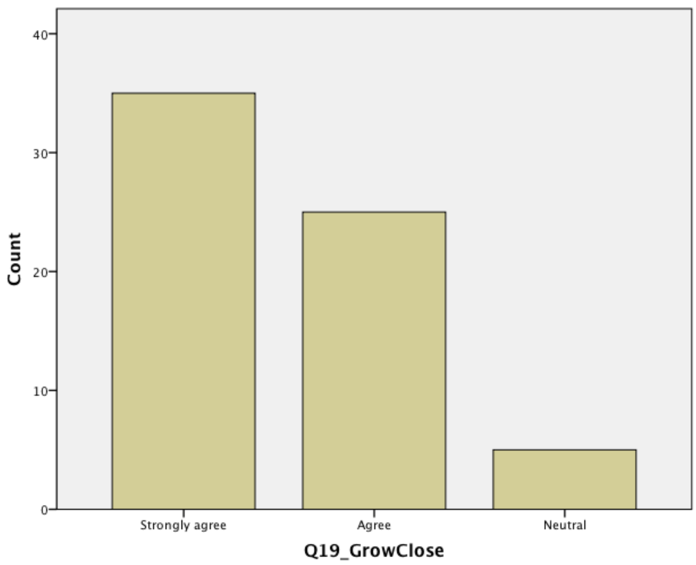


Figure 71: Question 19 "I would prefer to grow edible plants very close to the places I spend most of my time in (e.g. home and place of work)."

This parameter relates to ease of **access to the plants** (parameter BP3) as the proximity of the growing space can impact on the perceived ease of access as discussed above.
This parameter could be addressed at the design and planning stage, where a consultation process with the users can show the level of importance of proximity.

UP8. Physical and mental health

Physical exertion is needed during the set up of a cultivation space as well as during the maintenance, for example bringing in more compost. This can be especially challenging on a building if the only access to a space is via stairs. A cultivation space can be designed with raised beds suitable for wheelchair users and people who cannot bend down/squat etc. for long periods of time, but these people will need help from others during the set up and some parts of the maintenance of their garden. Interview participant 5 said, "I have back issues so the thought of having to dig...so health comes into it." This can restrict these users and discourage them from cultivating. Figure 72 from the data analysis of the questionnaire in phase 1 of this research study shows that 18 out of the 57 people who are growing something, agree that lack of physical ability would be a barrier for them when cultivating edible plants. Other people may not see this as a barrier as they feel it can be addressed, maybe through design adjustments and help from others.

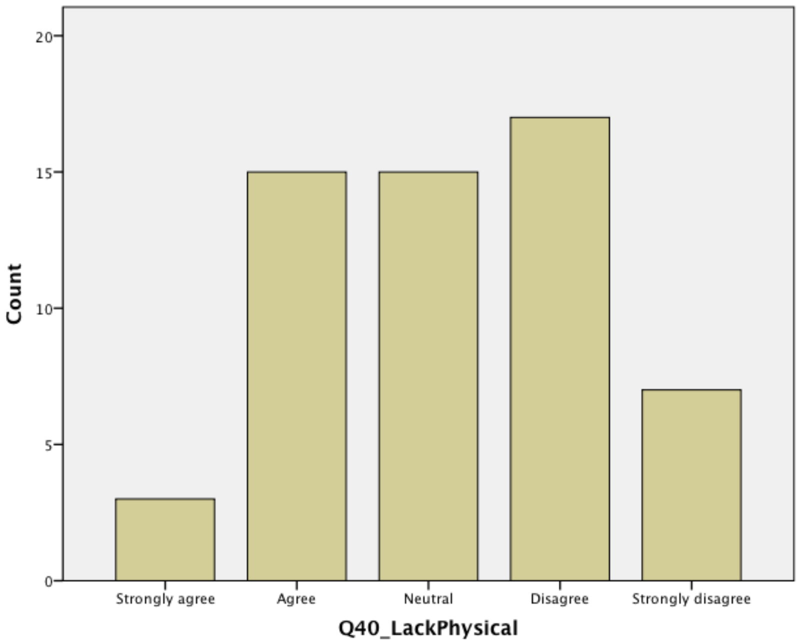


Figure 72: 18 people who are growing something (could be just herb bushes or fruit trees in their garden) agree that lack of physical ability would be a barrier Question 40 "What obstacles would have prevented your edible garden(s) from being set up?"

This parameter could be addressed at the design and planning stage, where the user requirements can be addressed using ergonomic principles discussed in chapter 3, section 3.3.5.1. This can also be addressed in the implementation stage, where requirements for help and support (parameter UC3) can be planned for in advance.

As well as physical health, mental health also affects a person's ability to cultivate edible plants on buildings. A person suffering from mental health (e.g. depression and anxiety) may have all the relevant parameters addressed, such as interest and have the skills to undertake the behaviour, but they cannot think about undertaking the behaviour due to their mental health problems. A person could have no mental health problems but not have the cognitive capacity to think about cultivating on a building, as their thoughts are taken over by other things (e.g. their work and dependants). Help and support from others (parameter UC3) could help address these psychological barriers.

UP9. Perceived level of security from vandalism and theft

Spaces for cultivation in urban areas can be victims of vandalism and theft if they are not secured appropriately (such as being locked at night). Interview participant 4 experienced theft in their communal garden, which is at ground level. Interview participant 13 said, "I can imagine a mind set where they'd be concerned or worried about, I mean not just sort of vandalism but if you invest a lot of effort into something, you'd want to know that they're going to be ok and if they are in a public environment, then I think you do get more concerned about that." There are issues with security amongst people sharing a cultivation space, for example people may take other people's produce without realising. Clear labelling and allocation of space is important in these circumstances, similar to an allotment garden (linked with UK2 project management and communication skills). Figure 73 from the data analysis of the questionnaire in phase 1 of this research study shows that 11 out of the 57 people who are growing something, agree that disaster from pests, vandalism and theft would be a barrier for them when cultivating edible plants. Other people may not see this as a barrier, as the issues could be addressed through design adjustments and management practices of the site.

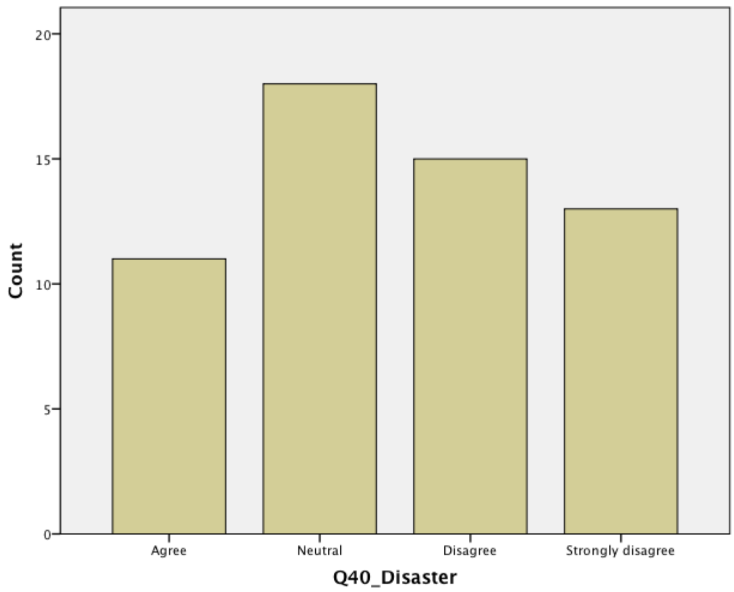


Figure 73: 11 people who are growing something (could be just herb bushes or fruit trees in their garden) agree that possible disaster from pests, vandalism and theft would be a barrier Question 40 "What obstacles would have prevented your edible garden(s) from being set up?"

This parameter could be addressed at the design and planning stage, where the level of security requirements can be discussed.

UP10. The visibility of the cultivation space

Some people may prefer their cultivation space to be hidden from view (they may not like to feel watched while gardening), whereas others would prefer their urban garden to be highly visible by others and themselves (maybe so they can see their space whilst doing other things or maybe because they would like their garden to inspire others). Interview participant 7 saw visibility as a positive thing about their garden: "I think people could even see it from when they'd come up the road. They could see all these plants growing so there'd be questions and people would come up and ask what was growing." Interview participant 17 saw visibility as a negative thing: "If you just want to go out and get away from students, you don't want them coming up to you and/or watching you particularly." The level of visibility can encourage or discourage people to cultivate in a space.

This parameter relates to ease of **access to the plants** (parameter BP3), as the level of visibility can impact on the perceived ease of access as discussed above. This parameter could be addressed during the design and planning stage by discussing the level of visibility required by the people who are gardening.

Personal psychological parameter (UPP)

UPP1. Interests, enjoyment, opinions and aims compatible with cultivating edible plants in general and/or on buildings

This parameter is about whether a person's general thoughts are positive or negative towards themselves undertaking the behaviour to cultivate edible plants at ground level and/or on buildings. Interview participant 6 expressed "Well I think that if, even if I had just a balcony I would do it because I like it, I like gardening." The findings of the research suggest that if people are not interested to grow edible plants anywhere then they are less likely to be interested to cultivate edible plants on buildings. If their opinions and aims are not orientated towards cultivating edible plants in general and/or on buildings then they are less likely to cultivate edible plants on buildings. Also, if they do not enjoy cultivating edible plants then they are less likely to cultivate edible plants on buildings, as they would not enjoy it. These findings confirm a hypothesis that is obvious: if a person is interested in a behaviour they are more likely to undertake that behaviour. Figure 74 shows that 56 out of 65 people who completed the questionnaire in phase 1 (quantitative study) of this research study agreed that they would grow their own food for personal interest and enjoyment. 29 out of 30 interviewees in phase 2 (qualitative study) of this research study talked about the importance of personal interest, enjoyment, opinions and aims supporting cultivating edible plants.

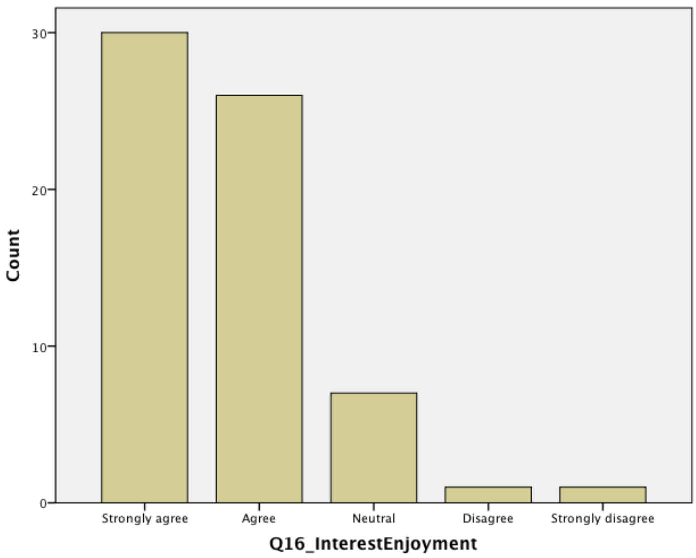


Figure 74: Answer to Question 16 – "You would grow your own food for…Personal Interest and Enjoyment"

If a person has aimed to grow food in a specific location and/or in a specific way that is not easily transferable to cultivating on a building, then they are less likely to undertake this behaviour. This parameter links with **opinions of using spare building space** (parameter BPP1), as their opinion of using that space for cultivation might be positive. This parameter also links with **knowledge of the benefits** of cultivating edible plants on buildings (parameter BK4), as having this knowledge may increase your interest to cultivate on a building.

This parameter is difficult to address as it brings forth the question "How is it possible to increase someone's interest of a behaviour?". The behaviour theory in Chapter 3, section 3.3 highlighted the impact of norms and social norms on behaviours. It may be possible to increase interest to cultivate on buildings if people saw others around them undertaking the behaviour (their community). This was also highlighted in phase 2 of this research study. Interview participant 14 said, "If my neighbour was doing it, it would make me think 'oh yeah that's easy, I'll do that too'." Education and training about a behaviour may also increase a person's interest to undertake a behaviour as they will gain an understanding of why the behaviour is important, and gain skills to be able to undertake the behaviour. How to increase a person's interest to cultivate edible plants on buildings is an area that requires further research.

UPP2. Valuing cultivating food in urban areas due to knowledge of the benefits

People who are aware of the various benefits of cultivating food in urban areas, value the behaviour more than people who are not aware of the various benefits. Interview participant 10 said, "I guess it all depends on the benefits and, I think the key thing that I always think of when I come back to this, without worth, it can be no value. So something has to be worth something to you in terms of what you get out of it otherwise it will have no value." The benefits cover social, environmental and economic areas, and can affect individuals, communities or people globally. Analysis from the questionnaire in phase 1 of this research also indicated these results, where there was a positive correlation of 0.335** (significance at the 0.1 level) between people who agree that they grow their own food for environmental reasons and whether or not they are interested to grow food on buildings. There were also positive correlations from other benefits (see table 30). This parameter can be addressed by increasing people's education about the benefits of cultivating edible plants on buildings.

Table 30: Correlations between a person's perceived benefits of cultivating food and whether they would be interested to cultivate on buildings (Ordinal)

Variable	Variable type	Q16_ Environmental reasons	Q16_ Learn how	Q16_ Gain skills and knowledge	Q16_ Food Safety	Q16_ Aesthetics	Q16_ Mental Health
Q54_InterestGrowOnBuildings	Ordinal	0.335**	0.330**	0.339**	0.317**	0.390**	0.374**

UPP3. Believing that food grown by themselves has fewer chemicals, is nutrient rich and flavoursome

Concerns about chemicals, the possibility of a lack of nutrients and lack of flavour in the food that they buy are highlighted in Chapter 3, section 3.3.1.1, Table 6, and also by comments from 18 interview participants. Interview participant 29 said, "It's nice to have fresh food there, there are some things that taste a lot better and you know it's more organic, I mean it's not completely organic but it's lot closer to being organic than a lot of the stuff you buy, and the flavour is very different. I'm about to get a plum tree because I think plums taste so watery the ones you buy in the shops, it's just a different fruit." These concerns encourage them to buy organically grown food or grow their own food as they know exactly how it has grown and can sometimes taste the difference. The expense of organic food and lack of choice also encourages people with these concerns to cultivate their own food. A key part of this parameter is that people say the produce that they grow is flavoursome. If they do not like to eat the produce (e.g. some people do not like to eat vegetables) then this will affect their behaviour to cultivate their own food, as they do not like to eat that kind of food. This was also found in Phase 1 of this research study (hypothesis 21). In contrast to this, some people eat a lot of vegetables or are vegetarian so they have more of an incentive to grow their own food. Figures 75 and 76 from the questionnaire data analysis of phase 1 of this research study show that a lot of people agreed that they would grow their own food for access to nutrient rich, fresh food and chemical avoidance and food safety.

Increasing **knowledge** of the above amongst communities can help them eat more fresh produce, eat more organic food and cultivate their own food (FLP, 2012).

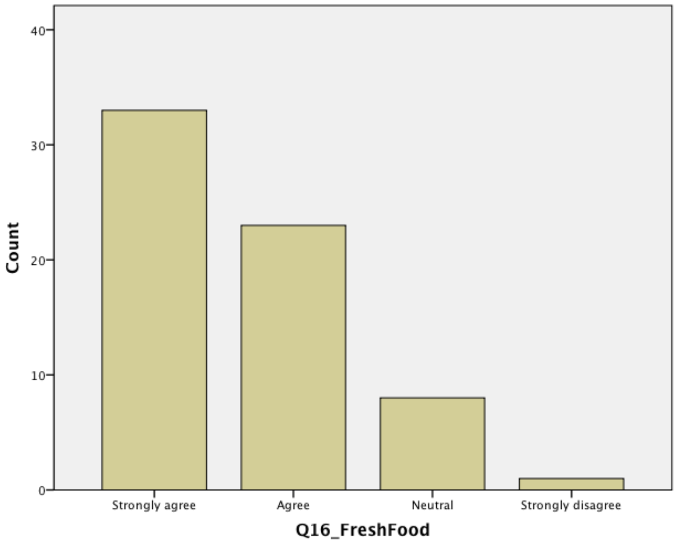


Figure 75: Answer to Question 16 – "You would grow your own food for…nutrient rich, fresh food"

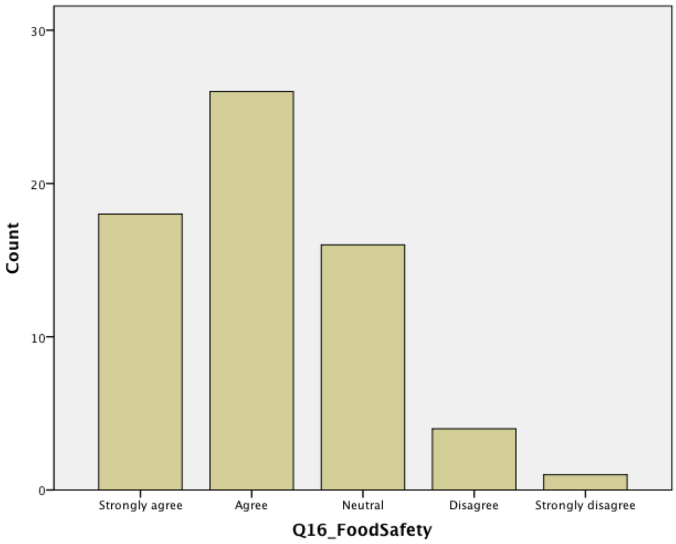


Figure 76: Answer to Question 16 – "You would grow your own food for…chemical avoidance and food safety"

UPP4. The value of the crop vs. the value of the space

Spaces in urban areas are of high value as they are in demand to be used for other purposes, thus it is more economically viable to grow high value crops in high value space, rather than low value crops. Examples of low value crops in the UK would be potatoes and onions, which are not easily perishable (transport well and store well). Examples of high value crops in the UK are tomatoes, aubergines and fresh herbs, which perish much more easily, especially in flavour. The perceived value of the crop is also personal to individuals. Owners of a building may think that cultivating edible plants on their building would decrease the retail or rentable value of the property. Interview participant 5 said, "as soon as you'd start affecting the fabric of the house, you've also got to think about the effect perhaps it will have on its resale value." Some spaces on buildings, such as a disused flat roof space, have little value and could be utilised for another purpose such as cultivating plants, which would then increase its value as a space. Spare land or derelict buildings in high-density urban areas are of high value if they can be used by city dwellers for housing/offices/retail or may want to be used for other purposes such as amenity space. A cultivating space could also be designed as an amenity space depending on whether there is enough space to fit both purposes. Interview participant 11 said, **"**A lot of the time you know you see these kind of ridiculous urban farms where there's no, there's no light apart from the first bit of the and it totally ignores the land, the socio-economic situation it's well why the bloody hell are you trying to grow low value crops in very high value land." The interviewee is talking about the use of whole buildings for the purposes of growing crops rather than for housing, offices etc. so high value crops should be grown in high value spaces. The interviewee goes on to say "It's the leftover spaces that, it's those, those weird spaces which if you monetise or view the whole city land values but it's the leftover space which almost by default do not have, they are leftover and often rooftops are leftover plots of land and that's, that's where it becomes feasible." Through the design, planning and maintenance of these cultivation spaces, they should incorporate high value crops if economics is an important factor for the user of the space.

UPP5. The commitment and determination to cultivate

Cultivating food requires a level of commitment for planning, maintaining and using the produce. A space that is designed with easy access to resources and facilities may still not be successful if the growers are not committed to using the space. This also relates to the **interest** parameter discussed above (parameter UPP1). A level of determination (for example wanting to solve issues) is also required when things go wrong. Interview participant 7 did not have easy access to water for irrigating their balcony garden. Their level of determination to make the garden was high, as they used a kitchen tap that was about 100m from the garden. They said, "In the summer it was a bit of a chore because we had limited amounts of jugs so it was a lot of journeys to and from the kitchen every evening." Seeing successful examples for cultivation on buildings can increase a person's determination to also do it successfully.

UPP6. Concerns about urban pollution contaminating food

People can be concerned about the uptake of chemicals from urban pollution into food when cultivating in urban areas where 6 out of 30 interviewees expressed this concern. Interview participant 12 commented, "I'm just wondering whether there's pollution from the traffic will affect the, the food itself. Particularly leafy food or fruits, root crops are not so bad but I know as children we were always told not to pick blackberries beside a road." Statistically, it does not seem to be a big concern amongst people as shown in Figures 77 and 78 from phase 1 of this research, but it is still a concern amongst some growers.

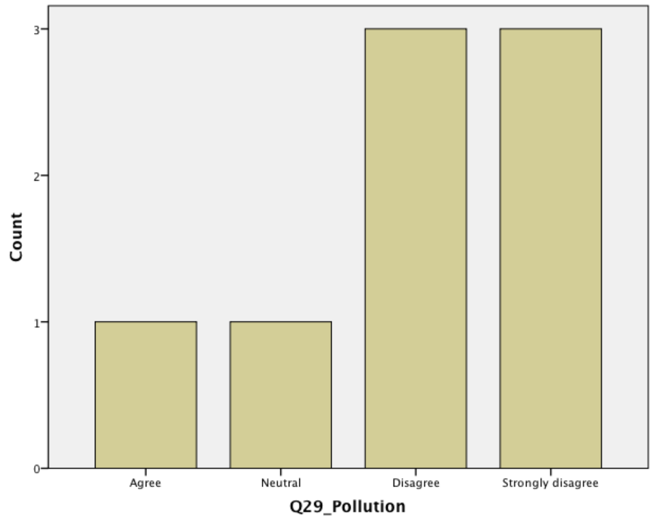


Figure 77: 1 person out of 8 people who aren't growing anything agrees that concerns about contaminated soil and air pollution is a barrier Question 29 "Why aren't you growing your own food?"

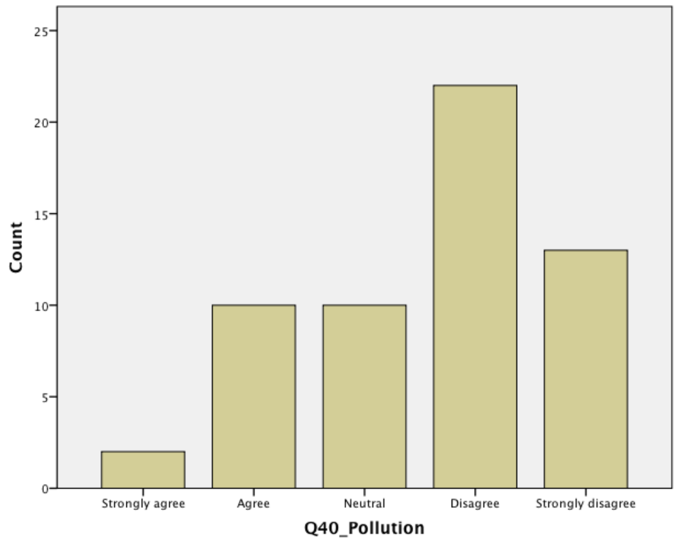


Figure 78: 12 out of 57 people who are growing something (could be just herb bushes or fruit trees in their garden) agree that concerns about contaminated soil and air pollution would be a barrier Question 40 "What obstacles would have prevented your edible garden(s) from being set up?"

As discussed in Chapter 2, section 2.3.3.1, knowledge of ways to reduce exposure of crops to urban pollution helps with these concerns.

UPP7. Belief in supporting food growers

Some people believe that it is important to support local food growers and put that as priority to cultivating their own food. Interview participant 11 said, "When I've got access to a local farmer's market and farmers who I know whose produce is coming from 5 miles away, a large part of me

thinks, it's kind of a disincentive, well why don't I, why don't I support these local growers erm rather, rather than take (time), don't want to put it in a kind of monetized way but since they're doing such a good job." This parameter relates to time (parameter UP1) and space requirements for productivity aims (parameter BP1).
This parameter can be addressed by helping growers decide what to buy and what to grow with the time and space that they have available.

Knowledge parameters (UK)

UK1. Having gardening skills and confidence in gardening (knowledge of cultivating food)

Having gardening skills and confidence can help people feel more prepared to cultivate at ground level or on buildings if they wanted to undertake the behaviour. Interview participant 7 said, "I don't know how keen I would have been to grow plants at work if I hadn't had a bit of experience doing it in my allotment." This was also found in Phase 1 of this research (Section 5.3.2.2) under Personal Psychology and Knowledge.
This parameter could be addressed through education and training on cultivating edible plants on buildings.

UK2. Project management and communication skills

People who have management skills (and communication skills if working with a team of gardeners) may feel more able start a cultivation project and/or be part of a cultivation space that has been set up already. Interview participant 27 said, "I think it just takes a few good people that come from any background but just have the knowledge or the understanding to lead these projects forward."
This parameter could be addressed through training about how to manage and maintain a space to cultivate on a building. Training about how to manage a group gardening project would be useful if the space is shared by gardeners.

UK3. Cooking skills and healthy food literacy

Cultivating edible plants requires a certain level of cooking skills, as people need to know how to cook the produce that they have grown into something that they would want to eat. Interview participant 19 said, "I'm also not a great cook so you know if I had lots of fresh vegetables, I mean I do know how to cook vegetables and I do make them with pasta or something but I am also someone who then puts a ready made sauce on it rather than makes it from scratch which again you know because it cuts an hour of work out of my daily chores." A level of healthy food literacy also encourages people to cultivate edible plants (this links with value of cultivating edible plants (parameter UPP2)).

This parameter could be addressed through education and training about the importance of eating fresh produce and how to cook with fresh produce.

Community Parameters (UC)

UC1. The benefits for community cohesion, engagement and socialising

Some people see cultivating edible plants as an opportunity to meet other people in their community and as an opportunity to socialise. 25 out of 30 interviewees talked about this in relation to cultivating edible plants in general and on buildings. Interview participant 16 said, "the offering of food is really important for the cohesion of any community so if there were more opportunities for people to grow, share not necessarily vegetables but plum wine but or a carrot or some chutney these are so good at gelling a community together."

Figure 79 from the questionnaire data analysis of phase 1 of this research study show that 27 out of 65 people agreed that they would grow their own food for being part of a community.

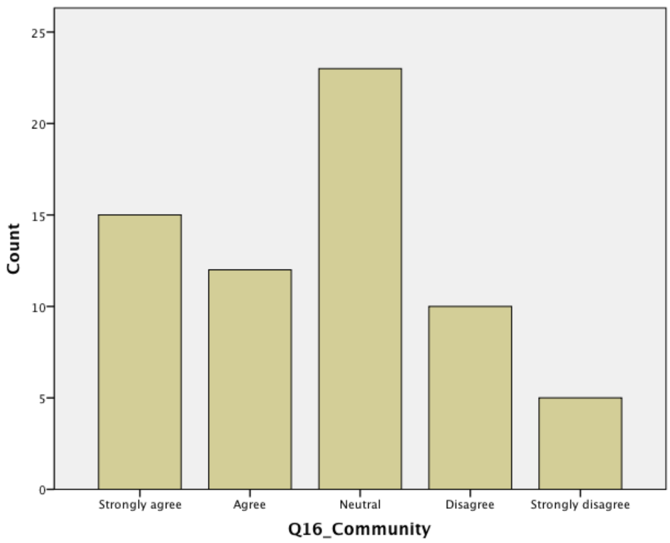


Figure 79: Answer to Question 16 – "You would grow your own food for…being part of a community"

This parameter is not relevant to everyone who would cultivate on a building, as some people prefer their garden to be a place that they can be in private. This parameter could be used as an incentive to gain funding for community gardening projects in urban areas and on buildings, which links with **financial incentives** (parameter UE2).

UC2. Sharing ideas, inspiring and giving reassurance

The literature review and the primary research showed that cultivating edible plants on buildings is a behaviour that is seen as innovative and not mainstream within the UK population, therefore sharing ideas about it, inspiring and giving reassurance could help motivate people to undertake the behaviour and/or continue undertaking the behaviour. Interview participant 23 said, "If you are growing even if it's just on your balconies on your windowsills or you know pots outside the house those kinds of things people will see it they will think hmm I'll try that particularly if you know if it looks good, smells well makes the house look nicer and things with you know with things like herbs you get the advantage of the way they smell." This also links with **visibility** (parameter UP10) and **knowledge of existing examples of cultivating on buildings** (parameter BK2). Some of the interviewees shared ideas with people who are cultivating on a building using internet based communication methods such as blogs and social networking, this also led to some inspiration to try different things and gives reassurance, for example when there have been problems. This parameter is linked with the parameter of **interest** (parameter UPP1), as people who are not interested in cultivating edible plants on buildings may not seek out information and communication with people who are undertaking the behaviour.

This parameter can be used as guidance to engage people with the behaviour of cultivating edible plants on buildings where existing projects can be used to inspire others. This parameter also provides guidance for the maintenance of spaces for cultivating edible plants on buildings, where gardeners could be encouraged to show their gardens on social media and/or open their garden sometimes to visitors.

UC3. Help and support from others

People can be encouraged to cultivate food if they have help and support setting up and/or maintaining their garden. Helpful and supportive in practical ways, and as a motivator (linked with UC2 above). 24 out of 30 interviewees talked about this. Interview participant 7 said, "The grounds team at the campus were really helpful, they provided soil and plant pots and plant themselves."

Figure 80 from the questionnaire data analysis of phase 1 of this research study show that 24 out of 65 people agreed that they would grow their own food for sharing tasks with others.

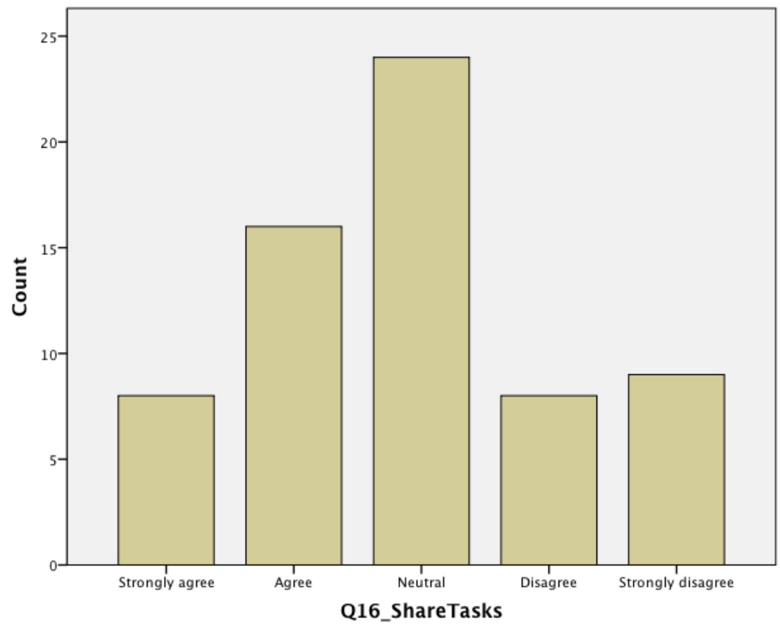


Figure 80: Answer to Question 16 – "You would grow your own food for…sharing tasks with others"

Figures 81 and 82 from phase 1 of this research show that, although lack of group help can be a barrier to growing, statistically it is not a parameter that would be a barrier for most people. However, 24 out of 30 interviewees talked about receiving help and support from others when cultivating and/or the importance of getting help and support for cultivating, thus having help and support would motivate some people to cultivate, and not having help and support could be a barrier to cultivating for some people.

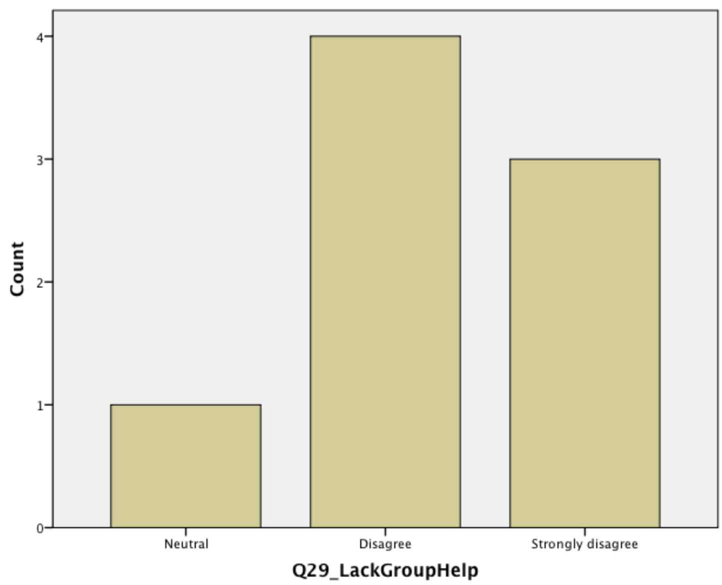


Figure 81: 1 person out of 8 people who aren't growing anything agrees that lack of group help is a barrier Question 29 "Why aren't you growing your own food?"

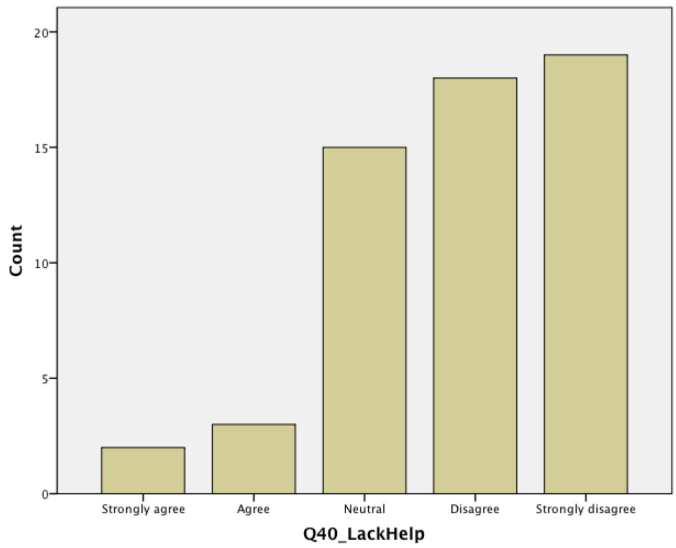


Figure 82: 5 out of 57 people who are growing something (could be just herb bushes or fruit trees in their garden) agree that lack of group help would be a barrier Question 40 "What obstacles would have prevented your edible garden(s) from being set up?"

The parameters that affect the behaviour to cultivate edible plants on buildings found in Phase 1 of this research study (Section 5.3.2.2), showed that cultivating in a community can help people to cultivate on buildings, where support from other members was seen as a possible reason as to why this could be the case.

The level of help and support required by the users should be determined at the planning and implementation stages. For example, if a housing development is implementing areas for residents to cultivate on buildings, the level of support that residents would require is difficult to determine if they do not know who the future residents are, so it may be helpful to provide all residents with a guidance document on how to use the space for cultivation. It may also be beneficial to have a workshop to introduce the residents to cultivating in the space provided.

UC4. Perceived attitude and judgement of others

Some people are affected by what others think of the behaviour that they undertake. Maybe because they do not see that behaviour as a normal thing to do in their social context (normative beliefs from Theory Reasoned Action (Ajzen, 2005)). This parameter can be either perceiving negative attitudes, which could be a barrier for some people, or perceiving positive attitude, which could be a motivator for some people. An example of a perceived negative attitude would be where interview participant 30 said, "Completely honestly my first thought would be how come they're not working?" which was in the context of growing edible plants on the building of where they work, so people may not want to cultivate on a building of their place of work if they feel that others may judge why they are not working. An example of a perceived positive attitude would be where interview participant 2 said, "People enjoy just coming up there and sitting up there… I think most people are surprised by how pretty it is in the summer."

Some businesses may think that people look at cultivating food on buildings in a positive way, thus if they did it on their building, it could be considered good marketing for their business. Interview participant 29 said, "I think you know if you've got a corporate company and it wants to be a something or something different that when you go in you remember that company because you can remember the squashes growing up the stairs then I think that's more conducive." 17 interviewees talked about something in relation to the media and growing food in general and on buildings. The media impacts people's ideas about behaviours in both positive and negative ways. Interview participant 12 talked about their surprise of what you can grow on balconies (positive impact) after watching a TV show: "Alan Titchmarsh has a series on ITV of 30 best gardens but one lot of 10 was on gardens in challenging places and he had one or two balcony gardens, absolutely incredible what people can grow on them." Interview participant 25 talked about a negative impact the media could have: "If I was about to conduct a media campaign to try to get people interested in cultivating edible plants on buildings I would be very careful, err I'd be a bit worried about the media doing trailing the story out "look at this lunatic".

Figures 83 and 84 from phase 1 of this research show that, although negative attitude of others can be a barrier, statistically the research in phase 1 did not show it as a parameter that would be a barrier for most people. This is also confirmed by the interviews where people did not see the negative attitude of others as something that would affect their behaviour to cultivate on buildings. However, many interviewees talked about the positive attitude of others, which can be a motivator to undertake the behaviour.

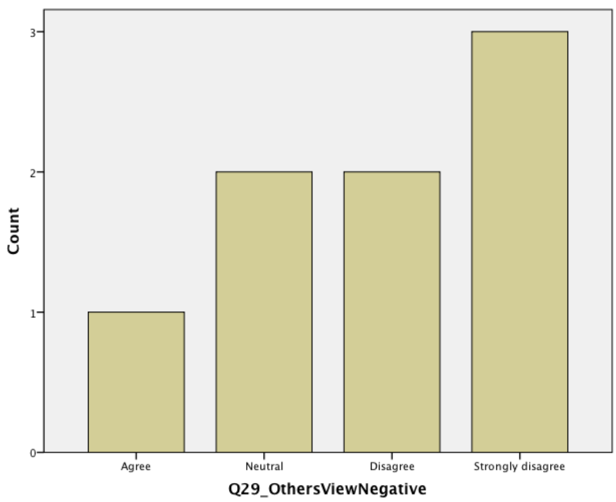


Figure 83: 1 person out of 8 people who aren't growing anything agrees that not supported or seen as a good thing by others is a barrier Question 29 "Why aren't you growing your own food?"

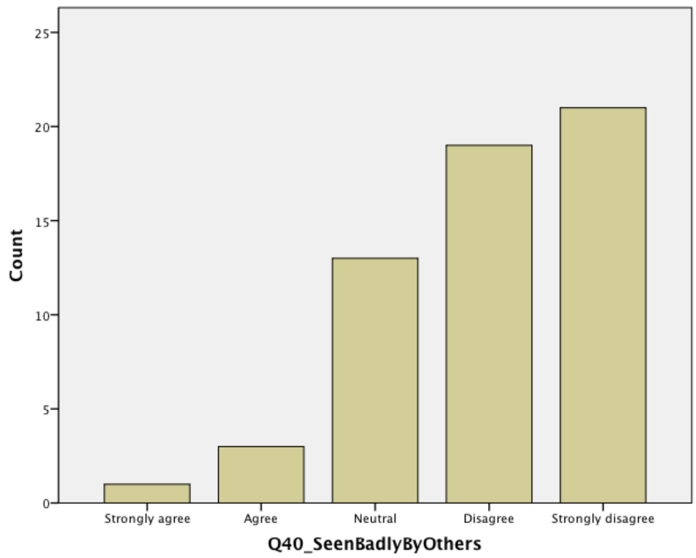


Figure 84: 4 out of 57 people who are growing something (could be just herb bushes or fruit trees in their garden) agree that not supported or seen as a good thing by others would be a barrier Question 40 "What obstacles would have prevented your edible garden(s) from being set up?"

UC5. Concerns about the cultivation space causing a nuisance to others

Spaces for cultivation in urban areas are at risk of causing a nuisance to others, as space is often shared or close together. People may be discouraged to start a cultivation space on their balcony or in their front garden, for example, as they think the plants may encroach on other people's space or block their light etc.

This parameter could be addressed through careful design, planning and maintenance. An example of a nuisance is growing edible plants that hang down from a balcony, blocking light/views for the owner of the balcony below. Interview participant 5 said, "If somebody wants to do something I'm not worried what they do as long as it does not interfere with me. So the caveat next door that if they put a tree on the roof, I do not want it to fall on to mine, but otherwise not that fussed." This comment also links with **knowledge of building construction** (parameter BK3).

Economic Parameters (UE)

UE1. Expense

18 out of 30 interviewees talked about cost, and 14 out of these 18 people talked about cost being an issue for them. Interview participant 5 felt that cultivating edible plants on buildings could require a large initial investment; "it will have a cost and the cost is significant in terms of initial investment." In contrast to this, interview participant 9 said "I mean it depends if we're talking seeds and plants it doesn't need to cost much at all does it and there's plenty of spaces that you could get that from anyway."

This was also found in Phase 1 of this research (Section 5.3.2.2) under Community and Physical. The cost can vary depending on various factors such as the size of the space, particular aesthetic they would like to achieve, maintenance costs required and tools and equipment needed. For example growing some vegetables in pots on a balcony area can be low-cost if the pots are reclaimed tubs (**UP3 aesthetics** can affect this choice). In contrast, if an individual would prefer to set up a hydroponic growing system on their balcony then they would have to pay the additional costs of the equipment and resources needed for this system, and the replacement of the equipment when it is needed. Some people feel that they do not have the correct amount of money available for the growing space that they would like to achieve. Some people do not know how much it costs to cultivate food, thus this links with **knowledge of gardening** (parameter UK1).
Figures 85 and 86 from phase 1 of this research show that, although lack of money can be a barrier to growing, statistically it is not a parameter that would be a barrier for about half of the UK population, which was shown in the questionnaire data where 14 out of 30 interviewees disagreed that lack of money is a barrier.

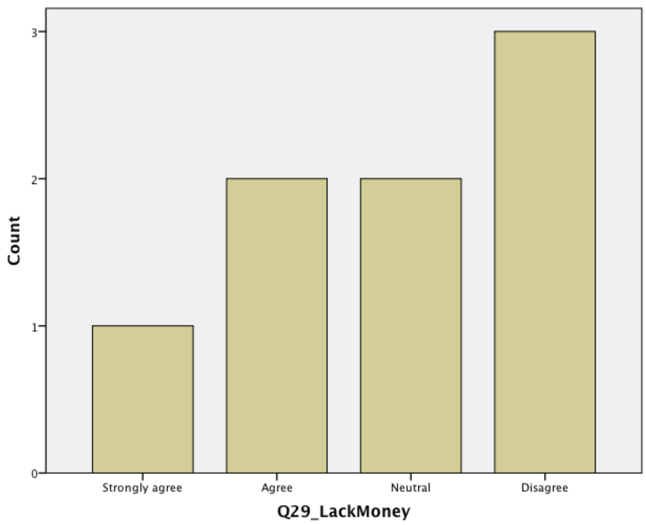


Figure 85: 3 out of 8 people who aren't growing anything agree that lack of money is a barrier Question 29 "Why aren't you growing your own food?"

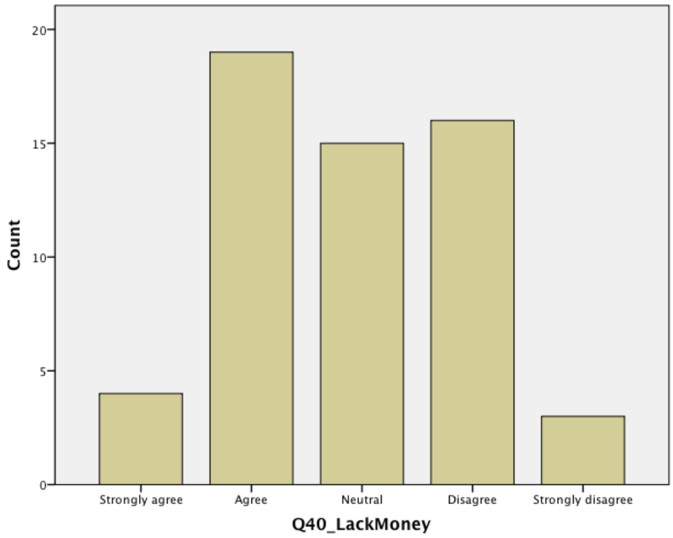


Figure 86: 24 out of 57 people who are growing something (could be just herb bushes or fruit trees in their garden) agree that lack of money would be a barrier Question 40 "What obstacles would have prevented your edible garden(s) from being set up?"

This parameter can be addressed through education and training about low-cost methods of cultivating edible plants on buildings.

UE2. Financial incentives

Some people would be encouraged to cultivate food if they were given grants to do so (Figure 87). Interview participant 5 said, "If there were some grants to cover all those little trivial things or sort of things." Some people think that the activity of cultivating food is a financial incentive itself as they are able to grow good quality, fresh food for much less money than it would have cost them to buy the food. Interview participant 2 said, "In central London they are very expensive, organic vegetables. You can get lovely organic vegetables but they're very pricey so you know, it's sensible to grow your own." In wealthy countries fresh food is affordable to a lot of people, thus there is less incentive for people to cultivate their own food. 1 person who completed a questionnaire in phase 1 of this research study and is not cultivating any edible plants, said that they agree that lack of money is a barrier to them cultivating edible plants, but being given a grant to cultivate would NOT encourage them to cultivate edible plants. This shows that although money is a parameter that would affect the behaviour to cultivate edible plants on building, the other parameters would also have an effect on a person's behaviour. This is indicating that a combination of parameters is needed in order for someone to cultivate edible plants on buildings and if one or more parameters is missing then the person may not cultivate on a building.

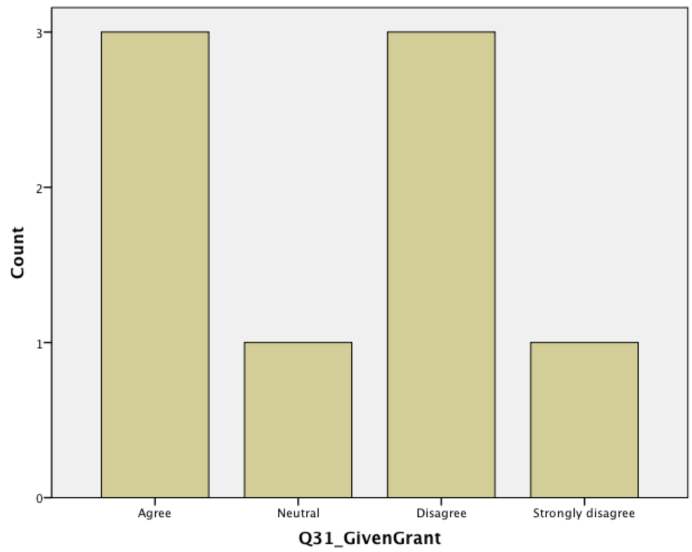


Figure 87: 3 out of 8 people who aren't growing anything agree that being given a grant would encourage them to cultivate their own food Question 29 "You would consider growing edible plants if…"

6.3.3 Scenarios of using the above parameters for the design and implementation of cultivating edible plants on buildings

This section introduces a few scenarios of how the parameters found in this research study can be used for the design development and implementation of cultivating edible plants on buildings.

Scenario 1 – A horticultural retailer

A horticultural retailer that specialises in self-assembly furniture has decided to design a product that their customers can put together for cultivating edible plants where they live or work. The retailer is given the results of this research to help with the design development of the product. They work through the parameters found in this research in relation to their target customer for the product. Examples of how they would work through the parameters are shown below:

Parameter BP1 – Space requirements for productivity aims, storage and propagation. They conclude that their target customer would be happy to cultivate in a small area of space and happy to cultivate edible plants that do not produce a lot of yield (e.g. herbs that are needed little and often). They decide that the storage space for tools will be available separate to the product they are selling. They conclude that there may be target customers who would prefer to have a high yield, so they design the product so that it can interlock/stack if a customer buys more than one.

Parameter BP2 – Access to irrigation. They conclude that their target customer may place the product in an area where there is not direct access to irrigation, so they design the product to be able to have a reserve of water available to be used by the plant roots as the growing medium begins to dry. This feature is included in order to add an element of resilience to the system when the user is not able to irrigate the system. They also decide to design the product in a way so that this reserve of water can be topped up during periods of rainfall.

Parameter BP3 - Access to plants. They conclude that the plants need to be easily accessible to the user of their product, so the product should be able to be placed/fitted somewhere the user can reach for cultivating, maintaining and harvesting.

Parameter BP4 - The availability of other space for cultivation. They conclude that the type of customer who is buying this product has decided that they don't have enough space elsewhere to cultivate edible plants, so they would like to give this product a try. The customer may decide to buy the product, even if they do have enough space elsewhere for cultivation, as the customer may decide that they like the idea of their edible plants being very close to where they are in their building.

BP5 Access to suitable growing medium. They decide to develop the product to be able to accommodate a growing medium that is easy for the user to source, for example compost that they can buy from a garden shop. They decide to sell a suitable growing medium alongside the product for easy access for the user.

BP6 Climate around building impacting cultivation. They include in the instructions for the product, guidance for avoiding harsh climatic conditions for the plants e.g. "Do not place this product in an areas with high wind speeds and try to create wind barriers where needed".

BPP1 Opinion of using spare space on buildings. They decide that the customer who is buying this product believes that it is a good idea to utilise spare space on buildings for cultivating edible plants. They decide to market the product in a way that highlights disused spaces on buildings and how this product can be placed in these spaces.

Scenario 2 – A housing developer

A housing developer has been given a planning condition by a Local Authority to incorporate areas for food production in the new housing development that they are proposing. The developer is given the results of this research to help with the development of design solutions. Examples of how they would work through the parameters are shown below:

Parameter BP1 – Space requirements for productivity aims, storage and propagation. They conclude that the people living in the housing development would be happy with 1.5m^2 of space, similar to what was allocated at the One Brighton housing development.

Parameter BP2 – Access to irrigation. They conclude that it is important to provide easy access to irrigation in the area where they have provided a cultivation space. They also conclude that it is important to provide easy access to stored rainwater for irrigation in order to reduce the amount of mains water used by the growers.

Parameter BP3 - Access to plants. They conclude that some growing areas need to be very close to resident's homes in order to provide easy access for growing for busy people. They also decide that some can be put together in an allocated area as a way to create community cohesion and so that residents can support each other. Due to limitation of space at ground level, they decide that the allocated area can be on a rooftop/terraces of a block of flats, similar to One Brighton.

Parameter BP4 - The availability of other space for cultivation. They conclude that due to budget restrictions and the need to maximise the number of dwellings on the site, they are not able to provide a lot of ground level space for residents to cultivate plants. This would result in the residents feeling that they don't have the space available at ground level for cultivation. They decide it is important to design areas on the buildings for cultivation.

BP5 Access to suitable growing medium. They decide that all areas for cultivating on the buildings should be designed to accommodate soil as a growing medium so that the residents can make use of compost from municipal food waste, which is readily available by the local authority.

BP6 Climate around building impacting cultivation. They undertake a wind assessment around their buildings in order to provide wind barriers for the cultivation areas, both for the plants and the comfort of the growers. They also conclude that it's important to have a sheltered area close to the cultivation spaces, for shading and shelter from sun/rain/snow etc.

BPP1 Opinion of using spare space on buildings. They decide to promote the idea of using spare building space for cultivating edible plants on buildings by incorporating this in their development. The spaces can inspire other home owners to implement similar interventions.

6.4 Conclusion

In this chapter, content and thematic analyses were undertaken of the interview transcripts, which highlighted parameters that affect the behaviour to cultivate edible plants on buildings, split into two locations of cultivation on buildings and urban environments in general. The parameters in each location were split into key categories including: physical parameters, personal psychological parameters, knowledge parameters, community parameters and economic parameters. The content and thematic analyses were underpinned by the main research question "What affects individuals to cultivate edible plants on buildings?" 41 parameters that affect the behaviour to cultivate edible plants on buildings were found. The parameters from Table 23 have been added to the theoretical framework diagram (Figure 88) below. The parameters in italic are the ones that have been added to the diagram after the data analysis in order to show the parameters that have been uncovered by this research study. The parameters in bold were the ones talked about by 20 or more interview participants, in order to give an indication of how the parameters can be prioritised. The parameter "Sharing tasks with others" from the literature review has been split into "Share ideas, inspire, reassurance" (UC2) and "Help and support from others" (UC3) due to the primary research in phase 2 showing these as two distinct areas of "sharing tasks with others".

The parameters in bold have been ordered by the number of people who talked about them, in order to see how they can be prioritised:

Most important parameters for cultivating edible plants on buildings:

- BP1 Space requirements for productivity aims, storage and propagation (26 participants)
- BP2 Access to irrigation (24 participants)
- BP3 Access to plants (23 participants)
- BP4 The availability of other space for cultivation (21 participants)
- BP5 Access to suitable growing medium (20 participants)
- BP6 Climate around building impacting cultivation (20 participants)
- BPP1 Opinion of using spare space on buildings (20 participants)

Most important parameters for cultivating edible plants in general in urban areas:

- UPP1 Interest, enjoyment, opinions, ideas and aims (29 participants)
- UPP2 Value growing food – knowledge of benefits (25 participants)
- UC1 Community cohesion, engagement and socialising (25 participants)
- UC2 Share ideas, inspire, give reassurance (24 participants)
- UC3 Help and support from others (24 participants)
- UP1 Time needed (24 participants)
- UK1 Skills and confidence of gardening (24 participants)
- UC4 Perceived attitude and judgement of others (23 participants)
- UP2 Accessibility of resources and facilities (20 participants)

- UP3 Aesthetics of the space (20 participants)

The list above highlights the importance of the four key categories, found in phase 1 of this research study (Chapter 5), to understand what affects individuals to cultivate edible plants on buildings. Phase 2 (Chapter 6) has highlighted the key parameters that affect the behaviour to cultivate edible plants on building, under each of these categories. The economic category is important for individuals to cultivate edible plants on buildings, but this research shows that it may be less important than some of the other parameters highlighted. This might be because, on an individual scale, it is possible to cultivate on buildings with inexpensive materials and resources (e.g. reclaimed plastic containers filled with compost).

In the next chapter, each of the parameters have been linked back with two behaviour theories from the literature review; the Theory of Planned Behaviour and the Behaviour Change Wheel. This helped towards understanding the parameters further and the interventions that could be used to address the parameters.

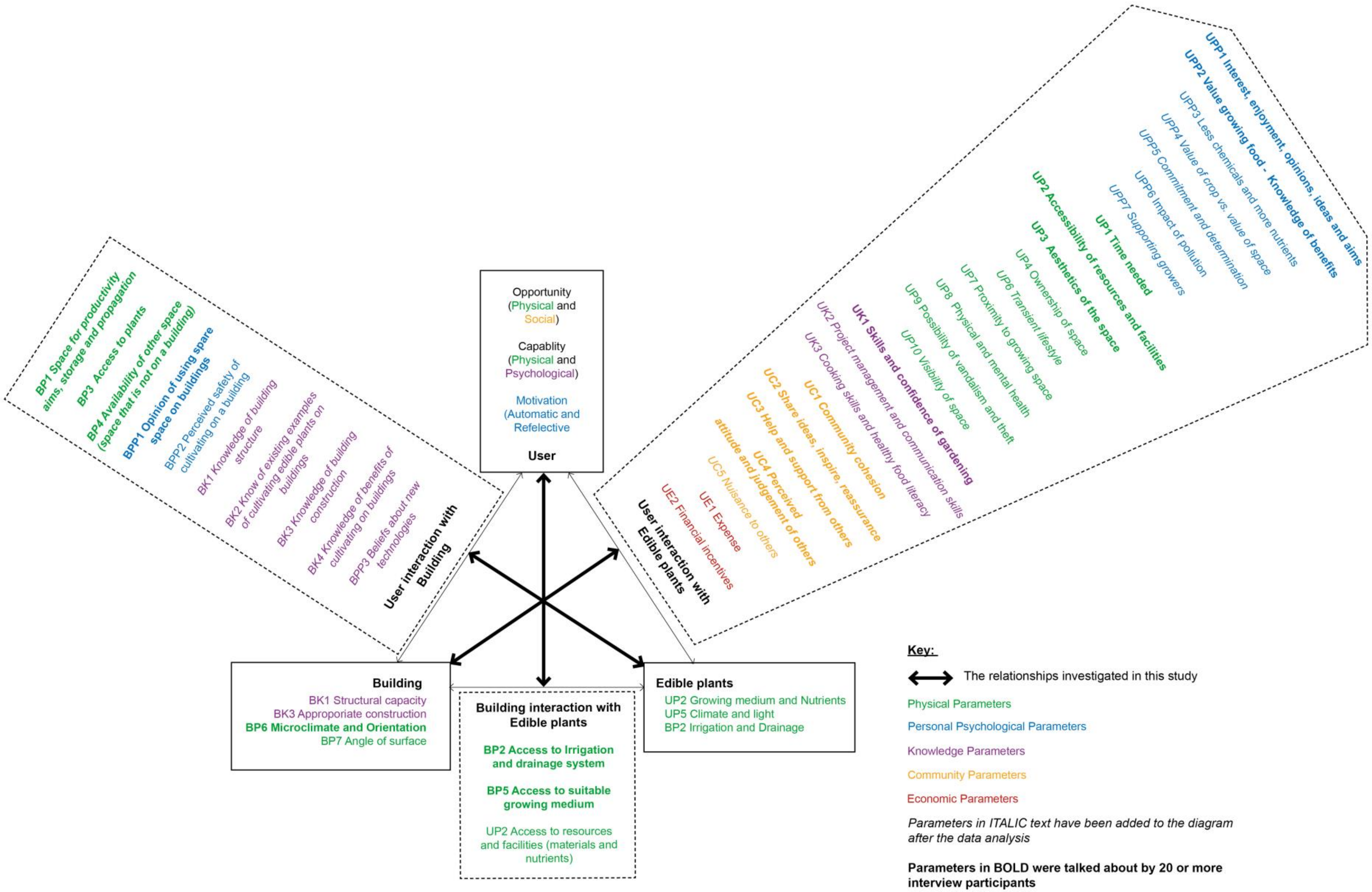


Figure 88: Theoretical framework showing the parameters that affect the behaviour to cultivate edible plants on buildings

Chapter 7 – How the parameters that affect the behaviour to cultivate edible plants on buildings, relate back to the behaviour theory

7.1 Introduction

Chapter 6 addressed the subsidiary research question: "What are the parameters that affect the behaviour to cultivate edible plants on buildings?" In this chapter, a discussion will be undertaken of the parameters in relation to two behaviour theories discussed in Chapter 3 (the Theory of Planned Behaviour and the Behaviour Change Wheel). This is undertaken by: 1. Evaluating the links between the parameters and the two theories to show how the parameters are supported by the theory and how the theory is further supported by the findings of this research and 2. Find the relevant interventions and policies from the Behaviour Change Wheel that could help address each parameter. This chapter aims to answer the subsidiary research question "How do the parameters that affect the behaviour to cultivate edible plants on buildings, relate to the behaviour theory?".

7.2 The links between the parameters and the behaviour theory

7.2.1 The Theory of Planned Behaviour and the Behaviour Change Wheel

In chapter 3, section 3.3.1 of this research study, behaviour theories were explored in order to grasp a better understanding of why someone may or may not undertake the behaviour to cultivate edible plants on buildings. Two main behaviour theories were explored; the Theory of Planned Behaviour (Figure 26) (Ajzen, 1985, 2005), which is one of the oldest and most commonly applied behaviour theories, and the Behaviour Change Wheel (Figure 32 and 33) (Michie et al, 2011), which is a newly established theory that was formed by identifying gaps in other behaviour theories.

The Theory of Planned Behaviour is split into three key areas each with determinants: behavioural beliefs which are the persons beliefs towards the behaviour and thus determines their attitude towards the behaviour, normative beliefs which are the person's beliefs about what other people think about the behaviour and thus determines what they think the subjective norms (or normal behaviours) are, and control beliefs which are what the person believes is encouraging or restricting them to undertake the behaviour such as physical parameters stopping them or psychological parameters (e.g. lack of knowledge), where the determinant is "perceived behavioural control" (their belief about how easy or difficult it would be to undertake the behaviour) (Ajzen, 1985).

Figure 33 shows that motivation is a core element in the Behaviour Change Wheel and can be the result of Capability and Opportunity, which then leads to the behaviour. Capability is split into psychological (whether your knowledge and thoughts give you capability to undertake the behaviour) and physical (whether your physical abilities give you capability to undertake the behaviour). Opportunity is everything that affects the behaviour that lie outside of the individual. Opportunity is split into physical (all physical parameters that would affect the behaviour) and social (all social parameters that would affect the behaviour). Motivation is split into two parts: automatic (desires, emotional responses, habits and psychological states) and reflective (beliefs about what is good and bad, conscious intentions, decisions and plans) (West & Michie, 2011).

A comparison of the two theories shows that the Theory of Planned Behaviour has a focus on what people perceive about a behaviour, which then leads to whether they intend to undertake the behaviour, thus addressing these parameters could encourage or discourage a behaviour. The Behaviour Change Wheel has a focus on the key areas (Capability, Opportunity and Motivation) that would encourage or discourage a behaviour, and then these are surrounded by the interventions and policies that could address the key areas. The Behaviour Change Wheel was developed through an evaluation in 2011 of a large number of key frameworks for behaviour change interventions (which included an evaluation of the Theory of Planned Behaviour) (Michie et al., 2011). It was found that frameworks for behaviour change interventions did not comprehensively cover all of the possible influences of behaviour, for example the Theory of Planned Behaviour does "not address the important roles of impulsivity, habit, self-control, associative learning, and emotional processing" (West & Michie, 2011, p. 2).

The behavioural influences from the two theories have been listed below:

A – The behavioural influences that are from a person's actual physical and psychological capability to undertake a behaviour:

Control beliefs and Physical and Psychological Capability

B – The behavioural influences that are from a person's perceived abilities to undertake a behaviour:

Perceived behavioural control and Psychological Capability

C – The behavioural influences that are from a person's thoughts towards a behaviour:

Behavioural beliefs, Attitude towards the behaviour, Psychological Capability and Reflective Motivation

D – The behavioural influences that lie outside of the individual that affect the behaviour:

Control Beliefs, Opportunity – Social and Physical

E – The behavioural influences that are affected by desires and emotional responses:

Automatic motivation

F – The behavioural influences about the behaviour that come from the people in the person's community:

Normative beliefs and subjective norms, Social Opportunity

7.2.2 Linking the parameters with the behaviour theory

The behavioural influences of these theories became an underpinning for the research questions formed for the questionnaire in the quantitative phase (phase 1) of this study. This section has looked back at these theories and assessed how they link with each of the parameters that affect the behaviour to cultivate edible plants on buildings from the theoretical framework (Figure 87 from the previous chapter). Appendix K provides this assessment. Appendix K also has a column, which looks at the interventions from the Behaviour Change Wheel that could help address each parameter that affects the behaviour to cultivate edible plants on buildings. Appendix K shows that each parameter has a link with one or more influences of behaviour from the behavioural theories. The table also shows the significance of particular interventions for most of the parameters: education, training, environmental restructuring, modelling, environmental/social planning, enablement and service provision. All of the interventions and policies from the Behaviour Change Wheel that are relevant to some or all of the parameters that affect the behaviour to cultivate edible plants on buildings, are discussed in more detail in section 7.3.

Through the assessment in Appendix K, it is found that both behavioural theories are useful when it comes to understanding the behavioural influences of each parameter that affects the behaviour to cultivate edible plants on buildings. The Theory of Planned Behaviour helps split the psychological influences that may influence a specific parameter. This is illustrated using the parameter "Knowledge of building structure" shown in Table 31, which is an extract from the main assessment table in Appendix K. Table 31 shows that this parameter is affected by several behavioural influences. Table 31 also shows that psychological capability from the Behaviour Change Wheel can be split into two psychological influences that are part of the Theory of Planned Behaviour (Control beliefs determining perceived behavioural control and Behavioural beliefs determining attitude towards the behaviour). However, Control beliefs from the Theory of Planned Behaviour also include physical influences that would influence the behaviour, which is shown in the Behaviour Change Wheel. Automatic motivation as an influence of behaviour is not present in the Theory of Planned Behaviour, but it is present in the Behaviour Change Wheel. This is another validation of the issue that was highlighted by the study that evaluated behaviour change interventions in 2011 (Michie et al., 2011). Overall, the Behaviour Change Wheel is a more comprehensive assessment of the influences that would affect a parameter, so although it is useful to see how both theories can be applied to the parameters, the Behaviour Change Wheel looks at influences of behaviour more comprehensively than the Theory of Planned Behaviour.

Table 31: An extract of Appendix K for the parameter "Knowledge of building structure" showing the influences of behaviour from two behavioural theories, the interventions that are linked with the influences and how they can address the parameter

Parameter found in literature review and phase 2	**Parameter found in Phase 2 only**	**The behavioural influences of the Theory of Planned Behaviour that this parameter is related to (Ajzen, 1985, 2005)**	**The behavioural influences of the Behaviour Change Wheel that this parameter is related to (Michie et al, 2011) NOTE: All lead to Motivation but Motivation is indicated below where there is a direct relationship with the parameter (See Figure 33)**	**Further discussion of relationship between behaviour theory and parameter**	**Intervention functions and policy categories from the Behaviour Change Wheel that could address the parameter**
BK1. Knowledge of building structure		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[ABC]) Opportunity (Social and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of building structure and "level of knowledge of building structure" as an obstacle to cultivation on buildings. B – Perceived level of ease/difficulty due to level of knowledge of building structure. C – The perceived ideas about building structure affects beliefs and attitude towards the behaviour. D – Is the	Education and training about building structure when cultivating on buildings (also through service provision below). Environmental restructuring – preparing the space for cultivating on buildings with structural issues resolved. Modelling – showing examples of how structural issues have been resolved when cultivating on buildings. Enablement – give resources/skills/support to overcome problems with the building structure (also through service provision below). Guidelines – creating a

				building structure appropriate for cultivation on buildings? E – Motivation to undertake behaviour affected by emotional responses towards the behaviour due to knowledge of building structure.	document that provides guidelines for cultivation on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated with solutions for structure.

7.3 The intervention functions and policy categories from the Behaviour Change Wheel that can help address the parameters

This section looks at the interventions and policies of the Behaviour Change Wheel and how they can be used to address the parameters that affect the behaviour to cultivate edible plants on buildings. The last column in Appendix K shows the interventions and policies that are relevant to each parameter. Parameter BP1 "sufficient space for productivity aims, storage and propagation" has been used to explain the interventions and policies in context.

7.3.1 Interventions:

7.3.1.1 Education

The definition of Education in the Behaviour Change Wheel is "Increasing knowledge or understanding" (Michie et al., 2011). Appendix K shows that education can help address 35 out of 41 parameters. This finding highlights that most of the parameters can be addressed by providing the knowledge that is relevant to the parameter. This finding also shows the significance of using education as an intervention to encourage more people to undertake the behaviour to cultivate edible plants on buildings, where individuals can be given the knowledge and understanding required for addressing a certain parameter. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier then it can be addressed through education by increasing the knowledge of how to grow and how much can be grown in smaller spaces. Or it can also be addressed by increasing understanding of the realistic levels of productivity, where it may not be possible to grow all your food requirements but where there are benefits to growing a proportion of your annual diet, which links with the parameter - how people value growing food through their knowledge of the benefits of cultivating food.

7.3.1.2 Training

The definition of Training in the Behaviour Change Wheel is "Imparting skills" (Michie et al., 2011). Appendix K shows that training can help address 35 out of 41 parameters, which shows the significance of using training as an intervention to encourage more people to undertake the behaviour to cultivate edible plants on buildings, where the relevant skills can be imparted to individuals. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier then it can be addressed through imparting skills on how to grow more in smaller spaces.

7.3.1.3 Modelling

The definition of Modelling in the Behaviour Change Wheel is "Providing an example for people to aspire to or imitate" (Michie et al., 2011). Appendix K shows that modelling can help address 34 out of 41 parameters, which shows the significance of using modelling as an intervention to encourage more people to undertake the behaviour to cultivate edible plants on buildings, where individuals can be provided with examples to aspire to. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier then it could be addressed by showing people examples of what people have grown in small spaces.

7.3.1.4 Enablement

The definition of Enablement in the Behaviour Change Wheel is "Increasing means/reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring)" (Michie et al., 2011). Appendix K shows that Enablement can help address 26 out of 41 parameters, which shows that increasing means/reducing barriers to increase capability or opportunity can be effective to encourage more people to undertake the behaviour to cultivate edible plants on buildings. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier, then it could be addressed by increasing means/reducing barriers to increase capability or opportunity through support from others who have experience cultivating edible plants in small spaces.

7.3.1.5 Persuasion

The definition of Persuasion in the Behaviour Change Wheel is "Using communication to induce positive or negative feelings or stimulate action" (Michie et al., 2011). Appendix K shows that Persuasion can help address 21 out of 41 parameters, which shows that using communication to induce positive or negative feelings, or stimulate action can be effective to encourage more people to undertake the behaviour to cultivate edible plants on buildings. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier, then it could be addressed through communication with the person to help them feel positive about cultivating in the space that they have.

7.3.1.6 Environmental Restructuring

The definition of Environmental Restructuring in the Behaviour Change Wheel is "Changing the physical or social context" (Michie et al., 2011). Appendix K shows that Environmental restructuring can help address 21 out of 41 parameters, which shows that changing the physical or social context can be effective to encourage more people to undertake the behaviour to cultivate edible plants on buildings, where the appropriate physical or social context can be created. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier then it can be addressed through providing the appropriate physical context.

7.3.1.7 Incentivisation

The definition of Incentivisation in the Behaviour Change Wheel is "Creating expectation of reward" (Michie et al., 2011). Appendix K shows that Persuasion can help address 6 out of 41 parameters, which shows that creating expectation of reward can be effective to encourage more people to undertake the behaviour to cultivate edible plants on buildings, but this intervention should be used specifically to the parameters it is relevant to, as it is not effective for addressing most of the parameters. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier then it could be addressed by showing what the incentives are to cultivate in the space that they have.

7.3.2 Policies:

Policies in the Behaviour Change Wheel have links with some interventions (Figure 89).

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Figure 89: Links between policy categories and intervention functions (Michie et al., 2011)

7.3.2.1 Communication/marketing

The definition of Communication/marketing in the Behaviour Change Wheel is "Using print, electronic, telephonic or broadcast media" (Michie et al., 2011). Appendix K shows that Communication/marketing can help address 27 out of 41 parameters, which shows that using print, telephonic or broadcast media can be effective to encourage more people to undertake the behaviour to cultivate edible plants on buildings. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier, communication/marketing about cultivating in small spaces may help people feel that it is worth cultivating in small spaces, and also show them how it can be done. Figure 89 above shows that Communication/marketing can aid the interventions: Education, Persuasion, Incentivisation, Coercion and Modelling.

7.3.2.2 Environmental/social planning

The definition of Environmental/social planning in the Behaviour Change Wheel is "Designing and/or controlling the physical or social environment" (Michie et al., 2011). Appendix K shows that Environmental/social planning can help address 26 out of 41 parameters, which shows that designing the physical or social environment to cultivate edible plants on buildings can be effective to encourage more people to undertake the behaviour to cultivate edible plants on buildings. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier, Environmental planning through the implementation of small spaces to cultivate on buildings could help address it, as the cultivation space has already been set up so people may be more likely to try growing something in the small spaces provided (such as the One Brighton roof top allotment raised beds that are 1.5 sqm, which is much smaller than a traditional allotment plots of 250 sqm (NSALG, 2015)). Figure 89 above shows that Environmental/social planning can aid the interventions: Environmental Restructuring and Enablement.

7.3.2.3 Service Provision

The definition of Service Provision in the Behaviour Change Wheel is "Delivering a service" (Michie et al., 2011). Appendix K shows that Service provision can help address 22 out of 41 Parameters, which shows that delivering a service to help aid cultivating edible plants on buildings can be effective to encourage more people to undertake the behaviour to cultivate edible plants on buildings. A company could provide a service with expert advice that can address some parameters, such as Up Top Acres based in Washington DC, USA (UpTopAcres, 2016). For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier, there could be services that aid gardening in small spaces, e.g. sections in garden shops dedicated to tools/resources needed for cultivation in small spaces. Figure 89 above shows that Service Provision can aid the interventions: Education, Persuasion, Incentivisation, Coercion, Training, Modelling and Enablement.

7.3.2.4 Guidelines

The definition of Guidelines in the Behaviour Change Wheel is "Creating documents that recommend or mandate practice. This includes all changes to service provision" (Michie et al., 2011). Appendix K shows that Guidelines can help address 18 out of 41 parameters, which shows that creating documents that recommend the practice to cultivate edible plants on buildings can be effective to encourage more people to undertake the behaviour to cultivate edible plants on buildings. For example, if parameter BP1 (having sufficient space for productivity aims) is a barrier, in the guideline document, there could be a section about how to cultivate in smaller spaces and the productivity levels that could be achieved. Figure 89 above shows that Guidelines can aid the interventions: Education, Persuasion, Incentivisation, Coercion, Training, Restriction, Environmental Restructuring and Enablement.

7.3.2.5 Regulation

The definition of Regulation in the Behaviour Change Wheel is "Establishing rules or principles of behaviour or practice" (Michie et al., 2011). Appendix K shows that regulations can help address 7 out of 41 parameters, which shows that establishing rules or principles of behaviour or practice to cultivate edible plants on buildings can be effective to encourage more people to undertake the behaviour to cultivate edible plants on buildings. For example, if parameter BP2 (access to irrigation and drainage) is a barrier, there could be regulations about how to access irrigation and also how to drain water properly on a garden space on a building. Figure 89 above shows that Regulations can aid the interventions: Education, Persuasion, Incentivisation, Coercion, Training, Restriction, Environmental Restructuring and Enablement.

7.3.2.6 Legislation

The definition of Legislation in the Behaviour Change Wheel is "Making or changing laws" (Michie et al., 2011). Appendix K shows that legislation can help address 1 out of 41 parameters (addressing the parameter "Ownership of space"). For example, legislations to protect landlords when tenants cultivate on their building space so that the landlords allow this cultivation to take place with peace of mind that they are protected by law. The other parameters could not be addressed by legislation due to the fact that cultivating food is not a behaviour that can be made law, as it is asking someone to undertake a behaviour rather than not undertake a behaviour, i.e. people cannot be forced to do something by law, but they can be forced not to do something by law (e.g. no smoking inside buildings). What reasons can be given to make it law that all people should cultivate food or that all flat roofs should be cultivated with edible plants? As a comparison, a lot of reasons can be given for making it law to not smoke inside buildings. In Bavaria, Germany it is law that all new flat rooftops above 100sqm should have extensive green roofs due to storm water retention, biodiversity and other benefits shown in chapter 2 (Ansel & Appl, 2010). It could be made law that these rooftops are rented to farmers, but the structure of these roofs may need to be strengthened, as people will be regularly accessing the roof (no regular access is required for extensive green roofs), so it would be more expensive to build these edible intensive green roofs. This could lead to developers preferring to bypass the law and build pitched roofs instead as they would be more cost effective. Figure 89 above shows that Legislations can aid the interventions: Incentivisation, Coercion, Training, Environmental Restructuring and Enablement.

7.3.2.7 Fiscal Measures

The definition of Fiscal Measures in the Behaviour Change Wheel is "Using the tax system to reduce or increase the financial cost" (Michie et al., 2011). Appendix K shows that fiscal measures can help address 1 out of 41 parameters (addressing the parameter "Financial incentives"). Figure 89 above shows that Fiscal Measures can aid the interventions: Education, Persuasion, Incentivisation, Coercion, Training, Restriction, Environmental Restructuring and Enablement.

7.3 Summary

The findings in this study have highlighted promising factors that affect the behaviour to cultivate edible plants on buildings. This chapter has shown how these parameters are supported by the Theory of Planned Behaviour and the Behaviour Change Wheel. The links between the parameters and the behaviour theory suggest that the parameters that affect the behaviour to cultivate edible plants on buildings may rely on a combination of physical and psychological conditions that lie both within the person and are external to the person. A combination of both is required in order for a person to cultivate edible plants on buildings. Said differently, a person may have all the required physical conditions needed to cultivate on a building but psychologically they are not able to or a person may have all the psychological conditions needed to cultivate on a building but are physically unable to. Further, the assessment in this chapter of the two behaviour theories also reinforced the idea that the Behaviour Change Wheel has more utility in the present work compared with the Theory of Planned Behaviour. It is argued that this is mainly because this theory does not look at Automatic motivations such as desires, emotional responses, habits and reactive psychological states.

The research in this chapter also linked the interventions and policies from the Behaviour Change Wheel with respect to the parameters under study. Figure 90 below provides a visual representation of the assessment in Appendix K. It presents an adapted version of the theoretical framework diagram (Figure 88) that illustrates the interventions and policies that can help address and understand cultivation behaviour. Figure 90 shows the number of parameters that can be addressed by each intervention and policy under each branch in Figure 88. It was found that education, training and modelling interventions are important, so significant interventions to explore when implementing cultivation of edible plants on buildings based on these factors would be promising. This further underpins the discussions of each parameter in Chapter 6 regarding how they could be addressed where knowledge was a frequent solution, for example related to cultivation skills, education of the benefits of cultivating edible plants on buildings and knowing existing examples. There are other interventions that are also helpful, so each parameter should be looked at individually. Although any given situation can be taken as unique, these findings suggest an understanding can be developed of the people who will be using the space, in order to assess the parameter's barriers for them and the interventions that can be used to address these parameters. This chapter provides a tentative approach to this end. As such it looks at how the parameters that affect individuals to cultivate edible plants on buildings can be addressed. Further research on how these parameters can be addressed is required, bringing together ideas from other relevant theories.

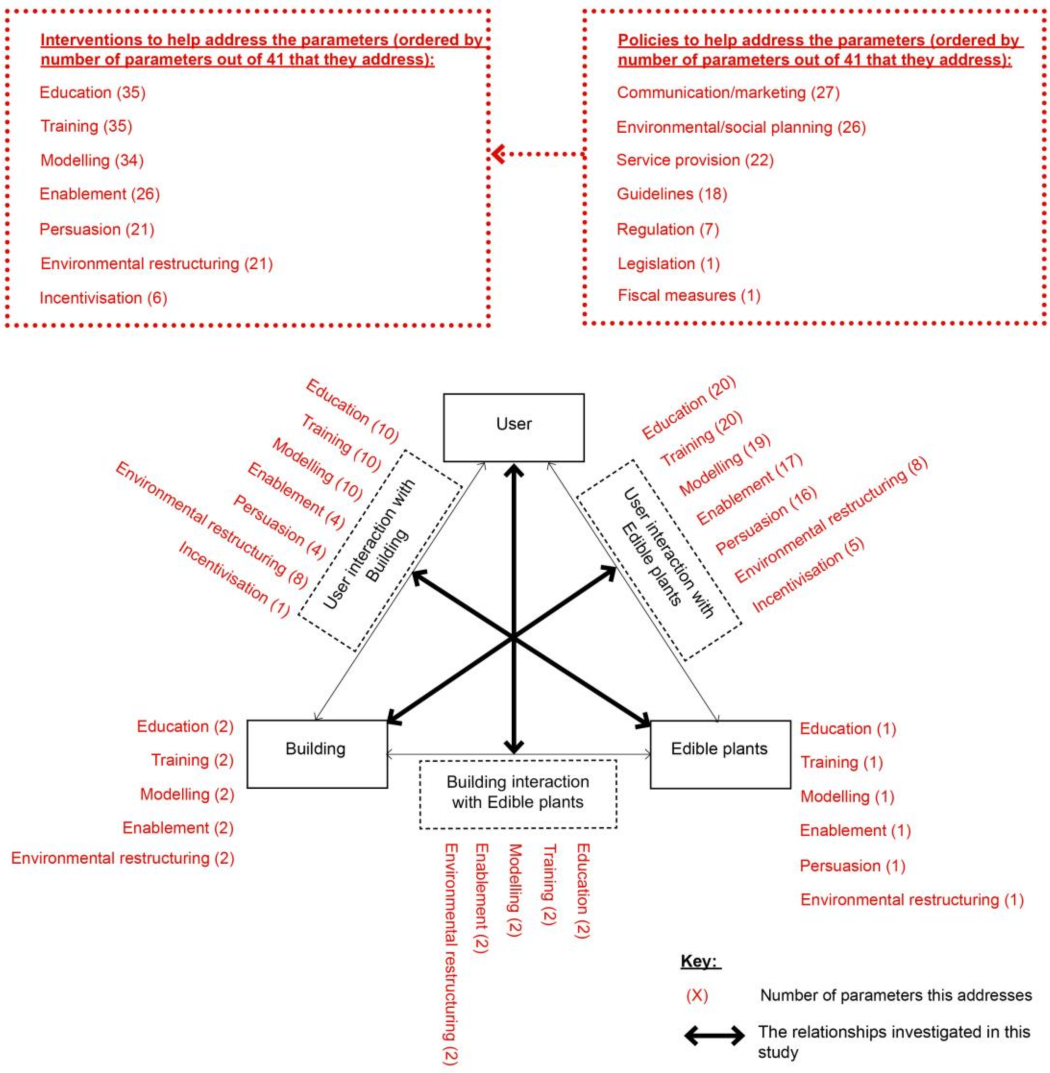

Figure 90: The intervention functions and policy categories within the theoretical framework

Chapter 8 – Conclusion: The parameters that affect individuals to cultivate edible plants on buildings

8.1 Introduction

This research was aimed at identifying the parameters that affect individuals to cultivate edible plants on buildings, in order to provide a better understanding of the "user" when designing, planning and implementing cultivation on buildings. Conclusions are based on empirical findings from 65 participants who completed questionnaires, and interviews with 30 participants with a range of experiences and backgrounds for cultivating edible and inedible plants on buildings. Findings from these participants indicated that a person's behaviour to cultivate edible plants can be affected by 41 parameters (see Figure 88 in Chapter 6 showing these parameters within a framework). The research also explored how interventions and policies from the Behaviour Change Wheel, behaviour theory (see Figure 90 in Chapter 7), could address these parameters.
The parameters within the theoretical framework of the thesis indicate that the following are important influences on the behaviour to cultivate edible plants on buildings. These are listed in order of importance and discussed further in section 8.2 below.

1. A person's cognitive capacity available to implement and maintain the system. This is the most important as without the available cognitive capacity, someone with high motivation and knowledge of cultivating edible plants on buildings, would still not be able to undertake the behaviour.
2. A person's knowledge of the how and why to cultivate edible plants on buildings.
3. A person's motivation to cultivate edible plants on a building.
4. The experience of outcomes obtained from undertaking the behaviour.
5. A person's community.

8.2 Summary of results

The thesis first examined why cultivating edible plants on buildings can be beneficial (Chapter 2, subsidiary research question a), concluding that cultivating edible plants on buildings has an important role to play in the progression to more sustainable cities. In addressing subsidiary research question (b) in Chapter 3, "What are the edible plant, user and building parameters that affect the implementation of cultivating edible plants on buildings?", it was found that extant empirical research has focused on technology developed for the production of edible plants on buildings (namely, plant and building parameters), but that very little empirical research exists which attempts to understand why users cultivate edible plants on buildings.

Given this, the present research employed behaviour theories in relation to cultivating edible plants on buildings in order to identify user parameters. To this end, a methodology (chapter 4) was adapted from the psychological and behavioural literatures in order to answer the main research question: "What affects individuals to cultivate edible plants on buildings?". This comprised a sequential-explanatory mixed methods approach which began with a questionnaire study (phase 1) developed by using presumed indicators from the literature review, and which was followed by semi-structured interviews (phase 2).

Chapter 5 showed the beginning of phase 1 of the research and answered subsidiary research question (c) "What are the categories that affect the behaviour to cultivate edible plants on buildings?" The results and analyses in phase 1 identified four categories; Community, Personal psychology, Physical and Knowledge, which guided the four open-ended questions to be asked in semi-structured interviews (phase 2 of this research study). The findings in Chapter 5 also identified three groups of individuals (people typologies) who are more likely to cultivate edible plants on buildings:

- People who are very environmentally conscious
- People who are experienced and confident cultivating edible plants
- People who think there are many benefits to cultivating edible plants on buildings

These groups helped guide the selection of individuals to interview in phase 2, in order to maximise diversity in backgrounds and experiences.

Chapter 6 presents phase 2 of the research, which addressed subsidiary research question (d) "What are the parameters that affect the behaviour to cultivate edible plants on buildings?" Content and thematic analysis of interview transcriptions, combined with the findings from phase 1, identified 41 parameters that affect the behaviour to cultivate edible plants on buildings, which could be further understood as falling into one of five categories: 1)Community (C), 2)Economic (E), 3)Personal Psychology (PP) 4)Physical (P) and 5) Knowledge (K). Out of the 41 parameters, 14 parameters were directly related to cultivating edible plants on buildings (e.g. BP – Building Physical), and 27 related to cultivating edible plants in urban areas more broadly (e.g. UP – Urban Physical). 18 parameters were found as a result of this research (i.e. they were not present in the literature review), 8 of which were directly related to buildings. These are listed in Table 23 in Chapter 6 and by order of importance below, defined by the number of participants out of the 30 interviewed who discussed them.

BP1. Space requirements for productivity aims, storage and propagation (26 participants)

BP4. The availability of other space (space that is not on a building) for cultivation (21 participants).

BPP1. Opinion of using spare space on buildings (20 participants)
BK1. Knowledge of building structure (19 participants)
BK2. Knowledge of existing examples of cultivating edible plants on buildings (17 participants)
BK3. Knowledge of building construction (15 participants)
BPP3. Beliefs about new building technologies (6 participants)
BK4. Knowledge of benefits of cultivating on buildings (5 participants)

Chapter 7 addresses subsidiary research question (e) "How do these parameters relate to behaviour theory?" Chapter 7 provides a further understanding of two behaviour theories (the Theory of Planned Behaviour and the Behaviour Change Wheel), where it was confirmed that the Behaviour Change Wheel is a more comprehensive model for looking at influences of behaviour compared with the Theory of Planned Behaviour. In Chapter 7, the 41 Parameters were linked back to two behaviour theories in order to understand where they sit within the theory, and to explore how interventions and policies based in these theoretical approaches can help encourage user engagement. Figure 90 provided a visual representation of this assessment by adapting the parameter framework (Figure 88). Education and training related to cultivating edible plants on buildings and modelling by showing people successful examples of cultivation on buildings, were highlighted as the key interventions that can address the parameters.

Figure 91 summarizes the significant findings of this research, and discusses their relationships with one another and the parameter categories (which are also discussed in greater detail below.) Figure 91 brings together the parameters in Figure 88 in the form of categories. The diagram provides a visual link between the parameter categories, showing how they related to each other in relation to someone undertaking the behaviour of cultivating edible plants on buildings. For example, Figure 91 shows that a level of knowledge is required in order for an individual to be able to cultivate edible plants on buildings, where motivation alone is not sufficient for individuals to undertake the behaviour. It also represents the underlying importance of cognitive capacity explained further below.

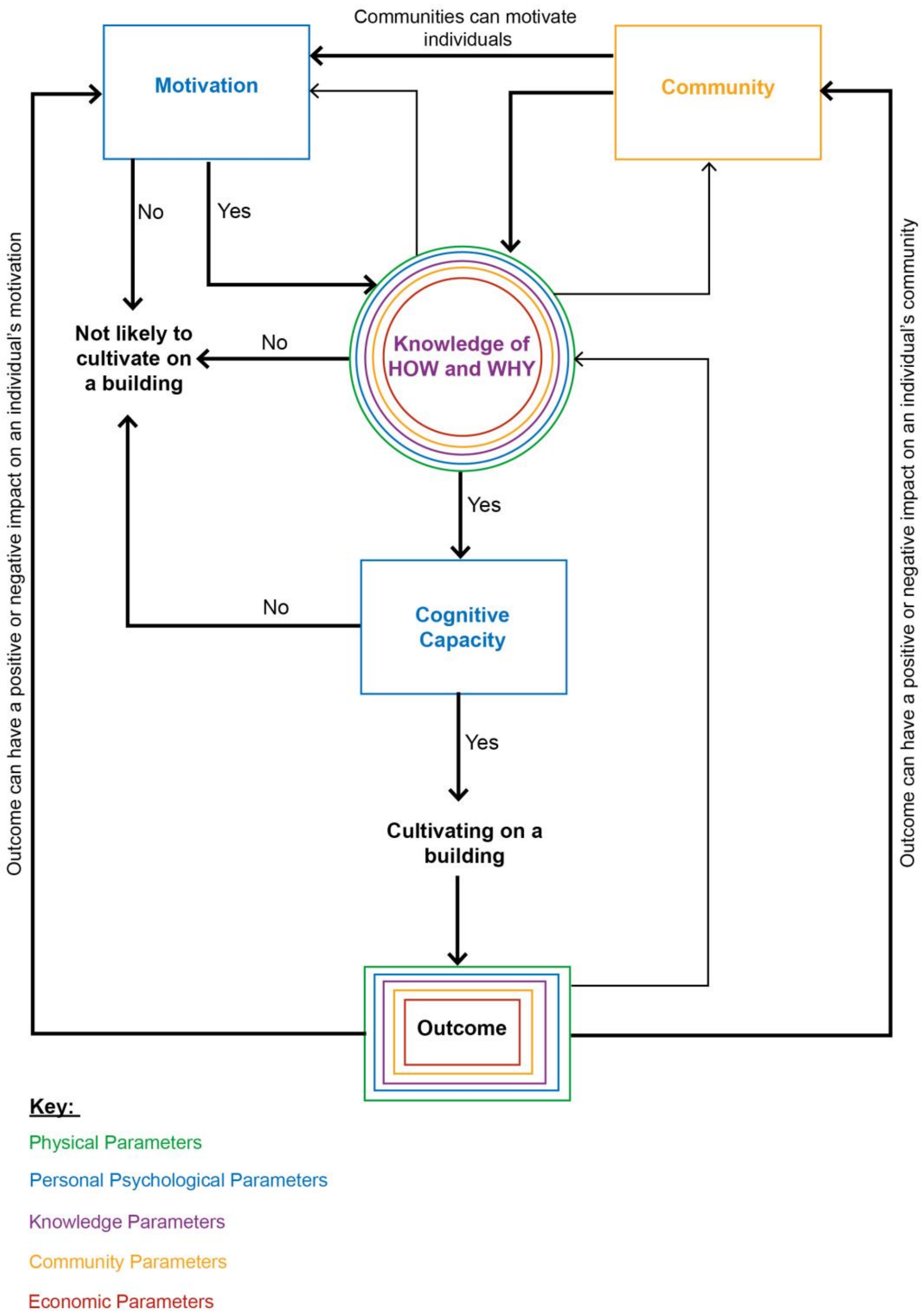

Figure 91: A summary of the parameters that affect individuals to cultivate edible plants on buildings

8.2.1 The significance of cognitive capacity

A person may know HOW and WHY to cultivate edible plants on buildings and be motivated to do it, but they may not have the cognitive capacity or mental energy (Lieberman, 2013) available to think about undertaking the behaviour. Such mental energy could be otherwise utilised by a number of other demands: due to individuals' thoughts being occupied with something else. For example occupied by work, which is linked with time (UP1) (amount of time free for other thoughts apart from work), due to sleep deprivation or poor mental health (linked with mental and physical health, UP8). The level of commitment and determination (UPP5) of an individual may be able to help to some degree to overcome a lack of cognitive capacity; If an individual is committed to undertake the behaviour, they will try hard to make it happen (Guengerich, 2013). Sharing ideas, inspiring others and giving reassurance (UC2) and help and support from others (UC3) can also help people who do not have the cognitive capacity available to cultivate edible plants on buildings.

8.2.2 The significance of knowledge of HOW and WHY to cultivate edible plants on buildings

The results in this research show that knowledge regarding how to cultivate edible plants on buildings and knowledge of why to cultivate edible plants on buildings are key to encouraging individuals to cultivate edible plants on buildings. Table 32 below shows how all 41 parameters could be addressed by knowledge of HOW and WHY. The parameters that require further explanation regarding how they can be addressed with knowledge of HOW and WHY are in bold in Table 32. Bolded parameters are especially complex, and thus are more likely to benefit from further explanation, which is given below.

Table 32: Table showing which parameters are addressed with knowledge of how and why to cultivate edible plants on buildings

Parameters addressed by knowledge of HOW to cultivate edible plants on buildings	Parameters addressed by knowledge of WHY to cultivate edible plants on buildings
- BP1 Space requirements for productivity aims, storage and propagation (26 participants) - BP2 Access to irrigation (24 participants) - BP3 Access to plants (23 participants) - BP4 The availability of other space for cultivation (21 participants) - BP5 Access to suitable growing medium (20 participants) - BP6 Climate around building impacting cultivation (20 participants)	- BPP1 Opinion of using spare space on buildings (20 participants) - **UPP1 Interest, enjoyment, opinions, ideas and aims (29 participants)** - UPP3 Less Chemicals and more nutrients - UPP4 Value of crop vs. value of space - UPP5 Commitment and determination - UPP7 Supporting growers

- UC3 Help and support from others (24 participants) - UK1 Skills and confidence of gardening (24 participants) - **UP1 Time needed (24 participants)** - UP2 Accessibility of resources and facilities (20 participants) - BPP2 Perceived safety of cultivating on a building - BK1 Knowledge of building structure - BK2 Knowledge of existing examples of cultivating edible plants on buildings - BK3 Knowledge of building construction - BP7 Angle of surface - UPP6 Impact of pollution - **UP4 Ownership of space** - UP5 Climate and light - **UP6 Transient lifestyle** - UP7 Proximity to growing space - **UP8 Physical and mental health** - UP9 Possibility of vandalism and theft - UP10 Visibility of space - UK1 Skills and confidence of gardening - UK2 Project management and communication skills - UK3 Cooking skills and healthy food literacy - UC2 Share ideas, inspire, reassurance - UC3 Help and support from others - UC5 Nuisance to others - **UE1 Expense** - **UE2 Financial incentives**	- UP3 Aesthetics of the space (20 participants) - UC1 Community cohesion - **UC4 Perceived attitude and judgement of others** - BK4 Knowledge of benefits of cultivating on buildings - BPP3 Beliefs about new technologies

- **UP1 Time needed** – It is possible to cultivate edible plants with less than 30 minutes per week if a person has the knowledge of how to cultivate edible plants that do not require a lot of maintenance. This knowledge is required in order for a busy person to address the time parameter for cultivating edible plants on buildings.

- **UP4 Ownership of space** – A person who knows how to cultivate edible plants on buildings and is not the owner of the space/building may be able to persuade the building owner that they can cultivate edible plants on the building without causing issues.

- **UP6 Transient lifestyle** – It is possible for a person who has a transient lifestyle to cultivate edible plants on buildings if they know how to arrange maintenance of their plants while they are away and/or how to take their plants with them when they relocate.

- **UP8 Physical and mental health** – A person may have knowledge of how and why to cultivate edible plants on buildings, but they are not physically or mentally able to do it. Lack of physical ability can be at different levels, ranging from unable to move without assistance to back pain when bending over. Knowledge of HOW can help address the less severe levels of physical ability, for example knowing how to set up higher planters that do not require bending down in order to alleviate the back pain issue. A person with a more severe level of physical ability could pass on their knowledge of HOW to their carer. Lack of mental ability could be addressed by other parameters such as UC3 Help and Support from others.

- **UE1 Expense and UE2 Financial incentives** – In this research, it is assumed that a person with the opportunity to cultivate edible plants on buildings has regular access to a building where they live and/or work (e.g. they are not homeless). It is possible to cultivate edible plants on buildings with very little financial input through re-using waste materials, for example plastic water bottles as planters, compost made from food waste, harvested rainwater and seeds from community seed swaps. Knowledge of how to cultivate edible plants on buildings well (productively, beautifully etc.) with little financial input can address this parameter.

- **UPP1 Interest, enjoyment, opinions, ideas and aims** – A person will not cultivate edible plants on a building if they are not interested to undertake the behaviour/if they do not enjoy it/if their opinions ideas and aims are not in support of it. Knowledge of WHY to cultivate edible plants on buildings can help address these. Someone may gain an interest/enjoyment/opinions/ideas/aims to cultivate edible plants on buildings if they obtain the knowledge of why to do it. It should be noted that even if someone knows HOW and WHY to cultivate edible plants on buildings, they still may not undertake the behaviour or continue to undertake the behaviour long term, due to lack of interest and enjoyment and other parameters related to motivation (discussed further in section 8.2.3 below).

- **UC4 Perceived attitude and judgement of others** – A person who has the knowledge of why to cultivate edible plants on buildings may perceive that others' views are positive towards the behaviour and/or may be confident enough to undertake the behaviour even with negative attitudes and judgements.

8.2.3 The significance of motivation

If a person has a strong desire to cultivate edible plants on a building they will try to work out how to do it. Knowledge of how and why to cultivate edible plants on buildings can help foster motivation, but someone can be motivated without this knowledge. Knowledge of HOW and WHY to cultivate edible plants on buildings is not easily available to 'normal' people who do not have the motivation to look for the knowledge. The stakeholders discussed below can help make this knowledge more easily available to people, which could in turn motivate more people.

8.2.4 The significance of the outcome

In order for a person to continue cultivating edible plants on buildings, they need to be pleased with the outcome. The outcome could be the edible plants that they produced, as well as the enjoyment that they had, knowledge gained, aesthetics enjoyed etc. and the physical outcome of exercise that they gained. Outcome leads to continued motivation (Figure 91).

8.2.5 The significance of the community of people around the grower

The community of people around the location where the grower would like to cultivate on a building can have a large effect on whether they do it or not. If the location were a private home, the community would be the people living with the grower. If the location were a place of work, the community would be the colleagues. The parameters related to community need to be addressed; is the community helpful and supportive in practical ways and as a motivator (UC3)? Do they see the growing as a nuisance (UC4)? The community could contribute to the knowledge where they may have shared ideas, inspired and given reassurance (UC4). As shown Knowledge of

HOW and WHY to cultivate edible plants on buildings can be shared with the community, as well as community feeding into Knowledge (Figure 91).

8.3 The key stakeholders

The key stakeholders for addressing the parameters have been identified and linked with the policy categories from the Behaviour Change Wheel (Figure 92). These stakeholders can help increase knowledge of HOW and WHY to cultivate edible plants on buildings, motivate individuals to undertake the behaviour and inform communities about the behaviour.

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Figure 92: Key Stakeholders linked with the policy categories from the Behaviour Change Wheel (Michie et al., 2011)

Built Environment Professionals (e.g. Architects, urban designers and developers), can design the physical environment for cultivating edible plants on buildings, underpinned by the parameters found in this research, in order to address the needs of the users. Built Environment Professionals can provide the practical guidelines related to cultivating on a building, where they can address the physical and knowledge parameters related to buildings, found in this research.

Local and national government, e.g. Local Authorities, can contribute the following:

- Provide practical guidelines to address the physical and knowledge parameters.
- Control the physical environment by supporting the implementation of systems for cultivating edible plants on buildings and helping address the physical parameters.
- Control the social environment by addressing the psychological, knowledge and community parameters.
- Create communication/marketing in television, in the news and in social media about cultivating edible plants on buildings, and by doing so address the psychological, knowledge and community parameters.
- Enforce legislation on building owners to allow tenants to cultivate edible plants on buildings.
- Create regulations to address the parameters in order to aid cultivating edible plants on buildings.
- Provide services to support and help people implement and maintain cultivating edible plants on buildings, for example providing an advice service for people.
- Provide reduced council tax for people who cultivate food on buildings.

Building owners can provide guidelines, control the physical and social environment of their buildings and provide services to their tenants for cultivating edible plants on buildings. Building owners can:

- Provide practical guidelines to address the physical, knowledge and community parameters. This would give tenants confidence that they have the support of their landlord and neighbours to cultivate edible plants on buildings.
- Control the physical environment by helping implement and maintaining the systems.
- Control the social environment by creating confidence amongst neighbours that it is permitted and supported to cultivate edible plants on their building.
- Provide services to help tenants cultivate edible plants on buildings, for example a service to help maintain their gardens when the tenants are away and providing an advice service.

Horticultural retailers (e.g. garden shops, supermarkets, DIY stores etc.) can provide guidelines, communication/marketing and services for cultivating edible plants on buildings.

- Provide practical guidelines to address the physical and knowledge parameters for cultivating edible plants on buildings.
- Provide communication/marketing that promotes cultivating edible plants on buildings to address the parameters.
- Provide services to help with cultivating edible plants on buildings such as implementation services to help with set up, maintenance services to help (e.g., when individuals are on holiday) and advice services. They could have a section in store dedicated to products needed for cultivating edible plants on buildings, such as tools and suitable soil for containers.

8.4 Contribution to knowledge

There has been a lack of understanding of people (users) in relation to cultivating edible plants on buildings. This thesis has used empirical data in order to identify the parameters that affect individuals to cultivate edible plants on buildings. This increased understanding informs anyone who plans to integrate edible plants with buildings in relation to the users who would be planning, maintaining, harvesting and eating edible plants. The findings of this thesis can be used in the planning, design and implementation of systems for cultivating edible plants on buildings by developing an understanding of the people who will use or are using the systems. The findings can be used for proposed systems and also for re-assessing existing systems that may not be working successfully. They can also be used for policy development.

The research has contributed to a further understanding of the Theory of Planned Behaviour and the Behaviour Change Wheel in relation to cultivating edible plants on buildings, where the strengths and weaknesses of the theories were highlighted.

8.5 Limitations of the research

The findings of this research are based on data from 65 participants who completed surveys, and 30 interview participants; All were from England, thus the results are confined to England. It is possible that, with a larger sample, these findings can be generalised more broadly with confidence. Although some of the results may be peculiar England, many will be relevant anywhere.

The sample of participants interviewed could have benefited from a greater mix of socio-economic background as only one interview participant was renting from the council and one living with their parents; the rest were homeowners or rented privately. Most of the interview participants did not have any dependants, and as such conclusions drawn are not sensitive to the role of dependants.

8.6 The potential for further research

This research has important implications for future research in relation to cultivating edible plants on buildings, with a focus on the people cultivating such plants. It would be beneficial to undertake this study in cities around the world, in order to assess how the parameters may differ as a function of culture and other contextual factors. Through such work, further parameters may become apparent that could also be applied to England. This research has highlighted potential areas of further research regarding some of the found parameters that affect individuals to cultivate edible plants on buildings:

- Sufficient space on building for productivity aims, storage and propagation, highlighted the question "What is a good amount of space for people to cultivate edible plants on buildings?" This could be undertaken through a series of questionnaires and interviews with people regarding how much space they would want if they were to cultivate edible plants on a building (Parameter BP1).

- Concerns about urban pollution contaminating food highlighted the need for further research regarding how to reduce the impact of urban pollution on edible plants. There is also potential for further research in relation to the uptake of pollution of edible plants grown on buildings in urban areas. A comparison of different locations would be beneficial in order to understand the impact of air pollution on edible plants grown on buildings (and in containers) in an urban setting. For example, edible plants could be grown on an elevation directly facing a busy road, on a rooftop of a building directly on a busy road, on the rear elevation of a building on a busy road and the same for a building that is on a quieter road (Parameter UPP6).

There is potential for further research on interventions that could help address the parameters identified in this research project, and explore the implementation and effectiveness of these interventions. For example, a future study could approach a housing estate that has a roof garden (such as Donnington and Rollo housing estate in London), implement the interventions and assess the successes and limitations.

This research focused on what affects individuals to cultivate edible plants on buildings. The findings can provide a platform for further research to understand what affects communities, developers, businesses or local and national government to implement cultivation of edible plants on buildings.

A longitudinal study was not undertaken due to limited resources. Future research could look at how the parameters that affect individuals to cultivate edible plants on buildings might change before and after cultivating edible plants on a building.

8.7 Epilogue – Designers collaborating with behavioural psychologists

Understanding the parameters that affect users' behaviour to cultivate edible plants on buildings is important for ensuring the development and successful implementation of the idea. Understanding the psychology of the user is essential for the design of anything that is going to be used. This thesis highlights the importance of the collaboration of behavioural psychologists with designers to achieve successful results.

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Appendices

Appendix A - Participant Information Sheets

QUESTIONNAIRE PARTICIPANT INFORMATION SHEET 1

Project title: Feasibility and desirability of growing food on buildings in the UK

You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. My name is Mina Samangooei, the principal researcher for this study. I am working on a research project looking at growing food in urban areas and on buildings. I am talking to several different groups in the UK about their experience of growing food in urban areas and on buildings.

Why have I been invited to participate?

You have been invited to take part as you may have an opportunity or experience in this area. 25-50 different case studies have been chosen.

What will happen to me if I take part?

We will ask you to complete a questionnaire that should take between 10-30 minutes to complete. Please answer the questions truthfully and to the best of your knowledge.

What are the possible benefits of taking part?

You will have access to the research results and gain a further understanding of the topic.

Will what I say in this study be kept confidential?

All the information you give us **will be confidential** and used for the purposes of this study only. The data will be collected and stored in accordance with the University's policy of Academic Integrity and will be kept securely in electronic form for a period of 10 years after the completion of the research project. The information will be used in a way that will not allow you to be identified individually.

What will happen to the results of the research study?

The results will be used to complete the final PhD thesis. The thesis can be accessed by contacting me at 10043333@brookes.ac.uk.

Who is organising and funding the research?

I am conducting the research as a student at the Faculty of Technology, Design and Environment, School of Architecture, Oxford Brookes University. The research is self-funded by the student.

If you want any more information about the study please do not hesitate to contact me at 10043333@brookes.ac.uk.

If you feel upset after the discussion and need help dealing with your feelings, it is very important that you talk to someone right away.

The contact details for the person to talk to are:
The Chair of the University Research Ethics Committee at Oxford Brookes University email: ethics@brookes.ac.uk

THANK YOU VERY MUCH FOR YOUR HELP!

DATE: XXXX

OXFORD BROOKES UNIVERSITY

INTERVIEW PARTICIPANT INFORMATION SHEET 2

Project title: Feasibility and desirability of growing food on buildings in the UK

You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. My name is Mina Samangooei, the principal researcher for this study. I am working on a research project looking at growing food in urban areas and on buildings. I am talking to several different groups in the UK about their experience of growing food in urban areas and on buildings.

What is the purpose of the study?

The study aims to look at how, where and why people are growing food on buildings. The study will run until September 2016. The research design takes a mixed-method approach using both questionnaires and interviews.

Why have I been invited to participate?

You have been invited to take part as you may have an opportunity or experience in this area. 25-50 different case studies have been chosen.

Do I have to take part?

No, **taking part is voluntary.** You may decide to stop being a part of the research study at any time without explanation. You have the right to ask that any data you have supplied to that point be withdrawn/destroyed.

What will happen to me if I take part?

If you agree to take part, we will ask you some questions in a 1:1 interview. The interview would last a duration of 1 hour. Please note that some of the questions will relate to your personal experiences related to the subject of this study. Please answer the questions truthfully and to the best of your knowledge.

What are the possible benefits of taking part?

You will have access to the research results and gain a further understanding of the topic.

Will what I say in this study be kept confidential?

All the information you give us **will be confidential** and used for the purposes of this study only. The interviews will be transcribed and the transcription will be sent back to you for you to check before the data is analysed. The data will be collected and stored in accordance with the University's policy of Academic Integrity and will be kept securely in electronic form for a period of 10 years after the completion of the research project. The information will be used in a way that will not allow you to be identified individually.

What will happen to the results of the research study?

The results will be used to complete the final PhD thesis. The thesis can be accessed by contacting me at 10043333@brookes.ac.uk.

Who is organising and funding the research?

I am conducting the research as a student at the Faculty of Technology, Design and Environment, School of Architecture, Oxford Brookes University. The research is self-funded by the student.

What should I do if I want to take part?

Please reply to my message with some dates and times that you would be available for an interview.

Please think about the information on this sheet, and ask me if you are not sure about anything. If you want any more information about the study please do not hesitate to contact me at 10043333@brookes.ac.uk. Please contact me if you would like to see the results of the study.

If you feel upset after the discussion and need help dealing with your feelings, it is very important that you talk to someone right away.

The contact details for the person to talk to are:
The Chair of the University Research Ethics Committee at Oxford Brookes University email: ethics@brookes.ac.uk

THANK YOU VERY MUCH FOR YOUR HELP!

DATE: XXXX

Appendix B - Consent form

CONSENT FORM FOR INTERVIEWS

Full title of Project: **Feasibility and desirability of growing food on buildings in the UK**

Mina Samangooei, PhD Research Student, email: 10043333@brookes.ac.uk

Please Initial Box

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason. ☐
3. I agree to take part in the above study. ☐
4. I agree to the interview being audio recorded ☐
5. I agree to the use of anonymised quotes in publications ☐
6. I understand that the data will be collected and stored in accordance with the University's policy of Academic Integrity and will be kept securely in electronic form for a period of 10 years after the completion of the research project. The information will be used in a way that will not allow me to be identified individually, however I understand that due to fact that the study is only looking at a small sample of cases, I may still be able to be identified. ☐
7. I understand that I will be given a copy of the interview transcription and that I can take away or add quotes if I would like to. I also understand that I can withdraw my transcription from the study. ☐

______________________	____________	______________________
Name of Participant	Date	Signature

______________________	____________	______________________
Name of Researcher	Date	Signature

Appendix C – Flyers and Emails

FLYER 1 - Posted in letterboxes of houses and flats. Shown to the office receptionist to introduce the project and ask if they could email it around the companies who work in the office.

OXFORD
BROOKES
UNIVERSITY

Research project title:

Feasibility and desirability of growing food on buildings in the UK

Would you fill out a questionnaire for our research project?

If yes, please email us at **10043333@brookes.ac.uk**, call at **07814388628** or follow this link to an online version of the questionnaire: **www.XXXX.co.uk**

It should take 10-30 minutes to complete. We are extremely grateful for your time.

THANK YOU!

FLYER 2 - Emailed to a main contact found on the organisations website, blog or facebook page.

Dear XXXX,

I am conducting a research project for my PhD thesis at Oxford Brookes University. The research project title is **"Feasibility and desirability of growing food on buildings in the UK."**
I am currently conducting my fieldwork. I am looking for people to complete an online questionnaire. Do you think members of your organisation would be willing to complete an online questionnaire? If so, I will send you another email to forward to members of your organisation. I have attached a participant information sheet to give further information about the project.

I would be extremely grateful for your time, as information from your organisation in particular would be invaluable for the research project.

I look forward to hearing from you.

Kind Regards,

Mina Samangooei
Research Student
Faculty of Technology, Design and Environment
School of Architecture
Oxford Brookes University
Mobile: 07814388628

FLYER 3 - Emailed to a main contact found on the organisations website, blog or facebook page once they have accepted to forward an email to other members of their organisation.

Dear XXXX,

Thank you for taking an interest in our research project. Please forward this email with the attached participant information sheet to members of your organisation. The link to the online questionnaire can also be found below:

www.XXXXX.co.uk

We are extremely grateful for your time.

Kind Regards,

Mina Samangooei
Research Student
Faculty of Technology, Design and Environment
School of Architecture
Oxford Brookes University
Mobile: 07814388628

Appendix D – Final Questionnaire that was sent to participants

Cultivating Edible Plants on Buildings in the UK

This doctoral (PhD) research project is aiming to find out the motivations and motivational barriers for cultivating food (edible plants) on buildings in the UK. Completing this questionnaire will help towards answering the research questions.

A. About you

* Required

1. **What is your age? ***
   Mark only one oval.
   - 15-25
   - 26-35
   - 36-45
   - 46-55
   - 56-65
   - Over 66

2. **What type of tenure is your current residence? ***
   Mark only one oval.
   - Rent a room in shared dwelling
   - Rent privately
   - Live in a dwelling that I own
   - Live with parents
   - Rent from local authority or housing association
   - Other: ______________________

3. **How many people are in your household? ***
   Type numbers only

   ____

4. **How many dependants are in your household? ***
   People under 18 and people who need full-time care.

   ____

5. **What type of home do you live in? ***
   Mark only one oval.
   - Detached house
   - Semi-detached house
   - Terraced house
   - Flat
   - Maisonette
   - Other: ______________________

6. **I use the following garden space at my current residence and/or place of work... ***
Mark only one oval per row.

	A lot	Occasionally	Rarely	Never	I don't have this
Private front garden					
Private back garden					
Balcony					
Roof terrace					
Communal garden					

7. **When it comes to adopting an idea or innovation for a good cause, which describes you best below? ***
Mark only one oval.

- I would take on any idea if it appeals to me.
- I am very comfortable with adopting ideas as long as there is some information on how to do it.
- I would try it if there is evidence that it's successful and worth doing.
- I would only take on a idea if it's successful and lots of other people have adopted it.
- I am rarely convinced to take on ideas and would only take it on if a lot of people are trying to persuade me or I had to for my own safety etc.

8. **On average, how many hours do you work per week? ***
This includes paid and voluntary employment and studying. Type numbers only.

9. **On average, how many hours of leisure time do you have per week? ***
Time not working, eating, or sleeping. Type numbers only

10. **How many of these hours would you be willing to devote to growing food? ***
State as hours per week. Type numbers only

11. **How many hours on average per year would you need for maintaining an apple tree? ***
State the hours that you think (guess) or know. This includes picking, pruning etc. Type numbers only.

12. **How many hours on average per year would you need for maintaining a rosemary bush? ***
State the hours that you think (guess) or know. Type numbers only.

13. **How many hours on average per year would you need for maintaining a tomato plant? ***
State the hours that you think (guess) or know. Type numbers only

14. **How many hours on average per year would you need for growing salad leaves if growing them all year? ***
State the hours that you think (guess) or know. Type numbers only.

15. **You think it's worth growing your own food if it contributes to... ***
Mark only one oval.

- A very small amount of your annual diet
- 1-5% of your annual diet
- 5-25% of your annual diet
- 25-50% of your annual diet
- 50-75% of your annual diet
- 75-100% of your annual diet

16. **You would grow your own food for... ***
Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Environmental reasons					
Learning about how to grow food					
Gaining skills and knowledge					
Personal interest and enjoyment					
Exercise					
Growing unique crops that you can't buy					
Saving money					
Eating nutrient rich, fresh food					
Being part of a community					
Sharing tasks with others					
Chemical avoidance and food safety					
Family influence					
Food Security					
Aesthetics/Beauty					
Mental Health					
Other (Please specify) (Select Neutral if no other) ________					

17. **You would eat... ***
Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Fruit from a garden					
Herbs from a garden					
Dandelions (leaves and flowers) from the side of a road					
Dandelions (leaves and flowers) from a garden					
Stinging nettles from a garden					
Tomatoes from a garden					
Courgettes from a garden					
Peas from a garden					

18. **In your opinion, when growing edible plants...** *
Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
grow all year round wherever possible					
avoid the use of artificial fertilisers					
use organic fertlisers e.g. compost					
use peat free compost					
minimise the use of tap water for watering the plants					
harvest rainwater for watering the plants					
avoid the use of artificial pesticides					

19. **I would prefer to grow edible plants very close to the places I spend most of my time in (e.g. home and place of work).** *
Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

20. **If you were to grow edible plants, what types of edible plants would you grow?** *
Mark only one oval per row.

	Grow a lot	Grow occasionally	Grow rarely	Grow none
Vegetables that need sowing every year				
Fruit				
Vegetables that do not need sowing every year				
Herbs that need sowing every year				
Herbs that do not need sowing every year				

21. **My friends and family grow edible plants.** *
Mark only one oval.

- Very likely
- Likely
- Unlikely
- Very unlikely

22. **How confident are you when it comes to growing edible plants in general?** *
1 = Very confident 5 = Not at all confident
Mark only one oval.

1	2	3	4	5

23. **How experienced are you when it comes to growing edible plants?** *
1 = Very experienced 5 = Not at all experienced
Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

24. **Growing edible plants does not have to be hard work.** *
Mark only one oval.

- ◯ Strongly agree
- ◯ Agree *After the last question in this section, skip to question 15.*
- ◯ Disagree
- ◯ Strongly disagree

25. **How much do you know about permaculture?** *
Mark only one oval.

- ◯ A lot
- ◯ A little
- ◯ Not much
- ◯ Nothing at all

26. **You believe that other people think that growing food...** *
Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
makes places ugly	◯	◯	◯	◯	◯
takes up too much time	◯	◯	◯	◯	◯
is expensive to run	◯	◯	◯	◯	◯
can be not inclusive for everyone (e.g. for disabled people)	◯	◯	◯	◯	◯
is difficult due to the need for resources that are not easily accessible (e.g. tools and seeds)	◯	◯	◯	◯	◯
provokes concerns about contaminated soil and air pollution	◯	◯	◯	◯	◯
provokes concerns about possible disaster (e.g from pests or vandalism and theft)	◯	◯	◯	◯	◯
Other (Please specify) (Select Neutral if no other) ____________	◯	◯	◯	◯	◯

27. **Are you currently growing any inedible plants (decorative bushes, flowers etc.)?** *
These would include anything that is growing in a garden that you own
Mark only one oval.

- ◯ Yes
- ◯ No

28. **Are you currently growing any edible plants (including herbs and fruit trees)?** *
Mark only one oval.

- ◯ Yes *Skip to question 33.*
- ◯ No

29. **Why aren't you growing your own food?** *

Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I could grow my own food, I just haven't really thought about it					
Lack of time					
Lack of money					
Lack of physical ability					
Lack of knowledge					
Lack of skills					
Lack of space					
Lack of interest					
Lack of easily accessible resources (e.g. tools and seeds)					
Concerns about contaminated soil and air pollution					
Not supported or seen as a good thing to do by others					
Lack of group help					
Possible disaster (e.g from pests or vandalism and theft)					
Squeamish about getting dirty and insects					
Legal and policy barriers (e.g. health and safety)					
I prefer growing inedible decorative plants					
Other (Please specify) (Select Neutral if no other) ________					

30. **Have you ever grown your own food?** *

This includes herb bushes and fruit trees in your garden

Mark only one oval.

- Yes
- No

31. **You would consider growing edible plants if...** *

Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
the plants needed only a few hours per year to maintain.					
you have help and support with set up					
you have help and support with maintenance					
you were given a grant to do so					
Other (Please specify) (Select Neutral if no other) ________					

32. **Would you consider growing your own food?** *

Mark only one oval.

- Yes *Skip to question 41.*
- No *Skip to question 41.*

B. About growing edible plants

33. **You are growing edible plants...** *
Mark only one oval per row.

	A lot	Occasionally	Rarely	Never
In an allotment				
In a communal garden				
Outside at ground level at your current residence				
Outside on a wall at your current residence				
On an internal windowsill at your current residence				
On an external windowsill at your current residence				
Outside on a balcony at your current residence				
Outside on a roof top at your current residence				
Inside a glazed space at your current residence				
Outside at ground level at work				
Outside on a wall at work				
On an internal windowsill at work				
On an external windowsill at work				
Outside on a balcony at work				
Outside on a roof top at work				
Inside a glazed space at work				
Other (Please specify) (Select Never if no other) ______				

34. **How many miles is your edible garden(s) from your home?** *
Type numbers only

35. **Who set up your edible garden(s)?** *
Mark only one oval per row.

	Mostly	A fair amount	A little	Not at all
Myself				
My family				
My friends				
The previous owner				
A specialist company				
Other (Please specify) (Select Not at all if no other) ______				

36. **How often do the following people help pay for your edible garden(s)?** *
Mark only one oval per row.

	A lot	Occasionally	Rarely	Never
Myself				
My family				
My friends				
Council				
Grant				
The previous owner				
If self-seeded naturally				
Other (Please specify) (Select Never if no other) ______				

37. **How often do the following people help with maintaining your edible garden(s)... ***
Mark only one oval per row.

	A lot	Occasionally	Rarely	Never
My family				
My friends				
My local community				
People from my city/town				
People from around the country				
People from international countries				

38. **What are the current aims of the edible garden(s)? ***
Mark only one oval per row.

	Very important	Important	Neutral	A bit important	Not important for the garden
To grow food					
For decorative purposes					
For training and education					
For mental and physical relaxation					
For artistic expression and creativity					
For physical exercise					
To add to the biodiversity of the area					
To create community cohesion					
To raise awareness of social, environmental and economic issues related to sustainability and climate change					
Other (Please specify) (Select Neutral if no other) ______					

39. **Where are the edible plants growing? ***
Mark only one oval per row.

	A lot	Occasionally	Rarely	Never
In the ground				
In raised beds				
In pots or other containers				
Other (Please specify) (Select never if no other)				

40. **What obstacles would have prevented your edible garden(s) from being set up?** *

Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Lack of time					
Lack of money					
Lack of physical ability					
Lack of knowledge					
Lack of skills					
Lack of space					
Lack of interest					
Lack of easily accessible resources (e.g. tools and seeds)					
Concerns about contaminated soil and air pollution					
Not supported or seen as a good thing to do by others					
Lack of group help					
Possible disaster (e.g from pests or vandalism and theft)					
Squeamish about getting dirty and insects					
Legal and policy barriers (e.g. health and safety)					
Other (Please specify) (Select Neutral if no other) ____________					

C. About the buildings that you occupy most days e.g. your flat block, your house, your office building etc.

41. **If permitted, I think it's possible to grow inedible plants on (including within) the building of...** *

Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
my current residence					
my place of work					

42. **If permitted, I think it's possible to grow EDIBLE plants on (including within) the building of...** *

Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
my current residence					
my place of work					

43. **You have grown inedible plants on the following parts of a building...** *

Mark only one oval per row.

	A lot	Occasionally	Rarely	Never
a roof				
a wall				
an internal windowsill				
an external windowsill				
a balcony				
a conservatory				
Other (Please Specify) (Select Never if no other) ____________				

44. **You have grown EDIBLE plants on the following parts of a building...** *
Mark only one oval per row.

	A lot	Occasionally	Rarely	Never
a roof				
a wall				
an internal windowsill				
an external windowsill				
a balcony				
a conservatory				
Other (Please specify) (Select Never if no other) ____________				

45. **Please share your experience of growing plants on buildings.**

46. **When it comes to growing inedible plants on a building you are...** *
Mark only one oval.

	1	2	3	4	5	
Very Confident						Not Confident at all

47. **When it comes to growing EDIBLE plants on a building you are...** *
Mark only one oval.

	1	2	3	4	5	
Very Confident						Not Confident at all

48. **You think that if people grow edible plants on buildings, it...** *
Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Helps developing countries become less reliant on external markets					
Helps keep buildings cool in hot weather					
Helps increase biodiversity (home for birds, insects etc.) in cities					
Helps reconnect people who live in cities with food production					
Helps increase people's consumption of healthy, fresh food					
Helps make cities more beautiful					
Helps increase people's mental health					
Helps increase people's physical health					
Helps towards a more sustainable social, economic and environmental future for everyone					

49. **What would be your concerns regarding growing edible plants on buildings?** *
Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Falling off the building	⬭	⬭	⬭	⬭	⬭
Lack of light	⬭	⬭	⬭	⬭	⬭
The weight of the soil	⬭	⬭	⬭	⬭	⬭
Too difficult to access	⬭	⬭	⬭	⬭	⬭
Too windy for the plants	⬭	⬭	⬭	⬭	⬭
Too polluted for the plants	⬭	⬭	⬭	⬭	⬭
Insects and pests would be attracted to the building	⬭	⬭	⬭	⬭	⬭
The plant roots would damage the building	⬭	⬭	⬭	⬭	⬭
Wouldn't be able to grow much	⬭	⬭	⬭	⬭	⬭
Too expensive	⬭	⬭	⬭	⬭	⬭
Other (Please specify) (Select Neutral if no other) ____________	⬭	⬭	⬭	⬭	⬭

50. **How likely do you think it is that careful planning and design could resolve the above issues?** *
Mark only one oval.

- ⬭ Very likely
- ⬭ Likely
- ⬭ Unlikely
- ⬭ Very unlikely

51. **The following would help persuade me to grow edible plants on buildings...** *
Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Media coverage e.g. newspaper or on television	⬭	⬭	⬭	⬭	⬭
Documented guidelines that recommend it	⬭	⬭	⬭	⬭	⬭
Tax incentives	⬭	⬭	⬭	⬭	⬭
Regulations that encourage it	⬭	⬭	⬭	⬭	⬭
Legislation that makes it mandatory e.g. if you have a large flat roof then you must rent it to a grower	⬭	⬭	⬭	⬭	⬭
Encouraged by council planning offices	⬭	⬭	⬭	⬭	⬭
Services are provided that help with maintenance	⬭	⬭	⬭	⬭	⬭
Financial help	⬭	⬭	⬭	⬭	⬭

52. **Do you know of any examples where people have grown food successfully on buildings (e.g. on a balcony, terrace or windowsill?)?** *
Mark only one oval.

- ⬭ Yes
- ⬭ No

53. **Would you grow edible plants on buildings?** *
Mark only one oval.

- ⬭ Yes
- ⬭ No

54. **How interested would you be to grow edible plants on the buildings that you occupy?** *
Mark only one oval.

- Very interested
- Interested
- Slightly interested
- Not interested

55. **Would you be happy to take part in a 1:1 interview?** *
If you say yes now you can still change your mind later.
Mark only one oval.

- Yes
- No *Skip to question 57.*

56. **Please give your preferred method of contact.** *
Any of the following would be fine: Email address, telephone number, mobile number, postal address

57. **Would you like to know the outcomes of this research?** *
If you say yes now you can still change your mind later.
Mark only one oval.

- Yes
- No *Skip to question 59.*

58. **Please give your preferred method of contact.** *
Any of the following would be fine: Email address, telephone number, mobile number, postal address

59. **Please give any further comments below.**

Appendix E – Phase 1 Bivariate Analysis, Chi-square test of significance

Cross tabulations (contingency tables) were drawn for Nominal (Dichotomous)/Nominal (Dichotomous) variables in order to see whether two variables have a relationship (De Vaus, 2002). Chi-squared tests were applied to the cross tabulations in order to establish the level of confidence that there is a relationship between two variables (Bryman, 2012).

Q7_Adopting Innovation → Q28_GrowingEdible

This test is another way of establishing whether there is a difference between the frequencies observed (O) in a cross-tabulation and the frequencies that would be expected (E) if there were no relationship between the row variable (dependant) Q28_GrowingEdible (Dichotomous) and the column variable (independent) Q7_AdoptingInnovation (Nominal) (Smith, 2011).

1. Firstly the hypothesis is defined:

Null Hypothesis, H_O: $X^2 = 0$ (No difference)

Alternative Hypothesis, H_A: $X^2 \neq 0$ (A difference)

2. The critical value on the chi-square sampling distributions is established on Figure 93.

Table 33: Cross-tabulation

Q28_GrowingEdible * Q7_AdoptingInnovation Crosstabulation

			Q7_AdoptingInnovation					
			I would take on any idea if it appeals to me.	I am very comfortable with adopting ideas as long as there is some information on how to do it.	I would try it if there is evidence that it's successful and worth doing.	I would try it if there is evidence that it's successful and worth doing.	I am rarely convinced to take on new ideas (need persuasion or feel they have to)	Total
Q28_GrowingEdible	No	Count	2	1	4	1	0	8
		Expected Count	2.9	1.6	3.3	.1	.1	8.0
	Yes	Count	21	12	22	0	1	56
		Expected Count	20.1	11.4	22.8	.9	.9	56.0
Total		Count	23	13	26	1	1	64
		Expected Count	23.0	13.0	26.0	1.0	1.0	64.0

The critical value (X^2_C) is found by calculating the degrees of freedom, and then looking up the degree of freedom against the critical value in Chi statistical table showing percentage points of the X2 distribution (Smith, 2011). There are 2 possible values for the row variables and 5 possible values for the column in the cross-tabulation (Table 33).

degrees of freedom = (row - 1) x (column - 1)

= (2 - 1) x (5 - 1)

= 4

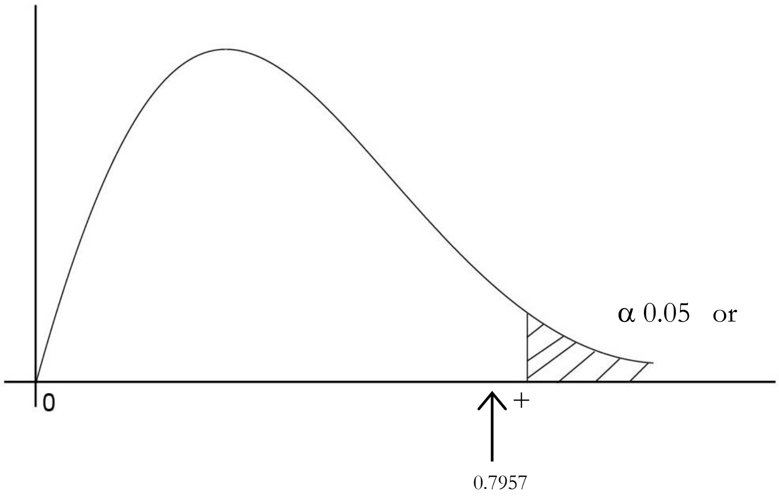


Figure 93: The critical value on a graph

Therefore using Table 34, $X^2{}_C$ = 9.488 using the common level of significance (α) 0.05.

X^2 is also shown in Table 34 below as 7.957. The number of rows and columns in Table 33 produces 4 degree of freedom. The significance level is set as 0.093 in order to accept the Null Hyphothesis, however 0.05 will be used.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.957[a]	4	.093
Likelihood Ratio	5.198	4	.268
Linear-by-Linear Association	1.236	1	.266
N of Valid Cases	65		

a. 7 cells (70.0%) have expected count less than 5. The minimum expected count is .12.

Table 34: Chi-Square Tests

With 0.05 as the significance level, the critical value ($X^2{}_C$) is 9.488 which means X^2 sits inside the critical range (see Figure 96). In this case the Null Hypothesis would be accepted. Therefore we can accept the hypothesis that there is no association between people who would easily take on an innovation and whether they are growing edible plants.

The assumption underlying a chi-square sampling distribution is that no more than 20% of the cells should have a frequency less than 5. This test is not valid because the number of cells with a frequency count of less than 5 is 70%, which is shown in the footnote in Table 34. The sample needs to be bigger.

Appendix F – Phase 1 Bivariate analysis, Correlations and Cross-tabulations

Correlations directly related to cultivating edible plants on buildings have been listed below in the form of sentences. General categories can be seen; A for community, B for Personal Psychology, C for Physical and D for Knowledge. Each correlation has been assigned a category that they fit under.

Q1:

1. C: B: The younger you are the more likely tax incentives would persuade you to grow edible plants on buildings (0.304**).

Q2:

2. C: People who rent their home from the council are more likely to grow edible plants on a wall at their place of work (-0.382**).
3. C: People who rent privately are more likely to grow edible plants on the roof at work (-0.333*).
4. C: People who own their own home are more likely to grow inedible plants on the building of their home (-0.327**).
5. C: People who rent privately are less likely to grow inedible plants on the building of their home (0.335**).

Q4:

6. A: B: People with more household dependants are less likely to have confidence when it comes to growing inedible plants on buildings (0.326**).

Q6:

7. C: Those who use balconies are less likely to use a private front (-0.335**) or back garden (-0.463**).
8. C: Those who use private front gardens are also more likely to use private back gardens (0.564**).
9. C: Those who use their private front gardens a lot are less likely to grow in an allotment (0.462**). (Possibly because the distance to their edible garden is important for them.)
10. C: People who use their back garden a lot are less likely to grow in a communal garden (-0.453**) and a wall at home (0.311*) and more likely to grow edible plants in the ground at home (0.498**). They are also less likely to grow on a balcony (-0.463**), roof at home (-0.324**) and an external sill at work (-0.324**).
11. C: People who use a balcony are less likely to grow edible plants in the ground at home (-0.365**) and more likely to grow edible plants on a balcony at home (0.673**)/work (0.343**) and external sill at work (0.455**).
12. C: People who use a roof terrace are more likely to grow on an external sill (0.301*) and a roof at home (0.444*) and a roof at work (0.346**).
13. C: D: A: People who use communal gardens a lot are more likely to grow edible plants in communal gardens (0.464**), balconies at home (0.324*), ground at work (0.364**) and wall at work (0.323**) and less likely to grow edible plant in the ground at home (-0.383**).
14. C: A: People who use a front garden a lot are less likely to have help from their friends to set up their edible garden (-0.342**) and a grant to help pay for their edible garden (-0.313**). They are more likely to have had their family help pay for (0.316**) and maintain their edible garden (0.403**).
15. C: A: D: People who use their back garden a lot are more likely to have had their family help pay for their edible garden (0.335**) and less likely to have their friends help with their edible garden (-0.358**). They are less likely to have had international help with maintaining their edible garden (-0.317**). They are also more likely to say one of

their garden aims is for training and education (0.315**) and less likely to say that an aim is to raise awareness of sustainability (-0.306**).

16. D: C: People who use balconies a lot are more likely to grow edible plants in pots and containers (0.328**).
17. A: B: D: People who use communal gardens a lot are more likely to grow edible (0.467**) and inedible (0.348**) plants on a roof and are more likely to be confident about growing edible plants on a building (0.305**).
18. C: D: People who use back gardens a lot are less likely to grow edible plants on a roof (-0.316**).
19. C: D: People who use roof terraces a lot are more likely to grow inedible (0.329**) and edible (0.427**) plants on a balcony and edible plants on an external sill (0.434**).
20. C: D: People who use balconies a lot are more likely to agree that cultivating edible plants on buildings is good for access to fresh food (0.306**).
21. D: A: People who use communal gardens a lot are more likely to agree that cultivating edible plants on buildings is good for biodiversity (0.305**) and physical health (0.317**).

Q7:

22. C: B: People who are less easily persuaded to take on an innovation are more likely to agree that lack of time (-0.340**) and lack of physical ability would stop them growing their edible plants (-0.320**).
23. B: D: People who can take on innovations more easily are also more likely to agree that it is possible to grow edible plants on their building at work (0.301*) (hypothesis 6 confirmed).

Q9:

24. D: People who have less hours of leisure per week and grow edible plants are more likely to grow edible plants in the ground at their place of work (0.323**).

Q11-14:

25. C: D: People who think it takes very little hours to maintain a rosemary bush are more likely to have a council help finance their edible garden (0.343**), are more likely to say that lacking resources would have been a barrier to having their edible garden (0.359**) and are more likely to have grown inedible plants on a roof (0.316**).

Q15:

26. C: B: People who agree that it's worth growing even a small amount of food are more likely to agree that they would grow on buildings (-0.348**).

Q16:

27. D: People who agree that they grow food to learn how are more likely to grow on a wall at work (0.316**).
28. A: D: People who agree that if permitted they can grow inedible plants on the building of their office are more likely to agree that they grow food to learn how (0.323**).
29. A: B: C: People who agree that if permitted they can grow edible plants on the building of their office are more likely to agree that they grow food for food safety (0.305**) and for mental health (0.310**).
30. A: People who grow edible plants on a roof are more likely to agree that they grow food to be part of a community (0.319**) and to share tasks with others (0.309**).

31. D: B: People who agree that growing edible plants on buildings is good for developing countries becoming less reliant on external markets are more likely to agree that they would grow food for environmental reasons (0.330**), to grow unique crops (0.348**) and for food safety (0.335*).
32. D: B: C: A: People who agree that growing edible plants on buildings is good for shading buildings are more likely to agree that they grow food for environmental reasons (0.346**), for exercise (0.337**), to be part of a community (0.362**), to share tasks with others (0.379**), for food safety (0.302**) and for mental health (0.371**).
33. D: B: C: A: People who agree that cultivating edible plants on buildings is good for biodiversity are more likely to agree that they would grow food for environmental reasons (0.358**), for personal interest (0.301**), for exercise (0.340**), to be part of a community (0.399**), to share tasks with others (0.366**), for food security (0.335**), for aesthetics (0.371**) and for mental health (0.542**).
34. A: D: B: C: People who agree that cultivating edible plants on buildings is good for reconnecting people with how food is grown are more likely to agree that they grow food for environmental reasons (0.345**), to learn how (0.370**), for personal interest (0.321**), for unique crops (0.327**), for access to fresh produce (0.384**), to be part of a community (0.383**), to share tasks with others (0.348**), for food safety (0.355**), due to family influence (0.341**), for aesthetics (0.416**) and for mental health (0.469**).
35. D: C: People who agree that growing edible plants on buildings is good for increasing access to fresh food are more likely to agree that they would grow food for environmental reasons (0.357**) and for food safety (0.421**).
36. B: C: A: People who agree that growing edible plants on buildings makes cities more beautiful are more likely to agree that they grow food for environmental reasons (0.404**), for personal interest (0.323**), for access to unique crops that you can't buy (0.379**), for access to fresh food (0.369**), to be part of a community (0.355**), to share tasks with others (0.315**), for food safety (0.408**), for aesthetics (0.501**) and for mental health (0.449**).
37. D: C: B: A: People who agree that cultivating edible plants on buildings is good for mental health are more likely to agree that they would grow food for environmental reasons (0.385**), for access to fresh food (0.332**), to be part of a community (0.347**), for food safety (0.328**), for food security (0.372**), for aesthetics (0.507**) and for mental health (0.559**).
38. D: A: B: C: People who agree that cultivating edible plants on buildings is good for physical health are more likely to agree that they would grow food for environmental reasons (0.426**), to learn how 0.337**), for exercise (0.508**), to be part of a community (0.352**), to share tasks with others (0.328**), for food safety (0.362**), due to family influence (0.315**), for aesthetics (0.442**) and for mental health (0.441**).
39. D: B: C: People who agree that cultivating edible plants on buildings is good for environmental, social and economic sustainability are more likely to agree that they would grow food for environmental reasons (0.404**), for access to fresh food (0.336**), for food safety (0.421**), for food security (0.348**), aesthetics (0.401**) and for mental health (0.318**).
40. D: People who disagree that cultivating edible plants on buildings could cause a problem with pests are more likely to agree that they would grow food for environmental reasons (-0.377**).
41. D: People who disagree that cultivating edible plants on buildings may cause damage to the building due to plant roots are more likely to agree that they would grow food for environmental reasons (-0.362**).
42. D: People who agree that issues with cultivating edible plants on buildings can be resolved with good design and planning are more likely to agree that they grow food for environmental reasons (0.311**).
43. D: A: People who agree that media coverage would encourage them to grow food on buildings are more likely to agree that they grow food on buildings due to family influence (0.305**).
44. B: A: People who agree that encouragement from their council would encourage them to grow food on buildings are more likely to agree that they grow food to grow unique crops (0.385**), eat fresh food (0.304**), avoid chemicals (0.300**) and for aesthetics (0.355**).
45. C: People who agree that financial help would encourage them to grow food on buildings are more likely to agree that they would grow food to save money (0.378**).

46. B: D: A: People who are interested to grow food on buildings are more likely to agree that they grow food for environmental reasons (0.335**), to learn how (0.330**), to gain skills and knowledge (0.339**), for personal interest and enjoyment (0.327**) (Hypothesis 17), to share tasks with others (0.317**), for aesthetics (0.390**) and for mental health (0.374**).

Q17:

47. D: People who agree that cultivating edible plants on buildings is good for biodiversity are more likely to agree that they would eat dandelions (0.328**).
48. B: People who agree that cultivating edible plants on buildings is good for beauty are more likely to agree that they would eat garden fruit (0.356**), nettles (0.309**), and courgettes (0.353**).
49. B: D: People who agree that cultivating edible plants on buildings is good for mental health are more likely to agree that they would eat garden courgettes (0.319*).
50. D: C: People who agree that cultivating edible plants on buildings is good for physical health are more likely to agree that they would eat garden herbs (0.348**), tomatoes (0.342**), courgettes (0.353**) and peas (0.328**).
51. D: People who agree that cultivating edible plants on buildings is good for social, economic and environmental sustainability are more likely to agree that they would eat garden courgettes (0.300**).
52. D: People who agree that guidelines would persuade them to cultivate edible plants on buildings are more likely to agree that they would eat garden fruit (0313**), herbs (0.326**), and tomatoes (0.339**).
53. B: People who are interested to grow food on buildings are more likely to agree that they would eat herbs (0.329**) and tomatoes (0.313**) from a garden (Hypothesis 21).

Q18:

54. B: D: People who grow food on an internal windowsill at home are more likely to agree that they would try to grow all year round (-0.380**).
55. D: People who cultivate edible plants in the ground at work are more likely to avoid the use of artificial fertilisers (0.311*), try to use peat free compost (0.321*), try to avoid the use of tap water for irrigation (0.353**) and try to collect rainwater (0.323**).
56. D: A: People who agree that if permitted it is possible to grow edible plants on their office buildings are more likely to agree to avoid the use of artificial fertilisers (0.302**).
57. D: People who agree that cultivating edible plants on buildings is good for shading a building are more likely to agree to use peat free compost (0.400**) and harvest rainwater (0.359**).
58. D: People who agree that cultivating edible plants on buildings is good for biodiversity are more likely to agree to avoid using artificial fertilisers (0.300**), try to use organic fertilisers (0.458**), use peat free compost (0.526**), minimise the use of tap water for irrigation (0.434**), harvest rainwater (0.508**) and avoid the use of artificial pesticides (0.341**).
59. D: A: People who agree that cultivating edible plants on buildings is good for reconnecting people with food production are more likely to agree to avoid using artificial fertilisers (0.308**), try to use organic fertilisers (0.452**), use peat free compost (0.512**), minimise the use of tap water for irrigation (0.338**), harvest rainwater (0.343**) and avoid the use of artificial pesticides (0.374**).
60. D: People who agree that cultivating edible plants on buildings is good for increasing access is to fresh food are more likely to agree that they use organic fertilisers (0.383**), peat free compost (0.403**) and avoid use of artificial pesticides (0.389**).
61. B: People who agree that cultivating edible plants on buildings is good for making cities more beautiful are more likely to agree to avoid using artificial fertilisers (0.359**), try to use organic fertilisers (0.496**), use peat free

compost (0.536**), minimise the use of tap water for irrigation (0.375**), harvest rainwater (0.473**) and avoid the use of artificial pesticides (0.374**).

62. D: People who agree that cultivating edible plants on buildings is good for mental health are more likely to agree to use organic fertilisers (0.461**), use peat free compost (0.475**), minimise the use of tap water for irrigation (0.329**), harvest rainwater (0.330**) and avoid the use of artificial pesticides (0.312**).
63. D: People who agree that cultivating edible plants on buildings is good for physical health are more likely to agree to use organic fertilisers (0.452**), use peat free compost (0.326**), minimise the use of tap water for irrigation (0.341**) and harvest rainwater (0.341**).
64. D: People who agree that cultivating edible plants on buildings is good for economic, social and environmental sustainability are more likely to agree to avoid the use of artificial fertilisers (0.360**), use organic fertilisers (0.448**), use peat free compost (0.427**), minimise the use of tap water for irrigation (0.376**) and harvest rainwater (0.332**).
65. D: People who think that the issues with cultivating edible plants on buildings are likely to be resolvable are more likely to agree that they use organic fertilisers (0.349**), minimise the use of tap water (0.349**) and avoid the use of artificial pesticides (0.305**).
66. B: A: People who would be encouraged to grow food on buildings if their council encourages it are more likely to agree to minimise the use of tap water (0.317**) and harvest rainwater (0.307**).
67. B: People who are interested to grow food on buildings are more likely to agree to minimise the use of tap water (0.403**) and harvest rainwater (0.361**).

Q19:

68. D: C: People who agree that cultivating edible plants on buildings is good for economic, social and environmental sustainability are more likely to agree that they would prefer to grow food close to where they live or work (0.352**).
69. D: C: People who disagree that it's not possible to grow much on buildings are more likely to agree that they prefer to grow food close to where they live or work (-0.297**).

Q20:

70. B: D: People who grow on an internal windowsill at home are more likely to grow a lot of perennial herbs (0.362**).
71. C: People who grow in an allotment are likely to grow a lot of annual vegetables (0.407**).
72. D: People who agree that it is possible to grow inedible (0.368**) and edible (0.370**) plants on the building of their home are more likely to grow a lot of perennial herbs.
73. D: People who have grown inedible plants on a wall are more likely to grow a lot of annual vegetables (0.329**).
74. D: People who have grown edible plants on an internal sill are more likely to grow a lot of perennial herbs (0.367**).
75. D: B: People who have a lot of confidence growing edible plants on buildings are more likely to grow a lot of perennial herbs (0.376**).
76. A: D: People who agree that cultivating edible plants on buildings is good for reconnecting people with food production (0.302** and (0.330**) and making cities more beautiful (0.340** and 0.424**) are more likely to grow a lot of annual vegetables and fruit.
77. D: People who agree that cultivating edible plants on buildings is good for mental health (0.339**), increasing access to fresh food (0.344**) and economic, social and environmental sustainability (0.395**) are more likely to grow a lot of annual vegetables.
78. B: People who are interested to grow food on buildings are more likely to grow a lot of annual vegetables (0.347**) and perennial herbs (0.386**).

Q21-25:

79. B: D: People who grow food on a wall at work are more likely to be confident (0.307**) and experienced (0.334**) when it comes to growing edible plants.
80. D: People who agree that it is possible to grow edible plants on the building of their home are more likely to agree that growing edible plants does not have to be hard work (0.317**).
81. D: People who have grown edible plants on a wall are more likely to know more about permaculture (0.319**).
82. D: People who agree that growing edible plants on buildings is good for shading the building are more likely to know more about permaculture (0.419**).
83. D: People who agree that growing edible plants on buildings is good for biodiversity are more likely to be confident about growing edible plants (0.359**) and know more about permaculture (0.442**).
84. A: D: People who agree that growing edible plants on buildings is good for reconnecting people with food production are more likely to have experience of growing edible plants (0.300**) and know more about permaculture (0.468**).
85. D: People who agree that growing edible plants on buildings increases access to fresh produce are more likely to know more about permaculture (0.387**).
86. B: D: People who agree that cultivating edible plants on buildings makes cities more beautiful are (0.351**, 0.316** and 0.470**), is good for mental health (0.377**, 0.335** and 0.469**), physical health (0.398**, 0.328** and 0.302**) and environmental, economic and social sustainability (0.360**, 0.297** and 0.362**) more likely to have confidence and experience of growing edible plants and know more about permaculture.
87. B: D: People who disagree that they would be concerned about growing edible plants on buildings attracting insects and pests to a building (-0.488**) and the roots damaging the building (-0.319**) are more likely to know more about permaculture.
88. D: A: People who disagree that it's not possible to grow much on a building are more likely to have family and friends who grow edible plants (-0.336**).

Q26:

89. B: C: People who grow food in the ground at work are more likely to agree that other people think that growing edible plants provokes concerns about contaminated soil and air pollution (0.321**).
90. B: C: D: People who have grown edible plants on a roof are more likely to agree that growing edible plants provokes concerns about contaminated soil and air pollution (0.335**) and possible disaster from vandalism/pests etc (0.336**).
91. A: B: C: D: People who agree that growing edible plants on buildings is good for biodiversity (0.334**), reconnecting people with food production (0.306**) and makes cities more beautiful (0.327**) are more likely to agree that other people think cultivating edible plants provokes concerns about possible disaster from vandalism/pests etc.
92. B: People who agree that guidelines (0.358**) and regulations (0.389**) would encourage them to grow edible plants on buildings are more likely to agree that other people think that growing edible plants makes places ugly.

Q27-28:

93. C: D: People who are growing edible plants on their wall at work are more likely to be also growing inedible plants somewhere (0.357**).
94. C: D: People who agree that it is possible to grow inedible plants on the building of their current residence are more likely to be growing inedible (-0.373**) and edible plants (-0.473**) somewhere.

95. C: D: People who agree that it is possible to grow edible plants on the building of their current residence are more likely to be growing edible plants somewhere (-0.473**).
96. C: D: People who have grown inedible plants on a wall are more likely to be growing inedible plants somewhere (-0.319**).
97. D: People who agree that growing edible plants on buildings is good for biodiversity are more likely to be growing edible plants somewhere (-0.305**).
98. B: People who would grow edible plants on buildings are more likely to be growing inedible (0.329**) and edible plants (0.373**) somewhere.
99. B: People who would be interested to grow edible plants on buildings are more likely to be growing edible plants somewhere (-0.332**) (Hypothesis 22).

It should be noted that only 8 out of 65 questionnaire participants completed questions 29-32. These have still been included as they give an indication of the categories that affect the behaviour to cultivate edible plants on buildings.

Q29:

100. C. A. People who disagree that it is possible to grow inedible plants on the building of their home are more likely to agree that they aren't cultivating edible plants due to lack of group help and possible disaster (-0.670* and -0.670*).
101. C. People who disagree that it is possible to grow food on the building on their current residence are more likely to agree that they aren't cultivating edible plants due to lack of space (-0.640*).
102. A. C. People who disagree that it is possible to grow inedible plants on the building of their office are more likely to agree that they aren't cultivating edible plants due to lack of resources, concerns about contamination and pollution, to lack of group help and possible disaster (-0.699*, -0.763*, -0.796*, -0.769*).
103. C. People who disagree that it is possible to grow edible plants on the building on their office are more likely to agree that they aren't cultivating edible plants due to lack of resource (-0.683*).
104. C. B. People who are less likely to have grown inedible things on a balcony are more likely to agree that they aren't cultivating edible plants due to lack of time (-0.723*).
105. D. People who are more likely to have grown edible plants on a wall are less likely to agree that they aren't cultivating edible plants because they haven't really thought about it (-0.726*). C. People who are less likely to have grown edible plants on a wall are more likely to agree that they aren't cultivating edible plants due to lack of money (0.694*).
106. B. C. D. People who are less confident to grow edible plants on a building are more likely to agree that they aren't cultivating edible plants due to lack of physical ability, lack of knowledge, lack of skills and lack of resources (-0.700*, -0.705*, -0.705* and -0.653*).
107. C. D. People who are less likely to agree that cultivating edible plants on buildings is good for biodiversity are more likely to agree that they aren't cultivating edible plants due to lack of space (-0.746*).
108. C. D. People who are less likely to agree that cultivating edible plants on buildings is good for mental health are more likely to agree that they aren't cultivating edible plants on buildings due to lack of space (-0.740*).
109. C. D. People who are less likely to agree that cultivating edible plants on buildings is good for physical health are more likely to agree that they aren't cultivating edible plants on buildings due to lack of space (-0.884**).
110. C. D. People who are more likely to agree that pollution is a problem when cultivating edible plants on buildings are more likely to agree that they aren't cultivating edible plants on buildings due to lack of space (0.827**).
111. C. D. People who are less likely to agree that pests would be a problem when cultivating edible plants on buildings are more likely to agree that they aren't cultivating edible plants due to a preference for inedible, decorative plants (-0.765*).

112. C. D. People who are more likely to agree that it's not possible to grow much on buildings are more likely to agree that they aren't cultivating edible plants due to lack of space (0.837*).
113. C. D. People who are less likely to agree that problems with cultivating edible plants on buildings could be resolved are more likely to agree that they aren't cultivating edible plants on buildings due to lack of space (-0.734*).
114. C. People who are more likely to agree that legislation would persuade them to grow food on buildings are more likely to agree that they aren't cultivating edible plants on buildings due to lack of time (0.734*).
115. C. People who are more likely to agree that financial incentives would persuade them to grow food on buildings are more likely to agree that they aren't cultivating edible plants due to lack of money (0.667*).
116. B. People who are less likely to be interested to grow food on buildings are more likely to agree that they aren't cultivating edible plants due to lack of resources (-0.759*).

Q31:

117. C. D. People who agree that it is possible to grow inedible plants on the building of their office are more likely to agree that they would be persuaded to grow edible plants if they had help with maintenance (0.781*).
118. C. D. People who have grown inedible plants and edible plants on their balcony are more likely to agree that they would be persuaded to grow food if they didn't take much time to grow (0.708*).
119. C. D. People who disagree that it's good to grow edible plants on buildings for easy access to fresh produce are more likely to agree that they would grow edible food if they had help from a grant (-0.734*).
120. C. D. People who agree that access is a problem when it comes to growing edible plants on buildings are more likely to agree that they would be persuaded to grow edible plants if they had help from a grant (0.716*).
121. C. D. People who have seen successful examples of cultivating edible plants on buildings are more likely to agree that they would grow food if they had help with maintenance (-0.756*).
122. C. D. People who wouldn't grow edible plants on buildings are more likely to agree that they would be persuaded to grow edible plants if they had help from a grant (0.716*).

Q32:

123. D: People who would consider cultivating edible plants are more likely to agree that it is possible to grow inedible and edible plants on the building of their home (-0.387** and -0.473**).
124. D: People who would consider cultivating edible plants are more likely to agree that they have grown inedible plants on a wall and inedible on an external window sill (-0.746* and -0.746*).

Q33:

125. A: People who grow in a communal garden are more likely to grow in the ground at work (0.538**) and on a wall (0.438**) at work.
126. B: C: D: People who grow in the ground at home are less likely to grow on a balcony at home (-0.428**).
127. B: C: D: People who grow in an external sill at home are more likely to grow in an internal glazed space at work (0.360**).
128. B: C: People who grow on a balcony at home are more likely to grow in an internal (0.337**) and external (0.535**) windowsill at work. They are more likely to agree that they would grow food for aesthetics (0.333**).
129. A: B: C: D: People who grow in the ground at work are more likely to grow on a wall at work (0.695**) and in an internal glazed space at work (0.438**). They are more likely to grow food to be part of a community (0.316**) and for aesthetics (0.337**).

130. A: B: C: D: People who grow in the ground at work (0.695**), on an external sill at work (0.388**) and in a internal glazed space at work (0.307**).
131. B: C: D: People who grow on an internal windowsill at work are more likely to grow on a balcony at home (0.337**) and in an external sill at work (0.689**).
132. B: C: D: People who grow on an external sill at work are more likely to grow on a balcony at home (0.535**), on a wall at work (0.388**) and in an internal sill at work (0.689**).
133. B: C: D: People who grow in an internal glazed space at work are more likely to grow on external sill at home (0.360**), in the ground at work (0.438**) and on a wall at work (0.307**).
134. A: C: People who grow in a communal garden (0.414**) and external sill at work (0.315**) are more likely to have had their friends help set up their garden,
135. C: People who grow on a wall at work (0.373**), external sill (0.329**) and internal sill (0.477**) at work are more likely to have had a company help set up their garden.
136. A: C: People who have received a grant to help pay for their garden are more likely to grow in a communal garden (0.645**), in the ground at work (0.429**), on a wall at work (0.324**) and in an internal glazed space at work (0.329**).
137. A: C: People who have had their friends help with their garden are more likely to grow in a communal garden (0.396**) and on a balcony at home (0.364**) and less likely to grow in the ground at home (-0.472**).
138. A: C: People who have their community help with their garden are more likely to grow in a communal garden (0.755**), in the ground at work (0.407**) and on a wall at work (0.392**).
139. A: C: People who have their city help with their garden are more likely to grow in a communal garden (0.714**) and in the ground at work (0.385**).
140. A: C: People who have national and international help with their garden are more likely to grow in a communal garden (0.561** and 0.476**) and on a wall at work (0.425** and 0.383**) and less likely to grow in the ground at home (-0.364**).
141. A: B: D: People who have training as a garden aim are more likely to grow in a communal garden (0.368**) and in the ground at work (0.340**) and less likely to grow in an internal glazed space at home (-0.352**).
142. B: C: People who have exercise as a garden aim are more likely to grow in an allotment (0.491**).
143. B: People who have relaxation as a garden aim are more likely to grow in the ground at work (0.330**).
144. A: B: People who have, biodiversity, community cohesion and raising awareness of sustainability as a garden aim more likely to grow in a communal garden and grow in the ground at work (0.382**, 0.458** and 0.384**).
145. A: People who have community cohesion as a garden aim are more likely to grow on a wall at work (0.320**).
146. C: People who grow in pots and containers are less likely to grow in an allotment (-0.291**) and more likely to grow in a internal sill at home (0.370**).
147. A: People who have grown inedible plants on a roof are more likely to be growing edible plants in a communal garden (0.360**) roof at home (0.326**) and roof at work (0.368**).
148. C: People who have grown inedible plants on an internal sill are more likely to be growing edible plants in an internal sill at home (0.370**).
149. B: D: People who have grown inedible plants on an external sill are more likely to be growing edible plants in an allotment (0.417**) and an external sill at home (0.305**).
150. B: C: D: People who have grown inedible plants on a balcony are more likely to be growing edible plants on a balcony at home (0.630**).
151. B: C: D: People who have grown inedible plants on a roof are more likely to be growing edible plants on a roof at work (0.376**).
152. A: B: C: D: People who have grown edible plants on a roof are more likely to be growing edible plants in a communal garden (0.535**) and on a roof at home (0.377**) and less likely to be growing in the ground at home (-0.445**).

153. B: C: D: People who have grown edible plants on a wall are more likely to be growing edible plants on a wall at home (0.436**) and on a wall at work (0.376**).
154. B: C: D: People who have grown edible plants on an internal sill are more likely to be growing edible plants on an internal sill at home (0.493**).
155. B: C: D: People who have grown edible plants on an external sill are more likely to be growing edible plants in an allotment (0.329**), on an external sill at home (0.293**), and on a roof at work (0.327**).
156. B: C: D: People who have grown edible plants on a balcony are more likely to be growing edible plants on a balcony at home (0.620**) and on an external sill at work (0.306**) and less likely to be growing edible plants in the ground at home (-0.314**).
157. B: C: D: People who are confident to grow edible plants on buildings are more likely to be growing edible plants on a wall at work (0.333**).
158. A: B: C: D: People who agree that cultivating edible plants is good for shading buildings (0.334**), biodiversity (0.311**), reconnecting people with food production (0.342**) and making cities more beautiful (0.402**) are more likely to be growing edible plants in the ground at work.
159. A: B: C: D: People who agree that cultivating edible plants on buildings is good for mental and physical health and economic, social and environmental sustainability are more likely to be growing edible plants in a communal garden (0.290*, 0.316** and 0.337**), in the ground at work (0.425**, 0.403** and 0.449**) and on a wall at work (0.295*, 0.321** and 0.311*).
160. B: D: People who disagree that cultivating edible plants on buildings attracting pests and insects to a building is an issue are more likely to be growing edible plants on a balcony at home (-0.326**).
161. D: People who disagree that root damage would be an issue when growing edible plants on buildings are more likely to be growing edible plants in a allotment (-0.365**).
162. A: D: People who disagree that you it's not possible to grow much on a building are more likely to be cultivating edible plants in a communal garden (-0.312**) and in the ground at work (-0.300**).

Q34:

163. C: People who grow closer to home are more likely to grow in pots and containers (0.378**).

Q36:

164. A: C: People who have had their friends (0.340**), council (0.435**), grants (0.352**) and previous owner (0.349**) help pay for their garden are more likely to have grown inedible plants on a roof.
165. C: People who have paid for their garden themselves are more likely to have grown inedible plants on a wall (0.338**) and internal sill (0.444**).
166. A: C: People who have had their friends (0.391**), council (0.399**) and grants (0.526**) pay for their garden are more likely to have grown edible plants on a roof.

Q37:

167. A: C: People who have grown inedible and edible plants on a roof are more likely to have their local community (0.357** and 0.527**), city (0.375** and 0.476**), national (0.420** and 0.531**) and international help (0.356** and 0.576**) with their garden.
168. A: C: People who have grown inedible and edible plants on a balcony are more likely to have their friends help with their garden (0.326** and 0.405**).

169. A: C: People who agree that edible plants growing on a building can help shade a building and good for physical health are more likely to have national (0.388** and 351**) and international help (0.339** and 0.342**) with their garden.
170. A: C: B: People who agree that growing edible plants on buildings can help make cities more beautiful are more likely have had city (0.318**) and national help (0.316**) with their garden.
171. A: C: People who agree that lack of light could be an issue when growing edible plants on buildings are more likely to have city help with their garden (0.311**).
172. A: B: People who have national help with their garden are more likely to be interest to grow food on buildings (0.309**).

Q38:

173. D: People who agree that it is possible to grow inedible plants on the building of their place of work are more likely to agree that a garden aim is for biodiversity (0.324**).
174. B: People who have grown inedible plants on a wall are more likely to agree that a garden aim is for artistic expression (0.318**).
175. B: A: D: People who have grown edible plants on a roof are more likely to agree that a garden aim is for training and education (0.335**), biodiversity (0.371**), community cohesion (0.396**) and raise awareness of sustainability (0.423**).
176. B: People who have grown edible plants on a wall are more likely to agree that a garden aim is for artistic expression (0.313**).
177. B: People who have grown edible plants on an internal sill are more likely to agree that a garden aim is for relaxation (0.333**).
178. B: People who are more confident when it comes to cultivating edible plants on buildings are more likely to agree that a garden aim is for relaxation (0.336**).
179. D: People who agree that cultivating edible plants on buildings can help developing countries become less reliant on external markets are more likely to agree that a garden aim is grow food (0.357**) and increase biodiversity (0.356**).
180. D: B: People who agree that cultivating edible plants on buildings is good for biodiversity are more likely to agree that a garden aim is to grow food (0.392**), for relaxation (0.345**) and for biodiversity (0.499**).
181. D: A: B: People who agree that cultivating edible plants on buildings is good for reconnecting people with food production, making cities more beautiful and for mental health are more likely to agree that a garden aim is to grow food (0.310**, 0.297** and 0.377**), for relaxation (0.323**, 0.390** and 0.487**), for artistic expression (0.312**, 0.456** and 0.368**), and for biodiversity (0.478**, 0.462** and 0.412**).
182. D: B: People who agree that cultivating edible plants on buildings is good for increasing access to fresh food are more likely to agree that a garden aim is to grow food (0.510**), for relaxation (0.399**), for artistic expression 0.351**), for biodiversity (0.438**) and to raise awareness of sustainability (0.308**).
183. A: D: B: People who agree that cultivating edible plants on buildings is good for physical health are more likely to agree that a garden aim is to grow food (0.418**), for training and education (0.314**), for relaxation (0.399**), for artistic expression (0.351**), for physical exercise (0.425**), for biodiversity (0.507**), to create community cohesion (0.359**) and to raise awareness of sustainability (0.388**).
184. D: B: People who agree that cultivating edible plants on buildings is good for economic, environmental and social sustainability are more likely to agree that a garden aim is to grow food (0.515**), for relaxation (0.316**), for biodiversity (0.555**) and to raise awareness of sustainability (0.369**).
185. D: People who disagree that its not possible to grow much when growing edible plants on buildings are more likely to say a garden aim is for biodiversity (-0.324**).

186. D: People who agree that it is likely to solve the issues related to growing edible plants on buildings are more likely to agree that a garden aim is to grow food (0.428**) and for biodiversity (0.360**).
187. B: D: People who agree that a garden aim is for growing food (0.348**), for relaxation (0.316**) and for biodiversity (0.341**) are more likely to be interested to cultivate edible plants on buildings.

Q39:

188. C: People who have grown inedible plants on an internal sill are more likely to be growing edible plants in pots and containers (0.362**).
189. C: People who have grown edible plants on a balcony are more likely to be growing edible plants in pots and containers (0.342**).
190. D: C: B: People who cultivate edible plants in pots and containers and more likely to be interested to cultivate edible plants on buildings (0.328**).

Q40:

191. D: People who agree that lack of knowledge (0.326**) and skills (0.312**) would have been a barrier to them cultivating edible plants are more likely to agree that they would be concerned about falling off a building when cultivating edible plants on a building.
192. D: People who agree that lack of skills (0.312**) would have been a barrier to them cultivating edible plants are more likely to agree that they would be concerned about lack of light when cultivating edible plants on a building.
193. D: People who agree that lack of knowledge (0.352**) and skills (0.355**) would have been a barrier to them cultivating edible plants are more likely to agree that media coverage would help persuade them to cultivate edible plants on a building.

Q41:

194. A: D: People who agree that it is possible to grow inedible plants on the building of their home (0.303** and 0.893**) and edible plants on the building of their place of work (0.811** and 0.301**) are likely to agree that it is possible to grow inedible plants on the building on their place of work and edible plants on the building of their home.
195. B: D: People who are more confident when it comes to cultivating edible plants on buildings are more likely to agree that it is possible to grow inedible (0.317**) and edible plants on the building of their place of work (0.376**).
196. B: D: A: People who agree that cultivating edible plants on buildings is good for biodiversity (0.373** and 0.392**), reconnecting people with food production (0.371** and 0.361**), making cities more beautiful (0.369** and 0.386**), good for mental health (0.356** and 0.353**) and economic, social and environmental sustainability (0.307** and 0.398**) are more likely to agree that it is possible to grow inedible and edible plants on the building of their place of work.
197. B: D: A: People who agree that the issues of cultivating edible plants on buildings are resolvable are more likely to agree that it is possible to grow inedible (0.316**) and edible (0.335**) plants on the building of their place of work.
198. A: D: B: People agree that it's possible to cultivate inedible and edible plants on the building of their place of work (0.331** and 0.410**) and home (0.319** and 0.378**) are more likely to be interested to cultivate edible plants on buildings.

Q43:

199. D: B: People who have grown inedible plants on a wall are more likely to have grown inedible plants on an internal (0.422**) and external sill (0.404**).
200. D: B: People who have grown inedible plants on an internal sill are more likely to have grown inedible plants on a wall (0.422**) ands external sill (0.346**).
201. D: B: People who have grown inedible plants on an external sill are more likely to have grown inedible plants on a wall (0.404**), internal sill (0.346**) and internal glazed space (0.477**).
202. D: B: People who have grown edible plants on a roof are more likely to have grown inedible plants on a roof (0.663**)).
203. D: B: People who have grown edible plants on a wall are more likely to have grown inedible plants on a wall (0.409**).
204. D: B: People who have grown edible plants on an internal sill are more likely to have grown inedible plants on a internal sill (0.531**).
205. D: B: People who have grown edible plants on a external sill are more likely to have grown inedible plants on a wall (0.366**), external sill (0.719**), balcony (0.354**) and internal glazed space (0.323**).
206. D: B: People who have grown edible plants on a balcony are more likely to have grown inedible plants on a balcony (0.788**).
207. D: B: People who have grown edible plants in a glazed space are more likely to have grown inedible plants in a conservatory (0.835**) and external sill (0.422**).
208. B: D: People who are confident to grow edible plants on buildings are more likely to have grown inedible plants on wall (0.309**).
209. D: B: People who agree that cultivating edible plants on buildings is good for biodiversity are more likely to agree that they have grown inedible plants on a roof (0.326**).
210. D: B: A: People who agree that cultivating edible plants on buildings is good for reconnecting people with food production (0.321**), increasing access to fresh food (0.348**), making cities more beautiful (0.322**), for mental health (0.340**) are more likely to have grown inedible plants on a wall.
211. D: B: People who disagree that cultivating edible plants on buildings attracting insects and pests to a building as being an issue are more likely to have grown inedible plants on a external sill (-0.320**).

212. Q44:

213. D: People who have grown edible plants on a roof are more likely to have grown edible plants on a wall (0.387**).
214. D: People who have grown edible plants on a external sill are more likely to have grown edible plants on a roof (0.312**), wall (0.349**), internal sill (0.338**), balcony (0.395**) and in a conservatory (0.374**).
215. D: People who have grown edible plants on a balcony are more likely to agree that they have grown edible plants in a conservatory (0.344**).
216. B: D: People who are confident cultivating inedible plants on a building are more likely to agree that they have grown edible plants on a roof (0.354**).
217. D: B: People who are more confident to grow edible plants on buildings are more likely to have grown edible plants on a roof (0.380**), a wall (0.314**), an internal (0.331**) and external (0.375**) windowsill and in a conservatory (0.339**).
218. D: People who agree that cultivating edible plants on buildings is good for shading a building (0.322**), biodiversity (0.307**), physical health (0.332**) and economic, environmental and social sustainability (0.301**) are more likely to have grown edible plants on a roof.
219. B: D: People who disagree that the issue of growing edible plants on buildings attracting insects and pests is not a problem are more likely to have grown edible plants on a external windowsill (-0.306**).

Q46:

220. B: People who are more confident to grow inedible plants on buildings are more likely to be confident to grow edible plants on buildings (0.736**).
221. B: D: A: People who agree that cultivating edible plants on buildings is good for reconnecting people with food production (0.316**) and making cities more beautiful (0.324**) are more likely to be confident about growing edible plants on buildings.
222. D: B: People who disagree that it is not possible to grow much on buildings are more likely to be confident about growing inedible plants on buildings (-0.349**).
223. D: B: People who agree that the issues of growing edible plants on buildings are resolvable are more likely to be confident about growing inedible plants on buildings (0.300**).
224. B: People who are confident when it comes to growing edible plants on buildings are more likely to be interested to do it (0.300**) (hypothesis 23 confirmed).

Q48:

225. A: B: D: People who agree about a possible benefit of cultivating edible plants on buildings are more likely to agree about the other benefits.

Variable	**Variable type**	**Q48_ExtMar**	**Q48_Shade**	**Q48_Bio**	**Q48_Reco**	**Q48_Fresh**	**Q48_Beau**	**Q48_Ment**	**Q48_Phys**	**Q48_Sust**
Q48_ExternalMarkets	Ordinal		0.402**	0.372**	0.414**	0.427**	0.361*	0.285**	0.280**	0.487**
Q48_ShadeBuilding	Ordinal	0.402**		0.526**	0.482**	0.335**	0.434**	0.428**	0.478**	0.506**
Q48_Biodiversity	Ordinal	0.372**	0.526**		0.634**	0.494**	0.557**	0.647**	0.441**	0.486**
Q48_Reconnect	Ordinal	0.414**	0.482**	0.634**		0.669**	0.655**	0.679**	0.463**	0.519**
Q48_FreshFood	Ordinal	0.427**	0.335**	0.494**	0.669**		0.604**	0.637**	0.442**	0.546**
Q48_Beauty	Ordinal	0.361**	0.434**	0.557**	0.655**	0.604**		0.718**	0.451**	0.662**
Q48_MentalHealth	Ordinal	0.285**	0.428**	0.647**	0.679**	0.637**	0.718**		0.641**	0.637**
Q48_PhysicalHealth	Ordinal	0.280**	0.478**	0.441**	0.463**	0.442**	0.451**	0.641**		0.562**
Q48_TripleBottomLine	Ordinal	0.487**	0.506**	0.486**	0.519**	0.546**	0.662**	0.637**	0.562**	

226. B: D: People who disagree that it is not possible to grow much on buildings are more likely to agree that cultivating edible plants on buildings is good for shading buildings (-0.306**), increasing biodiversity (-0.320**), help make cities more beautiful (-0.355**), helps mental health (-0.327**) and helps economic, social and environmental sustainability (-0.441**).
227. B: D: People who disagree that it is expensive to grow edible plants on buildings are more likely to agree that it is good for economic, social and environmental sustainability (-0.310**).
228. A: D: B: People who agree that the issues with growing edible plants on buildings are resolvable are more likely to agree with all the possible benefits.

Variable	Variable type	Q48_ExtMar	Q48_Shade	Q48_Bio	Q48_Reco	Q48_Fresh	Q48_Beau	Q48_Ment	Q48_Phys	Q48_Sust
Q50_LIkelyResolve	Ordinal	0.397**	0.348**	0.390**	0.356**	0.312**	0.413**	0.417**	0.395**	0.480**

229. A: B: People who agree that regulations would encourage them to grow edible plants on buildings are more likely to agree that its good for reconnecting people with food production (0.328**) and for physical health (0.310**).
230. B: D: People who agree that legislation would encourage them to grow edible plants on buildings are more likely to agree that it is good for shading a building (0.331**).
231. B: A: People who agree that their council encouraging would encourage them to grow edible plants on buildings are more likely to agree with all the possible benefits.

Variable	Variable type	Q48_ExtMar	Q48_Shade	Q48_Bio	Q48_Reco	Q48_Fresh	Q48_Beau	Q48_Ment	Q48_Phys	Q48_Sust
Q51_CouncilEncourages	Ordinal	0.359**	0.372**	0.384**	0.405**	0.294**	0.375**	0.360**	0.373**	0.384**

232. B: D: A: The more interested a person is to grow edible plants on buildings the more likely they are to agree that growing edible plants on buildings would help developing countries become less reliant on external markets (0.399**), help shade buildings (0.350**), help biodiversity in towns and cities (0.602**), reconnecting people with food production, (0.487**) increase access to fresh food (0.469**), make cities more beautiful (0.507**), for mental health (0.498**), for physical health (0.507**) and for overall, social, economic and environmental sustainability (0.549**) (Hypothesis 16 confirmed).

Q49:

233. B: D: People who agree that falling off the building is a concern when growing edible plants on buildings are more likely to agree that lack of light (0.465**), wind (0.374**), pollution (0.316**), pests (0.331**), root damage (0.418**), won't be able to grow much (0.311**) and expense are also concerns (0.413**).
234. B: D: People who agree that lack of light is a concern when growing edible plants on buildings are more likely to be concerned about all the other listed concerns.

Variable	Q49_LackLight
Variable type	Ordinal
Q49_FallingOff	0.465**
Q49_Weight	0.455**
Q49_Access	0.376**
Q49_Windy	0.417**
Q49_Polluted	0.303**
Q49_Pests	0.380**
Q49_Root Damage	0.370**
Q49_GrowMuch	0.414**

Q49_Expensive	0.300**

235. B: D: People who agree that weight is a possible concern when growing edible plants on buildings are more likely to agree that lack of light (0.455**), access (0.495**) and root damage (0.319**) are also concerns.
236. B: D: C: People who agree that access is a possible concern when growing edible plants on buildings are more likely to agree that lack of light (0.376**), weight (0.395**), wind (0.454**) and expense (0.380**) are also concerns.
237. B: D: C: People who agree that wind is a possible concern when growing edible plants on buildings are also more likely to agree that falling off (0.374**), lack of light (0.417**), access (0.454**), won't be able to grow much (0.348**) and expense (0.454**) are also concerns.
238. B: D: People who agree that pollution is a concern when growing edible plants on buildings are more likely to agree that falling off (0.316**), lack of light (0.303**) and won't be able to grow much (0.312**) are concerns.
239. B: D: People who agree that pests are a concern when growing edible plants on buildings are more likely to agree that falling off (0.331**), lack of light (0.380**) and root damage (0.463**) are concerns.
240. B: D: C: People who agree that root damage is a concern when growing edible plants on buildings are more likely to agree that falling off (0.418**), lack of light (0.370**), weight (0.319**), pests (0.463**) and expense are also concerns (0.307**).
241. B: D: C: People who agree that not being able to grow much is a concern when growing edible plants on buildings are more likely to agree that falling off (0.311**), lack of light (0.300**), wind (0.348**), pollution (0.312**) and expense (0.359**) are concerns.
242. B: D: C: People who agree that expense is a concern when growing edible plants on buildings are more likely to agree that falling off (0.413**), lack of light (0.300**), access (0.380**), wind (0.454**), root damage (0.307**) and not being able to grow much (0.359**) are concerns.
243. B: D: C: People who disagree that the concerns aren't resolvable are more likely to agree that not being able to grow much is a concern (-0.433**).
244. B: D: People who agree that guidelines would encourage them to grow edible plants on buildings are more likely to agree that weight is a concern (0.308**).
245. B: D: People who agree that services that help with growing edible plants on buildings would encourage them to grow edible plants on buildings are more likely to agree that lack of light would be a concern (0.314**).
246. B: D: People who aren't interested to grow edible plants on buildings are more likely to agree that not being able to grow much is a concern (-0.330**).

Q50:

247. B: D: People who agree that the problems are resolvable with careful design and planning are more likely to be interested to cultivate edible plants on buildings (0.521**) (hypothesis 13 confirmed).

Q51:

248. B: A: People who agree that media coverage would encourage them to grow edible plants on buildings are more likely to agree that guidelines (0.648**), regulations (0.397**) and their council encouraging (0.354**) would encourage them.
249. B: A: People who agree that guidelines would encourage them to grow edible plants on buildings are more likely to agree that regulations (0.510**), council encouraging (0.453**) and services (0.389**) would encourage them.

250. B: A: C: People who agree that tax incentives would encourage them to grow edible plants on buildings are more like to agree that regulations (0.428**), legislation (0.307**), council encouraging (0.425**), services (0.516**) and financial help (0.555**) would encourage them to grow edible plants on buildings.
251. B: A: C: D: People who agree that regulations would encourage them to grow edible plants on buildings are more likely to agree that media coverage (0.397**), guidelines (0.510**), tax incentives (0.428**), legislation (0.392**), council encouraging (0.646**) and services that help (0.516**) would encourage them.
252. B: A: C: People who agree that legislation would encourage them to grow edible plants on buildings are more likely to agree that tax incentives (0.307**), regulations (0.392**), council encouraging (0.482**), services (0.379**) and financial help (0.428**) would encourage them.
253. B: A: C: D: People who agree that their council encouraging would encourage them to grow edible plants on buildings are more likely to agree to all the other stated things that may encourage people.

Variable	Variable type	Q51_ Media	Q51_ Guidelines	Q51_ Tax	Q51_ Reg	Q51_ Legis	Q51_ Council	Q51_ Services	Q51_ Financial
Q51_CouncilEncourages	Ordinal	0.354**	0.453**	0.425**	0.646**	0.482**		0.606**	0.365**

254. B: A: C: D: People who agree that services that provide help with maintenance would encourage them to grow edible plants on buildings are more likely to agree to all the other stated things that may encourage people apart from media coverage.

Variable	Variable type	Q51_ Media	Q51_ Guidelines	Q51_ Tax	Q51_ Reg	Q51_ Legis	Q51_ Council	Q51_ Services	Q51_ Financial
Q51_Services	Ordinal		0.389**	0.516**	0.598**	0.379**	0.606**		0.394**

255. B: A: C: People who agree that financial help would encourage them to grow edible plants on buildings are more likely to agree that tax incentives (0.555**), legislation (0.428**), council encouraging (0.465**) and services (0.394**) would encourage them.

Q52:

256. B: D: A person who knows of successful examples of cultivating edible plants on buildings is more likely to agree that they grow food to grow unique crops (-0.303**) and for mental health (-0.334**).
257. B: D: A person who knows of successful examples of cultivating edible plants on buildings is more likely to agree that they try to avoid artificial pesticides when cultivating edible plants (-0.335**).
258. B: D: A: A person who knows of successful examples of cultivating edible plants on buildings is more likely to agree that growing edible plants on buildings is good for biodiversity (-0.369**), reconnecting people with food production(-0.455**), making towns and cities more beautiful (-0.352**) and good for mental health (-0.363**).
259. D: A person who knows of successful examples of cultivating edible plants on buildings is more likely to agree that they would grow edible plants on buildings (0.428**).
260. B: Cross-tabulations confirming that people who are cultivating edible plants on buildings are more likely to be interested to grow food on buildings (Hypothesis 18 confirmed):

Q54_InterestGrowOnBuildings * Q33_WallHome Crosstabulation

Count

		Q33_WallHome				Total
		A lot	Occasionally	Rarely	Never	
Q54_InterestGrowOn Buildings	Very interested	1	2	1	9	13
	Interested	1	2	3	16	22
	Slightly interested	0	1	2	13	16
	Not interested	0	1	1	4	6
Total		2	6	7	42	57

Q54_InterestGrowOnBuildings * Q33_InternalSillHome Crosstabulation

Count

		Q33_InternalSillHome				Total
		A lot	Occasionally	Rarely	Never	
Q54_InterestGrowOn Buildings	Very interested	7	2	1	3	13
	Interested	4	6	3	9	22
	Slightly interested	0	9	2	5	16
	Not interested	0	1	2	3	6
Total		11	18	8	20	57

Q54_InterestGrowOnBuildings * Q33_ExternalSillHome Crosstabulation

Count

		Q33_ExternalSillHome			Total
		Occasionally	Rarely	Never	
Q54_InterestGrowOn Buildings	Very interested	1	0	12	13
	Interested	2	3	17	22
	Slightly interested	1	1	14	16
	Not interested	0	1	5	6
Total		4	5	48	57

Q54_InterestGrowOnBuildings * Q33_BalconyHome Crosstabulation

Count

		Q33_BalconyHome				Total
		A lot	Occasionally	Rarely	Never	
Q54_InterestGrowOn Buildings	Very interested	2	1	0	10	13
	Interested	2	0	0	20	22
	Slightly interested	0	0	1	15	16
	Not interested	0	0	0	6	6
Total		4	1	1	51	57

Q54_InterestGrowOnBuildings * Q33_RoofHome Crosstabulation

Count

		Q33_RoofHome			Total
		A lot	Occasionally	Never	
Q54_InterestGrowOn Buildings	Very interested	1	0	12	13
	Interested	0	1	21	22
	Slightly interested	0	0	16	16
	Not interested	0	0	6	6
Total		1	1	55	57

Q54_InterestGrowOnBuildings * Q33_InternalGlazedHome Crosstabulation

Count

		Q33_InternalGlazedHome				Total
		A lot	Occasionally	Rarely	Never	
Q54_InterestGrowOn Buildings	Very interested	2	3	1	7	13
	Interested	1	4	1	16	22
	Slightly interested	3	3	2	8	16
	Not interested	0	1	1	4	6
Total		6	11	5	35	57

261. B: D: A: Cross-tabulations on SPSS confirm people who agree with a lot of the benefits of growing edible plants (question 16) are more likely to be growing edible plants on buildings. (Hypothesis 20 confirmed) (Also see correlation 276).
262. B: D: Cross-tabulations on SPSS confirm people who know successful examples of growing edible plants on buildings are more likely to be growing edible plants on buildings. (Hypothesis 5 confirmed):

Q54_InterestGrowOnBuildings * Q33_WallWork Crosstabulation

Count

		Q33_WallWork		Total
		A lot	Never	
Q54_InterestGrowOnBuildings	Very interested	2	11	13
	Interested	1	21	22
	Slightly interested	0	16	16
	Not interested	0	6	6
Total		3	54	57

Q54_InterestGrowOnBuildings * Q33_InternalSillWork Crosstabulation

Count

		Q33_InternalSillWork				Total
		A lot	Occasionally	Rarely	Never	
Q54_InterestGrowOnBuildings	Very interested	1	0	0	12	13
	Interested	0	1	0	21	22
	Slightly interested	0	0	1	15	16
	Not interested	0	1	0	5	6
Total		1	2	1	53	57

Q54_InterestGrowOnBuildings * Q33_ExternalSillWork Crosstabulation

Count

		Q33_ExternalSillWork			Total
		A lot	Rarely	Never	
Q54_InterestGrowOnBuildings	Very interested	1	0	12	13
	Interested	0	0	22	22
	Slightly interested	0	1	15	16
	Not interested	0	0	6	6
Total		1	1	55	57

Q54_InterestGrowOnBuildings * Q33_BalconyWork Crosstabulation

Count

		Q33_BalconyWork		Total
		A lot	Never	
Q54_InterestGrowOnBuildings	Very interested	1	12	13
	Interested	0	22	22
	Slightly interested	0	16	16
	Not interested	0	6	6
Total		1	56	57

Q54_InterestGrowOnBuildings * Q33_RoofWork Crosstabulation

Count

		Q33_RoofWork				Total
		A lot	Occasionally	Rarely	Never	
Q54_InterestGrowOnBuildings	Very interested	1	0	0	12	13
	Interested	0	1	1	20	22
	Slightly interested	0	0	0	16	16
	Not interested	0	0	0	6	6
Total		1	1	1	54	57

Q54_InterestGrowOnBuildings * Q33_InsideGlazedWork Crosstabulation

Count

		Q33_InsideGlazedWork			Total
		A lot	Occasionally	Never	
Q54_InterestGrowOnBuildings	Very interested	0	0	13	13
	Interested	1	1	20	22
	Slightly interested	0	1	15	16
	Not interested	0	0	6	6
Total		1	2	54	57

Q52_SuccessfulExamples * Q33_WallHome Crosstabulation

Count

		Q33_WallHome				Total
		A lot	Occasionally	Rarely	Never	
Q52_SuccessfulExamples	No	0	1	3	12	16
	Yes	2	5	4	30	41
Total		2	6	7	42	57

Q52_SuccessfulExamples * Q33_InternalSillHome Crosstabulation

Count

		Q33_InternalSillHome				Total
		A lot	Occasionally	Rarely	Never	
Q52_SuccessfulExamples	No	1	6	4	5	16
	Yes	10	12	4	15	41
Total		11	18	8	20	57

Q52_SuccessfulExamples * Q33_ExternalSillHome Crosstabulation

Count

		Q33_ExternalSillHome			Total
		Occasionally	Rarely	Never	
Q52_SuccessfulExamples	No	0	4	12	16
	Yes	4	1	36	41
Total		4	5	48	57

Q52_SuccessfulExamples * Q33_BalconyHome Crosstabulation

Count

		Q33_BalconyHome				Total
		A lot	Occasionally	Rarely	Never	
Q52_SuccessfulExamples	No	0	0	1	15	16
	Yes	4	1	0	36	41
Total		4	1	1	51	57

Q52_SuccessfulExamples * Q33_RoofHome Crosstabulation

Count

		Q33_RoofHome			Total
		A lot	Occasionally	Never	
Q52_SuccessfulExamples	No	0	0	16	16
	Yes	1	1	39	41
Total		1	1	55	57

Q52_SuccessfulExamples * Q33_InternalGlazedHome Crosstabulation

Count

		Q33_InternalGlazedHome				Total
		A lot	Occasionally	Rarely	Never	
Q52_SuccessfulExamples	No	3	2	3	8	16
	Yes	3	9	2	27	41
Total		6	11	5	35	57

263. C: D: Cross-tabulations on SPSS confirm people who think that growing edible plants does not need to be hard work are more likely to be interested to grow edible plants on buildings. (Hypothesis 7 confirmed):

Q54_InterestGrowOnBuildings * Q24_GrowingNotHard Crosstabulation

Count

		Q24_GrowingNotHard			Total
		Strongly agree	Agree	Disagree	
Q54_InterestGrowOn Buildings	Very interested	7	5	2	14
	Interested	3	15	4	22
	Slightly interested	1	15	2	18
	Not interested	1	7	3	11
Total		12	42	11	65

Q53_WouldGrowOnBuildings * Q24_GrowingNotHard Crosstabulation

Count

		Q24_GrowingNotHard			Total
		Strongly agree	Agree	Disagree	
Q53_WouldGrowOn Buildings	No	1	8	5	14
	Yes	11	34	6	51
Total		12	42	11	65

Q53:

264. B: D: A person who would grow edible plants on buildings is more likely to agree that it's worth cultivating edible plants even if it's a small amount of your annual diet (-0.348**) (Hypothesis 15 confirmed).
265. B: D: A person who would grow edible plants on buildings is more likely to agree that they would grow food for aesthetics (-0.334**) and for mental health (-0.396**).
266. B: D: A person who would grow edible plants on buildings is more likely to agree that they would try to minimise the use of tap water for irrigating their plants (-0.332**).
267. B: C: D: A person who would grow edible plants on buildings is more likely to agree that they would grow fruit (-0.311**) and perennial herbs (-0.357**).
268. B: A person who would grow edible plants on buildings is more likely to already be growing edible (0.373**) and inedible (0.329**) plants somewhere.
269. B: A person who would grow edible plants on buildings is more likely to agree that if permitted is it possible to grow edible plants on the building of their home (-0.354**) and work (-0.309**).
270. B: D: A: A person who would grow edible plants on buildings is more likely to agree that cultivating edible plants on buildings is good for biodiversity in towns and cities (-0.426**), reconnecting people with food production (-0.412**), making towns and cities more beautiful (-0.315**), for mental health (-0.357**) and for improving overall social, economic and environmental sustainability (-0.332**).
271. B: D: A person who would grow edible plants on buildings is more likely to know of successful examples of cultivating edible plants on buildings (0.428**) (hypothesis 4 confirmed).
272. B: A: A person who would grow edible plants on buildings is more likely to agree that encouragement for councils may persuade them to grow food on buildings (-0.316**).

Q54:

273. B: D: The more interested a person is to grow edible plants on buildings the more likely they are to agree that if permitted they think it's possible to grow inedible on the building of their home (0.319**) and work (0.331**) and edible plants on the building of their home (0.378**) and work (0.410**) (hypothesis 3 confirmed).
274. B: C: D: The more interested a person is to grow edible plants on buildings the more likely they are to agree that tax incentives (0.358**), regulations (0.315**) (hypothesis 11 confirmed), legislation, council encouragement (0.394**) (hypothesis 12 confirmed) and services which help with it (0.312**), may persuade them to grow edible plants on buildings.
275. B: The more interested a person is to grow edible plants on buildings the more likely that they would grow edible plants on a building (-0.446**).

Appendix G - Person Typologies

Variable	Variable type	Q1_ Environmentally Conscious	Q7_ Innovation	Q8_ Busy	Q22_ Experience and Confident	Q36_ Given Grant	Q46_ Confidence Growing on buildings	Q48_ Believe in many benefits of cultivating on buildings	Q2_ Wealthy
Q1_ Environmentally Conscious	Dichotmous				**0.506****			**0.644****	
Q22_ Experience and Confident	Dichotmous	**0.506****						**0.351****	
Q48_ Believe in many benefits of cultivating on buildings	Dichotmous	**0.644****			**0.351****				
Q6_PrivateFrontGarden	Ordinal				**0.363****				
Q6_PrivateBackGarden	Ordinal				**0.384****				
Q6_CommunalGarden	Ordinal	**-0.338****				**-0.471****			
Q7_AdoptingInnovation			**-0.864****						
Q8_HoursWorkordinal				**0.751****					
Q16_EnvironmentalReasons	Ordinal	**-0.538****						**-0.366****	
Q16_LearnHow	Ordinal	**-0.422****							
Q16_GainSkillsKnowledge	Ordinal	**-0.397****							
Q16_InterestEnjoyment	Ordinal	**-0.450****			**-0.364****				
Q16_Exercise	Ordinal	**-0.393****		**0.328****					
Q16_UniqueCrops	Ordinal	**-0.394****						**-0.365****	
Q16_FreshFood	Ordinal	**-0.412****			**-0.316****				
Q16_Community	Ordinal	**-0.509****			**-0.368****			**-0.356****	

Q16_ShareTasks	Ordinal	-0.495**			-0.341**			-0.351**	
Q16_FoodSafety	Ordinal	-0.466**						-0.324**	
Q16_FoodSecurity	Ordinal	-0.415**						-0.307**	
Q16_Aesthetics	Ordinal	-0.466**			-0.339**			-0.332**	
Q16_MentalHealth	Ordinal	-0.526**			-0.358**			-0.359**	
Q17_EatGardenFruit	Ordinal				-0.318*				
Q17_EatGardenTomatoes	Ordinal	-0.319*			-0.353**				
Q17_EatGardenCourgettes	Ordinal				-0.417**				
Q17_EatGardenPeas	Ordinal				-0.360**				
Q18_GrowAll Year	Ordinal	-0.315**			-0.327**	-0.306*			
Q18_AvoidArtificialFertilisers	Ordinal	-0.482**							
Q18_UseOrganicFertilisers	Ordinal	-0.601**			-0.318**			-0.375**	
Q18_UsePeatFreeCompost	Ordinal	-0.647**			-0.418**			-0.486**	
Q18_Minimiseuseoftapwater	Ordinal	-0.481**						-0.341**	
Q18_HarvestRainwater	Ordinal	-0.563**			-0.405**			-0.339**	
Q18_AvoidArtificialPesticides	Ordinal	-0.439**							
Q20_AnnualVeg	Ordinal	-0.330**			-0.400**				
Q21_FamilyFriendsGrow	Ordinal			0.311**					
Q22_Growing Confidence	Ordinal	-0.406**			-0.757**			-0.318**	
Q23_Growing Experience	Ordinal				-0.710**		-0.303**		
Q25_Permaculture	Ordinal	-0.484*			-0.392**			-0.505**	

		*****							
Q26_Disaster	Ordinal	**-0.357****							
Q33_Allotment	Ordinal				**-0.404****				
Q33_CommunalGarden	Ordinal				**-0.657****		-0.319*		**0.490****
Q33_GroundWork	Ordinal	**-0.359****				**-0.361****		-0.323*	0.328*
Q33_WallWork	Ordinal					**-0.357****			**0.413****
Q33_InsideGlazedWork	Ordinal					**-0.359****			
Q35_SetUpMyself	Ordinal					0.322*			
Q35_SetUpFriends	Ordinal					**-0.345****			**0.405****
Q36_PayFriends	Ordinal					**-0.317****			**0.423****
Q36_PayCouncil	Ordinal			**0.366****		**-0.852****			
Q36_PayGrant	Ordinal					**-0.887****		**-0.335***	
Q37_FamilyHelp	Ordinal								
Q37_FriendsHelp	Ordinal								**0.427****
Q37_CommunityHelp	Ordinal					**-0.574****			**0.466****
Q37_CityHelp	Ordinal	**-0.337****				**-0.436****			**0.523****
Q37_NationalHelp	Ordinal					**-0.368****		-0.321*	**0.467****
Q37_InternationalHelp	Ordinal					**-0.463****			**0.528****
Q38_GrowFood	Ordinal	**-0.436****	0.302*			**-0.498****		**-0.389****	
Q38_Relaxation	Ordinal	**-0.361****				**-0.438****			
Q38_ArtisticExpression	Ordinal	**-0.353****							
Q38_Exercise	Ordinal					**-0.363****			
Q38_Biodiversity	Ordinal					**-0.396****		**-0.498****	
Q38_CommunityCohesion	Ordinal					**-0.495****			

Q38_AwareSustainability	Ordinal					**-0.409****		**-0.319****	
Q40_LackTime	Ordinal		0.322*						-0.322*
Q40_LackPhysical	Ordinal		**0.390****						
Q40_SeenBadlyByOthers	Ordinal					-0.306*			
Q42_GrowEdibleOnOffice	Ordinal	**-0.309****							
Q43_InedibleOnRoof	Ordinal					**-0.443****			
Q43_InedibleInternalSill	Ordinal						**-0.343****		
Q43_InedibleExternalSill	Ordinal				**-0.444****				
Q44_EdibleOnRoof	Ordinal					**-0.520****		-0.309*	**0.384****
Q44_EdibleInternalSill	Ordinal						**-0.313****		
Q44_EdibleExternalSill	Ordinal				**-0.377****				
Q46_ConfidenceInedibleOnBuilding	Ordinal						**-0.735****		
Q47_ConfidenceEdibleOnBuilding	Ordinal						**-0.684****		
Q48_ExternalMarkets	Ordinal	**-0.390****						**-0.510****	
Q48_ShadeBuilding	Ordinal	**-0.569****						**-0.538****	
Q48_Biodiversity	Ordinal	**-0.678****			**-0.470****			**-0.637****	
Q48_Reconnect	Ordinal	**-0.582****			**-0.368****			**-0.629****	
Q48_FreshFood	Ordinal	**-0.548****			**-0.340****			**-0.551****	
Q48_Beauty	Ordinal	**-0.591****			**0.421****			**-0.632****	
Q48_MentalHealth	Ordinal	**-0.580****			**-0.406****			**-0.671****	
Q48_PhysicalHealth	Ordinal	**-0.571****			**-0.374****			**-0.521****	**0.305****
Q48_TripleBottomLine	Ordinal	**-0.555***			**-0.369****			**-0.638****	

		*							
Q49_GrowMuch	Ordinal							**0.420****	
Q50_LIkelyResolve	Ordinal	**-0.326****						**-0.469****	
Q51_Regulations	Ordinal	**-0.310****						**-0.334****	
Q51_CouncilEncourages	Ordinal	**-0.462****						**-0.461****	
Q51_Services	Ordinal	**-0.303****							
Q54_InterestGrowOnBuildings	Ordinal	**-0.511****						**-0.492****	

Variable	**Variable type (Pearson's)**	**Q1_ Environmentally Conscious**	**Q7_ Innovation**	**Q8_ Busy**	**Q22_ Experience and Confident**	**Q36_ Given Grant**	**Q46_ Confidence Growing on buildings**	**Q48_ Believe in many benefits of cultivating on buildings**	**Q2_ Wealthy**
Q1_Age	Interval			**-0.551****					
Q5_HouseType	Dichotomous				**0.337****				
Q8_HoursWorkPerWeek	Interval			**0.812****					
Q14_HoursSaladLeaves	Interval	0.315*							

Variable	**Variable type**	**Correlation with Q18_PersonTypologyEnvrironmentallyConscious (Nominal) (Kendall's tau_b)**
Q19_GrowEdibleOnOffice	Ordinal	**-0.309****
Q33_GroundWork	Ordinal	**-0.359****
Q48_ExternalMarkets	Ordinal	**-0.390****
Q48_ShadeBuilding	Ordinal	**-0.569****
Q48_Biodiversity	Ordinal	**-0.678****
Q48_Reconnect	Ordinal	**-0.582****
Q48_FreshFood	Ordinal	**-0.548****
Q48_Beauty	Ordinal	**-0.591****
Q48_MentalHealth	Ordinal	**-0.580****
Q48_PhysicalHealth	Ordinal	**-0.571****
Q48_TripleBottomLine	Ordinal	**-0.555****

Q50_LIkelyResolve	Ordinal	**-0.326****
Q51_Regulations	Ordinal	**-0.310****
Q51_CouncilEncourages	Ordinal	**-0.462****
Q51_Services	Ordinal	**-0.303****
Q53_WouldGrowOnBuildings	Dichotomous	0.305*
Q54_InterestGrowOnBuildings	Ordinal	**-0.511****

1. Correlations for person typology "More environmentally conscious people":

People who are more environmentally conscious are more likely to be experienced and confident gardeners.

D: B: People who are more environmentally conscious are more likely to believe that cultivating edible plants on buildings has a lot of benefits.

A: People who cultivate edible plants on the ground at work are more likely to be more environmentally conscious people.

D: People who grow edible plants on the building on their office are more likely to be more environmentally conscious people.

D: People who are more environmentally conscious are more likely to agree that the issues of cultivating edible plants on buildings are likely to be resolved with careful design and planning.

D: People who are more environmentally conscious are more likely to be persuaded to cultivate edible plants on buildings through regulations that encourage it, council that encourages it and services that help.

C: People who are more environmentally conscious are more likely to agree that they would be interested to cultivate edible plants on buildings.

2. Correlations for person typology "People who easily adopt innovations":

People who easily adopt innovations are more likely to say that an aim of their edible garden is to grow food.

C: People who easily adopt innovations are more likely to say that lack of physical ability would be a barrier to them having an edible garden.

3. Correlations for person typology "People who are busy (work more than 30 hours per week)":

Busier people are more likely to be younger.

Busier people are more likely to disagree that they would grow their own food for exercise.

Busier people are less likely to have friends and family who grow edible plants.

Busier people are less likely to have the council pay for their edible garden.

4. Correlations for person typology "People who are experienced and confident growing edible plants":

A: People who are experienced and confident growing edible plants are more likely to agree that they grow edible plants for interest and enjoyment, for increasing access to fresh food, for community cohesion, for sharing tasks with others, for aesthetics and for mental health.

B: D: People who are experienced and confident growing edible plants are more likely to agree that they would eat garden tomatoes, garden courgettes and garden peas.

B: D: People who are experienced and confident growing edible plants are more likely to agree that they would try to, if possible, grow all year, use organic fertiliser, use peat free compost and harvest rainwater.

B: D: People who are experienced and confident growing edible plants are more likely to grow a lot of annual vegetables.

B: D: People who are experienced and confident growing edible plants are more likely to know about permaculture.

B: D: People who are experienced and confident growing edible plants are more likely to grow in an allotment and in a communal garden.

D: People who are experienced and confident growing edible plants are more likely to have grown inedible and edible plants on an external sill.

D: People who are experienced and confident growing edible plants are more likely to agree that cultivating edible plants on buildings is good for biodiversity, reconnecting people with food production, increasing access to fresh food, making cities more beautiful, mental health, physical health and addresses triple bottom line of sustainability.

5. Correlations for person typology "People who are confident growing plants on buildings":

D: People who are more confident growing on buildings are more likely to be experienced cultivating edible plants.

D: People who are more confident growing on buildings are more likely to be cultivating edible plants in an edible garden.

D: People who are more confident growing on buildings are more likely to have grown inedible and edible plants on an internal sill.

6. Correlations for person typology "People who believe there are many benefits to cultivating edible plants on buildings":

D: A: People who believe there are many benefits to cultivating edible plants on buildings are more likely to agree that they would grow edible plants for environmental reasons, to grow unique crops, for community cohesion, to share tasks with others, for food security, for food safety, for aesthetics and mental health.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to agree that where possible they would use organic fertiliser, use peat free compost, minimise use of tap water and harvest rainwater when growing edible plants.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to agree that they are confident growing edible plants.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to know about permaculture.

D: A: People who believe there are many benefits to cultivating edible plants on buildings are more likely to grow in the ground at work.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to have a grant pay for their edible garden.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to have national help with maintaining their edible garden.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to have growing food, biodiversity and raising awareness of sustainability as important garden aims.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to have grown edible plants on a roof.

C: D: People who believe there are many benefits to cultivating edible plants on buildings are less likely to agree that you can't grow much on buildings.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to agree that the issues with cultivating edible plants on buildings can be resolved with careful design and planning.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to agree that regulations and council encouraging would persuade them to cultivate edible plants on buildings.

276. D: B: People who believe there are many benefits to cultivating edible plants on buildings are more likely to agree that they would be interested to grow edible plants on buildings (-0.492**) (Hypothesis 20 confirmed).

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to know of successful examples of cultivating edible plants on buildings.

D: People who believe there are many benefits to cultivating edible plants on buildings are more likely to agree that they would grow edible plants on buildings.

7. Correlations for person typology "People who are wealthier than others (own their homes or rent privately)":

C: A: People who own their own homes or rent privately are less likely to grow in a communal garden, ground at work and wall at work.

A: People who own their own homes or rent privately are less likely to have their friends, community, city, national and international help maintain their edible garden.

D: People who own their own homes or rent privately are less likely to have grown edible plants on a roof.

D: People who own their own homes or rent privately are less likely to agree that cultivating edible plants on buildings is good for physical health.

Correlations for typology "People who are given financial help for their edible garden":

A: People who have been given financial help for their edible garden are less likely to use front and back gardens and more likely to use communal gardens.

C: A: People who have been given financial help for their edible garden are more likely to grow in the ground at work, on a wall at work and inside a glazed space at work.

A: People who have been given financial help for their edible garden are more likely to have had community, city, national and international help with maintaining their garden.

A: People who have been given financial help for their edible garden are more likely to have growing food, relaxation, exercise, biodiversity, community cohesion and raising awareness of sustainability as important garden aims.

C: People who have been given financial help for their edible garden are more likely to have grown inedible and edible plants on a roof.

Appendix H – Interview Transcript Sample

Participant 2

Mina: The first question is about the physical aspects that have been a barrier or incentive for you to grow edible plants on your building.

Participant 2: Erm…well really there weren't very many physical, I did, I didn't perceive any physical barriers to be perfectly honest. I've always grown anything anywhere, there's always a little pot of, you know, lettuce leaves growing somewhere, so that flat roof up there just struck me as ideal for growing vegetables. Erm, so no anyone who comes says oh my god how do you get everything up here but of course most things go up as seeds and come down as food. So, erm, the only thing that we have to weak up is compost. So we bring compost up from the kitchen and obviously we buy a bag of something. If I grow tomatoes I might use some commercial compost or soil conditioner.

Mina: So who brings that up the stairs for you?

Participant 2: Mike brings a lot of it up but actually you can get it delivered and people will bring it upstairs. I mean we did take the hut and the greenhouse bits all upstairs ourselves. They were dismantled and brought up. Actually the sides of my hut where I do my writing, we had to cut them in half as we couldn't get them up the stairs. But we got them up there and put a bit of wood to join them. I mean that's been up there for about 12 years, it's done incredibly well.

Mina: Oh ok…so had the garden developed over time or was it decided as a project and you put it up there?

Participant 2: Erm…we've had a garden up there since 1997 and what I did, because we moved from Islington and I had a garden, a sort of very traditional town garden with beds and pots, I just brought all the pots and put them up there and then I bought some decking. And so the pots were sort of around the edge and grew flowers and the odd lettuce and things like that. Erm…but the when I, I went abroad for a while and I had a job in Hampshire for a while which meant I wasn't living here permanently and when I left that job, I came back here and I decided it would be really good to try and grow vegetables up here. Mainly because I…my professional practice has moved much further into sustainability and eco building and things like that and I had been looking at ideas of growing vegetables on roofs which is something that is shown in lots of architectural drawings and things like that and also I'd been getting very bored with the idea that green roofs are just sedum which is an immensely boring thing, it's sort of no good for man or beast really. And erm so I thought that it would be really interesting to see what I could grow up there, how much produce we could get, how long a growing period we could get because we're in a pretty favoured climate; central London we have a huge heat island effect around here and even thou that's not necessarily a good thing it does mean that we have very few frosts so we can plant things…the theory was that they would last longer and that we could plant earlier. In fact the limiting factor is daylight hours I've discovered. I don't actually think temperature is as important as the hours of daylight. When you get below 10 hours of daylight, it's quite difficult to grow things. It's February the 14th the 10 hour line which I think is very appropriate Valentine's day. The that's when the birds and bees start waking up and of course they're influenced by the daylight just as much as the plants.

Mina: Oooh yes. And do you find you have any pests, what are your main pest issues?

Participant 2: Erm, certainly slugs.

Mina: Slugs get up there?

Participant 2: Well of course, their eggs come in soil when I buy pots from the garden centre there will be slugs and again because we don't get any frosts it's quite difficult to mAnage them so I use nemitodes to mAnage them.

Mina: What's nemitodes?

Participant 2: Nemitodes are a natural predator of slugs that you water on twice a year once the spring and once in sort of mid-summer. So it's an organic method of control.

Mina: And where do you get them?

Participant 2: You buy them, because it's actually a live, I suppose you buy the eggs and they come by post and you have to keep in the fridge until you use them. And you, it's like a little box of stuff that looks like oatmeal actually which is presumably their food and you mix it with water and you water it on the garden and it does keep the slugs at bay. I also use galvanised chicken wire on my seed beds because slugs don't like walking over the galvanising so that works quite well just to get the seedlings going but of course once the leaves start to spread of course the slugs can climb on from the edge and it doesn't work. I get butterflies up there, so I get cabbage white but they're not too much of a problem. I don't grow cabbages and I mix things up so the butterflies don't find the cabbages to lay their eggs and I have lots of nasturtiums and they just as much like nasturtiums as cabbages so they often lay their eggs on the nasturtiums leaves and then you just pick the leaf off and pop it in the compost.

Mina: And do you have compost up there?

Participant 2: I have a big compost heap…yes…which…erm…gives me new soil every year because in a raised bed that's only 6 inches deep the nutrients are used up very quickly so you have to keep restocking the bed for the plants to…so mulching I use dried chicken pellets which are quite an easy thing. I use a foliar feed sometimes and erm I use compost and I also in the very early spring I put compost from the kitchen, just kitchen waste underneath the soil in the raised beds and then that makes a really rich mixture and things like broad beans you can sow.

Mina: Does that compost from the kitchen have any meat?

Participant 2: No we are vegetarIan so it has egg shells, lots of coffee grounds and lots of vegetable matter and sometimes a little bit of scrunched up paper but not very much because that doesn't break down so quickly. Coffee and I think the egg shells are good, they release lime slowly. With vegetables it's good to lime the ground but I use the coffee has some effect and also the slugs don't like coffee grounds and the egg shells release the lime slowly over a long period of time so they keep the soil sweet I hope.

Mina: So you have a closed lopp of waste going on.

Participant 2: Yes, that's the idea to have a closed system so you don't bring in much from outside. It does mean that you get a lot of vegetable seeds in the compost but if it's a vegetable in my view it's a volunteer, let it come. I'm a bit of a passivist when it comes to gardening so if it grows I let it stay. Growing what will thrive and not try to force things.

Mina: How did you know that the roof would be strong enough to take the loading? Is it because you knew it was designed to be an accessible terrace?

Participant 2: Yes well this is an old factory building and it's very, very strongly built. There are steel girders supporting the roof. It's not just timber construction. That was always a fire escape originally so in the, this building is probably around 1890 something like that so that period it was designed for foot traffic. We took the view that 6 inches of soil on raised beds would probably be fine.

Mina: So we've covered the physical aspects and a bit of your background personally. So how do you think your personal thoughts affect your behaviour of cultivating food on buildings?

Participant 2: Oh well quite a lot because as I say professionally I'm an architect and a planner and my specialism is sustainable development and so to a certain extent this is a demonstration of how you can grow vegetables in a city. Erm, I've always been a keen gardener and erm I've always liked growing edibles so you know that's another aspect which just comes from my personality I suppose. I'm a vegetarIan so vegetables are more important to me. I always buy organic vegetables if I can so…and in central London they are very expensive, organic vegetables. You can get lovely organic vegetables but they're very pricey so you know, it's sensible to grow your own. But when I started doing what I found very interesting was how very therapeutic it is, how much people enjoy just coming up there and sitting up there and were we in summer, were we having this discussion in the summer we'd be sitting up there under the sun shade and its extraordinarily, I think there is something very fundamental about a garden. I mean it features in all our cultures, in all our sort of religious iconography, not just ChristIan but you know Islamic as well. You know there's lots of, the garden has an incredible, erm, metaphor for humans I think and I think that's all over the world. I was very interested to see in the SyrIan refugee camps people are growing gardens and again if you look to Africa, even in very drought ridden places, people grow gardens so you know, it is very fundamental to our psyche and it's something that you don't get in the urban environment naturally. And I think living in the city, living in the city is fantastic, it's intellectually stimulating and you know immensely convenient and I like being in close proximity to my fellow men and women but I could not live somewhere without a little bit of green space. So I am part of a group that it designing a neighbourhood plan for this area and one of the things that we are saying is that we want to see more roof gardens and balconies and a lot of offices are being converted into flats around here because flats are just so valuable around here, I mean they've just gone up like anything and we're saying that all of them should have a balcony or access to some outside growing space not just space but space where you can grow something.

Mina: Great! So this leads us on to the community aspects. What are the community aspects that encourage you to undertake this behaviour?

Participant 2: My friends and neighbours certainly like coming and having a cup of tea with me on the roof. It's not a community garden, I do open it to the public and quite a lot of people come, erm, errr, I'm in two minds as to whether community gardens, I know there are a lot of community gardens. We have a few around here, erm, and I think they're very good for people who don't garden to get people who don't garden and have access to gardens out of their homes, erm, err, but I wouldn't say this garden fulfilled a function like that. It is essentially my back yard. You know like anyone's back yard you invite your friends and neighbours in.

Mina: How important do you think the kind of spreading the word is important for the garden?

Participant 2: Erm, well I do have a blog and I do have a twitter feed about it erm, which is quite well read. I think I get quite a lot of hits and I've got quite a lot of followers and erm, I found it very heartening actually that there are a lot of people out there who agree with me. The great thing about the web and social media is that you know you can talk to people in Australia or South Africa or CAnada, people who are doing similar things and suddenly something that might seem a little off the wall and unusual amongst the 20 people who live around you seems far more normal compared with what's happening all around the world, erm, so that's nice, that's enjoyable I think and of course you know one shares ideas.

Mina: And you start forgetting that it is something unusual.

Participant 2: Well I don't think it's unusual. I think most people are surprised by how pretty it is in the summer because if you think of an allotment, allotment has beauty, it has a sort of sturdy beauty doesn't it. You know sowed ranks of cabbages and leeks and things has a beauty but this is not formally laid out and erm, I use a lot of climbers and I use a lot of companion planting so there are a lot of flowers in the summer and erm, yeah I think the beauty of it surprises people and the they start looking and there's hardly anything up there that isn't edible. There are a couple of things left over from when it was a flower garden but you know even the rose, I've got a rose in a pot, but of course you can use the petals and the hips, it produces nice hips, not really enough to do anything with.

Mina: Do you think that this reaction that you get from people has any affect on you undertaking the behaviour?

Participant 2: Erm..yes it's reinforcement isn't it? Erm you know when people like and people want to see it and lots of people have photographed it and written articles and things and you know I opened it for the Chelsea fringe for the first time last summer and I was amazed at how many people came, how much publicity they gave it. You know I was on the radio talking about it and someone came to video it and I was really surprised so that is quite interesting.

Mina: Yes! So are there mostly annuals up there?

Participant 2: No there a few perennials and shrubs.

Mina: So it would grow back if you didn't do anything with the garden?

Participant 2: Erm well frankly if I did nothing it would still be a vegetable garden from next year as it would just reseed itself. I got very interested actually in medieval cottage gardens because I think from the research I've done that they were sort of weed gardens. I mean if you, if you erm, till the earth and just let it lay fallow weeds grow and most of our native, a lot of our native weeds are edible like daisies, dandelions and nettles, you know all sorts of things like that. Things really, really common are edible and I think that the medieval, country people would have had a garden and would have cultivated for the weeds, would, I mean certainly pre-historic people would have eaten weeds and they would have cultivated it, slowly cultivating things and saving seeds. And erm, you think of some of the sort of fairy tales I think like Jack and the Bean Stalk, you know the 5 beans being a really important thing for the widow and erm in Chaucer if you read the Nuns Priests Tale it's erm, it's all about erm, a widow who had a garden and lives from her garden and erm, he, he Chaucer says "Her meals were black and white" because they were mainly beans and erm grains and things like that and, and, so I I find that quite interesting our view, our English view of a cottage garden is you know the chocolate box, the pretty flowers, the fox gloves and things like that, erm and of course they would have grown flowers for medicinal purposes as well and I think the VictorIans sort of misunderstood. You know after the industrial revolution the cottage garden in England became a flower garden while in France which has a much more rural, agrarIan community the potage which is the same word as the cottage garden was a little vegetable garden and ern, they were called, erm in fact they were called cotars in English, in old English. Cottages were cotars and the potage, you know a potage was someone who had a little cottage who just had a little bit of space which was theirs to grow their food erm and so I am quite interested in seeing what sort of plants might actually keep going and annuals so not not, so this isn't really. I don't think it's really permaculture because I think permaculture certainly has been interpreted as using perennials but most vegetables you and I eat and enjoy are not perennials and certainly not grown as perennials. Thou things like beans are technically perennials and erm some tomatoes can be perennials, they tend to come again the next year, erm but erm if you think of all the leaf crops things like lettuces and stuff like that they're much better grown as annuals erm and so I, I, I wonder whether a traditional cottage garden might not have had those things and they just let a few of them seed and that's where the importance of flowers comes, you know if you don't let at least one lettuce flower and go to seed, you won't have any next year. You know Sutton Sir Thomson Organ didn't exist in those days and we've come to you know our culture has come to see that as picturesque and beautiful. Yeah so I think what's brought it back…when I went to university in the early 70s which was really when people were starting to think seriously about global warming and oil running out and things like that erm, I think I always assumed that all those things would come on stream. You know solar heating, you know all those things would come on much more quickly then it has done, erm so perhaps I'm part of a generation that was educated to believe that you shouldn't waste energy and you shouldn't buy your vegetables from Kenya or somewhere if you can actually grow them in your garden, goodness I'm sure the Kenyan's need those vegetables more than we do, I mean I recognise they need the money…

Mina: Well they've been set up that way.

Participant 2: Yes well they've been set up that way to be relIant on export, exporting things that they actually need themselves, hmmm…

Mina: Yeah it's really tricky, people's attitudes towards what they eat and their buying habits. What they find acceptable to eat anytime of year the disconnection they kind of have.

Participant 2: Hmmm, I think the other thing is that, I've now probably spent my life trying to change the world a little bit. The older I get the more I realise that that's quite a difficult thing to do and at least changing my habits and showing that I can do things differently, erm, at least sort of sets something of an example and I don't consider myself to be, erm, sort of 100% pure in my eco-credentials but erm, you know we don't have our house highly heated, we don't, you know we eat fresh vegetables. We don't eat meat, erm we do have a car but it's a very low energy car, we have a little smart car. You know we go around by bicycles. We use public transport. We don't fly if we can possibly help it, erm you know so, I, It's part of a whole philosophy a personal philosophy which is quite, erm, it's quite important to me because I don't think you can tell other people. In my professional life to a certain extent I'm telling other people that they need to have less, use less energy and that they should design things for less car use and stuff like that and you can't do that unless you can say well I don't use my car every day and that's really important.

Mina: So I think we've covered the last aspect which is personal knowledge.

Participant 2: Yes…I mean the other thing is that there is no book that tells you how to grow on a roof.

Mina: There are books about how to grow in containers…maybe you should write that book.

Participant 2: That's funny you should say that because a few of my friends are writing about growing in containers and you know growing vegetables in containers is a lot different to growing flowers in containers and erm, a lot of the sort of rules that you get in these books like you have to have containers that are deep is is, actually rubbish because erm, errr, roots don't go down that far expect to find water. Now one thing that you have to do in a roof like this is that you have to water it in the summer. There's no way that you could get away without watering it erm so, errr, you know the deep pots are unimportant so everything grows mainly in 6 inches. Obviously you can't grow really long carrots in 6 inches and things like potatoes.

Mina: Do you find that the watering takes a lot of time in the summer?

Participant 2: Erm…I do water twice a day in the summer and I tend not to go away between April and August. I…I…I would go away in April and then I would go away in September but not May, June, July, August. Well I do have an automatic watering system but it doesn't really work so well because plants need the amount of water they need and it's different every day. Yeah erm so I did have an automatic roof watering system that I just used all the time. Now it's a secondary system and I get up there…first thing we have breakfast up there everyday in the summer so while Mike puts the toast on I do the watering and erm in the evening. I work up there in the summer in that little hut and the when I've finished in the evening we might have a glass of wine and then I'll start watering again.

Mina: Ok so it becomes part of the daily routine.

Participant 2: It's part of the routine yes. It's like cleaning your teeth. You know it's as normal as that.

Mina: Is the not going away specifically for the watering?

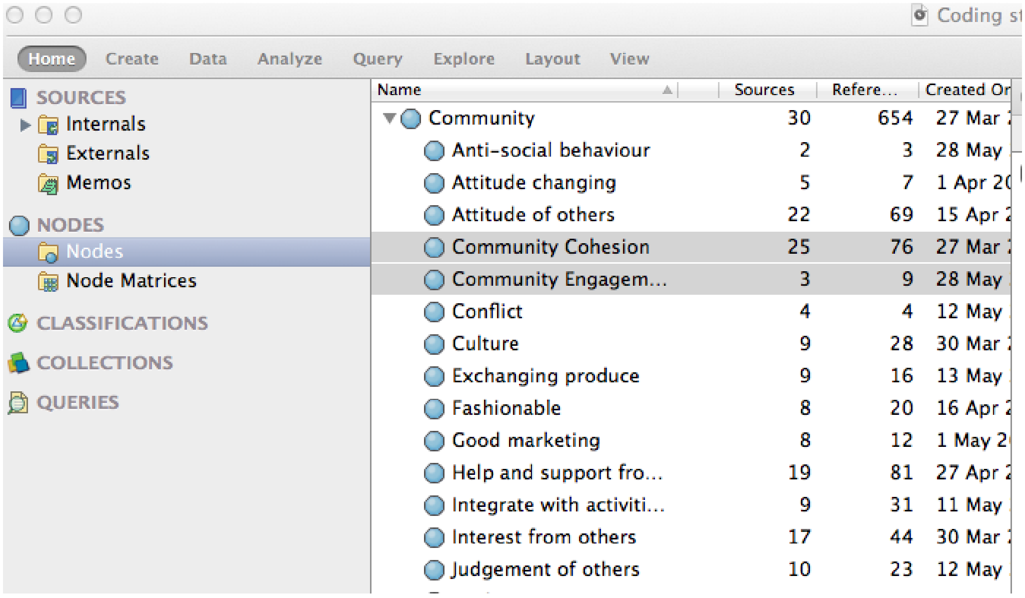
Participant 2: Well we run a B&B as well so they're really peak, they're really peak times and erm London is lovely in the Summer and when the garden is beautiful you just don't want to leave it so…

Mina: So I'll stop recording…

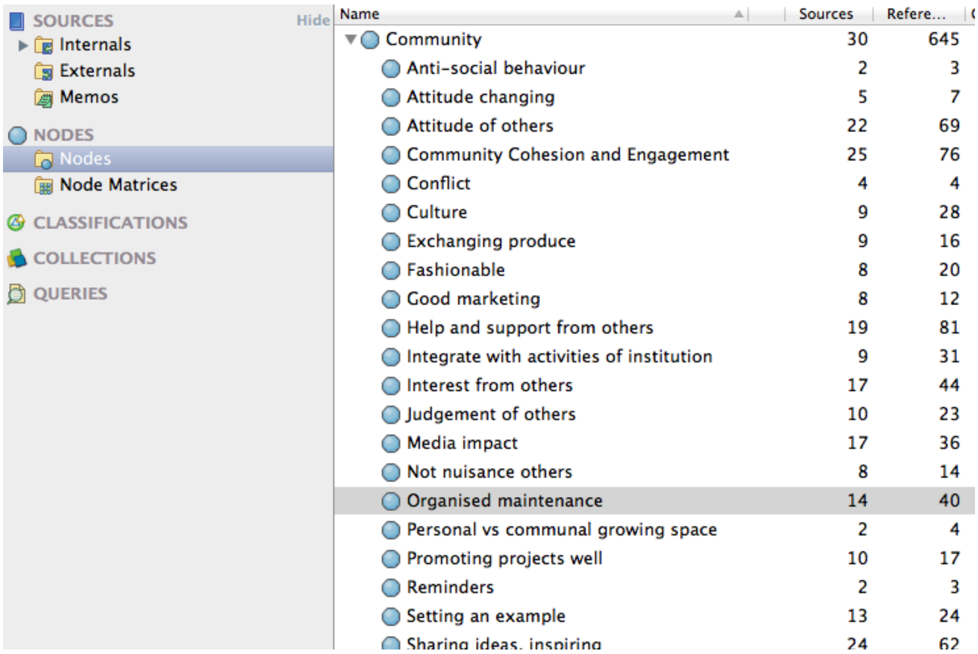
Appendix I – Combining nodes in Nvivo

Numbers of sources and similarity of nodes were looked at in order to aid combining nodes.

1. Combine 'Community Engagement' and 'Community Cohesion' and rename as 'Community Cohesion and Engagement' as 'Community Engagement' only has 3 sources and is very similar to 'Community Cohesion'.



2. Combine 'Reminders' into 'Organised Maintenance' as 'Reminders' only has 2 sources and is part of having an organised maintenance regime.



3. Combine 'Anti-social Behaviour', 'Vandalism' and 'Security' and rename as 'Security and Vandalism' and 'Anti-social Behaviour' only has 2 sources and they are all talking about the same issues around security.

Name	Sources	Refere...
Community	30	644
Anti-social behaviour	2	3
Attitude changing	5	7
Attitude of others	22	69
Community Cohesion and Engagement	25	76
Resources	18	37
Safety	14	35
Seating	7	10
Security	3	8
Services that help	19	42
Shade	10	13
Sheltered space	4	4
Smells nice	1	1
Soil Biodiversity	3	4
Space	2	2
Structural issues	18	35
Time	22	77
Transient	11	23
Vandalism	7	11

4.Combine 'Gardening Skills' and 'Horticultural Training' and rename as 'Horticultural Skills and Training' as they are talking about similar issues regarding the skills needed for growing.

Cooking	7	20
Education about the benefits of growi...	12	38
Existing examples	17	32
Experience	24	69
Family background	17	38
Gardening skills	21	75
Handy	3	5
Healthy Food Literacy	8	18
Horticultural training	7	9
Knowledge accessibility	15	26
Labelling plants	4	6
Learning by doing	9	14
Passing on skills to future generations	10	19
Past education and training	8	15

5. Combine 'Careful project planning', 'Communication and leadership skills' and 'Labelling plants' and rename as 'Project management and communication skills' as they all fit under this title.

Name	Sources	Refere...
Community	30	641
Economic Sustainability	29	209
Knowledge	30	442
Building Knowledge	14	27
Careful project planning	13	25
Communication and leader...	4	9
Cooking	7	20
Education about the benefi...	12	38
Existing examples	17	32
Experience	24	69
Family background	17	38
Gardening skills	23	81
Handy	3	5
Healthy Food Literacy	8	18
Knowledge accessibility	15	26
Labelling plants	4	6
Learning by doing	9	14
Passing on skills to future...	10	19
Past education and training	8	15

6. Combine 'Support local growers' into 'Food growers' and rename as 'Supporting food growers' and take out of concerns sub-category.

Name	Sources	Refere...
Aims	10	18
Amenity	2	3
▶ Beliefs	29	156
▶ Commitment	7	13
▼ Concerns	0	0
Energy concerns	15	25
Food growers	3	4
Food out of our po...	9	17
Food security	9	19
Pollution concerns	13	26
Population rise	1	5
Confidence	1	3
Eat in season	6	16
▶ Efficiency aims	8	24
Enjoyment	20	44
Food miles	9	22
Help with start up	16	33
Ideas	8	11
Importance	18	35
Innovation	1	1
Instinct to grow food	5	6
Interest, Opinons	26	98
Lifestyle	7	22
▶ Motivation	2	5
Part of process	1	2
Permaculture	1	1
▶ Poor quality produce	8	18
Practical to grow edib...	7	12
Small scale is a good...	1	2
Socialising	4	5
Spiritual connection...	4	5
Style of growing	1	2
Successful growing	12	22
Support local growers	2	3

7. Combine 'Building Maintenance' and 'Damage to building' and rename as 'Building damage and maintenance' because 'Building maintenance has only 2 sources and is related to damage to buildings.

Name	Sources	Refere...
▶ Community	30	641
▶ Economic Sustainability	29	209
▶ Knowledge	30	443
▶ Personal Psychology	30	713
▼ Physical	30	1059
Access	23	96
Aesthetics	16	55
Angle of building sur...	9	12
Bodily restrictions	11	25
Building maintenance	2	3
Central, visible space	7	7
▶ Climate	18	27
Crop rotation	1	1
Damage to building	13	27

8. Combine 'Nice space to be in' into 'Aesthetics' as they are used together in the same sources (see image of matrix below) and rename to 'Aesthetically pleasing space to enjoy'.

Physical matrix

	A : Physical	B : Access	C : Aesthetics
35 : Low maintenance...	30	0	1
36 : Matching plants t...	1	0	0
37 : Necessity	14	0	0
38 : Nice space to be in	4	0	3

9. Combine 'Soil Biodiversity' into 'Soil depth and type' and rename to 'Growing medium depth, type and microbiology'.

Name	Sources	Refere...	C
Priorities	1	1	
Smells nice	1	1	
▶ Space	2	2	
Soil Biodiversity	3	4	
Facilities	4	6	
Sheltered space	4	4	
Harvesting amounts a...	6	17	
Necessity	6	14	
Planning permission	6	8	
Central, visible space	7	7	
Grow things that you...	7	11	
Practicality	7	12	
Seating	7	10	
▶ Issues with container...	8	9	
Security and Vandalism	8	16	
Angle of building sur...	9	12	
Hard work	9	23	
Regulations	9	15	
It's not hard to grow f...	10	19	
Nutrients	10	29	
Shade	10	13	
Bodily restrictions	11	25	
Drainage	11	14	
Pests, Disease	11	27	
Proximity	11	29	
Transient	11	23	
Building damage and...	13	28	
Low maintenance pla...	13	30	
Safety	14	35	
Soil depth and type	14	30	

10. Combine 'Facilities' and 'Resources' and rename to 'Resources and facilities'.

Name	Sources	Refere...	C
Facilities	4	6	
Sheltered space	4	4	
Harvesting amounts a...	6	17	
Necessity	6	14	
Planning permission	6	8	
Central, visible space	7	7	
Grow things that you...	7	11	
Practicality	7	12	
Seating	7	10	
▶ Issues with container...	8	9	
Security and Vandalism	8	16	
Angle of building sur...	9	12	
Hard work	9	23	
Regulations	9	15	
It's not hard to grow f...	10	19	
Nutrients	10	29	
Shade	10	13	
Bodily restrictions	11	25	
Drainage	11	14	
Pests, Disease	11	27	
Proximity	11	29	
Transient	11	23	
Building damage and...	13	28	
Low maintenance pla...	13	30	
Safety	14	35	
Great to use spare bu...	15	38	
Green Spaces and Bio...	15	37	
Growing medium dep...	15	32	
▶ Health Benefits	16	42	
Ownership	16	46	
Aesthetically pleasing...	17	56	
▶ Climate	18	27	
Resources	18	37	

11. Combine 'Dislike physical excursion' into 'Bodily restrictions' and rename to 'Bodily Restrictions and Excursion'.

Name	Sources	Refere...
▶ Economic Sustainability	29	209
▶ Community	30	641
▶ Knowledge	30	443
▶ Personal Psychology	30	714
▼ Physical	30	1077
Crop rotation	1	1
Delaying goals	1	1
Dislike physical excur...	1	1
Matching plants to co...	1	1
Priorities	1	1
Smells nice	1	1
▶ Space	2	2
Sheltered space	4	4
Harvesting amounts a...	6	17
Necessity	6	14
Planning permission	6	8
Central, visible space	7	7
Grow things that you...	7	11
Practicality	7	12
Seating	7	10
▶ Issues with container...	8	9
Security and Vandalism	8	16
Angle of building sur...	9	12
Hard work	9	23
Regulations	9	15
It's not hard to grow f...	10	19
Nutrients	10	29
Shade	10	13
Bodily restrictions	11	25

12. Combine 'Delay goals' into 'Integrate into activities of organisation'.

Name	Sources	Refere...
▶ Economic Sustainability	29	209
▶ Community	30	642
▶ Knowledge	30	447
▶ Personal Psychology	30	715
▼ Physical	30	1074
Delaying goals	1	1

13. Combine 'Planning Permission' into 'Regulations' and rename to 'Regulations and Planning Permission'.

Name	Sources	Refere...
▶ Economic Sustainability	29	209
▶ Community	30	642
▶ Knowledge	30	447
▶ Personal Psychology	30	715
▼ Physical	30	1086
Smells nice	1	1
▶ Space	2	2
Sheltered space	4	4
Harvesting amounts a...	6	17
Necessity	6	14
Planning permission	6	8
Central, visible space	7	7
Grow things that you...	7	11
Practicality	7	12
Seating	7	10
Easy access to fresh f...	8	13
▶ Issues with container...	8	9
Security and Vandalism	8	16
Angle of building sur...	9	12
Hard work	9	23
Regulations	9	15

14. Combine 'Drainage' into 'Irrigation' and rename to 'Irrigation and Drainage'.

Name	Sources	Refere...
Harvesting amounts a...	6	17
Necessity	6	14
Central, visible space	7	7
Grow things that you c...	7	11
Practicality	7	12
Seating	7	10
Easy access to fresh fo...	8	13
Issues with container...	8	9
Security and Vandalism	8	16
Angle of building surf...	9	12
Hard work	9	23
It's not hard to grow f...	10	19
Regulations and Planni...	10	20
Shade	10	13
Bodily Restrictions and...	11	25
Drainage	11	14
Nutrients	11	30
Pests, Disease	11	27
Proximity	11	29
Transient	11	23
Building damage and...	13	28
Low maintenance plants	13	30
Safety	14	35
Green Spaces and Biod...	15	37
Growing medium dept...	15	32
Health Benefits	16	42
Ownership	16	46
Aesthetically pleasing...	17	56
Climate	18	27
Resources and Facilities	18	39
Structural issues	18	35
Services that help	19	42
Time	22	77
Access	23	96
Irrigation	23	72

15. Combine 'Personal vs communal growing space' into 'Ownership'.

Name	Sources	Refere...
Economic Sustainability	29	208
Community	30	642
Personal vs communal growing space	2	4
Conflict	4	4
Attitude changing	5	7
Fashionable	8	20
Good marketing	8	12
Not nuisance others	8	14
Culture	9	28
Exchanging produce	9	16
Integrate with activities of institution	9	32
Judgement of others	10	23
Promoting projects well	10	17
Sustained enthusiasm about involvement	12	31
Setting an example	13	24
Organised maintenance	15	42
Interest from others	17	44
Media impact	17	36
Help and support from others	19	81
Attitude of others	22	69
Sharing ideas, inspiring, reassurance	24	62
Community Cohesion and Engagement	25	76
Knowledge	30	447
Personal Psychology	30	753
Physical	30	1039

16. Combine 'Sustainable Irrigation' into 'Irrigation and Drainage'.

Name	Sources	Refere...
Sheltered space	4	4
Harvesting amounts a...	6	17
Necessity	6	14
Central, visible space	7	7
Grow things that you...	7	11
Practicality	7	12
Seating	7	10
Easy access to fresh f...	8	13
Issues with container...	8	9
Security and Vandalism	8	16
Angle of building sur...	9	12
Hard work	9	23
It's not hard to grow f...	10	19
Regulations and Plan...	10	20
Bodily Restrictions an...	11	25
Nutrients	11	30
Pests, Disease	11	27
Proximity	11	29
Transient	11	23
Building damage and...	13	28
Low maintenance pla...	13	30
Safety	14	35
Green Spaces and Bio...	15	37
Growing medium dep...	15	32
Health Benefits	16	42
Ownership	16	48
Aesthetically pleasing...	17	56
Climate	18	27
Resources and Facilities	18	39
Structural issues	18	35
Services that help	19	42
Time	22	77
Access	23	96
Irrigation and Drainage	24	80
— Sustainable irrigation	8	13

17. Combine services that help into Help and support from others

18. Combine shade with orientation and light and rename as “Orientation, light and shade”.

19. Combine Seating and Sheltered space with “Aesthetically pleasing place to enjoy” and rename as “Aesthetically pleasing space to enjoy, seating, shelter”.

20. Combine storage space and propagation space into “Lack of space on building” and rename as “Lack of space on building for growing, storage, propagation”.

21. Combine “Efficiency and Productivity” into “Lack of space on building for growing, storage, propagation” and rename as “Lack of space on building for high productivity and efficiency, storage, propagation”.

22. Combine “Regulations and planning permission” into Ownership and rename as “Ownership, permission and regulations”.

23. Combine “Water retention” with “Easy access to irrigation and good drainage” and rename as “Easy access to irrigation, good drainage and water retention.”

24. Combine “Size of container” with “Growing medium depth, type and microbiology” and rename as “Growing medium depth, area, type and microbiology”.

25. Combine “Nutrients” with “Growing medium depth, size, type and microbiology” and rename as “Growing medium depth, size, type, nutrients source and microbiology”.

26. Combine “Time needed to irrigate” and “Low maintenance plants” with “Lack of time” and rename as “Perceived time needed to maintain plants, irrigate, plan”.

27. Combine “Hard work” with “It’s not hard to grow food” and rename as “Perceived difficulty of work needed to grow food”.

28. Combine “Necessity” with “Buying food is very affordable” and rename as “Buying food is very affordable so there is no perceived necessity to grow food”.

29. Combine “Value of space” with “Value of the crop” and rename as “Value of the crop and the space”.

30. Combine “Grow things that you can’t buy” and “Eat in season” with “Lack of quality produce, nutrients and flavour” and rename as “Grow good quality produce full of nutrients, flavour and variety rather than the opposite sold on the market and produce that is not in season (6)”.

31. Go through “Practicalities” which were mainly using the word practical with the context of the different physical practicalities such as time, access etc. therefore rename the physical head node to “Physical Practicalities”.

32. Break up the “Beliefs” category and rename “Motivation, desire, worth” to “Motivation, desire, worth, values”.

33. Combine “Value growing food” with “Motivation, desire, worth, values” and rename as “Value growing food.”

34. Combine “A break from work” with “Therapeutic” and rename as “Therapeutic activity taken as a break”.

35. Combine “Pollution concerns” with “Chemicals in food” and rename as “Concerns about pollution and chemicals contaminating food”.

36. Combine “Age” with “Fashionable” and rename as “Age and Fashion”.

37. Combine “Food out of our Power” with “Food Security”.

38. Combine “Energy concerns”, “Waste as a resource” and “Food Miles” into “Environmental concerns” and rename as “Environmental concerns about general sustainability, energy concerns, waste, food miles.”

39. Combine “Social Beliefs” and “Socialising” with “Community cohesion and engagement” and renames as “Community cohesion, engagement and socialising”.

40. Combine “Skilful, handy” into “Gardening skills and confidence”.

41. Combine “Spiritual connection with nature” into “Importance of bringing green spaces and biodiversity into urban areas” and rename as “Importance of connection with green spaces and bringing biodiversity into urban areas”.

42. Combine “Cooking skills” with “Learn health food literacy” and rename as “Cooking skills and healthy food literacy”.

43. Combine “Judgement of others” into “Attitude of others” and rename as “Attitude and Judgement of others.”

44. Combine “Affecting property value” into “Value of the crop and the space”.

45. Combine “Inexpensive to grow food” with “Expense, Lack of money” and rename as “Expense of growing food”.

46. Combine “Orientation, light and shade” into “Climate on buildings; Wind, exposure, temperature and frost” and rename as “Climate on buildings; Wind, exposure, temperature, frost, orientation and shade.”

47. Combine “saves money” into “not much financial benefit” and rename as “Financial benefits.”

48. Combine “Ideas and aims” into “Interest and Opinions” and rename as “Interest, opinions, ideas, aims”.

49. Combine “Growing food on buildings is good marketing for businesses” into “Attitude and Judgement of others.”

50. Combine “Can grow a lot in a small space” with “Lack of space on building for high productivity and efficiency, storage, propagation” and rename as “Sufficient space for productivity aims, storage and propagation.”

51. Combine “Value growing food” with knowledge of the benefits of growing food” and rename as “Value growing food – knowledge of the benefits of growing food.”

Appendix J – Summary of results from analysis in Nvivo

Table 35: Parameters that relate to the building and cultivating edible plants (parameters either aid motivation to undertake the behaviour and/or they are barriers to undertaking the behaviour)

Main Parameters for Building	Sub-Parameter		Number of people who talked about this	Sub-sub-parameters		Number of people who talked about this
	Motivation	Barrier		Motivation	Barrier	
Physical – Building Parameters	Sufficient space for productivity aims (grow a lot in a small space (12)), storage and propagation. (Total 17 people)	Lack of space on building for productivity aims (18), storage (4), propagation (1). (Total 11 people)	26			
	Easy access to irrigation, good drainage and water retention (6) (Total 4 people)	Difficult access to irrigation and bad drainage (Total 20 people)	24			
	Easy physical and/or perceived access to the plants (Total 6 people)	Difficult physical and/or perceived access to the plants (Total 17 people)	23			
	Suitable growing medium depth, size (4), type, nutrients source (11) and microbiology (Total 7 people)	Difficult and or unsustainable growing medium depth, size (4), type, nutrients (11) source and microbiology (Total 13 people)	20			
NOTE: Also in cultivating in urban areas table under physical parameters	Don't have space at ground level to cultivate (Total 6 people)	Have space at ground level to cultivate (Total 15 people)	21			
	Perceive no climatic problems on buildings that are not solvable and/or have the knowledge to solve them and/or the financial resources to solve them (Total 3 people)	Perceive unsuitable climate on buildings; Wind, access to light, temperature, frost orientation and shade that are not solvable or do not know how to solve and/or have access to the financial resources to	20			

		solve them (Total 17 people)				
	Perceive angle of building surface not to be a barrier (Total 2 people)	Perceive angle of building surface to be a barrier (Total 7 people)	9			
Personal psychology affecting cultivating on building						
NOTE: Also in cultivating in urban areas table under personal psychology	Interest, Opinions, Ideas and Aims in favour of cultivating own food in general and/or cultivating food on buildings (Total 25 people)	Interest, Opinions, Ideas and Aims not in favour of cultivating own food in general and/or cultivating food on buildings (Total 4 people)	29			
	Great to use spare building space (Total 15 people)	Use spare building space in other ways (Total 5 people)	20			
	Perceive to be safe and/or not difficult to resolve safety issues (Total 2 people)	Perceive not to be safe and/or difficult to resolve safety issues (Total 12 people)	14			
	Technical beliefs in favour of cultivating on buildings (Total 6 people)	Technical beliefs not in favour of cultivating on buildings	6			
Knowledge	Have knowledge of building structure (Total 6 people)	Lack of knowledge of building structure (Total 13 people)	19			
	Know of existing successful examples of cultivating food on buildings (Total 10 people)	Do not know of existing successful examples of cultivating food on buildings (Total 7 people)	17			
	Have some knowledge of building construction (Total 1 person)	Don't have much knowledge of building construction (Total 14 people)	15	Building damage and maintenance carefully considered	Concerns about building damage and maintenance	14

	Knowledge of benefits of cultivating food on buildings (Total 5 people)	No knowledge of benefits of cultivating food on buildings	5			

Table 36: Parameters that affect the behaviour of cultivating edible plants in urban areas (parameters either aid motivation to undertake the behaviour or they are barriers to undertaking the behaviour)

Main Parameters for Cultivating in urban areas	**Sub-Parameter**		**Number of people who talked about this**	**Sub-sub-parameters**		**Number of people who talked about this**
	Motivation	Barrier		Motivation	Barrier	
Physical space and personal parameters	Perceive to have time to maintain plants (low maintenance plants (13)), irrigate (15), plan (Total 7 people)	Perceive to lack time to maintain plants (low maintenance plants (13)), irrigate (15), plan (Total 18 people)	24	Lifestyle in favour of cultivating	Lifestyle not in favour of cultivating	7
	Easy access to resources and facilities (Total 4 people)	Difficult to access resources and facilities (Total 16 people)	20			
	Aesthetically pleasing space that is enjoyed (seating (7), shelter (4)) (Total 9)	Un-aesthetically pleasing space that isn't enjoyed (Total 11)	20			
	Own space, permitted to do it and/or meets regulations	Lack of ownership, permission and meeting regulations (Total 19 people)	19			
	Climate motivates growing (Total 2 people)	Climate is bad for growing (Total 12 people)	15			
	Not transient lifestyle	Transient lifestyle (Total 11)	11			
	Close proximity to growing space from where they live and/or work (Total 6 people)	Not close proximity to growing space from where they live and/or work (Total 5 people)	11			

	Perceive bodily restrictions and excursion as not a major issue	Perceive bodily restrictions and excursion as an issue (Total 11 people)	11			
	Perceive security from vandalism and theft as not a major issue	Perceive security from vandalism and theft as a major issue (Total 8 people)	8			
	Some people would be more motivated if their garden is highly visible, others may be more motivated if their garden isn't highly visible.	Some people may not like to use a highly visible garden or may not like to use a garden that isn't highly visible.	8 (6 people in total said visibility is good and 2 people in total said visibility is bad)			
Personal Psychology affecting cultivating						
NOTE: Also in building parameters table under personal psychology	Interest, Opinions, Ideas and Aims in favour of cultivating own food in general and/or cultivating food on buildings (Total 25 people)	Interest, Opinions, Ideas and Aims not in favour of cultivating own food in general and/or cultivating food on buildings (Total 4 people)	29	Enjoy cultivating food	Do not enjoy cultivating food	20
				Instinct to cultivate food	No instinct to grow food	5
	Grow chemical free produce full of nutrients, flavour and variety rather than the opposite sold on the market and produce that is not in season (6) (Total 18 people)	Perceive that the food sold on the market is chemical free, nutrient rich and flavoursome or believe that the above are not issues (Total 1 person)	18	Concerned about food grown in conventional farms contaminated with chemicals from farming practices.	Not concerned about food grown in conventional farms contaminated with chemicals from farming practices.	19

				Dietary beliefs encourage to grow own food	Dietary beliefs discourage cultivating own food (e.g. people who don't like fruit and vegetables)	5
NOTE: Also in knowledge below.	Value growing food (17) – knowledge of benefits of cultivating in general and in urban areas (gaining this knowledge through seeing/doing cultivating (13)) (Total 18 people)	Don't value growing food – lack of knowledge of benefits of cultivating in general and in urban areas (Total 3 people)	25	Environmental concerns about general sustainability, energy concerns (15), waste (9), food miles (10)	Not concerned about environm ental issues	29
				Therapeutic (13) activity taken as a break (12)	Not seen as therapeuti c	20
				Knowledge of importance of bringing green spaces and biodiversity into urban areas.	Lack of knowledg e of importanc e of bringing green spaces and biodiversit y into urban areas.	18
				Important to cultivate own food and/or have food cultivation in urban areas.	Not important to cultivate own food and/or have food cultivation in urban areas	18
				Knowledge of health and wellbeing benefits	Lack of knowledg e of health and wellbeing benefits	16
				Helps alleviate some food security issues	Does not help alleviate some food security issues or do not see food security as	11

					an issue	
				Knowledge of importance of passing on cultivation skills to future generations	No knowledge of importance of passing on cultivating skills to future generations	10
				Easy access to fresh food when cultivating food	Perceive they already have easy access to fresh food without cultivating food or not important to have easy access to fresh produce	9
				Useful to grow edibles not just ornamentals	It's fine to just grow ornamental plants	7
				Past education and training gives awareness of benefits	Past education and training does not give awareness of benefits	7
NOTE: Also in economics below	High financial value crops grown on low/high financial value space (4) and/or improves property value (Total 13 people)	Low financial value crops grown on high financial value space (4) and/or does affect the property value	13			
	Commitment and determination (Total 5 people)	Not committed and determined (Total 6 people)	11			
	Perceive food grown in urban areas getting contaminated by urban pollution as not a major issue	Perceive food grown in urban areas getting contaminated by urban pollution as a major	6			

		issue (Total 6 people)				
	Supporting food growers important but also important to grow own food (Total 1 person)	Supporting food growers more important than cultivating own food (Total 4 people)	5			
Knowledge						
NOTE: Also in person psychology above.	Value growing food (17) – knowledge of benefits of cultivating in general and in urban areas (gaining this knowledge through seeing/doing cultivating (13)) (Total 18 people)	Don't value growing food – lack of knowledge of benefits of cultivating in general and in urban areas (Total 3 people)	25	See above		
	Have gardening skills and confidence in skills (Total 9 people)	Do not have gardening skills and confidence in skills (Total 15 people)	24	Cultivation experience	Not much cultivation experience	24
				Perceive easy to grow food	Perceive difficult to grow food	16
				Know how to access the knowledge needed	Don't know how to access the knowledge needed	15
				Grown successfully in the past	Haven't grown successfully in the past	12
				Perceive pests and disease as not a major issue	Perceive pests and disease as a major issue	11
				Can learn by doing	Find it difficult to learn by doing	9
	Have project management and communication skills (Total 3 people)	Do not have project management and communication skills (Total 13 people)	16	Promoting project well	Project not promoted well	13

				Right match between what is grown and building occupants	Wrong match between what is grown and building occupants	6
	Gaining cooking skills and healthy food literacy a motivator to growing (Total 9 people)	Lack of cooking skills and healthy food literacy a barrier to growing (Total 3 people)	12	Perceive harvesting overabundance and timing as not a major issue	Perceive harvesting overabundance and timing as a major issue	6
Community	Seen as good for community cohesion, engagement and socialising (Total 25 people)	Not seen as important for community cohesion, engagement and socialising	25	Interest from others	No interest from others	17
				Exchanging produce with others	No exchange of produce with others	9
	Share ideas, inspire, and/or give reassurance is a motivator to grow (Total 24 people)	Sharing of ideas, inspiration and/or reassurance not important	24	Important to set an example of cultivating food	Not important to set an example of cultivating food	13
				Cultivating own food changes attitudes towards food	Cultivating own food does not change attitudes towards food and/or attitude towards food does not need to be changed	5
	Help and support from others (Total 8 people)	Lack of help and support from others (Total 16 people)	24	Help with start up	No help with start up	16
				Organised maintenance	No organised maintenance	15
				Sustained enthusiasm about involvement	No sustained enthusiasm about involvement	12

				Perceive conflict with others as not a major issue when cultivating food	Perceive conflict with others as a major issue when cultivating food	4
	Perceived attitude and judgement of others in favour of cultivating in urban areas and/or on buildings, good marketing for businesses (3) (Total 16 people)	Perceived attitude and judgement of others not in favour of cultivating on buildings, bad marketing for businesses (Total 7 people)	23	Media impact in favour of cultivating in urban areas and/or on buildings	Media impact not in favour of cultivating in urban areas and/or on buildings	17
				Family background of cultivating own food	No family background of cultivating own food	17
				Fashionable to undertake the behaviour of cultivating food in general and on buildings	Not fashionable to undertake the behaviour of cultivating food in general and on buildings	10
				Culture, traditions promoting behaviour	Culture, traditions making behaviour difficult to do	10
				Integrated with activities of institution	Not integrated with activities of institution	9
	Does not cause a nuisance to others (Total 3 people)	Causes a nuisance to others (Total 5 people)	8			
Economic	Perceive expense as not an issue and/or perceive that it is inexpensive to grow food (5) (Total 4 people)	Perceive expense as a major issue and/or perceive that it is expensive to grow food (Total 14 people)	18			

	Financial incentives given (Total 6 people)	No financial incentives given but would encourage (Total 6 people)	12	Perceive there to be financial benefit (8) or not much financial benefit as not a major issue	Perceive not much financial benefit (9) as a major issue	15
				Buying fresh food is not affordable so there is a perceived necessity to grow food or perceive that buying fresh food is affordable but this is not a disincentive to grow own food	Buying fresh food is very affordable so there is no perceived necessity to grow food	11
				Perceive creating jobs through cultivating food on buildings as a great thing	Perceive jobs can be created in better ways	1
				Working in a business plan (Total 3 people)	Not sure it works in a business plan (Total 3 people)	6

Appendix K – Linking the parameters that affect the behaviour to cultivate edible plants on buildings with behavioural theory

Parameter found in literature review and phase 2	**Parameter found in Phase 2 only**	**The behavioural influences of the Theory of Planned Behaviour that this parameter is related to (Ajzen, 1985, 2005)**	**The behavioural influences of the Behaviour Change Wheel that this parameter is related to (Michie et al, 2011) NOTE: All lead to Motivation but Motivation is indicated below where there is a direct relationship with the parameter (See Figure 33)**	**Further discussion of relationship between behaviour theory and parameter**	**Intervention functions and policy categories from the Behaviour Change Wheel that could address the parameter**
Buildings					
BP1. Sufficient space for productivity aims		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Physical)[D]	A – Past experience of growing in small spaces to achieve required productivity aims and/or perceiving growing in small spaces as an obstacle due to productivity aims. B – Perceived level of ease/difficulty to cultivate in small spaces to achieve required productivity aims. C – Beliefs about lower productivity and how this affects their attitude towards cultivating in small spaces. D - Is there actually space to grow?	Education and training about cultivating in small spaces (also through guidelines, communication/marketing and service provision below). Environmental restructuring – preparing the space for cultivation. Modelling – showing examples of what people have grown in small spaces. Persuasion – communication to induce positive feelings about cultivating in small spaces (also through guidelines, communication/marketing and service provision below). Communication/marketing of cultivating in small spaces. Guidelines – creating a document that provides guidelines for

					cultivation on buildings. Environmental/social planning – designing small spaces on buildings in order to be cultivated. Service provision – providing services that help aid cultivation in small spaces on buildings (e.g. garden shops having a section with products/tools to help aid cultivating in small spaces)
BP2. Access to irrigation and/or drainage		Control beliefs[A/D] → Perceived behavioural control[B]	Capability (Physical[A]) Opportunity (Physical)[D]	A – Perceive access to irrigation and/or drainage as an obstacle. B – Perceived level of ease/difficulty the access to irrigation and/or drainage is. D – Is there actually access to irrigation and/or drainage?	Education and training about irrigation and drainage when cultivating on buildings (also through guidelines, regulations and service provision below). Environmental restructuring – preparing the irrigation and drainage for cultivation. Modelling – showing examples of irrigation and drainage when cultivating on buildings. Enablement – give resources/skills/support to overcome problems with irrigation and drainage (also through guidelines, regulations and service provision below). Guidelines – creating a document that provides guidelines for cultivation on buildings. Regulations – providing regulations for irrigation and

					drainage when cultivating on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated with good irrigation and drainage. Service provision – providing services that help aid cultivation on buildings (e.g. a service that provides expert advice for irrigation and drainage when cultivating on buildings).
BP3. Access to plants		Control beliefs [A/D] → Perceived behavioural control[B]	Capability (Physical[A]) Opportunity (Physical)[D]	A – Perceive access to plants as an obstacle. B – Perceived level of ease/difficulty the access to plants is. D – Is there actually access to the plants?	Education and training about accessing plants when cultivating on buildings (also through guidelines, regulations and service provision below). Environmental restructuring – preparing the access to plants for cultivating on buildings. Modelling – showing examples of how access to plants can be achieved when cultivating on buildings. Enablement – give resources/skills/support to overcome problems with access to plants (also through guidelines, regulations and service provision below). Guidelines – creating a document that provides guidelines for cultivation on buildings.

					Regulations – providing regulations for access when cultivating on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated with good access. Service provision – providing services that help aid cultivation on buildings (e.g. a service that provides expert advice for access when cultivating on buildings)
BP5. Suitable growing medium		Control beliefs[A/D] → Perceived behavioural control[B]	Capability (Physical[A] and Psychological[A]) Opportunity (Physical)[D]	A – Past experience of cultivating with type of growing medium and/or perceive type of growing medium as an obstacle. B – Perceived level of ease/difficulty to grow in type of growing medium. D – Is the growing medium actually suitable for cultivation?	Education and training about obtaining suitable growing medium when cultivating on buildings (also through guidelines, communication/marketing and service provision below). Environmental restructuring – preparing a suitable growing medium and putting in in-situ. Modelling – showing examples of how suitable growing media can be achieved when cultivating on buildings. Enablement – give resources/skills/support to overcome problems with growing media (also through guidelines and service provision below). Communication/marketing of suitable growing mediums.

					Guidelines – creating a document that provides guidelines for cultivation on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated with suitable growing media. Service provision – providing services that help aid cultivation on buildings (e.g. a service that provides expert advice for growing media when cultivating on buildings).
	BP4. The availability of other space	Control beliefs[A/D] → Perceived behavioural control[B]	Capability (Physical[A] and Psychological[A]) Opportunity (Physical)[D]	A – Past experience with growing in other space and/or perceive there is other space available so don't need to use space on building. B – Perceived level of ease/difficulty the other space available to cultivate is compared with growing on the building space available. D – There is other space available for cultivation.	Education and training about cultivating on buildings (also through guidelines, communication/marketing and service provision below). Environmental restructuring – preparing the space for cultivating on buildings. Modelling – showing examples of cultivating on buildings. Enablement – give resources/skills/support to overcome the feeling that using other available space rather than space on a building (also through guidelines and service provision below). Communication/marketing of cultivating edible plants on buildings.

					Guidelines – creating a document that provides guidelines for cultivation on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated. Service provision – providing services that help aid cultivation on buildings.
BP6. Climate around building impacting cultivation		Control beliefs[A/D] → Perceived behavioural control[B]	Capability (Physical[A] and Psychological[A]) Opportunity (Physical)[D]	A – Past experience with climatic problems on buildings for cultivation and/or perceive climate on building as an obstacle for cultivation. B – Perceived level of ease/difficulty the climate on building makes cultivation. D – Does the climate on building make cultivation impossible?	Education and training about solving climatic problems when cultivating on buildings (also through guidelines and service provision below). Environmental restructuring – preparing the space with interventions to alleviate the climatic problems when cultivating on buildings. Modelling – showing examples of how climatic problems have been resolved when cultivating on buildings. Enablement – give resources/skills/support to overcome problems with climate (also through guidelines and service provision below). Guidelines – creating a document that provides guidelines for cultivation on buildings. Environmental/social planning – designing spaces on buildings in

					order to be cultivated with interventions to help alleviate climatic issues. Service provision – providing services that help aid cultivation on buildings (e.g. a service that provides expert advice for alleviating climatic problems when cultivating on buildings).
BP7. Angle of building surface		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[A]) Opportunity (Physical)[D]	A – Past experience with angle of building surface for cultivation and/or perceive angle of building surface as an obstacle for cultivation. B – Perceived level of ease/difficulty the angle of building surface makes cultivation. C – Belief about angle of building surface being cultivated. D – Does the angle of building surface make cultivation not possible?	Education and training about working with different angled surfaces when cultivating on buildings (also through guidelines, communication/marketing, regulations and service provision below). Environmental restructuring – preparing the surface angle for cultivating on buildings. Modelling – showing examples of cultivating on different angles can be achieved when cultivating on buildings. Enablement – give resources/skills/support to overcome problems with the angle of the building surface (also through guidelines, regulations and service provision below). Communication/marketing of cultivating edible plants on buildings. Guidelines – creating a document

					that provides guidelines for cultivation on buildings. Regulations – providing regulations for different angled surfaces when cultivating on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated with solutions implemented for different surface angles. Service provision – providing services that help aid cultivation on buildings (e.g. a service that provides expert advice for cultivating on different angled surfaces when cultivating on buildings).
	BPP1. Opinion of use of spare building space	Behavioural beliefs → Attitude towards the behaviour[C]	Motivation (Reflective)[C]	C – Belief about use of spare building space for cultivation.	Education and training about using spare building space for cultivating on buildings (also through guidelines and communication/marketing below). Persuasion – communication to induce positive feelings about cultivating on buildings (also through guidelines and communication/marketing below). Environmental restructuring – preparing spare building space for cultivating on buildings. Modelling – showing examples of

					how spare building space has been used when cultivating on buildings. Communication/marketing of cultivating edible plants on buildings. Guidelines – creating a document that provides guidelines for cultivation on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated.
BK2. Knowing of existing examples of cultivating edible plants on buildings		Control beliefs[A] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Motivation (Automatic[E] and Reflective[C])	A – Past experience of seeing cultivation on buildings. B – Perceived level of ease/difficulty to cultivate on buildings due to seeing other projects. C – Belief and attitude towards the behaviour is affected by seeing cultivation on buildings. E – Motivation to undertake behaviour affected by emotional responses towards the behaviour.	Education and training about cultivating on buildings (also through guidelines, communication/marketing, regulations and service provision below). Environmental restructuring – preparing the space for cultivating on buildings. Modelling – showing examples of cultivating on buildings (also through communication/marketing). Guidelines – creating a document that provides guidelines for cultivation on buildings. Communication/marketing of cultivating edible plants on buildings. Regulations – providing

					regulations for cultivating on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated. Service provision – providing services that help aid cultivation on buildings (e.g. a service that provides tours of examples of cultivating on buildings).
BPP2. Safety		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (AutomaticE and Reflective[C])	A – Past experience of cultivation on buildings and level of safety and/or perceive safety as an obstacle to cultivation on buildings. B – Perceived level of ease/difficulty due to safety to cultivate on a building. C – The perceived level of safety affects beliefs and attitude towards the behaviour. D – Is the space actually safe for access/cultivation? E – Motivation to undertake behaviour affected by emotional responses towards the level of safety of the behaviour.	Education and training about safety when cultivating on buildings (also through guidelines, communication/marketing, regulations and service provision below). Environmental restructuring – preparing the space for cultivating on buildings with safety issues resolved. Modelling – showing examples of how safety issues have been resolved when cultivating on buildings (also through communication/marketing below). Enablement – give resources/skills/support to overcome problems with safety when cultivating on buildings (also through guidelines, regulations and service provision below).

					Communication/marketing of cultivating edible plants on buildings. Guidelines – creating a document that provides guidelines for cultivation on buildings. Regulations – providing regulations for safety considerations when cultivating on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated with solutions for safety. Service provision – providing services that help aid cultivation on buildings (e.g. a service that provides expert advice for safety when cultivating on buildings).
	BPP3. Technical beliefs	Control beliefs[A] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of cultivation on buildings forming technical beliefs and/or perceive technical solutions as an obstacle to cultivation on buildings. B – Perceived level of ease/difficulty of cultivating edible plants on buildings with technical solutions. C – How the technical solutions affect beliefs and attitude towards the behaviour. D – Are the technical solutions actually possible or do other parameters (e.g. expense) restrict them? E – Motivation to undertake	Education and training about the ranges of technical solutions (from low-tech to high-tech) for cultivating on buildings (also through guidelines, communication/marketing and service provision below). Modelling – showing examples of the use of a range of technical solutions when cultivating on buildings (also through communication/marketing). Persuasion – communication to induce positive feelings about the success of a range of different

				behaviour affected by desires towards the technical solutions.	technical solutions (also through guidelines, communication/marketing and service provision below). Communication/marketing of cultivating edible plants on buildings. Guidelines – creating a document that provides guidelines for cultivation on buildings. Service provision – providing services that help aid cultivation on buildings (e.g. a service that provides expert advice for the design of cultivating on buildings with knowledge of a range of technical solutions).
	BK1. Knowledge of building structure	Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of building structure and "level of knowledge of building structure" as an obstacle to cultivation on buildings. B – Perceived level of ease/difficulty due to level of knowledge of building structure. C – The perceived ideas about building structure affects beliefs and attitude towards the behaviour. D – Is the building structure appropriate for cultivation on buildings? E – Motivation to undertake behaviour affected by emotional responses towards the behaviour due to knowledge of building structure.	Education and training about building structure when cultivating on buildings (also through service provision below). Environmental restructuring – preparing the space for cultivating on buildings with structural issues resolved. Modelling – showing examples of how structural issues have been resolved when cultivating on buildings. Enablement – give resources/skills/support to overcome problems with the building structure (also through service provision below).

					Guidelines – creating a document that provides guidelines for cultivation on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated with solutions for structure.
	BK3. Knowledge of building construction	Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of building construction and "level of knowledge of building construction" as an obstacle to cultivation on buildings. B – Perceived level of ease/difficulty due to level of knowledge of building construction. C – The perceived ideas about building construction affects beliefs and attitude towards the behaviour. D – Is the building construction appropriate for cultivation on buildings? E – Motivation to undertake behaviour affected by emotional responses towards the behaviour due to knowledge of building construction.	Education and training about building construction when cultivating on buildings (also through guidelines and service provision below). Environmental restructuring – preparing the space for cultivating on buildings with construction issues resolved. Modelling – showing examples of how building construction issues have been resolved when cultivating on buildings. Enablement – give resources/skills/support to overcome problems with the building construction (also through guidelines and service provision below). Guidelines – creating a document that provides guidelines for cultivation on buildings. Environmental/social planning – designing spaces on buildings in order to be cultivated with solutions for building

					construction resolved. Service provision – providing services that help aid cultivation on buildings (e.g. a service that provides expert building construction solutions for cultivating on buildings).
BK4. Knowledge of benefits of cultivating on buildings		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Motivation (Automatic[E] and Reflective[C])	A – Past experience of the benefits of cultivating on buildings and "level of knowledge of benefits of cultivating on buildings" as an obstacle to cultivation on buildings. B – Perceived level of ease/difficulty due to level of knowledge of benefits of cultivating on buildings. C – The perceived ideas about the benefits of cultivating on buildings affects beliefs and attitude towards the behaviour. E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to knowledge of benefits of cultivating on buildings.	Education and training about the benefits of cultivating on buildings (also through guidelines and communication/marketing below). Modelling – showing examples of benefits achieved when cultivating on buildings (also through communication/marketing below). Persuasion – communication to induce positive feelings about the benefits of cultivating on buildings (also through guidelines and communication/marketing below). Incentivisation - Showing that there are incentives to cultivating edible plants on buildings (also through guidelines and communication/marketing below). Communication/marketing of cultivating edible plants on buildings. Guidelines – creating a document

					that provides guidelines for cultivation on buildings.
Cultivating edible plants in urban areas					
UP1. Time		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of time needed and time as an obstacle to cultivation. B – Perceived level of ease/difficulty due to perceived ideas about time needed to cultivate. C – The perceived ideas about time needed to cultivate affects beliefs and attitude towards the behaviour. D – Do they have enough time? E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived time needed to cultivate.	Education and training about time management when cultivating edible plants (also through service provision and communication/marketing below). Environmental restructuring – preparing the space for cultivating so that it has already been set up and time is just needed for the cultivation element. Modelling – showing examples of how busy people have cultivated using little time (also through communication/marketing below). Persuasion – communication to induce positive feelings about cultivating and that it doesn't have to take up a lot of time (also through service provision and communication/marketing below). Enablement – give resources/skills/support to overcome problems with time for cultivating (also through service provision below). Environmental/social planning – implementing spaces for cultivation. Planning time around

					the social time restrictions. Communication/marketing of cultivating edible plants. Service provision – providing services that help aid cultivation (e.g. a service that helps with maintenance (e.g. automatic watering system)).
UP2. Resources and facilities		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of access to resources and facilities and time as an obstacle to cultivation. B – Perceived level of ease/difficulty due to perceived ideas about resources and facilities needed to cultivate. C – The perceived ideas about resources and facilities needed to cultivate affects beliefs and attitude towards the behaviour. D – Do they have enough resources and facilities? E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived availability of resources and facilities to cultivate.	Education and training about the use of resources and facilities when cultivating edible plants (also through service provision and communication/marketing below). Environmental restructuring – preparing the space for cultivating. Modelling – showing examples of how problems with access to resources and facilities were resolved (also through communication/marketing below). Persuasion – communication to induce positive feelings about cultivating with difficult access to resources and facilities (also through service provision and communication/marketing below). Enablement – give resources/skills/support to overcome problems with access to resources and facilities (also

					through service provision below). Environmental/social planning – planning spaces read for cultivation. Communication/marketing of cultivating edible plants. Service provision – providing services that help aid cultivation (e.g. a service that provides expert advice for access to resources and facilities for cultivating).
UP3. Aesthetically pleasing space to enjoy		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of cultivating on buildings to be an aesthetically pleasing space to enjoy and aesthetics as an obstacle to cultivation. B – Perceived level of ease/difficulty due to perceived ideas about aesthetics and enjoyment of the cultivation space. C – The perceived ideas about aesthetics and enjoyable spaces to cultivate affects beliefs and attitude towards the behaviour. D – Can the space be aesthetically pleasing and enjoyable to use? E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived aesthetics and enjoyment of space.	Education and training about achieving good aesthetics when cultivating edible plants (also through service provision and communication/marketing below). Environmental restructuring – preparing the space for easy achievement of good aesthetics. Modelling – showing examples of how good aesthetics have been achieved with cultivating edible plants (also through communication/marketing below). Persuasion – communication to induce positive feelings about the aesthetics of cultivating edible plants (also through service provision and communication/marketing below).

					Enablement – give resources/skills/support to overcome problems with aesthetics when cultivating edible plants (also through service provision below). Environmental/social planning – planning spaces for cultivating edible plants with aesthetics considered. Communication/marketing of cultivating edible plants. Service provision – providing services that help aid cultivation and its aesthetics.
UP4. Ownership of space		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Reflective[C])	A – Past experience of ownership of space as a barrier/motivator and ownership of space as an obstacle to cultivation. B – Perceived level of ease/difficulty due to perceived ideas about the ownership of the space. C – The perceived ideas about ownership of the space affects beliefs and attitude towards the behaviour. D – Is cultivation of the space restricted due to ownership issues?	Education and training for the landlord about cultivating edible plants in their space (also through regulations and legislation and communication/marketing below). Modelling – showing the landlord how other rented spaces have been cultivated (also through communication/marketing below). Persuasion – communication to the landlord to induce positive feelings about cultivating edible plants in their space (also through regulations and legislation and communication/marketing below). Communication/marketing of

					cultivating edible plants. Regulations and legislations– providing regulations and legislations for the tenants that help protect the landlord's land when cultivating edible plants.
UP5. Climate of UK		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of cultivation in UK climate and climate as an obstacle to cultivation. B – Perceived level of ease/difficulty due to perceived ideas about time needed to cultivate. C – The perceived ideas about time needed to cultivate affects beliefs and attitude towards the behaviour. D – Do they have enough time? E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived climate needed to cultivate.	Education and training about cultivating in the UK climate (also through communication/marketing below). Environmental restructuring – preparing the space for cultivating in the UK climate (e.g. with sheltered spaces, tea making facilities etc.). Modelling – showing examples of how people can cultivate edible plants comfortably in the UK climate (also through communication/marketing below). Persuasion – communication to induce positive feelings about cultivating edible plants in the UK climate (also through communication/marketing below). Enablement – give resources/skills/support to overcome problems with the angle of the building surface. Environmental/social planning – planning the space so that it can

					be cultivated in the UK climate in all seasons. Communication/marketing of cultivating edible plants.
	UP6. Transient lifestyle	Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Reflective[C])	A – Past experience of cultivation with a transient lifestyle and transient lifestyle as an obstacle to cultivation. B – Perceived level of ease/difficulty to cultivate due to transiency of lifestyle. C – The perceived ideas about the compatibility of transient lifestyles with cultivation affects beliefs and attitude towards the behaviour. D – Is it possible to cultivate with their transient lifestyle?	Education and training about how to cultivate edible plants with a transient lifestyle (also through guidelines, communication/marketing and service provision below). Modelling – showing examples of how people with transient lifestyles have cultivated edible plants (also through communication/marketing below). Persuasion – communication to induce positive feelings about the possibility of cultivating with a transient lifestyle (also through guidelines, communication/marketing and service provision below). Enablement – give resources/skills/support to overcome problems with cultivating with a transient lifestyle (also through guidelines and service provision below). Incentivisation – show the incentives to cultivating edible plants (also through guidelines and service provision below). Communication/marketing of

					cultivating edible plants. Guidelines – creating a document that provides guidelines for cultivating edible plants with a transient lifestyle. Environmental/social planning – social planning designed around cultivating with a transient lifestyle (for example asking neighbours to keep an eye on plants). Service provision – providing services that help aid cultivation with a transient lifestyle (e.g. a service that provides plant maintenance while people are away).
	UP7. Proximity to growing space	Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Reflective[C])	A – Past experience of cultivation with proximity of growing space and proximity of growing space as an obstacle to cultivation. B – Perceived level of ease/difficulty to cultivate due to proximity of growing space. C – The beliefs and attitude towards the behaviour affect whether the proximity of growing space is an obstacle. D – Is it possible to cultivate with the proximity of growing space?	Proximity to the growing space is not an issue when cultivating on buildings as the building occupants are within walking to distance to the space as it is on their building. It can be an issue when cultivating in a space that is more than a mile away from where people live or work as they have to make an extra effort to go the space.
UP8. Physical and mental health		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Reflective[C])	A – Past experience of cultivation with bodily restrictions and bodily restrictions as an obstacle to cultivation. B – Perceived level of ease/difficulty to cultivate due to bodily restrictions.	Education and training about how to cultivate with bodily restrictions (also through service provision and communication/marketing below).

				C – The beliefs and attitude towards the behaviour affect whether the bodily restrictions are an obstacle. D – Is it possible to cultivate with the bodily restrictions?	Environmental restructuring – preparing the space for cultivating with certain type of bodily restrictions. Modelling – showing examples of how people with different bodily restrictions can cultivate edible plants (also through communication/marketing below). Persuasion – communication to induce positive feelings about cultivating with bodily restrictions (also through service provision and communication/marketing below). Enablement – give resources/skills/support to overcome problems with cultivating with bodily restrictions (also through service provision below). Inventivisation – showing the incentives to cultivating edible plants with bodily restrictions (also through service provision and communication/marketing below). Environmental/social planning – designing spaces and social planning with bodily restrictions in mind (e.g. a community garden set up so that cultivators with bodily restrictions have help and support with difficult tasks).

					Communication/marketing of cultivating edible plants. Service provision – providing services that help aid cultivation for those with bodily restrictions.
UP9. Vandalism and theft		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Reflective[C])	A – Past experience of cultivation with vandalism and theft and vandalism and theft as an obstacle to cultivation. B – Perceived level of ease/difficulty to cultivate due to threat of vandalism and theft. C – The beliefs and attitude towards the behaviour affect whether vandalism and theft is an obstacle. D – Is it possible to cultivate with the threat of vandalism and theft?	Education and training about dealing with vandalism and theft when cultivating edible plants. Environmental restructuring – preparing the space for cultivating with consideration about vandalism and theft. Modelling – showing examples of how vandalism and theft have been prevented in other cultivation spaces in a similar situation. Enablement – give resources/skills/support to overcome problems with vandalism and theft. Environmental/social planning – designing spaces for cultivation with security in mind. Social planning to avoid vandalism and theft from fellow gardeners.
	UC5. Nuisance to others	Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Reflective[C])	A – Past experience of cultivation with nuisance to others as an issue and nuisance to others as an obstacle to cultivation. B – Perceived level of ease/difficulty to cultivate due to nuisance to others. C – The perceived ideas about nuisance to others and how this	Education and training about how to avoid nuisance to others when cultivating edible plants. Environmental restructuring – preparing the cultivation space to avoid nuisance to others. Modelling – showing examples of

				affects the beliefs and attitude towards the behaviour. D – Does nuisance to others stop cultivation?	how nuisance to others has been resolved when cultivating edible plants. Enablement – give resources/skills/support to overcome problems with nuisance to others. Environmental/social planning – designing spaces in order to prevent nuisance to others. Social planning with neighbours to avoid nuisance.
	UP10. Visibility of space	Control beliefs[A] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Motivation (ReflectiveC)	A – Past experience of cultivation with level of visibility of space and level of visibility of space as an obstacle to cultivation. B – Perceived level of ease/difficulty to cultivate due to level of visibility of space. C – The beliefs and attitude towards the behaviour affect whether level of visibility of space is an obstacle.	Environmental restructuring – preparing the cultivation space so that it has the required level of visibility to aid cultivation. Enablement – give resources/skills/support to overcome problems with level of visibility. Environmental/social planning – designing spaces with the required level of visibility in mind.
UPP1. Interest, enjoyment, opinions, ideas and aims		Behavioural beliefs → Attitude towards the behaviour[C]	Motivation (Automatic[E] and Reflective[C])	C – Belief and attitude towards the behaviour is affected by interest, enjoyment, opinions and aims towards the behaviour. E – Motivation to undertake behaviour affected by desires, emotional responses, habits and psychological states towards the behaviour.	Education and training about cultivating on buildings (also service provision and communication/marketing below). Persuasion – communication to induce positive feelings about cultivating on buildings (also through service provision and communication/marketing below).

					Incentivisation - Showing that there are incentives to cultivating edible plants on buildings (also through service provision and communication/marketing below). Modelling – showing examples of how other people enjoy cultivating edible plants on buildings (also through communication/marketing below). Communication/marketing of cultivating edible plants. Service provision – providing services that help aid cultivation on buildings to make it more enjoyable.
UPP3. Believing food grown by themselves has less chemicals, is nutrient rich and flavoursome		Control beliefs[A] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Motivation (Reflective[C])	A – Past experience of cultivation with avoiding artificial chemicals. B – Perceived level of ease/difficulty to cultivate due to avoiding artificial chemicals. C – Opinion about avoiding artificial chemicals affects the beliefs and attitudes towards the behaviour.	Education and training about the health risks of consuming food grown with artificial chemicals (also through communication/marketing below). Modelling – showing examples of the effects of consuming foods with artificial chemicals (also through communication/marketing below). Persuasion – communication to induce positive feelings about the importance of consuming foods grown without artificial chemicals

					(also through communication/marketing below). Communication/marketing of cultivating edible plants.
	UPP2. Value growing food – knowledge of benefits	Control beliefs[A] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AC]) Motivation (Automatic[E] and Reflective[C])	A – Past experience of knowledge of benefits and lack of knowledge of benefits as an obstacle to cultivating food. C – Knowledge of benefits of cultivating food affects the beliefs and attitudes towards the behaviour. E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived value of growing food.	Education and training about benefits of cultivating edible plants (also through communication/marketing below). Modelling – showing examples of benefits of cultivating edible plants (also through communication/marketing below). Persuasion – communication to induce positive feelings about cultivating edible plants due to the benefits (also through communication/marketing below). Incentivisation – showing benefits to cultivating edible plants on buildings (also through communication/marketing below). Communication/marketing of cultivating edible plants.
	UPP4. Value of crop vs. value of space	Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Reflective[C])	A – Past experience of balancing value of crop vs. value of space and value of crop vs. value of space as an obstacle to cultivation. B – Perceived level of ease/difficulty to cultivate due to value of crop vs. value of space.	Education and training about what to grow in different spaces depending on the value of the space and the value of the crop (also through communication/marketing below).

				C – The beliefs and attitude towards the behaviour affect whether value of crop vs. value of space is an obstacle. D – Is it possible to cultivate with the value of crop vs. value of space?	Modelling – showing examples of how value of the crop and value of the space have been considered successfully (also through communication/marketing below). Communication/marketing of cultivating edible plants.
	UPP5. Commitment and determination	Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Psychological[C]) Motivation (Reflective[C])	C – The beliefs and attitude towards the behaviour affect whether level of commitment and determination.	Education and training about the level of commitment and determination required to cultivate edible plants (also through communication/marketing below). Incentivisation – showing the results of commitment and determination when cultivating edible plants (also through communication/marketing below). Communication/marketing of cultivating edible plants.
UPP6. Urban pollution contamination		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of cultivation in polluted areas and perceive urban pollution contamination as an obstacle to cultivation. B – Perceived level of ease/difficulty due to urban pollution contamination. C – The perceived ideas about urban pollution contamination affects beliefs and attitude towards the behaviour. D – Is the growing space too	Education and training about how to alleviate urban pollution contamination when cultivating edible plants (also through guidelines, regulations and service provision below). Environmental restructuring – preparing the space for cultivating with implemented methods for alleviating contamination from urban

				polluted and not protectable? E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived level of urban pollution contamination.	pollution. Modelling – showing examples of how people have alleviated contamination from urban pollution. Persuasion – communication to induce positive feelings about the how contamination from urban pollution can be alleviated (also through guidelines, regulations and service provision below). Enablement – give resources/skills/support to overcome problems with contamination from urban pollution (also through guidelines, regulations and service provision below). Guidelines – creating a document that provides guidelines for cultivation in urban areas. Regulations – providing regulations for cultivating to alleviate contamination from urban pollution. Environmental/social planning – designing spaces for cultivation that have looked at alleviating contamination from urban pollution. Service provision – providing services that help aid cultivation (e.g. a service that provides expert advice on how to alleviate

					contamination from urban pollution).
	UPP7. Supporting food growers	Behavioural beliefs → Attitude towards the behaviour[C]	Motivation (Reflective[C])	C – Belief and attitude towards the behaviour is affected by opinion about supporting other food growers.	Persuasion – communication to induce positive feelings about cultivating edible plants as well as supporting food growers (this may overlap with other interventions). Incentivisation – showing how cultivating your own food has incentives. Environmental/social planning – social planning in order to also support food growers and cultivate your own edible plants.
UK1. Gardening skills and confidence		Control beliefs[A] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Motivation (Automatic[E] and Reflective[C])	A – Past experience of cultivation increasing gardening skills and confidence and perceive gardening skills and confidence as an obstacle to cultivation. B – Perceived level of ease/difficulty due to gardening skills and confidence. C – Gardening skills and confidence affects beliefs and attitude towards the behaviour. E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to gardening skills and confidence.	Education and training to increasing gardening skills and confidence (also through service provision below). Persuasion – communication to induce positive feelings about cultivating edible plants (also through service provision below). Enablement – give resources/skills/support to overcome problems with gardening skills and confidence (also through service provision below). Service provision – providing services that help aid cultivation (e.g. a service that provides expert experience to increase gardening skills and confidence).

	UK2. Project management and communication skills	Control beliefs[A] → Perceived behavioural control[B]	Capability (Physical[A] and Psychological[AB])	A – Past experience increasing project management and communication skills and confidence and perceive project management and communication skills as an obstacle to cultivation. B – Perceived level of ease/difficulty due to project management and communication skills.	Education and training about project management and communication skills for cultivating edible plants (also through service provision below). Modelling – showing the project management and communication skills others have used for cultivating. Enablement – give resources/skills/support to overcome problems with project management and communication skills (also through service provision below). Service provision – providing services that help aid cultivation (e.g. a service that provides expert experience to teach project management and communication skills for cultivating).
	UK3. Cooking skills and healthy food literacy	Control beliefs[A] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AC]) Motivation (Automatic[E] and Reflective[C])	A – Past experience increasing cooking skills and healthy food literacy. C – cooking skills and healthy food literacy affects beliefs and attitude towards the behaviour. E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to cooking skills and healthy food literacy.	Education and training to gain cooking skills and healthy food literacy and showing how this can aid cultivation (also through service provision below). Modelling – showing examples of cooking skills and healthy food literacy can aid cultivation. Enablement – give resources/skills/support to overcome problems with cultivation due to lack of cooking skills and healthy food literacy (also through service provision

					below). Service provision – providing services that help aid cultivation (e.g. a service that provides expert advice on cooking skills and healthy food literacy in relation to cultivation).
	UC2. Share ideas, inspire, give reassurance	Behavioural beliefs[C] → Attitude towards the behaviour[C] Normative beliefs[F] → Subjective norm[F]	Capability (Psychological[C]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	C – Sharing ideas, inspiring and giving reassurance affects beliefs and attitude towards the behaviour. E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to sharing ideas, inspiring and giving reassurance. F – Sharing ideas, inspiring and giving reassurance affects belief that others think the behaviour is normal and accepted.	Education and training to share ideas, inspire and give reassurance for cultivation (also through communication/marketing below). Modelling – showing examples of cultivation to share ideas, inspire and give reassurance (also through communication/marketing below). Persuasion – communication to induce positive feelings about cultivation (also through communication/marketing below). Communication/marketing of cultivating edible plants.
UC4. Attitude and judgement of others		Behavioural beliefs[C] → Attitude towards the behaviour[C] Normative beliefs[F] → Subjective norm[F]	Capability (Psychological[C]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	C – Attitude and judgement of others affects beliefs and attitude towards the behaviour. E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived attitude and judgement of others. F – Attitude and judgement of others affects belief that others think the behaviour is normal and	Persuasion – communication to induce positive feelings about cultivation and the attitude and judgement of others towards cultivation (also through guidelines and communication/marketing below). Enablement – give resources/skills/support to

				accepted.	overcome problems with attitude and judgement of others (also through guidelines below). Communication/marketing of cultivating edible plants. Guidelines – creating a document that provides guidelines for cultivation on buildings. Environmental/social planning – social planning to aid a positive attitude and judgement of others.
UC1. Community cohesion, engagement and socialising		Normative beliefs[F] → Subjective norm[F]	Opportunity (Social)[DF]	D – Is there physically opportunity for community cohesion, engagement and socialising? F – Community cohesion, engagement and socialising affects belief that others think the behaviour is normal and accepted.	Environmental/social planning – social planning to aid community cohesion, engagement and socialising when cultivating. Communication/marketing of cultivating edible plants.
UC3. Help and support from others		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C] Normative beliefs[F] → Subjective norm[F]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Lack of help and support from others as an obstacle to cultivation. B – Perceived level of ease/difficulty due to cultivate due to available help and support from others. C –Help and support from others of others affects beliefs and attitude towards the behaviour. D – Is help and support from others available and/or needed in order to cultivate? E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived help and support from others. F – Help and support from others affects belief that others think the	Modelling – showing examples of how cultivation can be achieved with minimal help and support from others (also through communication/marketing below). Persuasion – communication to induce positive feelings about cultivation with little help and support from others (also through service provision and communication/marketing below). Enablement – give resources/skills/support to overcome problems with lack of help and support from others

				behaviour is normal and accepted.	(also through service provision below). Environmental/social planning – social planning to help increase chances of help and support from others. Communication/marketing of cultivating edible plants. Service provision – providing services that help aid cultivation (e.g. a service that provides expert help and support with cultivation).
UE1. Expense		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of cultivation with different amounts of money available and expense as an obstacle to cultivation. B – Perceived level of ease/difficulty due to expense needed to cultivate. C – The perceived ideas about money needed to cultivate affects beliefs and attitude towards the behaviour. D – Do they have enough money? E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived money needed to cultivate.	Education and training about how to cultivate with minimal expenditure (also through communication/marketing and guidelines below). Modelling – showing examples of how others have cultivated with minimal expenditure (also through communication/marketing below). Persuasion – communication to induce positive feelings about cultivating with minimal expenditure (also through communication/marketing below). Enablement – give resources/skills/support to overcome problems with expenditure when cultivating.

					Guidelines – on how to cultivate with minimal expenditure. Communication/marketing of cultivating edible plants.
UE2. Availability of financial incentives		Control beliefs[A/D] → Perceived behavioural control[B] Behavioural beliefs[C] → Attitude towards the behaviour[C]	Capability (Physical[A] and Psychological[AB]) Opportunity (Social[F] and Physical)[D] Motivation (Automatic[E] and Reflective[C])	A – Past experience of financial incentives from cultivation and lack of financial incentives as an obstacle to cultivation. B – Perceived level of ease/difficulty due to perceived ideas about time needed to cultivate. C – The perceived ideas about financial incentives to cultivate affects beliefs and attitude towards the behaviour. D – Do they have financial incentives? E – Motivation to undertake behaviour affected by desires and emotional responses towards the behaviour due to perceived financial incentives from cultivation.	Education and training about how to find financial help and/or the financial incentives of cultivating (also through communication/marketing below). Modelling – showing examples of how others found financial help and/or the financial incentives of cultivating (also through communication/marketing below). Enablement – give resources/skills/support to overcome problems with lack of financial incentives. Communication/marketing of cultivating edible plants. Incentivisation – Financial incetives Fiscal measures – reduction in council tax for people who cultivate food.

Appendix L – Published paper

Research Paper

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Soil-less systems vs. soil-based systems for cultivating edible plants on buildings in relation to the contribution towards sustainable cities

MINA SAMANGOOEI*[1], PAOLA SASSI[1], ANDREW LACK[1]

[1] Oxford Brookes University, Oxford, United Kingdom
* Corresponding author: *minasaman@gmail.com* | Tel.: +44 (0) 7814 388 628

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Abstract

Food production and consumption for cities has become a global concern due to increasing numbers of people living in urban areas, threatening food security. There is the contention that people living in cities have become disconnected with food production, leading to reduced nutrition in diets and increased food waste. Integrating food production into cities (urban agriculture) can help alleviate some of these issues. Lack of space at ground level in high-density urban areas has accelerated the idea of using spare building surfaces for food production. There are various growing methods being used for food production on buildings, which can be split into two main types, soil-less systems and soil-based systems. This paper is a holistic assessment (underpinned by the triple bottom line of sustainable development) of these two types of systems for food production on buildings, looking at the benefits and limitation of each type in this context. The results illustrate that soil-less systems are more productive per square metre, which increases the amount of locally grown, fresh produce available in urban areas. The results also show that soil-based systems for cultivation on buildings are more environmentally and socially beneficial overall for urban areas than soil-less systems.

Introduction

Urbanisation has resulted in more than half of the world's population living in cities. For the first time in history, in mid-2009 the world's population has become more urban than rural (R. C. Allen, 2009). Urban areas rely on external resources to function, including food, water and energy, where this reliance makes cities global risk areas for human habitation (Kraas, 2003) due to issues that could occur in the supply chains (e.g. food security where there is a risk that people are no longer able to access healthy food easily (FAO, 1996)) and in parallel to this, due to issues with unhealthy urban environments that degrade people's health and quality of life. Increasingly people have become interested in reducing this reliance by re-integrating the production of resources in cities, including producing food (urban agriculture). Creating healthier places for people (and other creatures) to live in is also on top of the agenda for the future sustainability of cities where the importance of green spaces and infrastructure has been highlighted (Kirby & Russell, 2015). Green infrastructure also increases biodiversity in urban areas (Newton, Gedge, Early, & Wilson, 2007). The benefits of continuous pockets of spaces for wild life inspired the "My Wild Street" project in Bristol, UK where front gardens in a dense urban street were transformed into havens for wildlife (WT, 2015).

Integrating green spaces and vegetation into urban areas also helps cities function more efficiently and sustainably by: helping the retention of storm water to contribute to sustainable urban drainage (Sheweka & Magdy, 2011), purifying air pollution (Ottele, van Bohemen, & Fraaij, 2010) and shading hard surfaces to help alleviate

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