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# Unlocking vertical farming potential through service design

How urban farming can foster the transition  
towards sustainable food systems:  
The GrowMi project

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In collaboration with

**AGRICOLA  
MODERNA**

and with the contribution of

**buono**

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**PSSD** PRODUCT-SERVICE  
SYSTEM DESIGN



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# Acknowledgements English

This thesis marks the end of a beautiful, intense and unforgettable chapter of my life that started 5 years ago, when I barely knew what design was and the impact it can have on people and society. Over the past years I have learnt a lot and I have grown so much as a designer and mainly as a person, thanks to all the experiences, lectures and people I met along the way. At the end of this journey, all my gratitude goes especially to the people who shared it with me and who have contributed to shape the person I am today in different ways.

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## Abstract English

Over the last mid-century our planet has undergone drastic climate and environmental changes, plunging humanity into an unprecedented crisis. Such an extreme condition finds its causes in anthropogenic GHG emissions produced by human activities: the current food system and agricultural practices have contributed significantly in endangering both the planet and human's health, causing multiple interconnected problems such as biodiversity loss, land degradation and climate change. These issues represent intertwined threats to human security, especially considering the rise of the global population that could reach 9.7 billion people by 2050, as well as the limited land and water availability combined with current harmful and polluting human practices. A transition towards sustainable food systems characterised by more efficient and nature-positive agricultural practices is therefore needed, and vertical farming is widely discussed as a promising farming method able to address next decades' challenges.

The aim of this thesis research is to understand the state of art of vertical farming and its current evolution and limitations in the Italian context: by detecting potential barriers that might hinder its development, greater attention has been given to consumers' perceptions and attitudes towards this innovative farming method. The thesis supports the adoption of service design as an effective practice in approaching the topic and generating creative solutions that could bring innovation within the vertical farming domain and to the stakeholders involved, while fostering the transition towards sustainable food systems.

The first part of the thesis is characterised by a description of our current food system and its underlying issues. Then a deep dive into vertical farming, including literature review and a collection of case studies is presented, followed by the introduction of food design as a new branch of the design practice and the description of the service design methodology and process. The second part of the thesis includes the results and the outputs of each stage of the design process that led to the development of a service design solution: the GrowMi project, a urban farming experience that enables Milan city dwellers to access fresh, healthy and locally grown food within short walking distances through the recovery of abandoned buildings disseminated throughout the city.

The project developed for the thesis validated the service design role in producing valuable outcomes for the stakeholders involved and bringing innovation in the field. Research has disproved consumers' resistance as a potential barrier in vertical farming development in Italy, identifying the lack of knowledge and visibility of this farming method and products as rather critical aspects. Despite the path to profitability still looks long, vertical farming is going through rapid development in Italy and in the world, gaining economical, environmental and social recognition and suggesting an auspicious future ahead even in more expensive urban areas. GrowMi represents a prototype that could be scaled up to different neighborhoods as it proves to have the potential to foster the shift to sustainable food systems. However, some limitations reveal the unlikelihood of vertical farming in coping with systemic challenges alone, highlighting the necessity of diversifying farming methods through a hybridisation of the food production systems that could optimise the transition towards sustainability. Finally, future directions of the projects have been identified by proposing the integration of vertical farming products with a larger variety of traditional products coming from regenerative agriculture methods.

**Keywords** Vertical Farming, Service Design, Sustainable Food System, Food Innovation

## Abstract Italiano

Nell'ultima metà del secolo il nostro pianeta ha subito drastici cambiamenti climatici e ambientali, portando l'umanità ad affrontare una crisi senza precedenti. Una condizione così estrema trova le sue cause nelle emissioni di gas serra generate dalle attività umane: l'attuale sistema alimentare e le pratiche agricole hanno contribuito in modo significativo a mettere in pericolo sia il pianeta che la salute umana, causando molteplici problemi interconnessi come la perdita di biodiversità, il degrado del suolo e il cambiamento climatico. Questi problemi rappresentano grandi minacce per l'uomo, soprattutto in relazione all'aumento della popolazione globale, che potrebbe raggiungere 9,7 miliardi di persone entro il 2050, e alla limitata disponibilità di terra e acqua in combinazione alle attuali pratiche agricole inquinanti e dannose. È quindi necessaria una transizione verso un sistema alimentare sostenibile caratterizzato da pratiche agricole più efficienti e rispettose della natura e, in quest'ottica, il vertical farming rappresenta un metodo di produzione agricola promettente in grado di affrontare le sfide dei prossimi decenni.

L'obiettivo della ricerca è quello di comprendere lo stato dell'arte del vertical farming, la sua attuale evoluzione e limiti nel contesto italiano. Rilevando potenziali barriere che potrebbero ostacolare lo sviluppo, maggiore attenzione è stata data alle percezioni e alla propensione dei consumatori nei confronti di questo metodo innovativo di coltivazione.

La tesi supporta l'adozione del service design come pratica efficace nell'approcciare questo tema e nel generare soluzioni creative volte a portare valore e innovazione nel settore stesso e a tutti agli stakeholder coinvolti, con l'obiettivo ultimo di favorire la transizione verso sistemi alimentari sostenibili.

La prima parte della tesi è caratterizzata da una descrizione del nostro attuale sistema alimentare e delle sue problematiche, seguita dall'introduzione e descrizione del vertical farming attraverso una literature review e una raccolta di casi di studio. Dopo una breve presentazione del food design come una nuova branca del design, la metodologia e il processo di progettazione vengono illustrati nel dettaglio. La seconda parte della tesi include i risultati e gli output di ogni fase del processo di progettazione che ha portato allo sviluppo di un nuovo servizio: GrowMi, un'esperienza di agricoltura urbana

che, attraverso il recupero di edifici abbandonati presenti nel tessuto urbano, consente ai cittadini milanesi di avere accesso a prodotti km0, freschi e sani entro brevi distanze raggiungibili a piedi.

Il progetto sviluppato per la tesi ha confermato il potenziale del service design nel generare valore per gli stakeholder coinvolti e a portare innovazione nel campo. La ricerca ha smentito la diffidenza dei consumatori come potenziale barriera allo sviluppo del vertical farming in Italia, identificando invece la mancanza di consapevolezza e visibilità di questo metodo e suddetti prodotti come aspetti piuttosto critici. Nonostante il percorso verso la redditività sia ancora lungo, il vertical farming sta vivendo un rapido sviluppo in Italia e nel mondo portandolo ad essere riconosciuto sia a livello economico che ambientale e sociale, suggerendo così un favorevole sviluppo anche nelle aree urbane solitamente più costose. GrowMi rappresenta un prototipo che potrebbe essere esteso ad altri quartieri della città in quanto dimostra di avere il potenziale per favorire il passaggio ad un sistema alimentare sostenibile. Tuttavia, alcuni limiti rivelano l'incapacità del vertical farming nel far fronte da solo alle sfide di livello sistemico, evidenziando la necessità di diversificare i metodi di coltivazione attraverso un'ibridazione dei sistemi di produzione agricoli che potrebbe ottimizzare la transizione verso la sostenibilità. Infine, vengono individuate le direzioni future del progetto proponendo l'integrazione dei prodotti coltivati in vertical farming con una più ampia varietà di prodotti coltivati tradizionalmente attraverso metodi di agricoltura rigenerativa.

**Parole chiave** Vertical Farming, Service Design, Sistema Alimentare Sostenibile, Innovazione Alimentare

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1.

The current  
food  
system



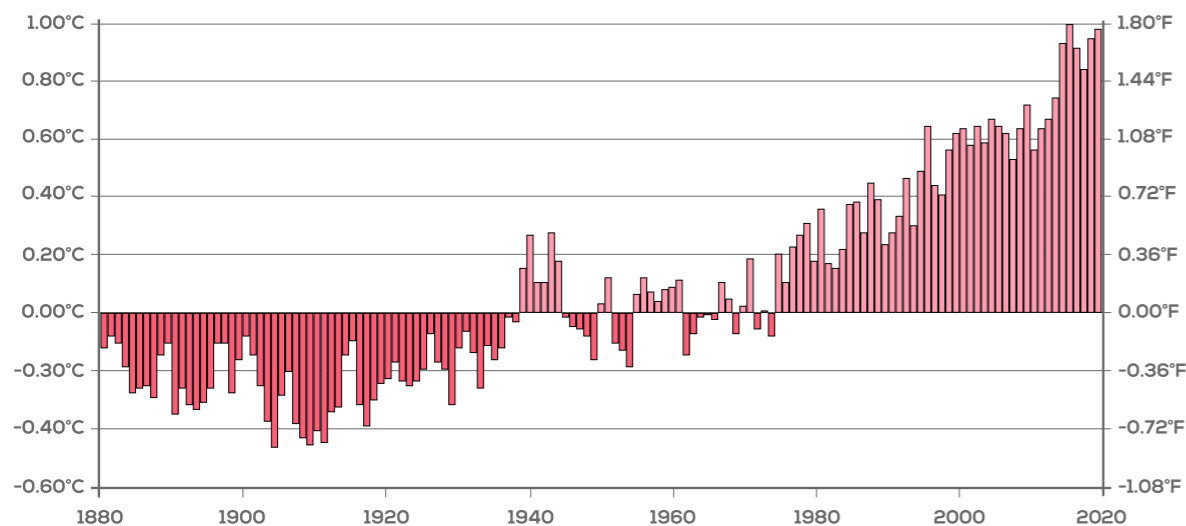
# 1.1 Climate change

In recent years climate change and environment-related issues have gained global attention due to the need and urgency in tackling this phenomena. According to the United Nations Framework Convention on Climate Change (UNFCCC, 1992, p.7) **climate change** refers to "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". Although climate change is a natural occurrence and our planet has been affected by major global-scale climate variations in its geological past, it is "unequivocal that human influence has warmed the atmosphere, ocean and land." (IPCC, 2021, p.6). The anthropogenic influence on climate change is supported by paleoclimatic studies that show **unprecedented and unusual warming of the last half century** compared to the climate variations within the previous millenium (IPCC, 2007). According to NOAA (2021) the global annual temperatures have increased over time, at an annual average rate of 0.08 °C per decade since 1880, which has doubled over the past 40 years, reaching a rate of 0.18 °C. Furthermore they state that 2011-2020 was the warmest decade with a global surface temperature of 0.82°C above the 20th century average (Figure 1). It is clear that the temperatures have risen dramatically over the last 50 years and they continue rising.

To understand causes and consequences plenty of studies regarding climate change have been carried out and accumulating evidence based on rigorous data analysis shows that "most of the observed global warming over the past 50 years or so cannot be explained by natural causes and instead requires a significant role for the influence of human activities" (The Royal Society & National Academy of Sciences, 2020). The Intergovernmental Panel on Climate Change (IPCC, 2001) estimates that the global average surface temperature has increased by  $0.6 \pm 0.2^{\circ}\text{C}$  over the 20th century and the major cause can be found in the **increase of greenhouse gases (GHG) concentration in the atmosphere**: starting with the Industrial Revolution, large quantities of anthropogenic greenhouse gases and aerosol were emitted, reaching **unprecedented levels of greenhouse gas concentrations in the recent years** (Figure 2). The massive impact of current human activities that have grown to become "significant geological forces" (Crutzen, 2006, p.13) led to the definition of a new geological epoch, the Anthropocene (Crutzen & Stoermer, 2000). As the greenhouse emissions increase, global warming and changes in the climate system become more severe, leading to critical global environmental changes and affecting many weather and climate extremes across the world: evidence shows that changes in weather extremes such as heatwaves, heavy precipitation, droughts, tropical

Average annual global temperatures (NOAA, 2021)

Figure 1



Co2 concentrations over 800 000 years (NOAA, 2021)

Figure 2

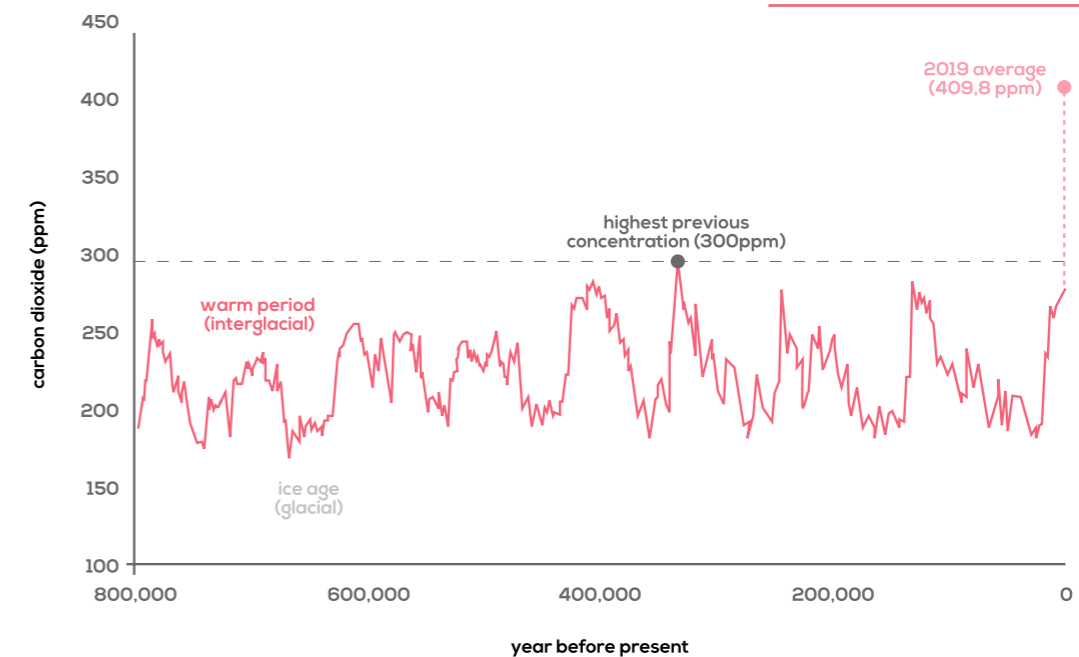


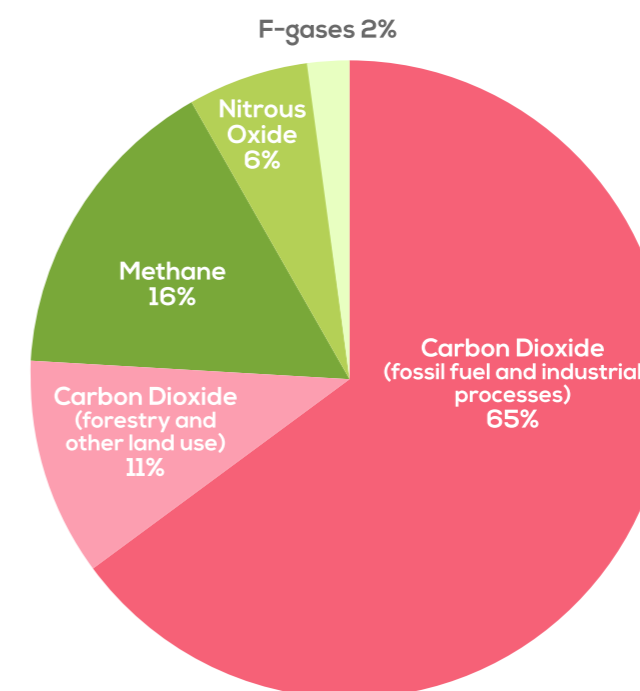
Figure 3

cyclones and reduction in Antarctic sea ice have become more frequent and more intense over the last half-century (IPCC, 2021). Scientists of the IPCC (2021, p.18) state that global temperatures will continue to increase and "global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO<sub>2</sub> and other greenhouse gas emissions occur in the coming decades."

It's undeniable that concrete actions must be taken and to be able to address this issue a clear understanding of the main drivers of GHG emissions is needed.

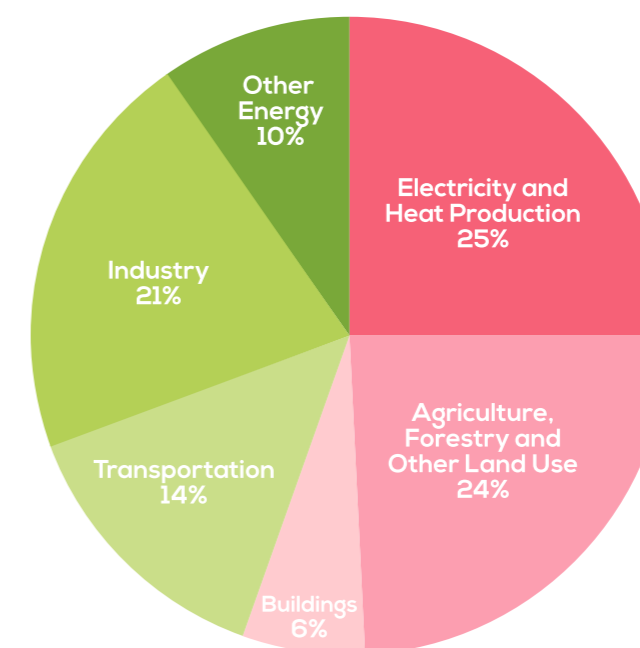
According to the United States Environmental Protection Agency (2021), **Carbon Dioxide** (CO<sub>2</sub>) is responsible for the largest amount of GHG emissions coming from human activities, mainly from fossil fuels, deforestation and land use changes, and it accounts for about 80% of the global gas emissions; **Methane** (CH<sub>4</sub>), with 16% of the overall GHG emissions, is connected with agricultural activities, waste management energy use and biomass burning; agricultural activities and fossil fuel combustion are also responsible for **Nitrous Oxide** (N<sub>2</sub>O) emissions, accounting for 6% of the overall emissions; finally, **Fluorinated gases** (F-gases) are 2% and are generated by industrial processes and refrigeration (Figure 3).

By looking at the global GHG emissions by economic sector, it's evident that **one of the most impactful sectors is the one of Agriculture, Forestry and Other Land Use that contributes to 24% of 2010 total GHG emissions** (EPA, 2021) (Figure 4). Agriculture, and food systems more broadly, have a great role in addressing the climate change, as they affect the environment in many ways, "including through their impact on biodiversity, soil and water quality, animal and plant health, greenhouse gas emissions, toxicity, as well as food loss and waste" (FAO, 2021a, p.112). **The current food system is indeed responsible for multiple interconnected problems** and its harmful nature characterises every stage of the process, from production to consumption, contributing to environmental deterioration, the impoverishment of natural capital and pollution "from the field to the stomach" (Fassio and Tecco, 2019, p.2).



Global GHG emissions by economic sector (EPA, 2021)

Figure 4



## 1.2 Biodiversity loss

**Biodiversity loss** is one of the major underlying issues of the current farming methods: over the years **intensive agriculture** practice determined **environmental degradation** and **surface and groundwater pollution**, upon which the production depends, due to the **excessive use and misuse of pesticides and fertilizers** (FAO, 2011).

In FAO's Land Use Statistics and Indicators report (2021b), data show that in 2019 agricultural land was about 37% of the world land area. **If we just consider the habitable land, agriculture covers 50% of the total habitable land**, with approximately 23% dedicated to cropland and the other 77% for livestock (Ritchie, 2019) (Figure 5). According to the United Nations Convention to Combat Desertification (2017), between 1998 and 2013, roughly 20% of the Earth's vegetated land surface experienced productivity declines, especially the cropland, proving that it is highly degraded or is undergoing degradation. This means that production systems got impoverished, vulnerable and dependent on continuous use of external inputs (FAO & PAR, 2011): these chemical inputs, along with the intensive production through monocultures and genetically modified crops, undermine long-term sustainability and induce mass extinction of flora and fauna, jeopardising resilience and adaptive capacity (UNCCD, 2017).

## 1.3 Land and water availability

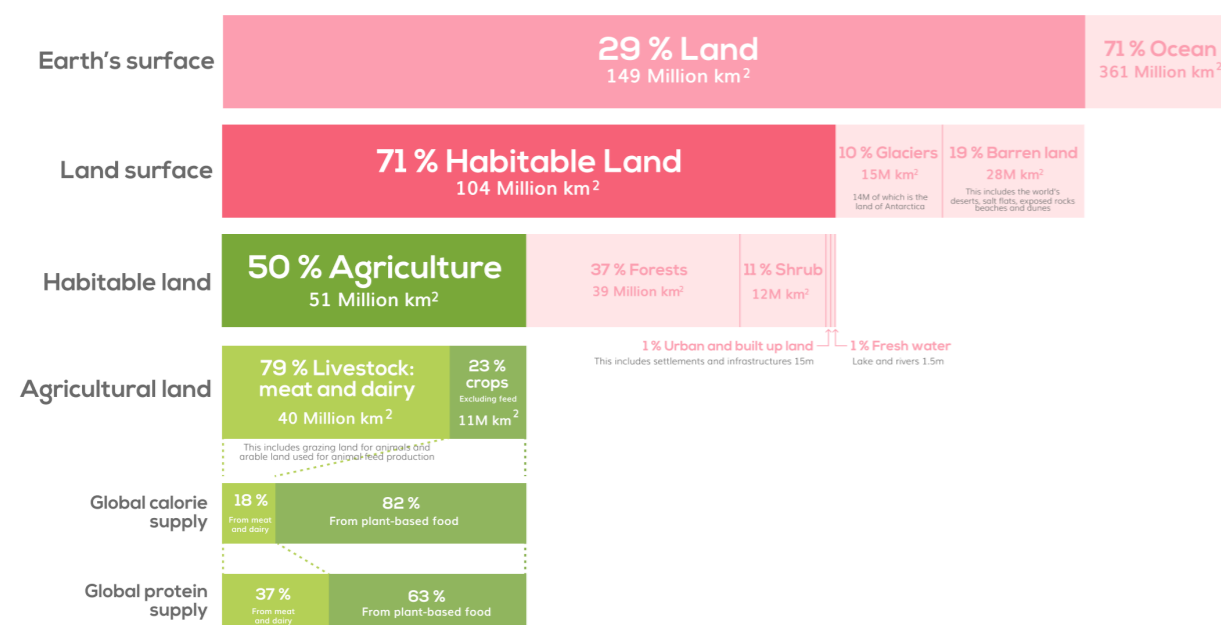
**Agricultural land degradation and the consequent reduction of land's productivity determines a decrease in land's availability.** Land limited availability is also determined by land competition with other sectors, with the rise of cultivated land dedicated to biofuel crops, used as an energy source (FAO & PAR, 2011). However, according to NEAA (2010) data, in a "business-as-usual" scenario over the next 40 years, energy crops' impact on biodiversity loss is relatively small compared to other factors, and a major role among the human induced pressures is played by agricultural crops, encroachment and climate change instead.

Another major issue is related to the **water availability**. FAO studies (2011a) reveal that **agriculture accounts for 70% of the water** withdrawn from aquifers, rivers and lakes. Over the last 50 years, water withdrawals for agriculture have been rising with large geographical discrepancies depending on countries' water resources, leaving 34% of the global population in 2005 with scarce water resources (Porkka et al., 2016): some countries are already withdrawing in excess of crucial thresholds in several regions, especially the Middle East, Northern Africa, and Central Asia, and will be stressed by unprecedented levels of demand, and will be further exacerbated by climate change effects.

**Biodiversity loss, land degradation and climate change** are therefore interconnected problems that represent both the causes and consequences of the land and water availability issue, and must be recognized as "**intertwined threats to human security**" (UNCCD, 2017, p.14).

Global land use for food production (Ritchie, 2019)

Figure 5

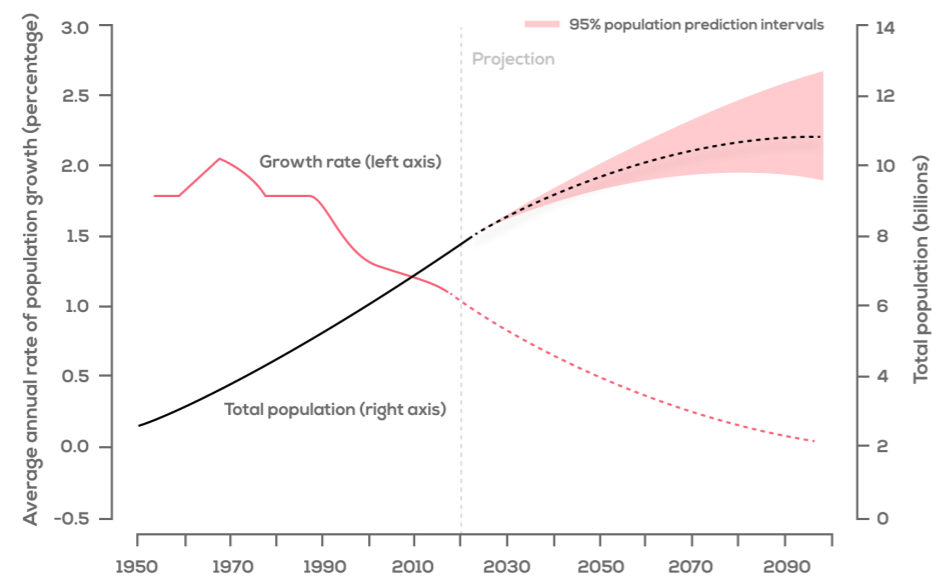


## 1.4 Food security

This unveils another problem determined by **demographic pressures** that the world is facing and will face in the next decades. According to the UN (2019) population projections, from an estimation of 7.7 billion people worldwide, **the population could reach 9.7 billion in 2050**. The global population is therefore considerably increasing, although at a lower growth rate than in the previous years (Figure 6).

Annual population growth rate estimates (United Nations, 2019)

Figure 6



Considering that on a global level consumption equals production, **world production for both food and non-food uses in 2050 is projected to be 70% higher than that of 2005-2007** (FAO, 2011a). These data raise the fear that global production might have difficulties in meeting the rising demand and might not feed the growing population. However, research shows that the finite land and water resources and the limited yield growth potential would not threaten food security for the growing population. Rather, the question is whether the resources are adequate to satisfy future demands and requirements (Alexandratos & Bruinsma, 2012). So, **while it is probable that production will respond to increased demand, it is the way to achieve it that will be crucial**: providing a consistent and reliable supply of quality food to the world's

population will not be the only criteria to measure success, yet the land and water environmental sustainability, as well as their ability to meet livelihood needs of both urban and rural population, will be essential factors (FAO, 2011a).

Nevertheless, food insecurity is an existing issue in the current years, as many people in the world experience hunger with dramatic differences across regions of the world: FAO estimates that the number of people facing hunger in 2020 ranged from 720 and 811 million, with an increase from 2019 under the shadow of the covid-19 pandemic (FAO, 2021a).

Yet, our current food system is characterised by paradoxical coexistence of distant issues: if on one side there's a large portion of the world that doesn't get enough food, on the other hand there's a large amount of food that is lost or wasted. It is estimated that **approximately one-third of all food produced for human use is lost or wasted globally**, from agricultural production through final consumption, however with a significant loss early in the supply chain (FAO, 2011b). The impact of such waste is larger if we consider that the huge amount of resources implied in the production phase, as well as the greenhouse gases emitted, are used in vain.

## 1.5 Human health

Food systems impact human health and well-being in several ways, and food security is not the only health related issue concerning the food system: the so-called "triple burden" of malnutrition, which consists of undernutrition, micronutrient deficiency and overweight and obesity, is considered as a major global health emergency (FAO, 2017). Special attention must be given to a form of hunger that is often overshadowed, the **hidden hunger**, also known as micronutrient deficiency, that occurs when the quality of food consumed does not meet people's dietary needs, resulting in a chronic lack of vital vitamins and minerals necessary for growth, development and well-being (FAO, 2014). It is estimated that 2 billion people are affected by the hidden hunger both in the developed and in the developing worlds, and it can coexist with appropriate or even excessive consumption of macronutrients, such as fats and carbohydrates, therefore with overweight or obesity (von Grebmer et al., 2014).

Some other health related complications derive from agricultural practices that characterise our current food system. The use and the consequent exposure of pesticides and fertilisers can have bad effects on human health and **long-term exposure to pesticides** can even cause **serious illnesses** such as asthma, depression, attention deficit or cancer (Claydon et al., 2021). Pesticides, together with poor wastewater management, can also contribute to **water contamination**, causing foodborne diseases and mortality, while the excessive use of fertilisers and manure is responsible for **air pollution** deaths determined by the release of ammonia in the atmosphere, an harmful pollutant for its ability to combine with other gases to form PM2.5 (Ellen Macarthur Foundation, 2019).

An additional interesting point of the consequences of modern agricultural practices is related to food **nutrient concentration**: evidence show that yield increases produced by fertilisation and other environmental means has an inverse relationship with minerals concentration, and more recent studies on historical nutrient content data spanning from 50 to 70 years, found apparent median declines of 5% to 40% or more in minerals, vitamins and proteins in groups of vegetables (Davis, 2009).

## 1.6 Sustainable food systems

Given all these interconnected factors characterising our current food system, it is clear that substantial changes in the way we produce food must happen. The data and evidence previously listed show that food and **agricultural production systems have a huge impact on the environment**, including greenhouse gas emissions, biodiversity, soil and water quality, human health and well-being, and food loss and waste. As a result, there is a rising awareness of the **need for "nature-positive production and supply models which produce more with less to ensure sufficient nutritious food supplies for a growing world population over the coming decades"** (FAO, 2021a, p.112).

On the path to sustainable development, more **sustainable food systems are thus required** and they represent a central point in The 2030 Sustainable Development Agenda. Some of the 17 Sustainable Development Goals (SDGs) adopted in 2015 aim for substantial changes in agricultural and food systems by 2030 in order to end hunger, ensure food security, and enhance nutrition (SDG 2), while protecting, restoring and promoting sustainable use of terrestrial ecosystems (SDG 15). In order to achieve these goals, the global food system "needs to be reshaped to be more productive, more inclusive of poor and marginalized populations, environmentally sustainable and resilient, and able to deliver healthy and nutritious diets to all" (FAO, 2018, p.1). During a symposium organised by FAO and Biodiversity International in 2010 in Rome, the definition of "sustainable diets" was debated, underlying the importance of the interconnection of human health and the health of the ecosystem: sustainable diets are "those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources" (Burlingame & Dernini, 2012).

The World Resources Institute also emphasises on the need to achieve a sustainable food future "by meeting growing demands for food, avoiding deforestation, and reforesting or restoring abandoned

and unproductive land - and in ways that help stabilise the climate, promote economic development, and reduce poverty" (Searchinger et al., 2018, p.1).

To be able to achieve these goals, the report underpins the necessity to close three great gaps by 2050:

► **the food gap:** the difference between the amount of food produced in 2010 and the amount required to fulfill the food demand in 2050. It is estimated that 56% more crops calories will be needed to fill the food gap.

► **the land gap:** the difference between global agricultural land area in 2010 and the projected area of land needed to fulfill global food demand in 2050. The target is to keep the agricultural land area the same as the area used in 2010. Assuming that crop and pasture yields continue to grow at past rates, it is estimated that this gap will be 593 million hectares, which is about twice the size of India.

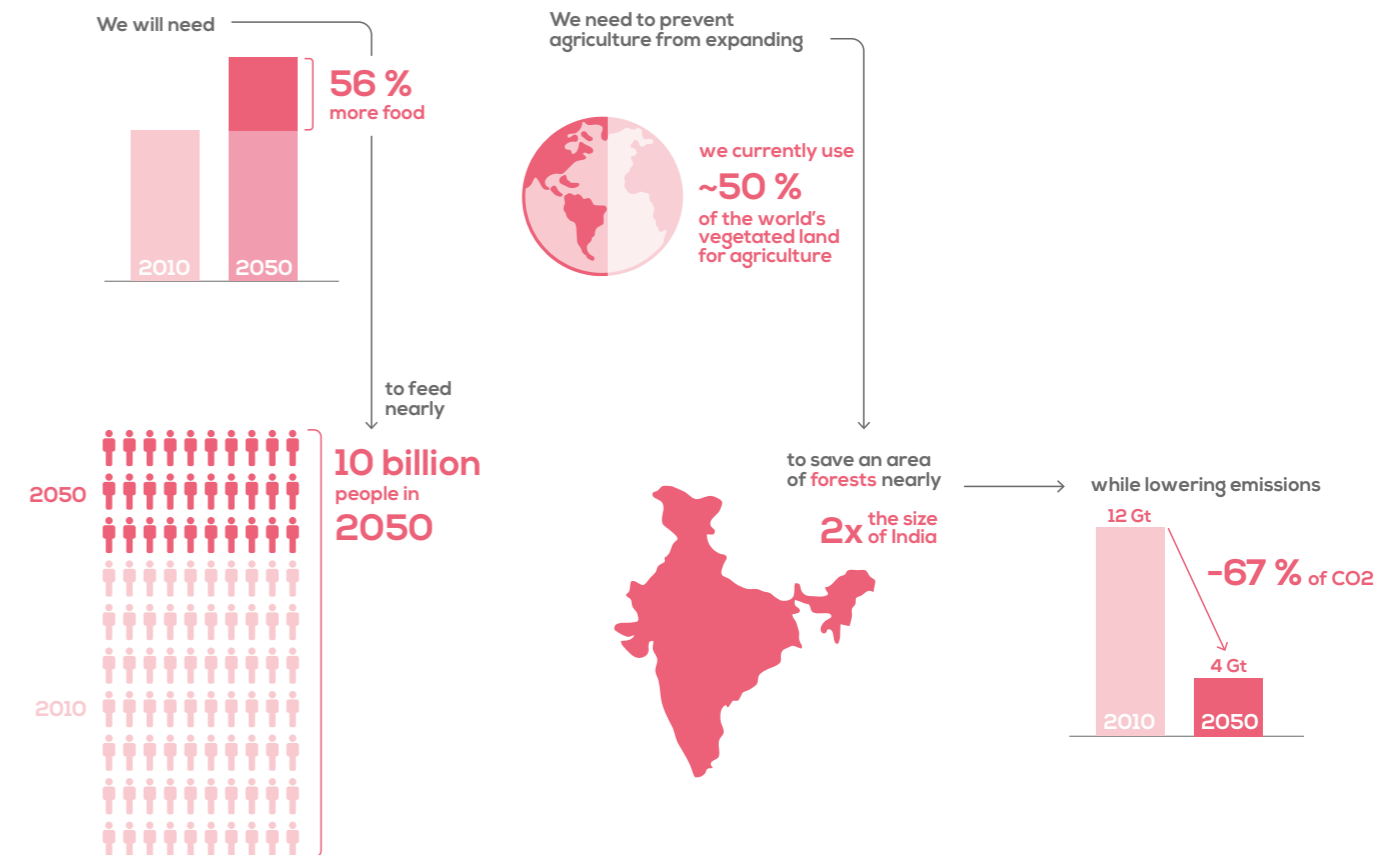
► **the GHG mitigation gap:** the difference between the agriculture-related GHG emissions projected for 2050 and the targeted agricultural GHG emissions set for 2050 in order to limit global warming to 2°C above pre-industrial levels. Data show that agriculture alone would fill 70% of the total emissions budget in 2050, meaning 15 of 21 Gt: it is therefore estimated that the GHG mitigation gap is 11 Gt, the difference between 15 Gt of the projected emission in 2050 and a target of 4 Gt.

(Figure 7)

It is therefore clear that creating a sustainable food future "presents a set of deeply intertwined challenges" (Searchinger et al., 2018, p.75) that can be addressed by adopting strategies aimed at setting guidelines for the future: **mitigation** and **adaptation** are two-pronged approaches that can help humanity to respond to climate change while rethinking our food system, respectively by reducing heat-trapping GHG emissions and by adapting to actual or expected future climate (NASA, n.d.).

Agriculture has indeed great mitigation potential if more efficient and nature-positive agricultural practices are adopted.

Organisations and researchers suggest the adoption of **circular**



**economy** principles for a shift towards **regenerative food systems**, representing "an attractive model with huge economic, health and environmental benefits across the food value chain and society more broadly" (Ellen MacArthur Foundation, 2019, p.9). Circular economy represents a promising model to apply to our food system as "humankind needs to shift from an economic model of competition between sides, based on the evolution of the individual, to one of cooperation, based on biodiversity and co-evolution" (Fassio and Tecco, 2017, p.2). According to Fassio and Tecco, circularity can lead to a holistic regenerative model, in which the defining of a multi-dimensional and system quality characterises a food system that is

in harmony with nature while keeping up with the times.

The Ellen MacArthur Foundation (2019) identifies cities as the key agents able to trigger this shift and apply the three goals that would lead to a regenerative food system, which are: (a) Source food grown regeneratively and locally where appropriate: encompassing all the regenerative production techniques that enhance the ecosystem and support the development of healthy soils; (b) Make the most of food: transforming by-products into new valuable materials; (c) Design and market healthier food products: changing production patterns and encouraging people towards new habits. Regenerative practices include any practice that supports the growth and development of healthy soils, ensuring they are rich with microorganisms and nutrients needed to safeguard long-term food productions. Examples of regenerative practices are: the use of organic fertilisers instead of synthetic ones, employ crop rotation, use great crop variation to promote biodiversity, adopt farming methods such as agroecology, agroforestry, rotational grazing, permaculture etc.

Ellen MacArthur Foundation (2021) has recently published a report that underpins the role of **food design, combined with circular economy principles, as an opportunity to create products that are tasty, nutritious and help nature to thrive**. This means that "positive outcomes are maximised by designing with the whole system in mind and applying circular economy principles across all dimensions of food design, from product concept, through ingredient selection and sourcing, to packaging" (Ellen MacArthur Foundation, 2021, p. 29) (Figure 8).

The role of **cities** is discussed to be fundamental in the shift towards more sustainable food systems. Today more than a half of the global population lives in cities, and by 2050 it is projected that **70% of the world's population will live in urban areas** (Ritchie & Roser, 2018), meaning that the **largest share of food will be consumed in cities**. Ellen MacArthur Foundation (2019) endorses **cities as catalysts for change**, as they can influence the way food is grown, hence playing a major role in the shift towards sustainable food systems.

Moreover, agriculture in the urban context has gained major attention thanks to its potential to contribute to mitigation and adaptation strategies.

The role of cities in contributing to more sustainable and resilient food systems, able to endure and recover from the consequences of crises and changes, is receiving increasing international policy attention, and urban agriculture has rapidly moved to the forefront of policymakers and urban planners (Dubbeling et al., 2019). The role of urban and peri-urban agriculture is indeed widely recognised as a significant strategy for improving urban adaptation and building resilient and food secure cities (Dubbeling & Zeeuw, 2011).

Within this context, **vertical farming constitutes a promising urban farming technology that can contribute in making cities more resilient and the food systems more sustainable**.

Circular Design for Food (Ellen MacArthur Foundation, 2021)

Figure 8





2.

Vertical  
farming



## 2.1 What is vertical farming

### Urban agriculture

Urban agriculture is defined as the production of agricultural goods (crop) and livestock goods within a city (intra-urban areas) or in the surrounding areas of a city (peri-urban agriculture) (Chatterjee et al., 2020). The advantages of **urban agriculture** make it a broadly discussed solution able to deal with the challenges that cities will face in the next upcoming years, as it helps cities to **improve the urban environment and become more resilient**.

The constantly increasing population growth, with the consequent growing food demand, and the decrease of arable land available for agriculture together with the need to limit agricultural land expansion, has led many farmers and entrepreneurs to look up for new technologies and methods that could meet these requirements. **Vertical farming** is widely discussed as a promising farming method suitable for urban areas able to cope with the next decades challenges.

Vertical farming can be defined as a **farming method that “involves growing crops in controlled indoor environments, with precise lights, nutrients and temperatures”** (Birkby, 2016, p.1), where plants are stacked in layers that may reach several stories high. Similarly, other researchers talk about vertical cultivation as a way to grow “plants in piled layers reaching to a number of stories packed with controlled environments like temperature, light, and nutrition inside” (Kumar et al., 2020, p.2491). Another definition is given by Benke & Tomksin (2017, p.15) referring to the vertical farming model as an “indoor farm based on a high-rise multi level factory design”.

Dickinson Despommier, an American professor known as the “father” of the vertical farming concept, underpins the potential of vertical farming in reducing agricultural impact while sustaining a growing human population, and he firmly supports it as an opportunity to be explored in the upcoming years “especially if we are serious about living our lives in balance with the rest of the life forms on Earth without further endangering both theirs, and ultimately ours” (Despommier, 2013, p.2).

Vertical farming is therefore considered a more sustainable agricultural practice than **conventional farming**, which refers to “large scale, outdoor agriculture that embraces systems that engage heavy irrigation, intensive tillage and excessive use of fertilizers, pesticides, and herbicides” (Healy & Rosenberg, 2013, as cited in Al-Kodmany, 2018, p.3). However, less invasive outdoor farming methods exist, and are mainly those that relate to **organic agriculture**, that was defined in 2008 by IFOAM Organics International as “a production system that sustains the health of soils, ecosystems and people that relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects”. Differently from conventional agricultural practices, vertical farming aims at enhancing productivity significantly while reducing the environmental impact within a framework of urban, indoor, climate-controlled structures (Benke & Tomkins, 2017).

Although it might seem a brand new, up to date concept, vertical farming origins can be found back in the years.

The concept of vertical farming is not entirely new. By looking back at the Ancient Times, the Hanging Gardens of Babylon built around

600 BC, can be considered a first example of a “vertical farm”: They could reach a height of 20 metres and they consisted of a series of terraces stacked on top of another, where plants were irrigated with a rudimental engineering innovation that involved buckets and pulleys to bring water from the Euphrates River (Crumpacker, 2018) (Figure 9).

Hanging Gardens of Babylon (National Geographic, 2020)

Figure 9



More recently, in 1915 the American geologist Gilbert Ellis Bailey coined the term “vertical farming” and wrote a book with the same name, arguing that growing hydroponically in a controlled vertical setting would be beneficial to both the economy and the environment (Al-Kodmany, 2018).

A few years later, in the 1930s Dr. William Gericke with some colleagues from the University of California, Berkeley, pioneered and developed modern hydroponics, outlining in a book the process of growing plants in absence of soil (Despommier, 2013).

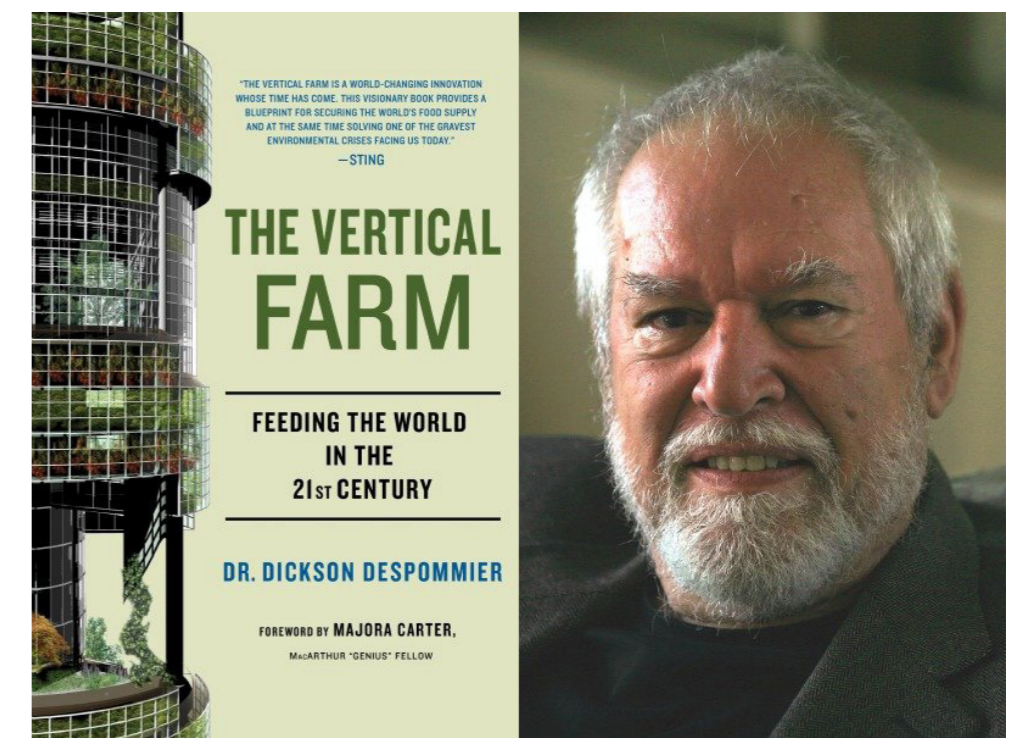
During the Second World War hydroponic growing systems were used on a large scale for the first time in modern history, ensuring fresh hydroponically grown vegetables on South Pacific Island to the Allied force (Despommier, 2009).

In the 1980s vertical farming was also advocated by Ake Olsson, a Swedish ecological farmer, as a method of raising vegetables in cities, and it was finally in 1999 that **Dickinson Despommier** introduced the concept of a vertical farm (figure 10), becoming the world’s leading expert and exponent of vertical farming (Al-Kodmany, 2018).

We can then maintain that the concept of vertical farming is not new, but it’s only in recent years that this not-so-new farming method has gained major attention, leading entrepreneurs, farmers and researchers to explore, develop and advance increasingly sophisticated vertical farming systems. These systems are characterised by several elements that together provide “maximum production and minimum environmental impact” (Al-Kodmany, 2018, p.6), thanks to the limited use of resources in a controlled environment.

Dickinson Despommier and his book The vertical farm (Inhabitat, 2014)

Figure 10



## 2.2 Vertical farming key elements

In the past years technological innovation allowed the evolution of indoor controlled environments, evolving indoor farming into a commercially viable approach for large-scale production (Despommier, 2013). Nevertheless, vertical farms exist in a variety of shapes and sizes, ranging from basic two-level or wall-mounted systems to multi-story warehouses, but all of them have key elements that are fundamental for the correct and efficient functioning of such systems: the **irrigation system**, the **lighting system** and the **monitoring system**.

### 2.2.1 The irrigation system

All the vertical farms are characterised by a soil-free growing system that provides nutrients to the plants through water. The three main systems are **hydroponics**, **aquaponics** and **aeroponics**.

#### Hydroponics

Hydroponics is the prevalent irrigation system used in vertical farms. The term is derived from the Greek word *hydro* meaning water, and *ponos* meaning labour: it uses nutrient solutions rather than soil to grow plants (Khan et al., 2018). Encyclopedia Britannica defines hydroponics as a "cultivation of plants in nutrient-enriched water, with or without the mechanical support of an inert medium such as sand or gravel".

There are different hydroponics techniques: plants are either suspended in a medium and provided with nutrients (Continuous Flow Solution Culture), or the plant roots are directly immersed in the nutrient liquid (Static Solution Culture). In both cases, nutrients are dissolved into water in inorganic and ionic forms using different chemical combinations, providing to plants all the 17 essential nutrients for plants to grow (Sharma et al., 2018).

In the **Continuous Flow Solution Culture** a pump is used to circulate the nutritional solution through the roots and the surplus is then

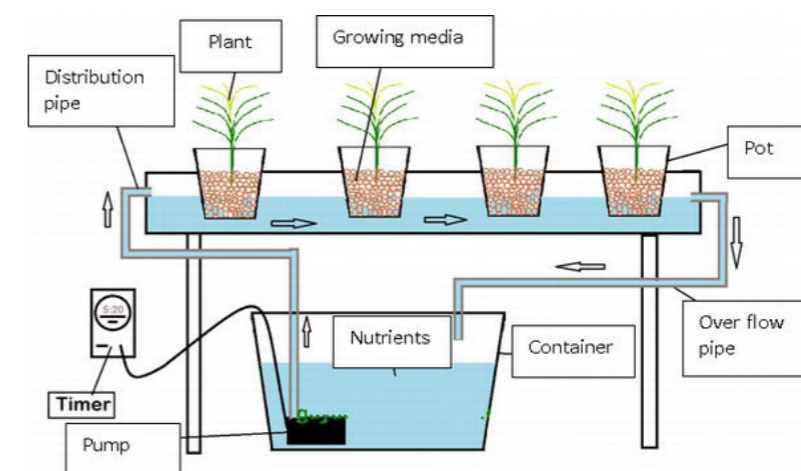
collected and reused in the system. This technique has two types of systems:

► In the **Nutrient Film Technique (NFT)** the solution gets pumped through the tube, flowing over the roots of the plants, and then draining back into the reservoir (Figure 11).

► In **Deep Flow Technique** systems plants are grown in pots located in PVC pipes and the bottom of these pots are in contact with the nutrient solution that flows through the pipe (Figure 12).

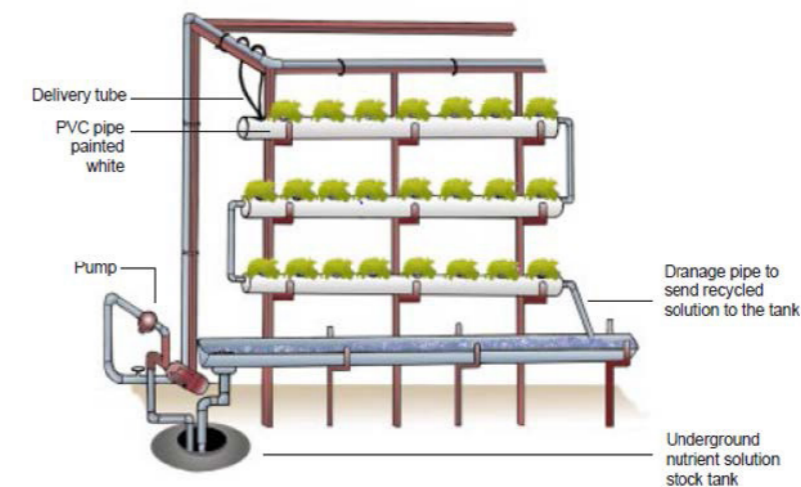
Nutrient Film Technique (Maldonado et al., 2019)

Figure 11



Deep Flow Technique (Mariyappillai et al., 2020)

Figure 12



In the **Static Solution Culture**, the nutrient solution is provided only when the Electric Conductivity (EC) within the solution changes. These technique includes three types of system:

- ▶ **Root Dipping Method**, where plants grow in pots and 2-3 cm bottom of it is immersed into nutrient solution (Figure 13).
- ▶ **Floating Method**, where plants grow in pots immersed in a container with nutrient solution and fixed with a styrofoam sheet, which floats in the nutrient solution (Figure 14).
- ▶ **Capillary Action Technique**, where seeds are planted in pots filled with inert medium and located in a shallow container with the nutrient solution; by capillary action the nutrient solution reaches the plant (Figure 15). (Khan et al., 2018).

Figure 15

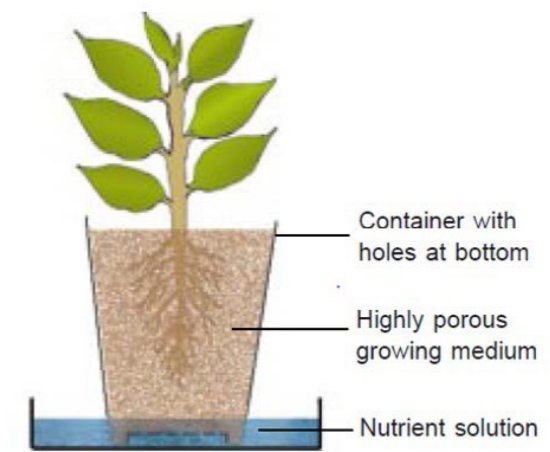


Figure 13

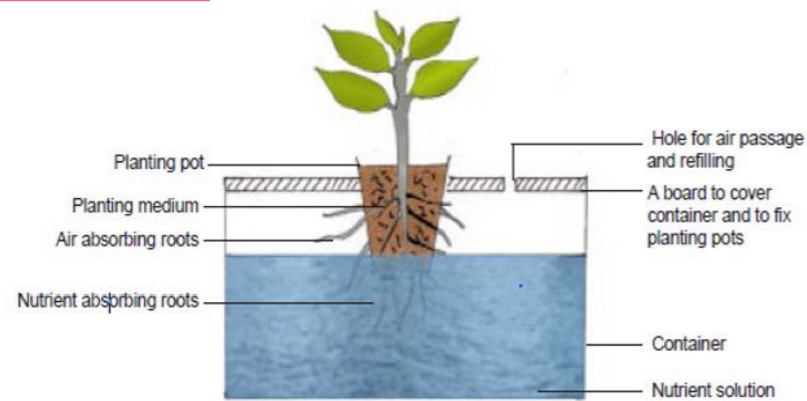
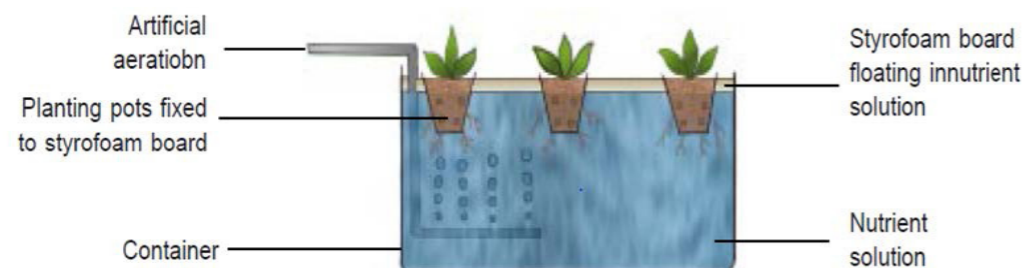


Figure 14



## Aquaponics

Aquaponics is defined as a “technology that is part of the broader integrated agri-aquaculture systems discipline which seeks to combine animal and plant culture technologies to confer advantages and conserve nutrients and other biological and economic resources” (Lennard & Goddek, 2019). According to Lennard & Goddek (2019), aquaponics definition fits into the broader definition of integrated agri-aquaculture systems, however aquaponics is more strictly associated with tank-based **fish culture** technologies with aquatic or **hydroponic plant culture** technologies. It basically combines fish culture with plant production in the same system.

The goal of integrated agri-aquaculture systems is to attain economically viable and environmentally sustainable production practices by exploiting the shared resources of aquaculture and plants, such as water and nutrients (Gooley & Gavine, 2003, as cited in Lennard & Goddek, 2019).

Rakocy (2006), one of the first researchers reviewing aquaponics, effectively explains how recirculating aquaponics systems (RAS) work (Figure 16): plants grow quickly with the dissolved nutrients, which are either secreted directly by fish or produced by the microbial digestion of fish waste. In closed recirculating systems,

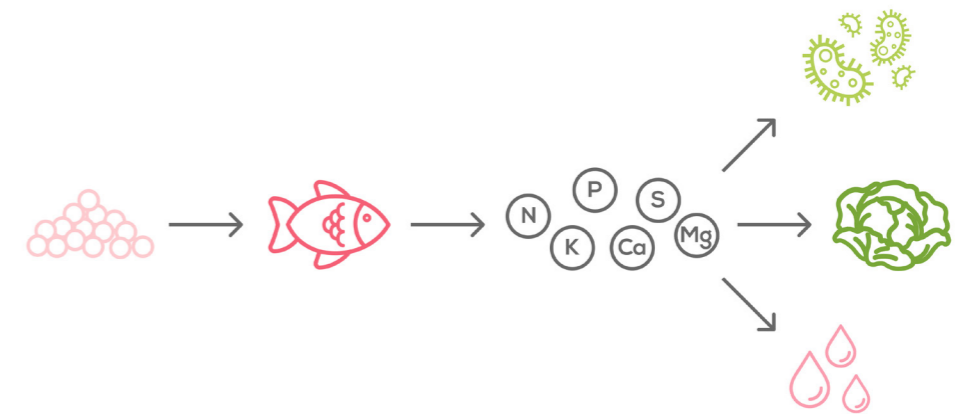
dissolved nutrients accumulate in quantities similar to those found in hydroponic nutrient solutions. Dissolved nitrogen, in particular, can accumulate to dangerously high amounts, but through their gills, fish excrete waste nitrogen in the form of ammonia directly into the water. Ammonia is converted by bacteria to nitrite, which is then converted to nitrate, that is harmless to the fishes and it's nutrient for the plants. As the dissolved waste nutrients are recovered by the plants there's a very limited daily water exchange (less than 2%), and reduced discharge to the environment. According to Rakocy (2006), the essential elements of an aquaponic system are the fish-rearing tank, a component that settles and removes suspended solids, a biofilter, a hydroponic component, and a sump (Figure 17).

Most of the aquaponics systems are built and operated as a **recirculating loop**, but a few researchers and commercial growers have started to expand the initial aquaponics system design towards systems with independent units with the intent to have control on each independent unit. These systems where the RAS (fish), the hydroponic unit (plants) and the remineralisation are integrated as separate components that can be controlled independently, but still comprising the same water cycle, are called Decoupled Aquaponic Systems (Goddek et al., 2016). Such systems aim at providing extra nutrients to the plants in order to expose them to optimal nutrient concentration (Goddek et al., 2019).

According to Junge (2017), aquaponic systems can be designed for different contexts, from small, private installations to large commercial enterprises. Of course, there's a clear distinction to from hobby forms of aquaponics and commercial production as the latter has to comply with many legal requirements. On the other hand, aquaponics has greater potential to contribute to communities' well-being if designed to be operated by non-professionals, for example educators, that could use aquaponics systems at different educational levels.

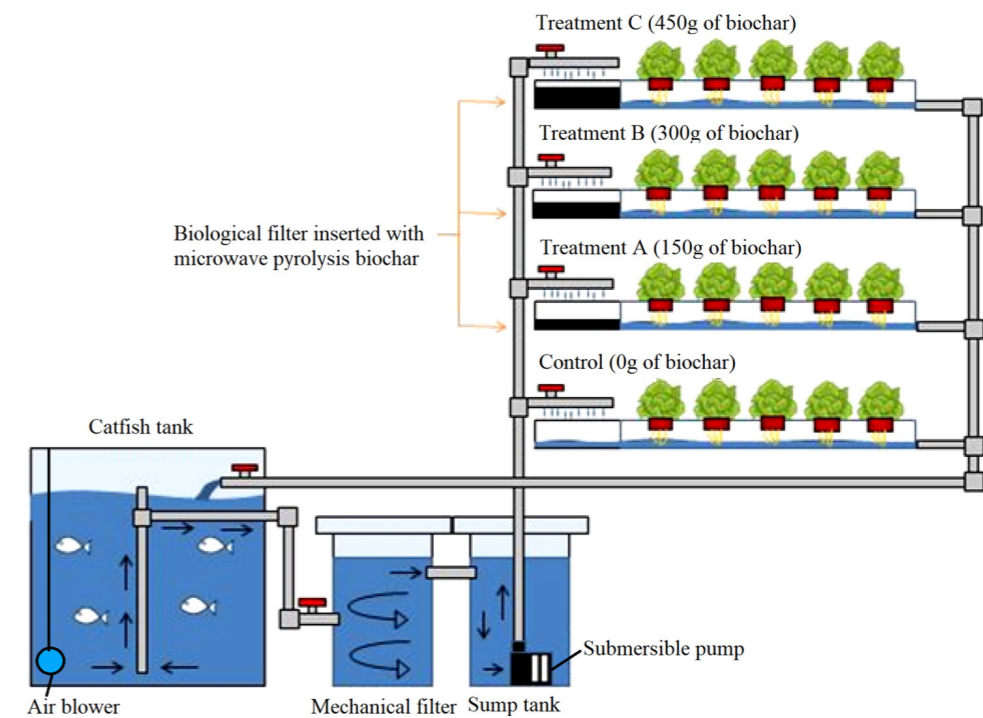
Representation of the nutrient flow within aquaponic systems (Lennard & Goddek, 2019)

Figure 16



Design and layout of aquaponic systems (Su et al., 2020)

Figure 17



## Aeroponics

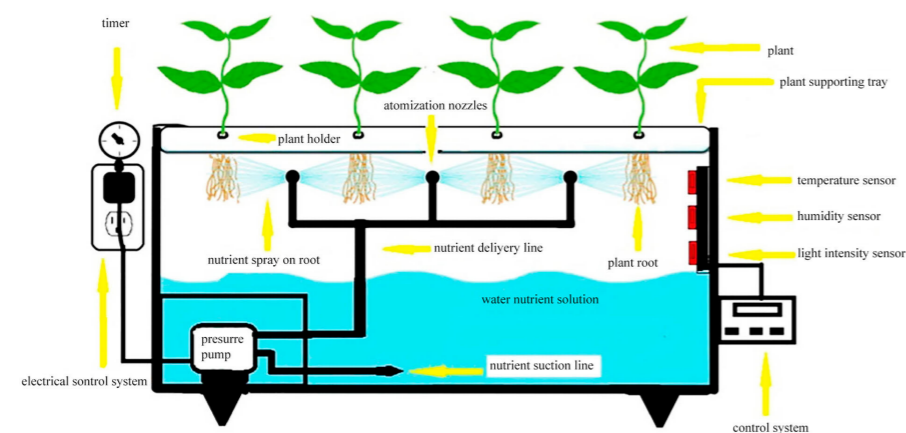
Aeroponics is a technological leap ahead of hydroponics that was developed by the National Aeronautic and Space Administration (NASA) in the 1990s as an efficient way to grow plants in space (Chatterjee et al., 2020). Aeroponics is defined as “an **air water culture cultivation system** where the roots of plants are hanged inside a sealed container under darkness and openly exposed in the air to get water nutrient-rich spray through atomizers” (Lakhiar et al., 2018). It is basically a plant cultivation method without soil and without any growing medium that supports the plants that grow in the air with the aid of an artificial support.

Lakhiar (2018) effectively explains the key elements that characterise the aeroponics system. The upper part of the plants extend above the wet zone underneath, where the plants' roots and canopy receive the nutrient spray mist. This spray is ejected from atomisation nozzles that break up the liquid into fine droplets, while an ultrasonic fogger is used to simulate ideal artificial humidity with a little mist. This aspect is fundamental in aeroponic systems as humidity is the main factor required for successful plant growth and development. For this reason constant monitoring of temperature and humidity through sensors is essential.

In this system the plants are sustained by specially designed lattice pots or cuttings that are placed directly in the system so that the lower portion of the plants is entirely suspended in the mist air environment for rapid root formation. One of the major advantages of aeroponics is that aeroponics consumes less water and nutrients: because the plant roots are sprayed at intervals with a specific droplet size that is absorbed by the plants through osmosis, water and nutrients are used most efficiently (Figure 18).

Aeroponics growing system (Lakhiar, 2018)

Figure 18



## 2.2.2 The lighting system

Although the previously described growing systems can also be set up in greenhouses and grow using natural light from the sun, vertical farming, to be defined as such, is characterised by the use of **artificial lighting**.

Despommier (2013) underpins that in the past years with the adventum of spectrum-specific, higher efficiency light-emitting diodes (LED) has increased the efficiency and viability of vertical farms. In more recent years, further experimental developments in LEDs have increased even more the vertical farming viability. Philips lighting specialists in the Netherlands have developed LEDs that are 68% efficient, contributing in dramatically cutting the cost of the lighting expenses (Figure 19). The new lighting technique offers the blue, red, and infrared light that plants require for photosynthesis, without wasting energy with light spectra not used. (Al-Kodmany, 2018).

LED lights simulate the **color spectrum of sunlight** to foster the growth of the plants: light units are tuned to produce high-quality illumination that is close to daylight, creating an ideal microenvironment for plants.

Plant photoreceptors absorb light energy for photosynthesis and are influenced by light wavelength and intensity. The concentrations of nutritionally essential primary and secondary metabolites in speciality vegetable crops have been shown to alter depending on the spectral content of illumination, such as blue wavelength in LED lighting. In particular, “plant response to different wavelengths of light from LED sources suggests very significant improvements in productivity are possible” (Benke & Tomksin, 2017, p.16). Controlled illumination with regard to intensity and time duration, in addition to wavelength, is another area where potential optimisation methods are conceivable.

Philips vertical farming LED lights (Philips, n.d.)

Figure 19



### 2.2.3 The monitoring system

Vertical farming can be simply referred to as **Controlled Environment Agriculture (CEA)**: this means that full control on the indoor environment is fundamental for plants to grow and develop.

Computer-assisted monitoring operations are therefore needed in order to monitor and deliver precise amounts of nutrients, adjust pH, temperature, humidity and generally assess the growth of the plants and the overall health of the crops (Despommier, 2013).

In addition to the lighting component that is fundamental for plants to develop and enhance growth, other elements such as temperature, humidity, pH and EC and CO<sub>2</sub> levels are also fundamental. To be able to monitor these elements, monitoring systems in form of **sensors** for each plant bed are required, to be able to detect the plants' requirements or even harmful bacteria, viruses or microorganisms that could cause disease (Al-Kodmany, 2018).

The major environmental element influencing the frequency of plant growth and development is **temperature**. Different levels of temperature produce chemical reactions and affect the physical properties of plants, and quality of most crops is affected by different temperature patterns (Khan et al., 2018). The chemical reactions speed up as the temperature rises, deteriorating the enzyme activities: 15–25°C is the ideal temperature range for all plants (Lakhiar et al., 2018). It is therefore important to monitor temperature in order to assure plants' health and optimise the rate of growth.

Vertical farms' indoor environments also require precise **CO<sub>2</sub> concentration** levels, as research showed that when CO<sub>2</sub> levels rise, the plant dry weight, height and number of leaves and branches also increases (Khan et al., 2018). **Air conditioning** is therefore used to maintain a steady flow of air that can be supplemented with carbon dioxide (CO<sub>2</sub>) to help plants grow and develop more quickly (Benke & Tomksin, 2017).

The **nutrient solution** is also determining for the plants' correct growth. Quantity and timing of nutrient delivery is fundamental, as well as its **pH level** and **EC (Electrical Conductivity)**. A change in pH is likely to cause nutrient imbalance affecting plants' health directly, that will show some deficiency or toxicity symptoms (Sharma et

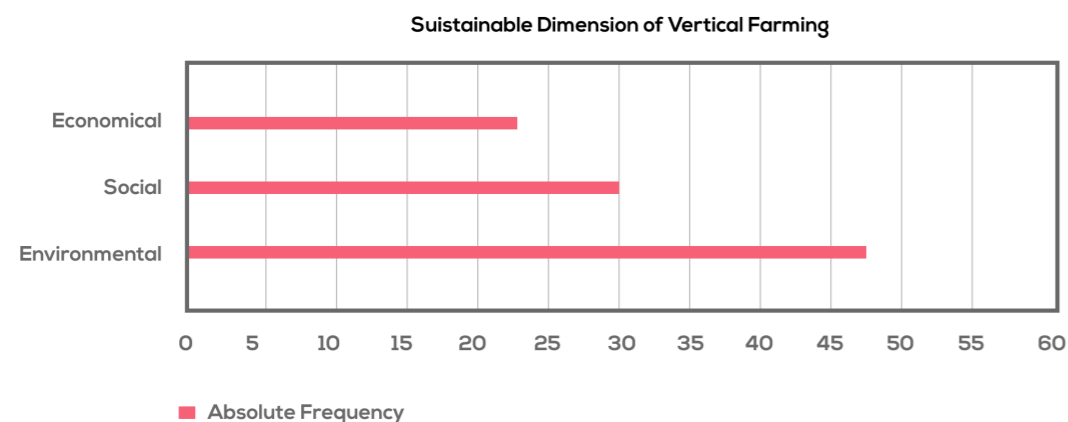
al., 2018). The pH is the degree of acidity or alkalinity of the liquid solution, and EC is a measure of all the salts dissolved in the water. As in most growing systems the water and nutrient solution is recycled repeatedly is important to regularly measure pH and EC value, and adjust the proper level if needed to ensure plants' growth (Lakhiar et al., 2018).

## 2.3 Vertical farming potential

Vertical farming is widely discussed as a promising solution able to address the multiple interconnected challenges the world will face in the upcoming decades. A systematic review on vertical farming literature was performed by Kalantari (2018) with other researchers to understand the most frequently mentioned opportunities offered by vertical farming. They organised the findings in a framework based on the three sustainability dimensions: environmental, social and economical. Within a total of 60 sources, 47 mentioned at least one issue linked with the environmental aspect, 30 looked into topics related with the social sphere, and 23 mentioned economic related issues (Figure 20). The majority of the reviewed papers dealt with issues of all the three aspects.

Frequencies of sustainability dimensions in literature review (Kalantari, 2018)

Figure 20



Vertical farming opportunities and advantages are strictly related with all the factors previously listed in chapter 1 that describe the future challenges and requirements to be able to deal with next years' changes.

### 2.3.1 Environmental benefits

#### Food security and land availability

The most important and broadly discussed topic that is a major argument among research practitioners in underpinning the potential of vertical farming is the issue related to **population growth** and **limited land availability**. Despommier (2013) argues that there are limited technological options available that can reduce the environmental impact of agriculture while at the same time sustaining a growing population. One of these is vertical farming, which he considers a promising solution to this problem.

Vertical farming can indeed produce **high yields in a limited space**, ensuring **crop production all year round**, "because they maintain consistent growing conditions regardless of the weather outside and are much less vulnerable to climate changes" (Chatterjee et al., 2020, p.1). Despommier (2010) in his book *The Vertical Farm: Feeding the World in the 21st Century* states that, taking the quantity of crops produced every season into account, **a single indoor acre of a vertical farm may generate output equivalent to more than 30 acres of farmland**. This guarantees that customers have a continuous and secure supply of products and that producers have a stable revenue all year round.

#### Climate change

Concerning the climate change issue, vertical farming constitutes an effective measure to **climate change adaptation** and an effective method to increase **resilience** within the food system. Since vertical farming works under a controlled environment, **crops are repaired and safe from unexpected and severe extreme weather events**, such as floods, droughts, storms, etc. On the other hand, indoor farming provides the chance to return farmland to its original biological role, minimizing the damages caused by conventional open field agriculture and **contributing in this way to restore the ecosystem** (Despommier, 2013). Furthermore, vertical farming implies a reduction of fossil fuels and greenhouse gases that derive from food miles, meaning the distance food has to travel to reach urban locations. In a research aimed at calculating the average distance fresh food has to travel in order to reach Chicago Terminal Produce Market, it is estimated that "an average item of food" travels about



1500 miles (Pirog, 2001 as cited in Schnell, 2013). Vertical farming has the potential to **avoid all the costs related to transportation**, as production and consumption could potentially happen in the same place: vertical farming can move food production "closer to where most people live (i.e., cities), would of course reduce or even eliminate this drawback, and would establish the option for buying on-demand, ultra-fresh (i.e., hours old), locally grown, pathogen-free food" (Despommier, 2013, p.2).

### Water availability

As already cited in chapter 1, agriculture accounts for 70% of the total water withdrawn from aquifers, rivers and lakes (FAO, 2011a). Vertical farming methods are able to reduce water usage for crop production by consuming 70-80% less water than conventional agriculture according to Despommier (2013). The closed loop irrigation systems adopted into vertical farms, either hydroponics, aquaponics or aeroponics, can even **save up to 95% of water**, meaning that water used in vertical farming is just 3% of the water used in conventional farming (Kalantari et al., 2018).

### Human health

Conventional agriculture is characterised by the use of external inputs such as pesticides and fertilisers and their intensive use have caused soil depletion and land degradation. Not less important, human health can be affected by the use and exposure to pesticides, causing different diseases and illnesses. As vertical farms benefit from controlled environments they **are not threatened by external pathogens, thus they don't require pesticides or herbicides** to prevent or combat viruses, bacteria, or plant pests. In some regions of the world where farmers cannot afford commercial products, human feces are used as fertilisers, resulting in a dangerous spread of bacterial or viral infections: vertical farming irrigation systems employ nutrient solutions that do not include any metabolic waste from human metabolism, eliminating the issue of fecal contamination of food sources entirely (Despommier, 2013).

Another issue that involves conventional agriculture is the **heavy**

**metals concentration** in the soil that has increased dramatically over the past decades, due to atmospheric deposition, livestock, irrigation with wastewater or polluted water, metallo-pesticides and herbicides and phosphate-based fertilisers (Rai et al., 2019). Heavy metals contamination in soil-food crops has multiple risks for the population, as heavy metals can seriously affect human health, causing diseases such as morbidity or even mortality. The intrinsic nature of **vertical farming simply avoids this issue, providing products that are clean, healthy and nichel-free.**

### 2.3.2 Social benefits

One of the major benefits that comes from the introduction of vertical farming on a commercial scale is linked with providing **job opportunities**, both directly and indirectly. New jobs will be in engineering, biochemistry, biotechnology, construction and maintenance, and in the research and development realm in order to advance and improve the technology of the systems (Benke & Tomksin, 2017). Other jobs will be the work force of a typical large indoor working facility, specifically like "management of the nursery (seed germination); transplanting seedlings into the vertical farm; resource procurement and management (i.e., water, nutrients, growing systems, lighting systems, and automation); monitoring plant growth and development; pollination strategies; harvesting; distribution of harvest to local greengrocers; waste-to-energy management; quality control (DNA-based laboratory surveillance for plant pathogens and arthropod pest control); IT personnel; human resource management; and business office personnel (Despommier, 2013, p.2). Moreover, vertical farming would also feature a system of grocery shops, organic food markets and cafes, as well as local distribution and transportation networks, all of which would provide job possibilities in the food service industry (Besthorn, 2013).

Vertical farming may also uncover **educational opportunities**, becoming a place for teaching and learning and a good platform to educate people about health and nutrition (Kalantari, 2018). Because the foods we acquire and consume now originate from farms outside of the city, little is known about how they are grown, transported, and how they eventually arrive on our dining tables. Vertical farms have great potential in becoming learning and education facilities for children and adult city-dwellers by bringing farming activities closer to them and helping to "bridge the gap between consumers and producers" (Specht et al., 2014, p.43).

Vertical farming has indeed great potential in the **urban context**, enhancing citizens' **access to locally grown fresh food**: for cities in developing countries with limited food availability or difficulties in getting in, vertical farms can guarantee access to fresh food improving people's basic needs; in developed countries vertical farms may act as educational facilities, which are coupled with both experiences of food production and consumption (Specht, 2014).

Vertical farms have also the potential to be adapted and reintegrated to existing buildings, especially vacant older properties, through constructions and **retrofitting**. Their flexibility in terms of design and set up is translated into diverse examples of vertical farming systems integrated within existing and unusual spaces.

#### Case study 1 - Growing Underground

A famous example is **Growing Underground**, a British company that set up its production system "33 metres below the busy streets of Clapham" becoming the first world's underground farm by giving a new life to part of the abandoned London underground system (Growing Underground, n.d.) (Figure 21).

Growing Underground (Reynolds, 2019)

Figure 21



## Case study 2 - LettUs Grow

Another example of "adapted " vertical farm comes from **LettUs Grow**, a company founded in Bristol in 2015 by University of Bristol Alumni. They first developed a small aeroponic grow-at-home kit, which was then transformed into a 40ft container farm that contains an aeroponic system that is controlled by their software Ostara (Figure 22), (Figure 22b), (LettUs Grow, n.d.).

LettUs Grow container farm (LettUs Grow, 2015)

Figure 22



LettUs Grow container farm - inside (LettUs Grow, 2015)

Figure 22b



Vertical farms offer different opportunities on a social level, becoming even a chance for **social inclusion and integration**. Aquaponics is recognised as an innovative form of therapeutic activity that can help provide employment to people with disabilities while improving their mental well-being (Milliken & Stander, 2019). Therapeutic horticulture is a "nature-based approach that can promote well-being for people with mental health problems through using a range of green activities such as gardening and contact with animals" (Milliken & Stander, 2019, p.608). Over the past decades, social enterprises have appeared with the aim to create employment, work experience and training for people with mental health problems, facilitating their re-engagement with the workplace while developing new skills.

## Case study 3 - Duurzame Kost

A good example of social project within a vertical farming context is **Duurzame Kost**, an indoor aquaponics farm in an old Philips Factory in Eindhoven, Netherlands. The setup includes Philips LED lights & decoupled aquaculture and hydroculture systems that enables the production of both herbs and leafy greens as well as the trouts that are then sold in local shops. The farm is conceived as a social project that intends to re-integrate young people in society through the cooperation with a non-profit social organisation (Duurzame Kost, 2019), (Figure 23).

Duurzame Kost farm (Duurzame Kost, 2019)

Figure 23



### 2.3.3 Economic benefits

From the economic perspective, vertical farming can have several advantages compared to traditional farms. First, **indoor farming is protected** from floods, droughts, sun damage etc, therefore **from unexpected expenses** in case of extreme weather events. Moreover, there's no requirements for chemical inputs nor farm machineries such as tractors, trucks etc. (Benke & Tomksin, 2017). When vertical farms are strategically situated **in metropolitan areas**, it would be possible to **sell food directly to consumers, lowering transportation expenses by removing intermediaries**, which can account for up to 60% of costs (Al-Kodmany, 2018). Food is also an integral part of the city economy as all food-related businesses like restaurants, supermarkets, cafeterias, etc, comprise the urban economy. Incorporating local food production into the system is challenging yet beneficial, and vertical farming has the potential to be set up either in public or private structures (Kalantari, 2018).

Within this context there is also potential to cut down on costs by implementing innovative strategies, such as further integrating vertical farms into buildings and creating symbiotic exchanges to employ more residual energy and use the building waste itself (Martin & Molin, 2019; Kalantari et al., 2018); setting vertical farms in **unused spaces** and creating **synergies with the existing buildings through construction and retrofitting** (Specht et al., 2014); integrating vertical farms with municipal **wastewater treatment**, thanks to hydroponics cost-efficient potential to remove pollutants while reducing maintenance and energy costs for conventional wastewater treatment (Magwaza et al., 2020). All these strategies could help vertical farms to reduce costs as well as the environmental impact.

Finally, the technological advances and the adventum of **increasingly efficient LED lights** and **computer-assisted control hardware and softwares** have rapidly evolved vertical farming into a commercially viable method able to produce a diverse range of crops on a big scale in proximity to, or even within, metropolitan areas (Despommier, 2013).

### Case study 4 - The Plant Chicago

**The Plant Chicago** is a great example of a fully integrated and circular structure that involves an aquaponics system together with a multiplicity of different activities, such as indoor and outdoor classrooms, maker spaces, a teaching kitchen, and a community meeting and event space. The Plant Chicago is located in a structure that served as a firehouse from 1908 until 1978 and, more recently, has been used for a variety of other industrial purposes. The building was then empty for nearly three years until Plant Chicago moved in and designed a "closed-loop" system, where every activity or space serves another one: fish waste as an input for indoor farms and brewers waste as an input for growing mushroom; an anaerobic digester will convert waste to biogas, which will then be used to power turbines that create electricity (Plant Chicago, 2020), (Figure 23).

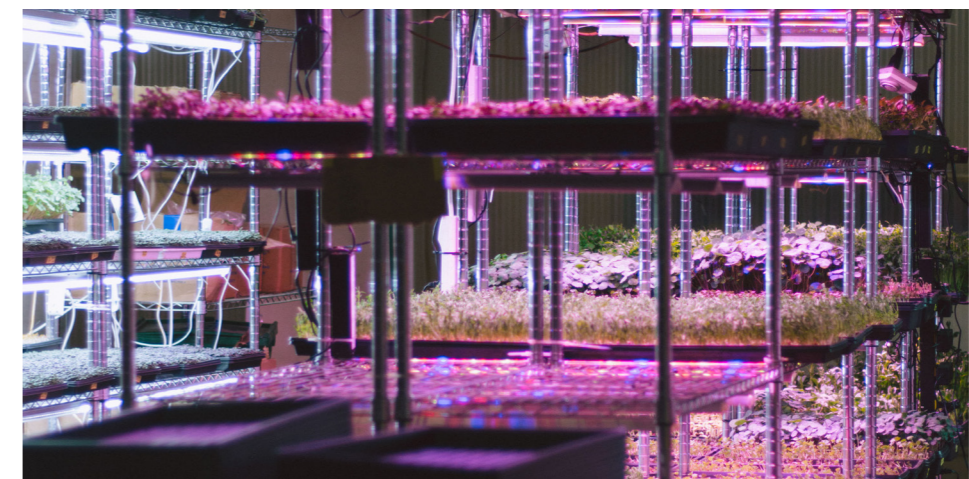
The Plant Chicago (The Plant, n.d.)

Figure 24



The Plant Chicago - inside (The Plant, n.d.)

Figure 24b



## Case study 5 - AeroFarms

One of the first vertical farms producing on a commercial scale is **AeroFarms**, an indoor agriculture company founded in 2004 and based in Newark, New Jersey, USA. By using their proprietary aeroponics technology in a fully-connected environment they aim at growing the best plants possible for the betterment of humanity. They have developed a patented, reusable cloth medium for seeding, germinating, growing, and harvesting leafy green, as well as proprietary LED lighting to create a custom light algorithm for each plant giving them exactly the spectrum, intensity, and frequency they need for photosynthesis in the most energy-efficient way possible. This allows them to optimise the size, shape, texture, color, flavor, and nutrition of our plants with high precision and increased productivity. The fully connected farm is made possible by the proprietary softwares that allows plant scientists to monitor millions of data that are constantly reviewed and analysed in order to deliver consistent and optimal results. They have produced several varieties of plants including leafy greens, berries, tomatoes and more. At the moment they distribute their baby greens and microgreens in some of the most popular American supermarket chains such as Whole Foods, Walmart and others (Figure 25), (Figure 25b), (AeroFarms, 2021).

AeroFarms products (AeroFarms, 2021)

Figure 25b



AeroFarms farm (AeroFarms, 2021)

Figure 25



## 2.4 Vertical farming limitations

Despite the significant potential benefits and the promising future of vertical farming as reviewed in an increasing body of literature, several challenges and barriers on the way to implementing vertical farms have been observed, especially within a commercial context.

### 2.4.1 Environment-related limitations

The first big controversial topic is that of **energy consumption**. A few studies have been made to evaluate environmental performance aimed at assessing environmental impacts of vertical farming. A study was conducted by Martin & Molin (2019) who adopted a life cycle perspective and based their assessment on the annual production of a developing hydroponic vertical farm in Stockholm by Grönska, investigating mainly its greenhouse gas emissions and acidification and eutrophication impacts. The elements taken into consideration are all the elements and resources that enable the vertical farm to work, from input materials to the materials needed for transportation.

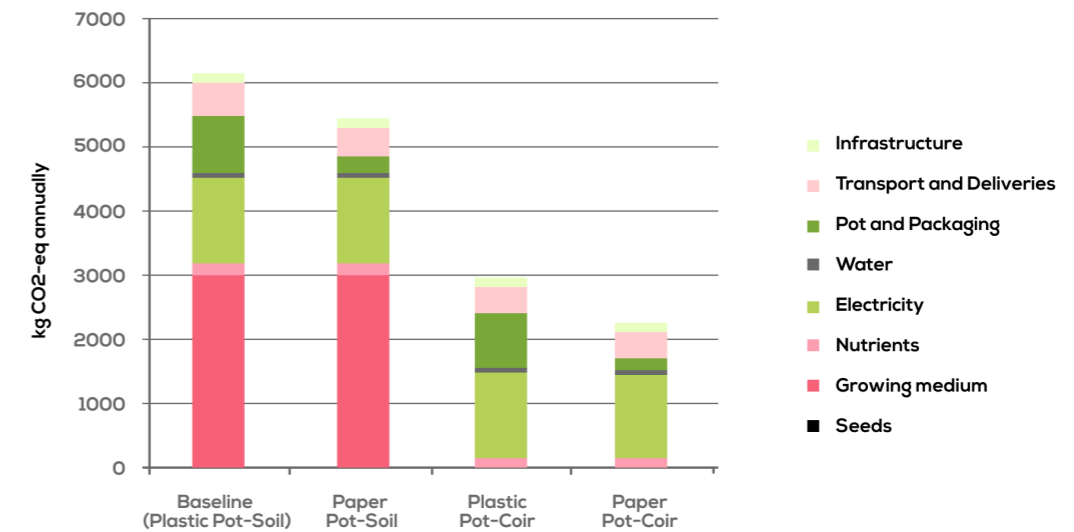
Taken into analysis only the scenario with coir as growing medium and paper pots used as packaging, the results of the study shows that the **most impactful factors both in terms of greenhouse gases emissions** (Figure 26) and **acidification** (Figure 27) are **electricity, transportation and packaging**. More than 50% of the overall greenhouse gases emissions were determined by the **electricity used for the lighting system, for pumps, heating and ventilation**.

The largest share of the **impacts originated from electricity** is the LED lighting system but the researchers underline that these results are **sensitive to the electricity mix employed**, estimating that the use of renewable sources might have lower environmental impacts.

This hypothesis was confirmed in a master thesis developed by a student from Aalto University, who used a Life Cycle Assessment (LCA) to achieve comparable results of the environmental impacts of vertical farming and conventional agriculture. Hallikainen (2019) states that vertical farming is significantly more energy-intensive than conventional agriculture, with electricity used for lighting as the major energy consumer. Nevertheless, **energy-related emissions**

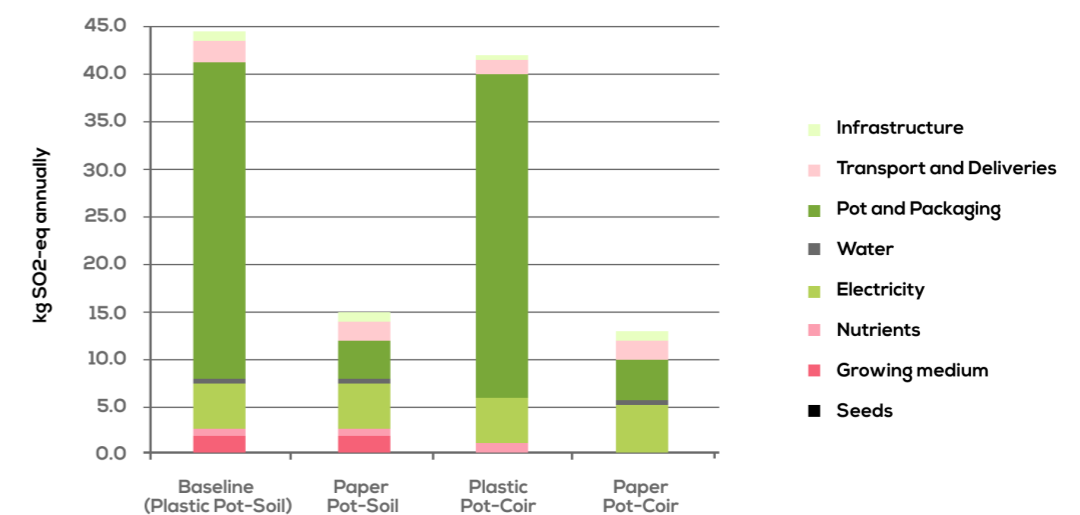
GHG emissions (Martin & Molin, 2019)

Figure 26



Acidification (Martin & Molin, 2019)

Figure 27



**depend largely on the energy sources used in the vertical farm:** greenhouse gases emissions produced by coal-powered vertical farms are 17 higher compared to a vertical farm using solar power, about 35 times higher compared to a vertical farm using hydropower and even 70 times higher compared to a vertical farm using nuclear

or wind power.

Al-Kodmany (2018) however highlights a limitation of current renewable energy sources: according to him these sources, such as **photovoltaics or wind turbines, produce too little energy that would make it hard for vertical farms to be entirely independent**, meaning that they would have to rely on the city grid.

This was also confirmed by another more recent study by Udovichenko et al. (2021) aimed at assessing costs and greenhouse gases emissions of a renewable energy-assisted hydroponics farm compared to the traditional supply chain. A retrofitted building in a rural community in Alberta, Canada, was taken into analysis for this study and a hybrid renewable energy system (HRES) was developed. A solar photovoltaic array was the primary source of renewable and low maintenance electricity for the building, while the rest of the energy required was imported by fossil fuel sources. The study results show that greenhouse gases emissions generated by the local hydroponic lettuce production are three times higher than greenhouse gases emissions emitted by transporting an equivalent amount of the same product from southern California. Despite the solar photovoltaic system, researchers recognise that the significant reliance of the hydroponic system on the electricity grid of the town, which depends on diesel combustion, contributed to a large share of the greenhouse gases emissions.

Furthermore, it's relevant to underline that only the emissions related to the transportation of the equivalent product, therefore just the emissions from fuel combustion and the energy used for refrigeration in the truck, were taken into account for this study. Although it highlights the need to rely on renewable energy sources which is definitely fundamental for vertical farming sustainability, to have a clear understanding of the environmental impact of vertical farming products, the whole traditional supply chain should be taken into account for a comparison in terms of greenhouse gases emissions.

In terms of economic sustainability of the lettuce produced by the retrofitted hydroponics building, the study reveals that the price of the lettuce is comparable to the price of the lettuce available from traditional import, showing promising potential to provide fresh and cost-competitive products to the community.

## 2.4.2 Economic-related limitations

Energy consumption is impactful not only from an environmental point of view, but also from an economic perspective. **Electricity for lighting and energy supply is indeed one of the major operational costs** that vertical farms have to deal with to be able to run the system: energy to pump the water-mixed nutrients, energy to power exhaust fans and sensors, in addition to other expenses, such as resources to maintain a high concentration of nutrients in the water, necessitate a high level of maintenance and running costs (Khan, 2018).

One of the main economic barriers for vertical farmers is also related to the **high start up costs**. The expenses for implementing a hydroponic farm can vary greatly but they are often higher than the costs of soil-based farming (Sharma et al., 2018). High initial costs are mostly linked with the **expensive real estate in urban areas** compared to rural land, where the market is more competitive and residential, retail, office and commercial uses continue to be more profitable than agricultural activities (Al-Kodmany, 2018). According to Benke & Tomkins (2017), a new urban farm might face an initial cost of US\$317 per square meter for arable land, not including building and equipment. This cost would be eventually reflected in the product price. However they also underpin that if the yield per hectare is significantly higher than that of outdoor rural farming, maybe up to 50 times. This factor, although it might mean a late return on investment, will ultimately outweigh the original land acquisition costs, allowing to reach the break even point and to provide products' prices that are not be hampered by the initial cost structure.

A study performed by Turnsek (2020) and other researchers, aiming to collect insights on the barriers to early development in commercial aquaponic production, revealed that raising **initial investment** was the main difficulty in beginning a commercial activity, together with finding the **right location**. The result is that 19% of the European respondents abandoned their aquaponics projects, while only one fifth of the participants are involved in aquaponics activities that generate revenue. **To become commercially viable businesses need to scale up or develop additional business models** expanding, for example, their product range and offer consulting services,

educational activities, etc. However, the difficulty in starting aquaponics commercial production may be strictly linked with its complexity, as "it includes both aquaculture and horticulture, most investment costs are doubled when compared to the competing enterprises that engage only in aquaculture or horticulture" (Turnsek et al., 2020, p.15).

Although it is claimed that it's possible to grow any plant completely indoors, the **number of crop types available on the market is currently very limited**. This is mainly for economic reasons, as producers tend to limit their production to crops that have smaller growing habits to maximise the number of plants in a limited space (Vertical Farming, n.d.). As a result, most productions involve leafy greens as they provide a premium profit margin, but also microgreens, strawberries and so on, while the production of tree crops might require more effort and more space between the crop modules (Benke & Tomkins, 2017).

Another challenge for vertical farming is the **absence of policy regulations**. In vertical farms with aquaponics systems regulations barriers are doubled since the farm has to adhere to both regulations pertaining to aquaculture and horticulture. Moreover, while vertical farming in the United States can be certified as organic, vertical farms in Europe cannot benefit from any **certification**, since the farming method is not yet recognised by any official label (Turnsek et al., 2020).

### 2.4.3 Social-related limitations

Commercial production also requires **technical knowledge** as great care is needed in respect of plants' health control and maintaining pH, EC and proper concentration of the nutrient solution is of prime importance (Sardare & Admane, 2013). For this reason, vertical farming is mainly an opportunity for job creation, on the other hand the novelty of this business requires **specific skilled workforce** for new jobs, as consulting engineers will require, for example, to install and manage air conditioning, lighting control and water recycling (Benke & Tomkins, 2017). Thus, a high level of management is required for commercial production, as vertical farms demand a high degrees of management, including production knowledge of various crops, technical abilities, and appropriate expertise in the hydroponic sector (Khan, 2018).

Finally, another barrier in the path to vertical farming expansion is **social resistance**. In this early innovation stage, the opinions of relevant stakeholders and societal acceptability of vertical farming are crucial preconditions for the success or failure of future dissemination of this practice. For this reason, researchers investigate stakeholders' views in order to identify the key elements that may hinder or encourage the introduction of vertical farming practices (Specht et al., 2015).

Several studies show consumers' scepticism in regards to vertical farming. Research has highlighted that "masses of people do not accept the alteration of traditional farming as it is the natural way to grow food" (Al-Kodmany, 2018, p.28). The production system itself, based on **soil-less growing techniques**, is indeed what makes consumers critical to vertical farming and consequently to the products (Specht et al., 2014). A study based on 38 qualitative interviews to key stakeholders in Berlin shows that the major perceived risks associated with growing techniques that are considered **unnatural** are: health risks due to urban pollutants, conflicts with traditional farming imagery, the rejection of animal production in cities (in the case of aquaponics), and concerns about the complexity and the expensiveness of this kind of projects (Specht et al., 2015).

Another study in Fukushima, Japan was performed in order to understand current consumers' perceptions of vegetables grown in plant factories with artificial lights (Yano et al., 2015). The study



reveals that the level of knowledge about vertical farming methods affects consumers' attitude towards vegetables grown in plant factories with artificial lights: those who had a **prior knowledge** about it had more **positive impressions** about the products, which were linked with the concepts of "safe and reliable", "fresh and tasty" and "stable supply"; consumers who had **never heard** about plant factories before had more **negative perceptions** about the products and the plant factory itself, such as "anxious about the nutritional value and taste", "low cost and cheap" and "large-scale mass production". These **negative images** were mainly evoked by the words "**artificial lights**" and "**plant factory**".

A couple of studies were conducted to strictly investigate consumers' perceptions about aquaponics systems in Minnesota, USA (Short et al., 2017) and Europe, mostly Belgium, Greece, Iceland, Slovenia and The Netherlands (Miličić et al., 2017). Both studies revealed that the majority of the respondents had never heard of aquaponics before, nevertheless consumers had positive or neutral attitudes towards aquaponics. Although price might be an issue for some participants, as only 17% of the respondents expressed their willingness to pay more for aquaponically produced products, general willingness to pay is mainly related to "products free of antibiotics, pesticides and herbicides and connected with local well-known producers" (Miličić et al., 2017, p.13).

Another study by Bradford and Ellison (2017) helped to understand consumers' perceptions and willingness to pay for products grown in vertical farms, especially lettuce. The participants were asked to express their opinions on three different production systems, including field farming, greenhouse farming and vertical farming, through different activities.

The results show that **vertical farming** is the **production system that consumers have less knowledge about**. In terms of safety and quality, lettuce grown in vertical farming was rated lower than greenhouse grown lettuce but higher than field-grown lettuce. Despite the strong quality and safety ratings, lettuce produced in vertical farming was considered **the least natural and the least likely to be purchased by an average consumer** (Figure 28).

Attitudes expressed by the consumers suggest that "participants are open to a type of agriculture, such as vertical farming, that uses land

intensively to grow pesticide-free plants at an accelerated pace year-round" (Bradford & Ellison, 2017, p.5). More specific declarations by the consumers indicate a general positive view of vertical farming, as it can solve environmental problems improving the standard of living for future generations while reducing the price of lettuce. This last statement suggests an underlying assumption that higher yield per acre is associated with lower-cost lettuce, mainly for those who received proper information about the vertical farming production system. Those who are unfamiliar with his farming method, instead, see vertically grown lettuce as a premium product that should be sold in premium stores.

Consumers' perceptions by production system (Bradford & Ellison, 2017)

Figure 28

Production System	Knowledge of System	Naturalness Rating	Safety Rating	Quality Expectation	Willingness of Average Consumer to Buy
Vertical Farm	2.3 <sup>a</sup>	3.1 <sup>a</sup>	3.7 <sup>a</sup>	3.8 <sup>ab</sup>	3.0 <sup>a</sup>
Greenhouse	3.1 <sup>b</sup>	3.5 <sup>b</sup>	4.0 <sup>b</sup>	4.1 <sup>a</sup>	3.6 <sup>b</sup>
Field Farming	3.4 <sup>b</sup>	4.4 <sup>c</sup>	3.4 <sup>c</sup>	3.6 <sup>b</sup>	4.3 <sup>c</sup>

NOTES: Averages in column that share the same letter in the superscript are not significantly different at the 5% significance level. Participants were asked to rate their response on a five-point scale where 1=No Knowledge, Unnatural, Very Unsafe, Low, or Very Unwilling and 5=Very Knowledgeable, Natural, Very Safe, High, or Very Willing

Define

The  
Optimizer  
The Planner

groups of  
friends  
travelling  
together

Understand RC

## 2. PROBLEMS / PAINS

Which problems do you solve for your customer?  
There could be more than one, explore different ones.  
eg. existing solar solutions for private houses are not considered  
a good investment (1).

TOO MANY  
POINTS FOR  
COMPARISONS  
(FI) X

Hard to  
coordinate  
booking for  
a group.

TOO MANY  
ABS

# 3.

# Service design for food innovation

## 3.1 Research questions

According to literature, vertical farming is therefore a promising solution that could help address some of the major issues of the next decades and could enhance the transition towards more sustainable food systems. Nevertheless, there are some barriers that could prevent vertical farming to expand or, in some cases, to be properly introduced.

In some countries vertical farming is already "the norm", or at least commercial-scale entities have been operating for several years becoming commercially viable.

In the **Italian context**, specifically, vertical farming is a relatively new concept. Although the food topic has been widely discussed in relation to the sustainability issue, vertical farming is just now becoming real in the practical sense.

Such a novel approach to farming in Italy presents for sure several challenges that might undermine vertical farming growth and development. Therefore, a first question to answer is:

### What are the barriers that may hinder vertical farming practice and prevent it from becoming widespread in Italy?

Supposing that major barriers are the same described in the previous chapter, one important challenge in Italy could be **consumers' resistance** to vertical farming methods and products, for a few reasons:

- ▶ Multiple studies performed in different countries of the world have shown criticalities concerning consumers' acceptance and willingness to purchase products grown in vertical farms. However, there is a lack of Italian sources and research within the Italian population, which makes it hard to know the state of consumers' acceptance in Italy.
- ▶ Italy has a strong relationship with food as it constitutes a pillar of Italian culture, especially when food is inherently part of a specific territory and with a long story ahead. Given this important food culture and strong bond with traditions and territories, the question is if the Italian population is ready to accept artificially grown food products.

The assumption is further supported by a first brief investigation on people's interactions on social media, specifically the comments under some public Instagram posts about vertical farming (Jane, 2021). While some of the comments were positive, others revealed some bias and concerns about vertical farming techniques and products. As a result, this short investigation demonstrates the need for further research and analysis on this topic to be able to gather more robust evidence and insights.

Hence, assuming that consumers' acceptance may be a major critical point in Italy, secondary research questions are:

### What are Italian consumers' attitudes and perceptions towards vertical farming? Are they actually reluctant to vertical farming products?

The aim of the work is to answer these research questions and collect insights on consumers' views about vertical farming and more generally about their habits, needs and desires regarding their relationship with food. The collected insights will serve as a starting point for defining project directions for the design and development of a service idea in the vertical farming realm. The **service design** practice has indeed the potential to bring **innovation** in a sector that is growing and evolving, while bringing **value to all the stakeholders involved**.

## 3.2 Service design potential

While most of the design world already recognises **service design**, service-design related activities, events, and research projects are on the rise, attempting to clearly describe what service design is and what it achieves is a more challenging process (Sangiorgi, 2009). Sangiorgi and Prendiville (2017) defines service design as “the activity of planning and organizing people, infrastructure, communication and material components of a service in order to improve its quality and the interaction between service provider and customers” (p.1). Nevertheless, the growth of the service design field, both in practice and academic literature, contributes to the evolution of service design and its definition. The difficulties in giving a definition of service design lies, indeed, in the continuous evolution of the design practice that is changing the scale and the mode of intervention (Sangiorgi & Pacenti, 2008), as it spans from service development to the transformation of service organisations (Clatworthy, 2017).

Many designers and researchers have contributed to define service design in different ways, some have even crowdsourced possible definitions and interpretations from different designers to be able to shape a more robust definition of service design: this is how Megan Erin Miller (2015) shaped her definition of service design, which was then defined as the most popular definition by Stickdorn, Hormess, Lawrence, and Schneider (2018) in their book *This Is Service Design Doing: Applying Service Design Thinking in the Real World*, where they asked 150 designers to share and vote their favourite one.

According to Miller (2015) **“service design helps organizations see their services from a customer perspective. It is an approach to designing services that balances the needs of the customer with the needs of the business, aiming to create seamless and quality service experiences. Service design is rooted in design thinking, and brings a creative, human-centered process to service improvement and designing new services. Through collaborative methods that engage both customers and service delivery teams, service design helps organizations gain true, end-to-end understanding of their services, enabling holistic and meaningful improvements”**.

Moreover, Stickdorn et al. (2018) describes the service design approach as a “human-centred, collaborative, interdisciplinary, iterative approach which uses research, prototyping and a set of

easily understood activities and visualization tools to create and orchestrate experiences to meet the needs of the business, the users and other stakeholders” (p.26). This statement effectively summarises the set of service design principles pinpointed by the authors:

▶ **Human-centred:** it refers to the service design fundamental imperative of putting people at the centre of the design process. It defines the importance of considering all the people affected by the service system, meaning not only the end-users of the service, but also the service providers and all the other stakeholders involved that make the service work.

▶ **Collaborative:** it refers to the act of engaging all the different stakeholders in the design process. The service designer facilitates the interaction of all the people with different backgrounds and expertise that are involved in the service, and through participatory practices of the service design domain, can contribute in developing the optimal service.

▶ **Iterative:** it refers to the exploratory, adaptive and experimental approach of service design that is characterised by continuous iteration all along the design process.

Sequential: it refers to the sequential nature of the service experience, as services should be visualised and orchestrated as a sequence of interrelated phases and actions, both in the front-end and back-end perspectives.

▶ **Real:** it refers to the need of collecting evidence and insights from the real context, in every step of the design process. It means that needs should be researched in reality, ideas prototyped and tested in reality, and values created by the service should be made tangible in the physical and/or digital experience.

▶ **Holistic:** it refers to the systemic approach service design should have to shape the entirety of the service, sustainably addressing the needs of all the stakeholders involved, while complementing the service with the business goals and identity.

Clatworthy (2017) describes service design as an application of design thinking to service, therefore it involves a "messy process" characterised by **continuous iteration**. According to him, this messy approach reveals a key aspect of design thinking, which is that "designing is much a way to gain understanding as it is to resolve a project brief" (p. 169). The design thinking approach has been broadly adopted in different fields and within organisations as a valuable approach for innovation and innovation processes. More and more frequently, designers are considered to have a **strategic and transformational role** as they are able to link the strategic and operational level within an organisation, bringing new kinds of value relation between the actors and within a socio-material configuration (Kimbell, 2009 as cited in Clatworthy, 2017). This perspective can be found in the shift towards a service-dominant logic underpinned by Vargo and Lusch (2004), that focuses on the intangible resources rather than tangible goods, where **value is co-created by diverse economic and social actors**.

This means that "when value is recognized in the process of use, the focus shifts from the units of outputs to the interactions" (Sangiorgi, 2012, p.97, as cited in Clatworthy, 2017). Hence, **value is produced through interactions**, meaning that service design is a "means of specifically developing value-in-use" (Clatworthy, 2017, p.180) through the design of touchpoint interactions.

The human-centred and collaborative nature of service design is what makes the value co-creation possible. Human-centred design is both about understanding and engaging people in **participatory design** techniques, resulting in a key concept for value co-creation in design (Wetter-Edman et al., 2014). According to Holmlid (2012, p.154), in participatory design "multiple user groups and stakeholders bring their resourcefulness to the development of the projects", suggesting that value co-creation is not only a result of service interactions that happens during use, but it also happens during the different stages of the design process, especially during the design and development of the service.

Thus, for the overall service innovation practice to be effective, it must be connected and integrated inside the existing economic and organizational strategy, as well as the **relational dimension** in

which the user perspective is included, including the social and cultural factors that affect and shape the service experience (Maffei et al., 2005). This last dimension is linked to the role of the designer who develops a value proposition that delivers emotional, self-expressive and idealistic meanings, and translates it on the customer experience through the touchpoints in the service context (Clatworthy, 2017).

So it is clear that when organisations rely on service design approach and methods, innovation on a service level often impacts the organisation dynamics, especially when **new service models** are created (Sangiorgi & Pacenti, 2008).

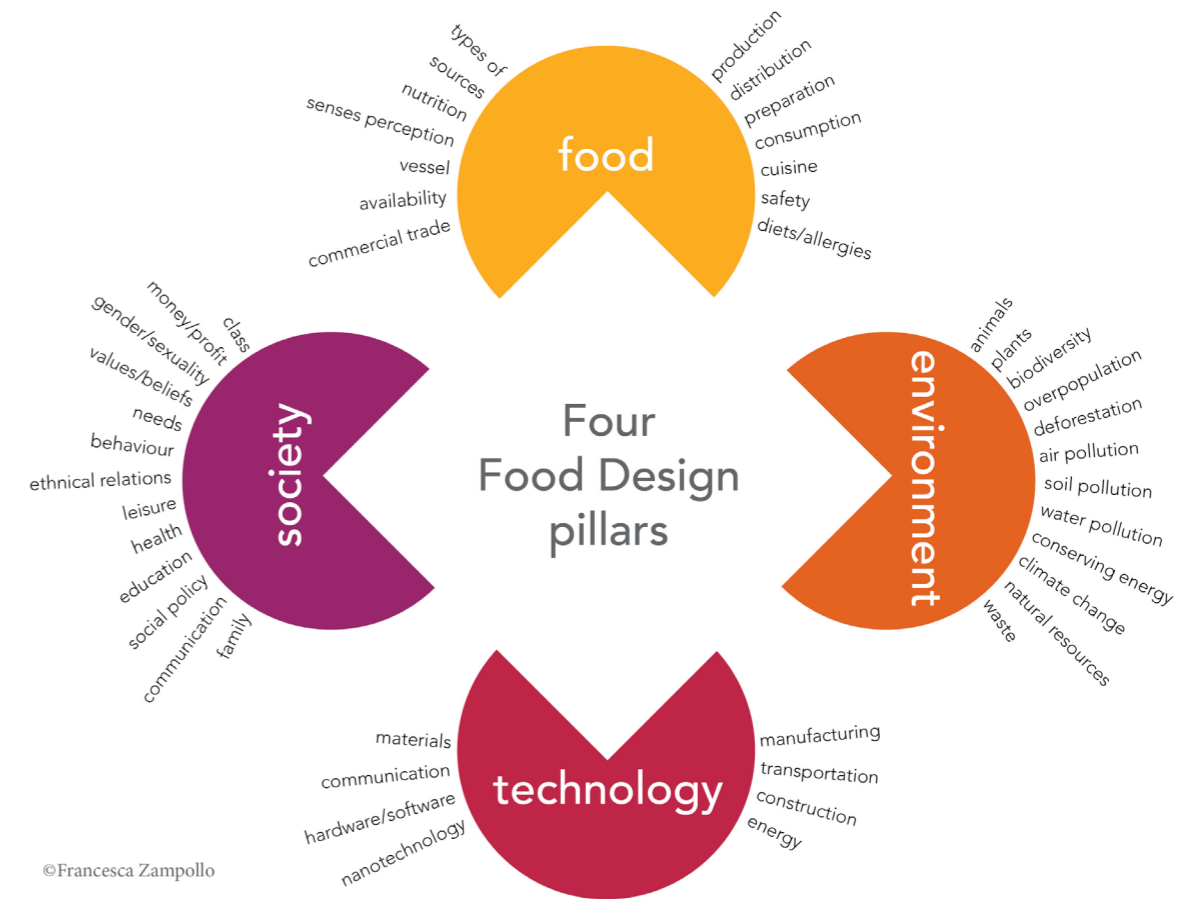
### 3.3 Food Design Thinking

As stated in the previous chapter, design thinking has the potential to be applied to different purposes in different sectors, as a means to create value for, and with, the stakeholders involved in the system. Recently, a new branch of design, characterised by the application of the **design thinking** within the **food sector**, has gained recognition. Francesca Zampollo, the promoter of this new design theory, defines **Food Design Thinking** as a "process by which designers transform knowledge and ideas derived from food science, food psychology and food culture into creative solutions" (Zampollo & Peacock, 2016, p.2). Food Design thinking, therefore, "triggers creativity and leads to innovative, meaningful, and sustainable propositions for new dishes, food products, food events, food services, food systems, and anything in between" (Zampollo, 2021). According to her, the Food Design discipline is characterised by **four major pillars** that designers should constantly consider when it comes to designing anything linked to food and eating (Figure 29). Dishes, products, events, services are all part of a system, and each food system is defined by these pillars that designers should take into account in order to achieve radical innovation in meaning, technology and sustainability within the food sector. These are:

- ▶ **Food:** the subject matter of the design process.
- ▶ **Society:** the context in which the system sits, and will be impacted by the solution, in terms of individuals, communities and society, and the factors that characterise such elements.
- ▶ **Technology:** all the man-made factors and technological elements, such as materials, manufacturing, transportation, energy consumption and so on.
- ▶ **Environment:** the ethical aspects related to plants, animals and environment, considering the food systems-related issues of the current times. (Zampollo, 2017).

The four pillars of Food Design (Zampollo, 2017)

Figure 29



Other practitioners underpin the need of exploring design thinking as a process to apply for **food innovation**, given the dynamic and changing world of food product development and in the shift in consumers' attitudes and behaviours across many food categories. In this context, Food Design Thinking, thanks to its human-centred approach, is recognised as a valid method for understanding **consumers' behaviours, perceptions and needs**, as well as other **key stakeholders' needs and requirements**, and for ultimately creating meaningful and relevant **break-through innovations** by meeting those needs (Shimek, 2018).

Olsen (2015) advances the idea that innovation in the food sector can be much more than user-oriented and the food industry must first understand individual customers and the context in which they live in order to provide effective new food solutions. By providing a case study, she proves design thinking methods and tools to be an effective and cheap way to include all the actors involved in the system within the product development process, generating with them meaningful concepts.

However, "processes by which creative ideas are generated in Food Design have rarely been investigated" (Zampollo and Peacock, 2016, p.3) as design methods and tools should be specifically designed to facilitate reflection on food and eating related experiences. Hence, a new set of tools and methods specifically conceived for the Food Design process is needed, and Zampollo's research is currently focused in proposing, developing and advancing methods for creating food products.

Within this work it will be explored **how Food Design Thinking and the Service Design practice can be applied to generate and design a service solution able to bring innovation in the vertical farming sector**. For this purpose, a description of the process and methods followed in shaping a service solution will be provided in the next chapter.

## 3.4 Design process

Since the emergence of Design Thinking, researchers and organisations have contributed in different ways to provide frameworks of the design process, by structuring it in general and schematic visualisations. Frameworks are needed “to develop a shared understanding of the stages of the project and how they can link to each other” (Moritz, 2005, p.154) and, although each designer or company manages the design process differently, there are some shared approaches and activities (Design Council, 2007a). These activities and methods are generalised and identified as core activities that are then pulled together in a standardised process that can be adapted to fit a particular situation or project (Best, 2006, as cited in Design Council, 2007b). This flexibility suggests the iterative nature of the design process, as the activities can happen in different order and sometimes at the same time (Moritz, 2005), resulting in a process that is not linear and involves zooming in and out of the problem context as well as jumping between phases (Clatworthy, 2017).

However, as mentioned before, within the service design practice there is no best process, but there are commonalities across the processes generally used, and these usually consist in four or five phases (Design Council, 2007b).

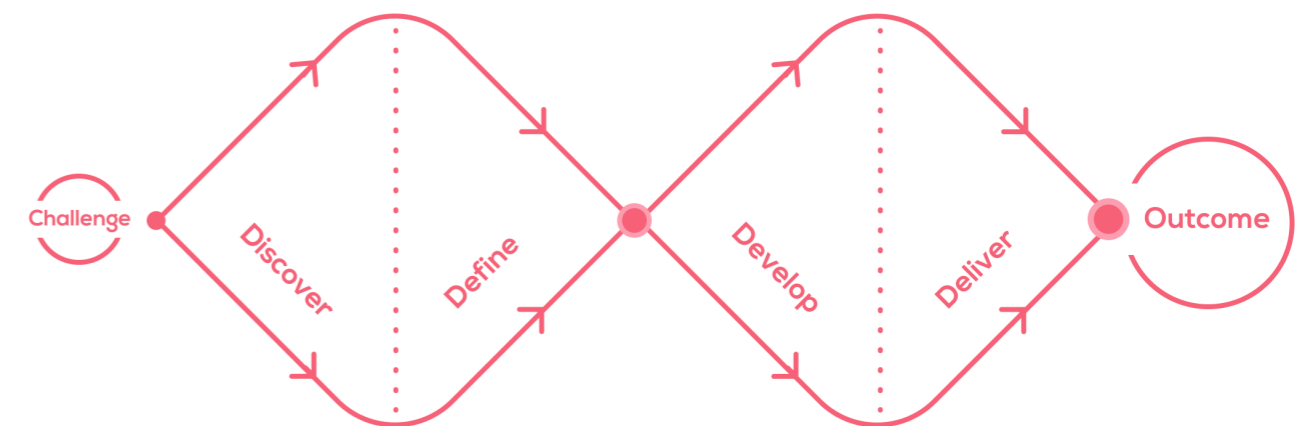
One of the most popular and frequently adopted frameworks representing the iterative design process is the **Double Diamond**, a model developed by the Design Council in 2004 with the aim to describe the design process in a clear, comprehensive and visual way (Design Council, 2019), (Figure 30).

At the core of the Double Diamond is the recurring pattern of diverging and converging thinking and doing: the design process is an interplay between **divergent phases**, that are about exploring issues more widely and deeply and seeking opportunities, and **convergent phases**, about making decisions and taking focused actions (Stickdorn et al., 2018). An effective statement expressed by Stickdorn et al. (2018) in their book synthesise this approach: “make sure you are solving the right problem before solving the problem right” (p. 85), suggesting the importance of taking a step back and understanding the right problem before moving on and jumping into the solution to be able to come up with better solutions.

The two diamonds are divided into four distinct phases, where divergent and convergent moments interchange with one another: **discover, define, develop and deliver**.

Double Diamond (elaborated from Design Council, 2019)

Figure 30





### 3.4.1 Discover

**Discover** is the first quadrant of the double diamond and marks the initial phase of the project. It is the **exploratory phase** where designers understand the context and the issue, identify users' needs, gather insights and seek inspirations in order to define the solution space and build a rich knowledge resource with insights and inspirations that will inform the rest of the design process. The discovery phase may include desk research, quantitative and qualitative research methods and can engage users directly through different tools and methods (Design Council, 2015).

#### ► Project methodology

This first discovery phase in my thesis project was articulated into different activities based on the purpose and available resources.

First, a **primary desk research** aimed at understanding vertical farming, its technical aspects, its potential and limitations. A few case studies were also collected as a reference point to understand the state of vertical farming in the world in terms of existing functioning and viable solutions. This initial research helped in gaining awareness about the topic and realising that little is discussed about vertical farming in Italy, which led me to define the research questions previously mentioned, that are: **what are the barriers that may hinder vertical farming practice and prevent it from becoming widespread in Italy?** And, assuming that a major barrier is consumers' acceptance: **What are Italian consumers' attitudes and perceptions towards vertical farming? Are they actually reluctant to vertical farming products?**

Through a **secondary desk research**, the research scope narrowed down within the Italian context to understand the state of diffusion and evolution of the vertical farms in Italy while understanding the context in which they are: spanning from economical, governmental and social perspectives, the possible barriers as well as the factors that may contribute to the diffusion of vertical farms, were analysed. This part was also intended to do a **benchmark** of the vertical farms currently present on the Italian territory, specifically in the Milan area, as the next step was to find a point of contact with one of those to be able to learn and gain insights from entrepreneurs.

In the meanwhile, a more **qualitative research** phase was launched. Through a semi-structured **interview** with Alberto Arossa, one of Slow Food leading exponents, the intention was to gain insights on Slow Food core values and activities and understand why vertical farming has never been discussed or mentioned as a promising farming method by Slowfood.

Later on I managed to engage in a form of collaboration with **Agricola Moderna**, a startup based in Melzo (MI), and an initial research on-field and **interviews** were conducted while **visiting the vertical farm**. On the same day the terms of the collaboration were discussed and the scope of the research was defined, informing the next steps of the research phase: from both sides, there was a significant interest in understanding consumers' behaviour and perceptions about vertical farming methods and products.

In order to collect data and get a first understanding of people's attitudes towards vertical farming, a **quantitative research** method was selected. Together with Agricola Moderna an **online survey** was prepared and finally shared via social media. The survey wanted to be a first step in understanding people's thoughts and attitudes towards vertical farming. It was structured in two main parts:

- The first part aimed at collecting anagraphic data, identifying people's purchasing habits and capturing people's ideas, impressions and biases about vertical farming. This latter part was based on the Free Words Association method which is defined by Encyclopaedia Britannica as "an association test used in psychology to study the organization of mental life, with special reference to the cognitive connections that underlie perception and meaning, memory, language, reasoning, and motivation". During this test the participants are asked to express the first word that comes to their mind in response to a given word, concept or other stimulus. Similarly, this method was adapted to the survey and respondents were asked to write the words, sentences or feelings that raised from some given concepts, specifically "lettuce grown with LED lights" and "hydroponics grown lettuce (soilless technique)". The additional question "What do you believe vertical

farming is?" intended to investigate the possible biases people might have towards this farming method, especially if cross-checked with the next question in the second part of the survey.

- ▶ The second part of the survey aimed at assessing people's ideas about vertical farming in a more direct way: after completing the free-word association questions, the respondents were provided with an exhaustive definition of vertical farming with an exemplary photo. Based on this definition, respondents were then asked to express how much they believed to know about vertical farming by selecting the corresponding number on a linear scale from 0 to 5. This question served as a means to understand people's preconceptions and bias when compared with the question in the previous part "What do you believe vertical farming is?". The next questions were built upon each other according to the possible answers the respondents could give: the aim was to understand how many people had already purchased vertical farming products, and for those who had never bought these products, understand how many would be actually willing to purchase them and the reason why they never did. In this case, the next questions' intention was to investigate what elements attract this group of consumers. In case the respondents expressed they wouldn't purchase vertically grown products, the aim was to understand the main reasons determining their unwillingness to try these products, the elements of scepticism and, in case they simply preferred products grown with traditional farming methods, understand why.
- ▶ The final section was dedicated to collecting a contact list by asking the respondents to provide their email or phone number in case they were willing to help further in the research and be involved in an interview.

The results of the survey provided a solid basis to build the script for the **consumers' interviews**, and especially to start the recruiting process: many people expressed their willingness to be involved in an interview and, by filtering all the data collected, a list of possible

interviewees was made based on their answers to the survey.

The **criteria for the interviewees recruitment** were:

- ▶ Diversify as much as possible the people involved, by selecting people with different ages, different places of residence (big city, medium city, small city or village), different grades of education and background and so on.
- ▶ Based on the answers given to the survey, select:
  - a larger group of people that expressed negative views and opinions about vertical farming and demonstrated unwillingness to purchase vertical farming products.
  - a group of people who would purchase vertical farming products, but that would still prefer products grown with traditional farming methods.
  - a couple of people that expressed positive ideas about vertical farming and had already purchased vertically grown products. (Figure 31)

In the first two groups the intention was to dig deeper into the motivations and reasoning that influenced their reluctance or hesitancy in choosing products grown in vertical farming.

Generally, the interviews were intended to get more qualitative information about people's ideas and especially people's purchasing behaviours and the related motivations regarding their relationship with food.

Figure 31

	Age	Occupation	Place of residence	Family unit	Purchasing habits (lettuce and similar)	Opinions about vertical farming
P01	24	University student	Vimercate (small / medium city)	<ul style="list-style-type: none"> <li>• mather</li> <li>• father</li> <li>• brother</li> </ul>	Packed at the supermarket	-prefers traditional products (more natural and taste better) -doesn't know VF and would'nt purchase VF products
P02	43	UX researcher	Modena (medium city)	Alone	At the farmers' market	-expressively against VF -cares about sustainability and only buys local organic products
P03	25	Working student	Italian living in Copenaghen	<ul style="list-style-type: none"> <li>• boyfriend</li> <li>• flatmate</li> </ul>	Loose at the supermarket, personal garden	-knows VF and has purchased VF products already -cares about products' sustainability
P04	30	Physiotherapist	Small village near Como	<ul style="list-style-type: none"> <li>• boyfriend</li> </ul>	Packed at the supermarket	-skeptical about VF (how can plants actually grow?) -traditional products perceived as more natural
P05	29	Technician	Arluno (small city near Milan)	<ul style="list-style-type: none"> <li>• mother</li> <li>• grandma</li> <li>• uncle</li> </ul>	Loose at the supermarket	-has already bought VF products, but prefers traditional products
P06	56	Unemployed (housewife)	Small village near Como	<ul style="list-style-type: none"> <li>• husband</li> <li>• son</li> </ul>	Packed at the supermarket, greengrocer	-doesn't know VF -doesn't distinguish the products, would like to try VF products
P07	65	Retiree	Small city near Vicenza	<ul style="list-style-type: none"> <li>• wife</li> </ul>	Personal garden	-totally against VF -natural and organic are very important, all natural elements are fundamental for plants' growth
P08	26	Designer	Milan	<ul style="list-style-type: none"> <li>• flatmates</li> </ul>	Packed at the supermarket, Cortilia	-doesn't know VF much, has some doubts -curious and innovation oriented

■ Negative    ■ Doubtful  
■ Positive / curious

### 3.4.2 Define

**Define** is the second quadrant of the first diamond that represents the **definition phase**, where designers try to make sense of all the insights and possibilities gathered in the discovery phase. The goal is to develop a clear creative brief and define the challenge more accurately (Design Council, 2019). The main activities are the analysis of the outputs of the discovery phase and the synthesis and interpretation of the findings into a reduced set of problem statements and number of opportunities (Design Council, 2015). Generally, tools and methods used in the design practice within this phase are the ones that help synthesising, that might differ from one project to another based on its nature and goals.

#### ► Project methodology

This second definition phase in my thesis project was aimed at gathering together all the insights collected all along the research phase and through the different research methods. To be able to have a clear understanding and facilitate the analysis process, all the evidence from desk research, survey and interviews were organised in a table, where each column included the evidence from each research method. Having all the evidence in one place helped in finding commonalities across them: by linking together and clustering all the evidence that were related and had a common meaning, it was possible to **synthesise** and craft robust and grounded insights effectively and finally develop **insights statements**. The insights were then further organised and clustered depending on the pertaining cluster, which were:

- **Vertical farms insights:** all the insights related to **companies'** difficulties in running the activity and the potential of vertical farming that might bring added value to the companies and to the products sold.
- **Consumers / vertical farming insights:** all the insights about the consumers' in relation with vertical farming, including their opinions, perceptions and concerns.

- ▶ **Consumers insights (others):** all the insights that relate to consumers' behaviour, needs and desires as well as inner motivations that guide their actions and habits.

Having an organised overview of the synthesised insights helped in framing the **core challenge** for this project which was expressed through the **How Might We question**:

### How might we bring vertical farming products into people's daily lives?

This question was identified as the major direction that must guide and inform the next steps and lead to the design of a service able to address the identified challenge. A few minor yet determining directions have been identified as additional perspectives that are important to consider when generating the possible solutions and fulfilling the main challenge of bringing vertical farming products into people's daily lives.

In the meanwhile the insights collected about the consumers were used to shape **personas**. Personas are research-based archetypes representing "a group of people with shared needs or common behaviour patterns" (Stickdorn et al., 2018, p.40), resulting in a useful reference throughout the whole design process as well as a means to synthesise and clearly communicate research findings and insights to Agricola Moderna. Two personas were built paying attention in expressing the reasoning and inner motivations underlying their habits and behaviours: Stefania "the conscious eater" and Matteo "the curious eater". The two personas include a description of their relationship with food and purchasing behaviour, that were graphically synthesised into three dimensions expressing the personas distinctive characteristics. The grocery habits and drivers of purchase were also described including the motivations that guide each personas' choice, expressing also their pain points, needs and goals. Finally their relationship with vertical farming was made explicit by showing the grade of knowledge about vertical farming

and the willingness to buy vertically grown products, including the underlying reasoning and concerns. Instead of portrait images that could generate stereotypical assumptions, a photo showing a distinctive behaviour was used, while demographic information was also limited in order to avoid stereotypical assumptions (Stickdorn et al., 2018).

### 3.4.3 Develop

**Develop** is the third quadrant of the Double Diamond and it represents the stage of the process in which **ideas are generated, prototyped and iterated**, encouraging designers to answer to the challenge clearly defined in the previous phase and develop service solutions. This phase of the process often involves participatory design practices that include **co-design sessions**. Co-design refers to a practice based on the idea that "people having different voices should collaborate within a design process" (Meroni et al., 2018, p.17), meaning that designers and non-designers collaborate in the design development process. Sanders and Stappers (2008) explain co-design as a moments in which the roles get mixed up: the people that will benefit from the service cover the position of "experts" and play a major role in knowledge development, idea generation and concept development, while the designer supports the people involved in the co-design by providing tools for ideation and expression. How designers interact with the co-design participants is crucial for the success of the co-design session, as the style of guidance, that should range between "active listening" and thought provoking", influences participants' contribution, critical thinking and the capacity to think beyond their own comfort zone (Meroni et al., 2018).

The benefits of co-design in service design projects are multiple and Steen et al. (2011) identify three types of benefits:

- ▶ for the service design project itself, as co-design improve the creative process and helps developing better service definitions;
- ▶ for the service customers' or users, as co-design ensures that the service is more likely to respond to users' needs and provide a better service experience and higher satisfaction;
- ▶ for the organisation(s) involved, as co-design enhances creativity and innovation by bringing the focus on the users and the actors involved and fostering collaboration between disciplines.

Collaborative practices may take place all along the design process and in different ways, depending on the situation, the purposes and the actors engaged. During this phase, activities such as

brainstorming are used to generate ideas and co-design participants can be engaged in different moments in order to iteratively test the concepts with them.

#### ▶ Project methodology

Within this project, the "develop" phase began with a desk research informed by the directions identified and aimed at finding **case studies** of real, tangible examples of solutions that could potentially provide inspirations for the next concept generation phase. The majority of them were food-based solutions pertaining to other food sectors, but were considered interesting examples for the business model or the experience provided.

Then a solo **brainstorming** aimed at generating as many **concepts** as possible. A few ideas were generated based on the directions previously identified and by keeping an eye on the personas. Finally, by converging ideas that contained similarities and by better delineating the characteristics, four concepts were defined more accurately and made more robust. These four concepts were shaped into 'cards' containing the name of the concept, a description and a moodboard with images aimed at evoking the concept idea and mood in a visual and more immediate way. This 'card' format was also intended to be used as boundary objects in the co-design sessions that would be the next step within this phase.

Before stepping into this stage, the four concepts were analysed to understand if all of them could have the potential and were meaningful enough to be evaluated and implemented in the co-design sessions. One of the concepts resulted to be a bit weak if analysed within the purpose of the project, as it didn't properly respond to the HMW question and, therefore, was not achieving the ultimate goal for this study.

Three concepts were then selected to be implemented in the **co-design sessions**. Referring to the Collaborative Design Framework proposed by Meroni et al. (2018) (Figure 32), the co-design sessions should be located in the 'Concept Driven' and 'Facilitating' quadrant, where the collaboration aims at expanding, assessing and

consolidating options, while adding elements of interests, feasibility and concreteness. For this purpose, at least two co-design sessions needed to be done:

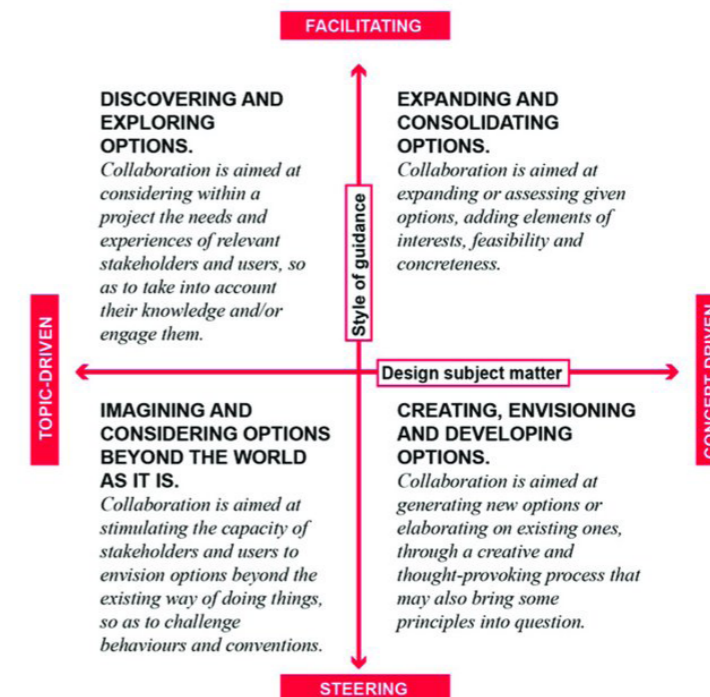
- ▶ **co-design with Agricola Moderna**, in order to understand the potential of the concepts from an entrepreneurial point of view, understand feasibility and viability aspects of each idea and point out the possible barriers that would prevent the concepts to be implemented. Finally, understand which concept is the most appealing to them;
- ▶ **co-design with consumers**, to be able to understand which elements are the most appreciated in each concept and what is most appealing from their point of view, both in terms of idea and single elements characterising the concepts. Moreover, understand the potential obstacles that would prevent consumers from going for the given solution.

Through these two co-design sessions with Agricola Moderna and the consumers the aim was to gain insights from both points of view and be able to finally choose the most meaningful idea to bring on in the next phases of the design process. Since two out of three concepts involved other stakeholders, such as restaurant chefs or social workers, a third co-design session with professionals would have been fundamental for implementing the idea in case one of these ideas was selected.

#### *Difficulties and limitations*

The recruiting process for the consumers' co-design sessions revealed some difficulties and limitations. First, the recruiting criteria were defined and, as for the interviews in the discovery phase, the participants should:

- ▶ be diversified in terms of age, place of residence and education and background, to be able to catch different opinions from different mental models and habits.
- ▶ represent the two personas.



The people were selected again by cross-checking the data from the survey or by sourcing them from the list of suitable interviewees previously made.

Some difficulties in recruiting participants resulted in some limitations that affected the co-design sessions. First, a few participation refusals and last-minute turndowns resulted in a co-design, performed online, with just two participants instead of four. This anyway led me to find other participants to be able to gain more insights from a second co-design session, which was organised in presence mainly because of the technological barrier, as participants didn't feel comfortable in using digital devices.

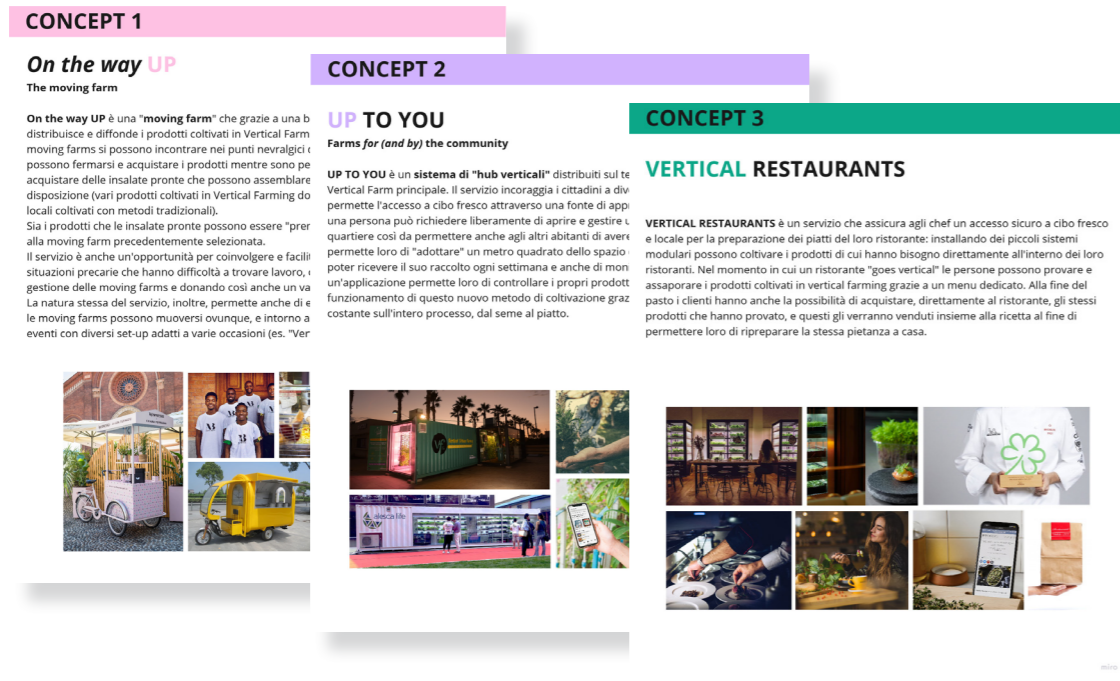
The limitation lies in the possibility of gaining better insights and more value from a unique co-design, instead of two. On the other hand, the possibility to organise a co-design in presence resulted in a chance of creating a more relaxed and informal atmosphere, where human contact made participants feel more comfortable to express their ideas and opinions.

**Boundary object and tools**

On a practical level, the tools designed for all the co-design sessions, including the one with Agricola Moderna, had some elements in common. First, an agenda pointing out the activities of the co-design session was provided. Second, the **boundary objects** (Figure 33), that are the 'concept cards', were also common elements. Boundary objects are defined as "representatives of the subject matter of design in the material form of design artefacts" (Meroni et al., p.44) and are needed to facilitate the engagement and the discussion upon the subject design matter during the co-design sessions. Regarding the **tools**, that are specific design artefacts that are designed according to the purpose of the co-design, a set of different tools were designed for each session:

Boundary Objects - Concept cards

Figure 33

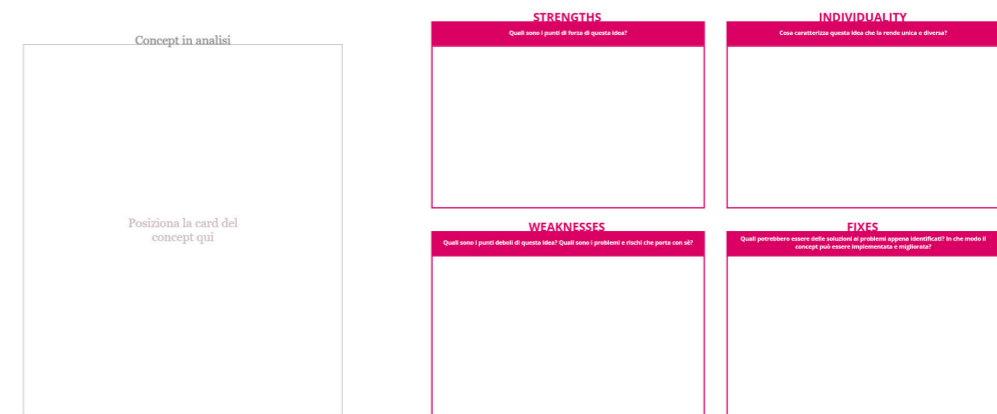


- ▶ The **co-design with Agricola Moderna** included two main activities. First, a SWIFT template (Figure 34) intended to assess the existing ideas by analysing each idea through four different lenses, in four different quadrants: (a) Strengths, meaning the positive aspects of each idea; (b) Weaknesses, meaning the weak points, difficulties and problems the ideas might face; (c) Individualities, meaning the characteristics that make each idea unique; (d) Fixes, meaning the creative possibilities that could fix the weaknesses and improve the ideas. The second and last tool (Figure 35), aimed at evaluating the three concepts in terms of desirability, feasibility and viability by rating it on a 1 to 5 scale.

SWIF template

Figure 34

Co-design - SWIFT template



Evaluation tool

Figure 35

Co-design - Evaluation



Figure 36

- The **co-design with the consumers** on a similar extent aimed at assessing and improving the three ideas from an end-user perspective. In this case, the three ideas were first analysed using the Thinking Hats tool (Figure 36), where participants were asked to discuss about the ideas switching “from one hat to another”: (a) the yellow hat represented all the positive aspects that characterise the idea, and participants were asked to point out the elements they liked the most; (b) the red hat was the emotional hat that intended to raise all the inner, emotional aspects that make each idea unique and valuable from participants' point of view; (c) the black hat represented all the negative aspects, the elements that users disliked or generated concern; (d) the green hat was dedicated to all the creative solutions and in this case the participants were asked to brainstorm ideas or share their intuitions in order to improve the concepts. In the second part of the co-design, a “Where would you go?” tool (Figure 37) aimed at spotting the most attractive service solution, giving participants the space to point out the single elements that they appreciate the most, either from the selected idea or the other ideas.

## Co-design - Thinking hats

Istruzioni: Analizza i concept sotto diversi punti di vista



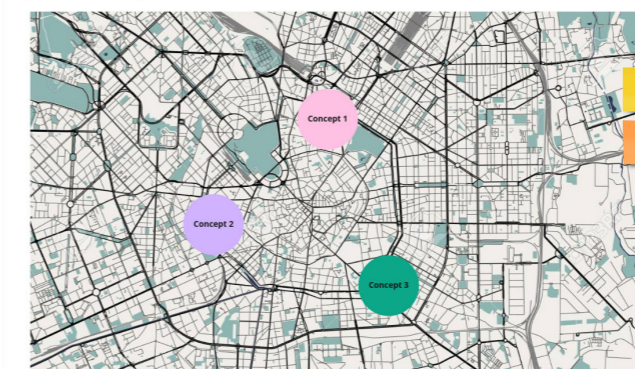
'Where would you go?' tool

Figure 37

The co-design sessions were a fundamental step of the design process as it allowed **concept prioritisation and consequent improvement**. Through the diverse sessions a multiplicity of insights were collected and major awareness about consumers' needs was achieved, as well as a clearer understanding of all the makings and the risks on an entrepreneurial level. Through a critical insights' analysis, a set of new **insights statements** allowed to prioritise the concept with major potential and that could possibly bring more value to the end-users, the community and the service provider.

## Where would you go?

Istruzioni: Posiziona il tuo post-it vicino al concept che ti attira di più e che ti porterebbe a preferire l'acquisto di insalate o altri prodotti in vertical farming piuttosto che i prodotti coltivati con metodi tradizionali.

Quali sono gli elementi che apprezzi maggiormente? (anche delle altre idee)  
Sposta il tuo post-it vicino alla card corrispondente.

Comments:



### 3.4.4 Deliver

**Deliver** is the fourth quadrant that includes all the activities aimed at **finalising the service project** and making it ready for launch. This phase involves prototyping and testing solutions at small scale, rejecting what doesn't work and improving what works (Design Council, 2019). This **prototyping** and developing phase involves different design tools depending on the desired outputs which in turn depend on the nature of the service solution itself. Some of the most frequently used tools in service design practice include user journey maps, service blueprints, offering maps, system maps, stakeholder maps etc. These tools can be used throughout different stages of the design process, however in this phase they help analysing, prototyping and implementing well defined concepts: user journey maps help depicting the whole user experience, representing the interactions with the service step-by-step including pain points and emotional flows; service blueprints, describes the entire service process by listing all the activities performed by the different roles in the front-end and in the back-end; offering maps clarify what the service provides to the users by detailing the value proposition into clusters of features; system maps are a synthetic representation of all the actors involved in the service system and their mutual links; stakeholder maps represent all the stakeholders involved in the service aimed at clarifying roles and relationships.

Experience prototypes are also important tools to learn and refine the service experience, specifically to collect insights on the interactions with specific touchpoints. Wireframes, mock-ups and any kind of physical or digital prototype allow designers to test the solution by actively engaging the users, gaining feedback on the single touchpoint or the overall flow (Service Design Tools, n.d.).

#### ► Project methodology

Within the thesis project, the "deliver" phase involved two main stages: the **concept development** and the **testing phase**.

- The **concept development** involved the use of several tools commonly used in the service design practice. First, the **offering map** helped in the definition of the service offering for the target user, who recalls the persona "the curious eater" with the addition

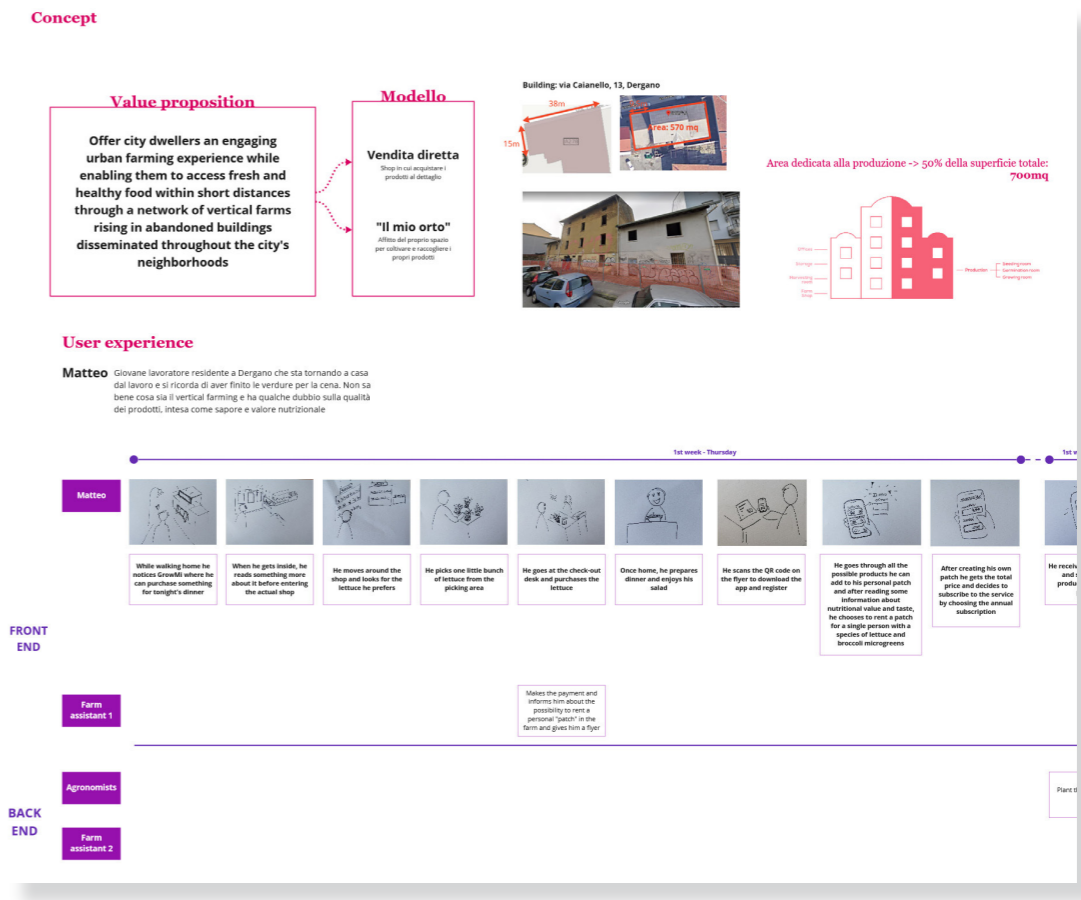
of some specifications and information that could help define the user experience. The user experience was indeed developed in the form of a **user journey**, where the main actions, touchpoints and thoughts were identified for each interaction with the service. To better understand and define the tasks of each actor involved in the service system, a **service blueprint** was developed and a system map helped clarify the interrelation among them, the material, financial and information flows as well as the exchange of value among one another. A **stakeholder map** and a **stakeholder matrix**, finally, were useful to clearly show the stakeholders involved and mainly their motivations and contribution in taking part in the service system.

For the service development, the visual elements as well as the design of the service app were fundamental. While defining the **brand identity**, logo and visual style, the UX design of the **app**, involving the information architecture, flows and wireframes, was developed. After the definition of the brand identity, a small library and set of components for the app was also developed to be able to design the UI and mockups of the app. Finally some visuals representing the two staples of the service offerings, the Farm Shop and the Harvesting room, were created through the **photomontage** technique.

- The **testing** phase involved two sessions: one with an **entrepreneur** and the other one with the **target user** of the service. The former aimed at understanding the realistic potential of the service idea and its feasibility and viability, while the second intended to validate the service idea with a potential user and understand critical aspects that should be enhanced for the service implementation. First, the **identification of a real building** where the service could be implemented served as a reference point to base the calculations and **cost estimations** on. Thanks to the map of the abandoned buildings disseminated throughout the city of Milan, a degraded building in Dergano was selected. The choice was determined by the neighborhood itself, as it is a residential suburban area that belongs to the areas in need of renovation identified by the Piano di Governo del Territorio by the Municipality of Milan (Comune di Milano, 2020d). During the **testing session** with Pietro from

**Buono Farm**, a recently born startup in Milan, a brief summary of the research and the service offering and value proposition was explained to him before going deeper into the analysis. To help him imagine the service properly, a user experience in the form of a storyboard intended to foster imagination and help fully understand the concept, with the operational processes it involves (Figure 38). For this purpose, the storyboard was integrated with a simplified service blueprint that helped identify the actors involved and their tasks and understand with him the feasibility of the operations. The final activity consisted in a moment of reflection to help identify potential barriers, especially concerning the viability. Finally, some simplified estimations of the costs and calculations were carried out to understand the actual viability of the vertical farm in the context considered for the project. The **testing session** with the **target user** was organised with Chiara, a **young worker** living in Milan and who struggles to balance her needs and preferences for convenience, when doing the grocery, with more sustainable habits. First a brief description of the service and its offer wanted to foster her imagination, then a concept walkthrough was used to "walk" the user through the service experience and gain feedback (Figure 39). Finally, the insights coming from the analysis of both testing sessions were summarised in **key findings** that informed the writing of the thesis conclusions.

Figure 38



Tool for testing session with target user

Figure 39





**Discover.**  
**Understanding**  
**the Italian context**

## 4.1 Milan

To understand the current state of diffusion of vertical farming in Italy, a **secondary desk research** was conducted. It was mainly aimed at detecting commercially viable vertical farms within the territory and at spotting existing barriers that could hinder their evolution as well as unveiling opportunities that would encourage their development. The research revealed the existence of a few **recently-born vertical farms** within the Italian territory, especially in the area around **Milan**, proving that vertical farming is moving from a trend into something real. They are all startups that found their way through in the large-scale distribution by experimenting, improving, implementing their products and technologies while expanding their structures into bigger systems. They are all very young environments that are still dependent on investors' fundings but through experimentation and research they all aim at becoming major players on the market, especially within the fourth range products market.

**Planet Farms**, located in Cavenago (MB) and founded by Luca Travaglini and Davide Benatoff (Figure 40), and it is renowned to be one of the most advanced vertical farming systems in Europe using the hydroponic method. In 2018 it was a smaller laboratory in Cinisello Balsamo, where they started doing experimentations and research together with their partners, one among them is Philips, also provider of Planet Farms' lighting system. Now they have moved to their bigger system in Cavenago to operate at full capacity, thanks to their fully automated system that produces 40 thousand packs every day (Felice, 2020). Their products are mainly leafy greens and aromatic herbs: Lattugood, Yummix Orientale, Yummix Delicato and Yummix Piccante are all different lettuce species with different tastes, and finally the Basilichooh, their basil. Very recently, since September 16th 2021, they started distributing in some of the major supermarkets in northern Italy, including Esselunga, Il Viaggiator Goloso, Iper la grande i, TO.MARKET srl and Gorillas digital stores (Planet Farms, 2021) (Figure 41).

Davide Benatoff (left) and Luca Travaglini (right)

Figure 40



Planet Farms products in supermarket

Figure 41



**Local Green** is a startup founded in 2019 by Paolo Forattini and Lorenzo Beccari (Figure 40), located in Giussago (PV). Their small production system uses aeroponic technology, and it is located in one of NeoruraleHub, one of their main investors' buildings. The system produces only 300 packs each week, but they have patented a new automated system that has recently gone under construction, in September 2021, and that will produce 20 thousands packs each week, reducing costs by 40%. Until the end of June 2021, they have been testing the distribution of their leafy greens through Coop Lombardia and Coop Italia (Colombo, 2021). What differentiates LocalGreen from other vertical farming products is probably the packaging that aims at communicating the "local" origin by using the names of some of Milan neighborhoods: Melange Sarpi, Melange Moscova and Melange Brera (Local Green, 2021) (Figure 41).

Paolo Forattini and Lorenzo Beccari

Figure 42



**Buono** is a very recent vertical farm located 10 minutes walk from Piazza Gae Aulenti in Milan. They are young people (Figure 44) passionate about food and sustainability who just embarked on this journey creating a small hydroponic vertical farm that produces microgreens, seedlings of vegetables and herbs that get harvested in only 7-20 days (Buono Farm, 2021a). Seedlings are particularly rich in vitamins, nutrients and prebiotics and it is the only vertical farm among the ones taken in analysis that focuses on the production of microgreens only: at the moment they grow "Happy Broccoli" (Figure 45), "Volcano Radish", "Stretchy Peas" and "Crunchy Sunflower", that are being distributed through the service L'Alveare che dice sì, a community of local producers. They are also the only ones that use 100% renewable energy sources, provided by the supplier ènostra (Buono Farm, 2021b).

Figure 44



Figure 45



**Agricola Moderna** is another recent startup founded by Pierluigi Giuliani and Benjamin Franchetti located in Melzo (MI). Agricola Moderna was determinant for my thesis research, therefore it will receive major attention and more details will be provided in the next chapter fully dedicated to Agricola Moderna.

All these new-born vertical farms have elements in common and all of them had to deal with more or less the same struggles. The main difficulties for vertical farmers are the ones that entrepreneurs normally face whenever they throw themselves into a new business in Italy: **initial capital** and assets are fundamental to set up a company, and this is true for most business activities that need technical systems and tools. Moreover, in the specific case of vertical farming, being a new and innovative field that needs research and experimentation, it requires additional costs and effort. However, the presence of researchers in the teams allows vertical farms to be classified as innovative firms, and consequently receive **financing** by participating in calls for bids, either Italian or European. As startups, they depend on investors and equity as well as subsidised loans and public tenders. Their main goal is therefore to be recognised as major strengthened players in the market and reach the break even point.

An additional barrier vertical farms in Italy have to deal with are the italian **regulations**. The recent development of vertical farms in Italy has raised the need for laws that could regulate vertical farming products' commercialisation and distribution (Senato della Repubblica, 2021). The underlying problem was determined by the restrictions of the current law about fourth range products: vertical farming products respect all the requirements imposed for production, packaging and distribution of fourth range products, except for the two cycles washing and drying procedures. Vertical farming products don't require any washing and drying process since the products grown in indoor environments are clean and compliant with the hygienic norms. The request to adapt the existing law to vertically grown products that do not require washing and drying procedures was advanced in March 2021 (Confagricultura, 2021).

Over the months the existence and the potential of urban farming has been explored and widely discussed, leading to the approval of the law **"Agricoltura urbana, periurbana e metropolitana"** in October 2021 by **Regione Lombardia** (2021). Through this law Regione Lombardia endorses the implementation of innovative farming methods, such as vertical farming, acknowledging its economical, social, environmental and cultural value and its potential to achieve sustainability, resilience and urban regeneration goals. The latter is a key aspect within this law, as it states that vertical farming activities, even if located in urban environments, such as industrial areas in need of regeneration, will still be recognised as agricultural settings: vertical farms are compatible with any building's intended use and can be settled exclusively in existing buildings, which can also go through renovation and recovery in compliance with the current law of urban recovery. The aim is to prevent the depletion of urban soil and favor urban regeneration initiatives while boosting healthy food self-supply capacity and fostering new job opportunities. In support of this intention, Regione Lombardia may provide specific concessions and financial support measures, as well as funding priorities within regional calls.

Urban regeneration represents a priority for the Municipality of Milan as it is also included in the **Piano di Governo del Territorio for "Milano 2030"**, a plan approved by the City Council in 2019 and which became effective in February 2020 (Comune di Milano, 2020). The Plan for Milan 2030 defines measures aimed at combating the abandonment of buildings, considered elements of physical and social decay of the city, both by proposing simplified mechanisms and incentives for their recovery with a stringent legislation that penalises inert owners who do not provide the requalification of their assets, up to the demolition with the transfer of existing building rights. In this regulatory scenario, the mapping of the unused and degraded properties in the Municipality of Milan launched in 2014, represented the first phase of a broader analysis of the city territory, with the aim of regenerating and mending the urban fabric of the city, placing the suburban areas at the core of this strategy. In the first phase, cases of inactivity and degradation of entire buildings and areas were examined and, finally, a map of abandoned and degraded buildings of private property was developed. The regulation decrees

the right for the building owners to start reconstruction works for the buildings' recovery within 18 months from the identification of their property or from the entry into force of the given regulation. Once the time has elapsed and the reconstruction works haven't started, the building area will be recognised with a lower building index of only 0,35 mq/mq.

These last regulatory norms create great opportunities for vertical farming in the Lombardy region, which become even greater in the area of Milan, a city where the food topic has gained major attention in recent years. The municipality of Milan is indeed one of the most prominent examples in the definition of the interventions on a policy level aimed at fostering the transition to more sustainable and resilient food systems.

In 2015 the Municipality of Milan and Fondazione Cariplo began working together on the creation of the **Milan Food Policy**, a 12 months process that involved actively citizens, governmental and non-governmental organisations and higher education institutions. As final output, five priority actions have been identified and summarised in the vision of a "food system that guarantees healthy food and water to everyone, assuring equity, resilience and sustainability from a social, economic and environmental perspective" (Comune di Milano, 2015, p.13). Specifically, the five priorities are:

- ▶ **Guarantee access to healthy food for all**
- ▶ **Promote the sustainability of the food system**
- ▶ **Educate about food**
- ▶ **Combat waste**
- ▶ **Support and promote local agri-food research**

These priorities serve as guidelines to encourage the adoption and development of solutions that could help the transition to a sustainable food system in all its facets. Within these guidelines, vertical farming offers great opportunities in developing solutions aligned with Milan Food Policy goals and ambitions. Especially for the first, second and fifth priority guidelines, vertical farms could take

advantage of the potential vertical farming offers and contribute in achieving those intentions: thanks to the innovative farming method, they could enable the Municipality to ensure that affordable, healthy and sustainable food is available in every neighborhood of the city within distances that can be reached by everyone, including people with limited mobility (Comune di Milano, 2015).

By looking from a wider perspective, urban food policies represent, therefore, a chance for cities to lead their citizens toward a more sustainable, inclusive, and inviting urban environment (BCFN & MUFPP, 2018), where primary need facilities can be found within a walking distance.

The concept of 'proximity' has indeed gained greater attention both from a theoretical and practical point of view as cities are moving towards making this concept real and tangible for the citizens. In literature, the concept of proximity has been widely discussed by Ezio Manzini who has recently published a book called "Abitare la prossimità: Idee per la città dei 15 minuti". In his book Manzini (2021) contributes to the discussion about the **15 minutes city**, a vision that is increasingly becoming up to date and real, as it can be a positive and doable guideline that would effectively respond to the environmental and social challenges, especially within a post-pandemic society. The 15 minutes city refers to a city model where citizens have access to all services within a walking distance of 15 minutes. This model aims at creating more resilient cities made of distributed systems, meaning networks of interconnected elements, which are the results of technological and social innovation processes: the emergence of communities, as localised, small and connected organisms open to others' ideas, have in this sense a major role in the realisation of these distributed systems, and on the other hand these distributed socio-technical systems may create a society where these kind of social innovations are fostered (Manzini, 2009). Moreover, he argues that the 15 minutes model city may be the "contemporary expression of the cosmopolitan localism" (Ferri & Manzini, 2020, p.4), which refers to the idea of that are local and place-based, adopting strategies that enhance self-sufficiency, are also global in terms of interconnectivity and flow of information, ideas and things (Manzini, 2009). The result is the birth of hybrid communities able to foster transformational social innovations generating new ideas of proximity (Ferri & Manzini, 2020).

Milan, as many other cities in the world, has also embraced the 15 minutes city concept by including it in the Milan Adaptation Strategy (2020). During the Covid-19 pandemic and in a post-pandemic scenario, the **neighborhood dimension** has become increasingly important and by rethinking the timeline, spaces and service, Milan will work to ensure that services are made available on a neighborhood level and within 15 minutes walking distance. Rethinking the way services are distributed in the community is also important to come up with new practices and patterns, especially by supporting social innovation and startups that combine economic and social goals while fostering community cohesion. This idea is also supported by Manzini (2021) that underpins the importance of rethinking a new generation of services that do not simply involve citizens as service users or customers: citizens should be involved in distributed and collaborative services to enhance citizens' care for their city, forging new relationships within the city and with the city itself.

Within this context it is clear that the potential of vertical farming can be exploited to bring fresh food that is produced and consumed within a walking distance, contributing to creating an inclusive and healthy society where citizens may be actively involved through collaborative practices.



## 4.2 Agricola Moderna

As previously mentioned, **Agricola Moderna** is a startup founded by Pierluigi Giuliani and Benjamin Franchetti (Figure 46), two friends passionate about food and research who had the idea to found Agricola Moderna during a holiday together: Pierluigi has a long experience in food and beverage while Benjamin has a PhD in energy engineering, and together decided to combine their passion for food and research. Agricola Moderna was born as an experimentation lab in 2018 in Via Col di Lana, Milan, but they are now in a bigger production plant in **Melzo**, only a few kilometres out of Milan (Zordan, 2020). This location was chosen for mainly two reasons: the structure itself was suitable for the location, as it is near GDOs sorting centres, and for administration, allowing them to start production and all the other activities in a very short time. The location is very functional considering that their products, belonging to the **fourth range market**, are destined for the **large distribution** and this involves delivering their products to the logistic centres, located out of the city, that will eventually sort out the products to all the stores. In addition, the **cost** per square metre outside the city is far **lower than within the city centre**.

Benjamin Franchetti (left) and Pierluigi Giuliani (right)

Figure 46



Agricola Moderna's products can be found from april 2020 in some selected **Carrefour** stores in Milan and in the area near Milan, or, since september 2020, can be received at home through **Cortilia**. Their products are mainly baby leaves: "Baby Lattuga", "Japanese Mix" (Figure 47), "Spicy Baby", "Lattughino Biondo" are their salad mixes so far, but are continually experimenting with new varieties and products. Recently they have also added basil to their products offer, which they call "Basilico Baby" (Agricola Moderna, 2021).

Agricola Moderna's products

Figure 47



Agricola Moderna's main goal is to revolutionise the current food supply chain and make it more sustainable while offering better and healthier products to consumers. To achieve this, vertical farming is the key. Their hydroponics production system enables the growth of their greens and aromatic herbs from the seed to the packaging within a few metres. The **seeds** are planted into an **organic growing medium made of muss and peat** and are watered before entering the **germination room**. The agronomists control the plants' germination happens correctly and uniformly and after 2 to 5 days the plants are moved into the **growing cells**, where LED lights provide specific light waves to each plant species. In these cells humidity and temperature are controlled and monitored and water provides plants with nutrients without wasting any resources, as water is collected and reused. The agronomists take care of the plants by monitoring their

growth and after **approximately 20 days**, when plants are ready to be harvested, they proceed with a first quality control (Figure 48). Plants are then moved to the **preparation room** where temperature is 10°C in order to preserve products' quality. Here, plants undergo cutting procedures and receive a second quality control. Finally, products get weighed and packed with a recycled and recyclable PET packaging, ready to be delivered to final consumers.

Agricola Moderna's plants quality control

Figure 48

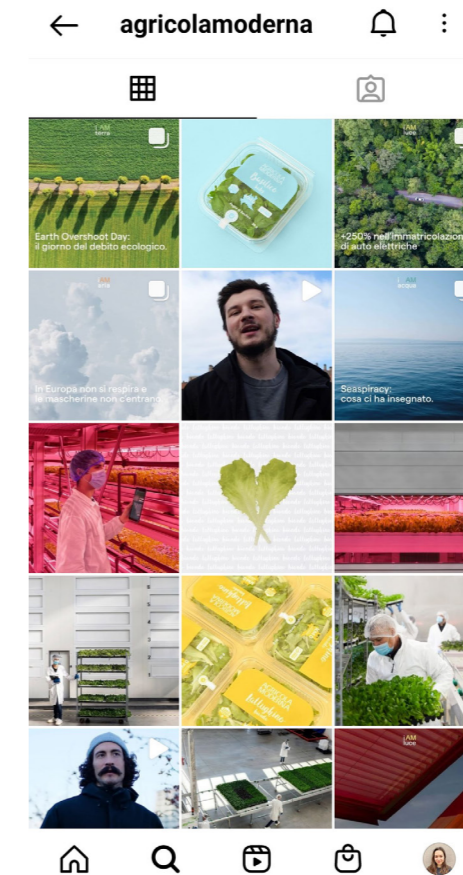


Agricola Moderna hinges on three pillars: **quality, sustainability and technology innovation**. Their main focus is on the quality, as they promote their products as more tasty, more healthy and more fresh. Sustainability is also a relevant aspect that they want to communicate on the packaging together with quality, while innovation, upon which the other two characteristics depend, is a topic they tackle more on social media. The name of the company and the brand identity intend to express the union of past, present and tradition with innovation, quality and sustainability: the name Agricola Moderna summarises this intention and values. The communication strategy is based on the attempt to communicate technology in a very human manner:

social medias' photos, for example, include technological elements combined with natural elements (water, air, soil) or people, that somehow warm the atmosphere but still represent real facts and elements that characterise vertical farms (Figure 49).

Agricola Moderna's Instagram feed

Figure 49



Agricola Moderna was determinant for my thesis project: after sending several emails, they contacted me back expressing their willingness to start a **collaboration**. They allowed me to visit the vertical farm in Melzo, do some interviews and get deeper into the production process of a vertical farm. From their side, this was a

chance to gain insights from my research and ultimately be inspired with a new service solution that could potentially be implemented by them. Their goals within this collaboration were mainly:

- ▶ **Understand their target:** they had never collected data, they did only some estimation and assumption based on their social media followers, that might not reflect the real consumers segment;
- ▶ **Understand how to differentiate Agricola Moderna from other players:** being a field that is evolving rapidly and involves other players on the market, their need is to find an element or more that would distinguish Agricola Moderna from the other startups;
- ▶ **Understand how to talk about the innovation pillar:** so far they have communicated this element only on social media channels, but they would like to understand if and how this aspect can be communicated on the packaging as well.

## Key findings

- ▶ In Italy, especially in the area around Milan, there are multiple new born vertical farms (startups). The main hurdles they have to face are the same ones of starting a new business in Italy (initial capital and assets, etc), with more difficulties as this new field requires research and experimentation which involves more costs and efforts. However this is also positive as innovative fields like vertical farming are widely supported by investors, tender announcements and calls for bids.
- ▶ To reduce rental costs and to be located near large distribution logistic centres, vertical farms are located a few kilometers out of Milan.
- ▶ Italy's regulations should be revised and adapted to vertical farming products: the restrictions imposed for fourth range products (vertical farming products' market category) are not suitable for vertical farming. As a result, it is not clear how vertical farming products should be commercialised and distributed.
- ▶ Recently, vertical farming has gained increasing recognition and its economical, social, cultural and environmental potential has been acknowledged: a new law approved by Regione Lombardia fosters the placement of vertical farms within the urban context exclusively in existing buildings, especially those in need for restoration, contributing to urban regeneration and abandoned buildings recovery.
- ▶ Milan's Food Policy reveals major opportunities for vertical farming as its main objective is to favor a transition towards more sustainable and resilient food systems, guaranteeing access to healthy food for all, promoting the sustainability of the food system, educating about food, combatting waste and supporting and promoting local agri-food research.
- ▶ The concept of proximity has gained attention in recent years, especially within the pandemic and the Milan Adaptation Strategy: 15 minutes cities is a model embraced by many cities in the world, including Milan. It is about giving citizens the possibility to access all services within a 15 minutes walking distance.



## 4.3 Survey

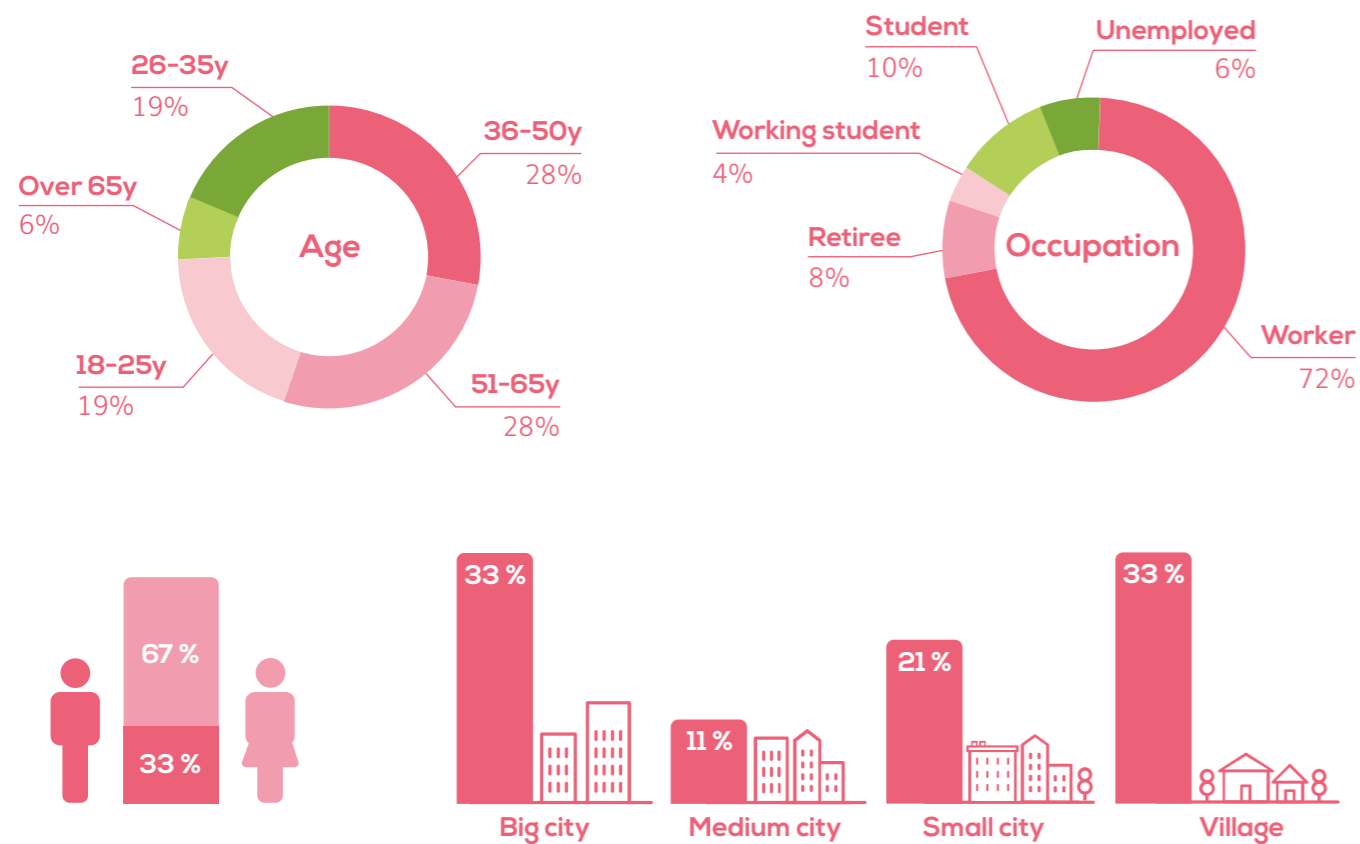
The survey was conceived and structured in collaboration with Agricola Moderna, trying to find a balance between the goals of my study, in relation to the research questions, and Agricola Moderna's specific objectives and expectations from this collaboration.

The **survey** was shared through social media, mainly LinkedIn, Instagram, Facebook and WhatsApp in order to reach a large number of diversified people.

In total, **284 answers** were collected and the respondents' anagraphic data were diverse enough to have a quite heterogeneous group to be taken into analysis: the age groups and the place of residence were fairly balanced, while the genre was mainly female and almost 3/4 of the respondents were workers (Figure 50).

Survey - Anagraphic data

Figure 50



As previously mentioned, the survey was structured in two parts: the first part was articulated in a way that could provide people's real perceptions and knowledge about vertical farming without being influenced by external factors, while the second part intended to inform people about the topic through a description and photo before asking them to answer the next vertical farming-related questions.

A first analysis was therefore aimed at revealing **people's perceptions and thoughts about key elements of vertical farming**, and detecting possible biases and beliefs concerning vertical farming. The survey showed more concerns with the artificial lighting aspect rather than the soilless growing method used in vertical farming (Figure 51):

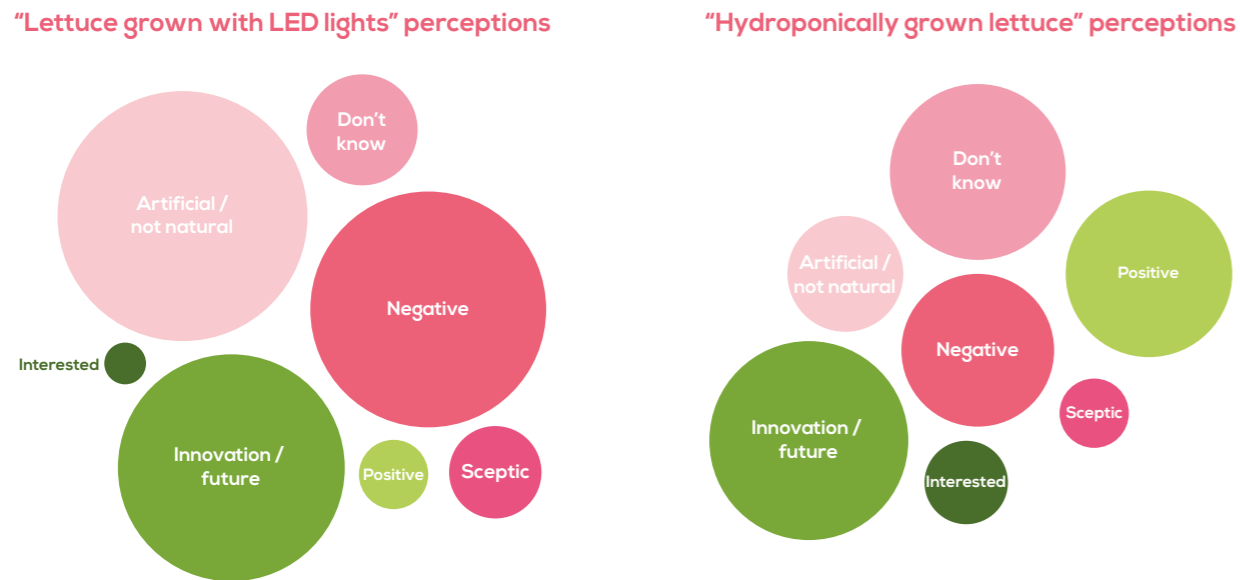
- ▶ **"Lettuce grown with LED lights"** revealed a large number of either neutral and negative comments linked with the idea of **artificial or non-natural**, resulting many times in negative impressions, revealing doubts, scepticism and sometimes fear. These feelings had diverse motivations, some were linked with something **not good nor healthy** ("poco gusto", "schifo", "con pochi nutrienti", "non sano", "poco salutare") sometimes resulting in something even **dangerous and not trustful** ("Non commestibile, pericolosa", "perché il sole non è più buono? mi spaventa", "non affidabile"). Despite some negative ideas, some respondents have also expressed neutral/positive opinions referring to the idea of innovation and future.
- ▶ **"Hydroponically grown lettuce"**, instead, received less negative comments, and far more were associated with the idea of **innovation and future**, revealing a more positive attitude and curiosity towards this method.

The preconceptions and biases were detected by asking people "What do you believe vertical farming is?": the answers revealed just a few biases mainly linked with the image of "Bosco Verticale" ("Coltivazione su pareti di edifici? Un po' come il bosco verticale, solo con l'insalata al posto delle piante?", "Tipo il bosco verticale a certe coltivazioni sui muri in appositi contenitori", "Una coltivazione in un grattacielo tipo il bosco verticale") and skyscrapers or domestic buildings ("Grattacieli di orti", "Coltivazione su terrazzi, quindi in vasi", "La crescita di ortaggi lungo pareti urbane, che si sviluppano

verso l'alto. Effetto e' bellissimo da vedere ma mi sa di sporcizia, inquinamento. Sei comunque in citta"). However, this kind of comments were limited, while the number of people who had no clue about what vertical farming is was way higher: at least **1/4 of the respondents declared to not know anything about vertical farming** ("Non lo so, "Non ne ho idea", "Non so di cosa si tratti", "Sinceramente non ne ho mai sentito parlare, almeno da noi"). Other comments revealed a general knowledge about vertical farming, defining it as a new agricultural method that develops vertically, optimising space and the use of resources ("Coltivazione in altezza che sfrutta al massimo lo spazio disponibile", "Coltivazione in verticale; innovativo, permette di ottimizzare gli spazi" and many more like these ones).

Survey - Consumers' perceptions about vertical farming's key elements

Figure 51



The most relevant evidence is probably the ones coming from the second part of the survey that reveal probably the main issue for vertical farming in Italy: the lack of visibility. To the question **"Have you ever purchased vertical farming products?"** the greatest majority of people answered **no (87%)** and

Survey - Consumers' purchasing behaviour concerning vertical farming

Figure 52



the underlying reasons are basically two: **50% of them don't know where to find these products, 43% didn't know this kind of products** and the remaining percentage expressed other more specific reasons (Figure 52). Specifically to people's knowledge about vertical farming, on a scale 0 to 5 where 0 stands for "I don't know anything", 1 and 2 "I heard of it", 3 and 4 "I know" and 5 "I know well", the average of the total answers is 2 (Figure 53), proving that vertical farming is on average vaguely known among the respondents, they have heard of it but don't actually know what it is.

However, the **limited knowledge doesn't really prevent people from purchasing this kind of products**: both those who didn't know vertical farming and those who know about it are actually willing to purchase vertically grown products, but upon purchase those who don't know vertical farming would make no difference in choosing

Survey - Consumers' knowledge about vertical farming

Figure 53

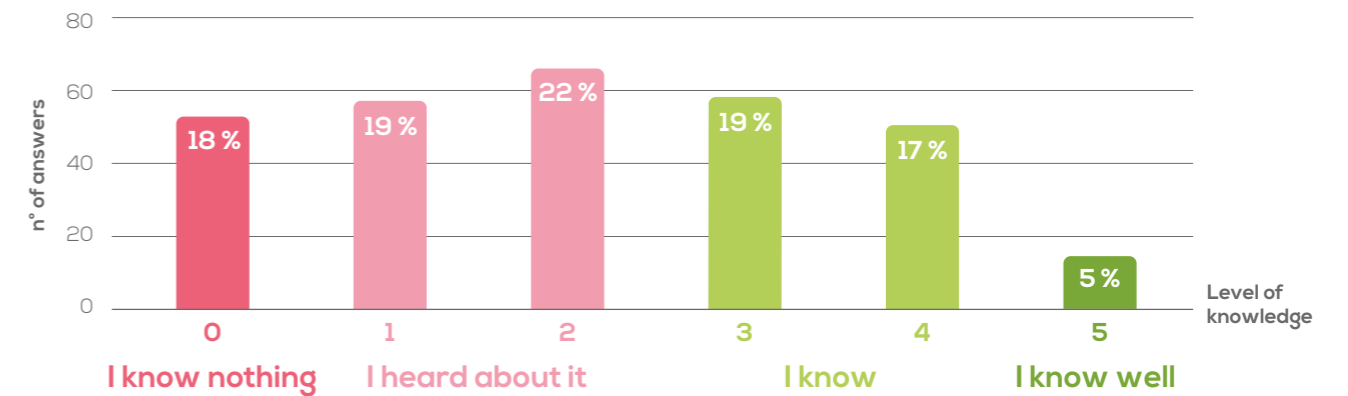


Figure 54

what product to buy while those who know are more likely to choose vertically grown products. Moreover, even those that expressed negative impressions about the key elements of vertical farming in the previous section of the survey, declared that they would be willing to purchase vertically grown products, but still expressed their preference for products grown using conventional farming methods (Figure 54).

In general, the **majority of the respondents (88%) are therefore attracted by vertical farming products and expressed willingness to buy these products**, with no relevant difference among age groups, place of residence etc. They are mainly attracted by the sustainability of the vertical farming products and by the fact they are healthy because they are nichel-free, pesticide-free and repaired from external pathogens. Only a **small percentage (12%)** declared that they **wouldn't buy vertically grown products**, and those are mainly retired people over 65 and also people between 36 and 50 years old living in medium-size cities. The reasons are several, but more than a half expresses the preference for products grown with traditional farming methods. The underlying reason is that **products grown with traditional farming methods are perceived as more natural** (Figure 55).

Other relevant evidence is related to the respondents grocery habits concerning fresh products, specifically lettuce, that give a first idea of what consumers' behaviours are from a quantitative perspective: the majority of the respondents are used to buying **packed salads at the supermarket** (Figure 56) and **convenience** is the major driver for purchasing decisions (Figure 57).

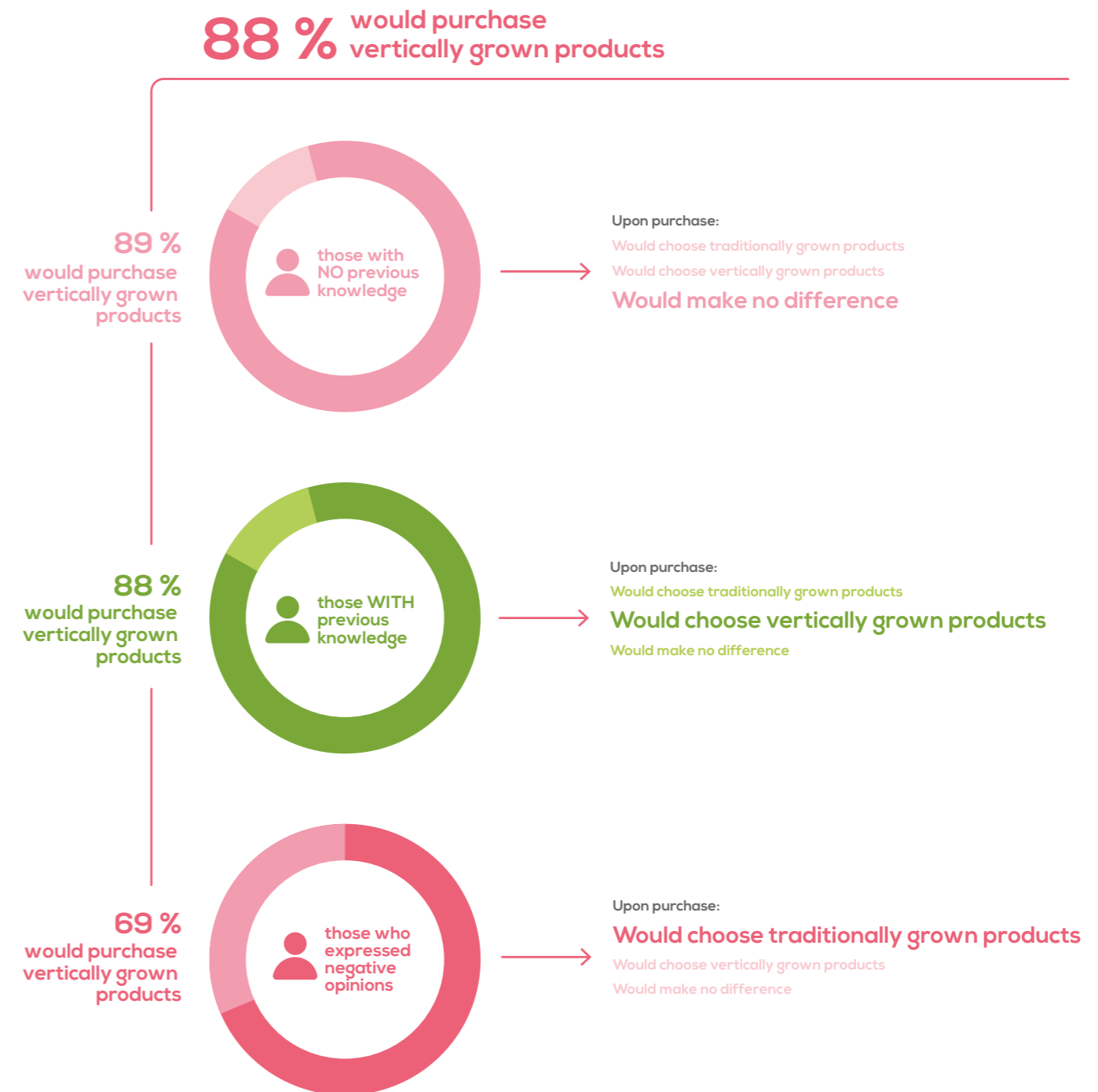


Figure 55

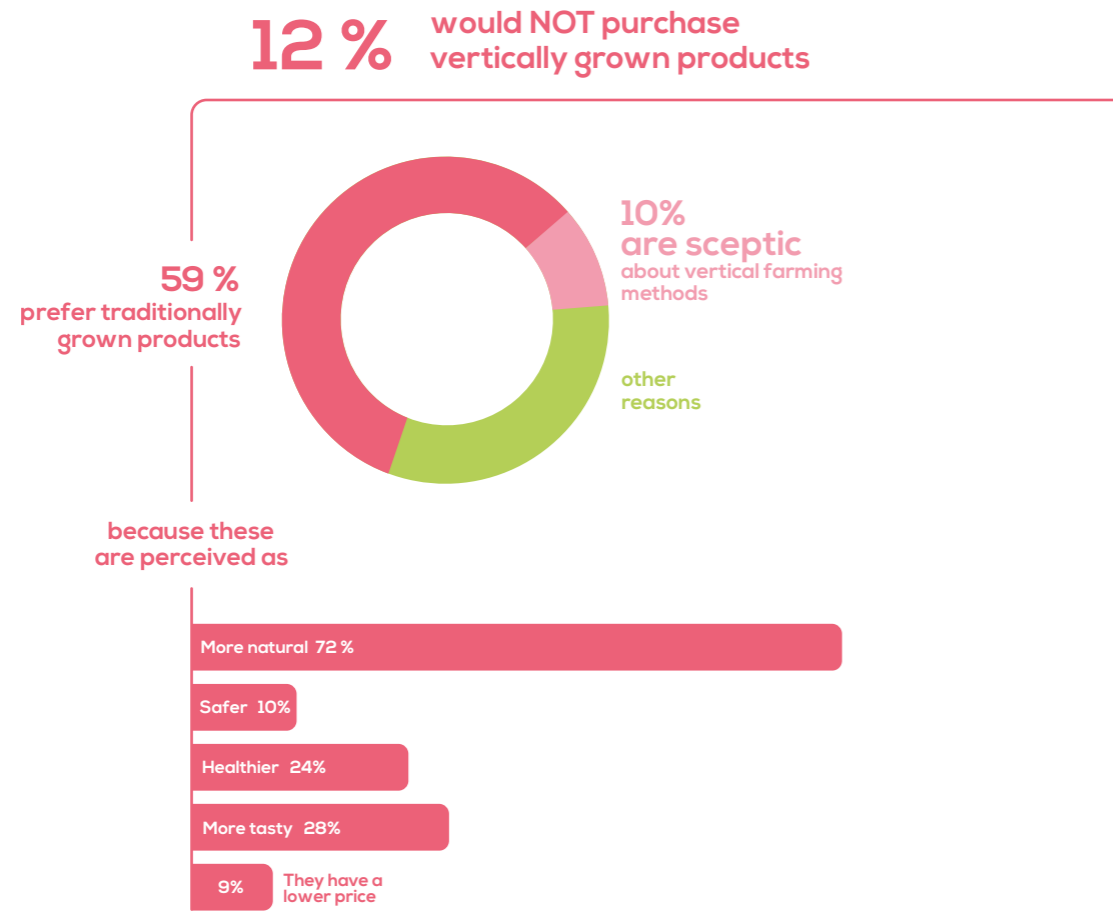
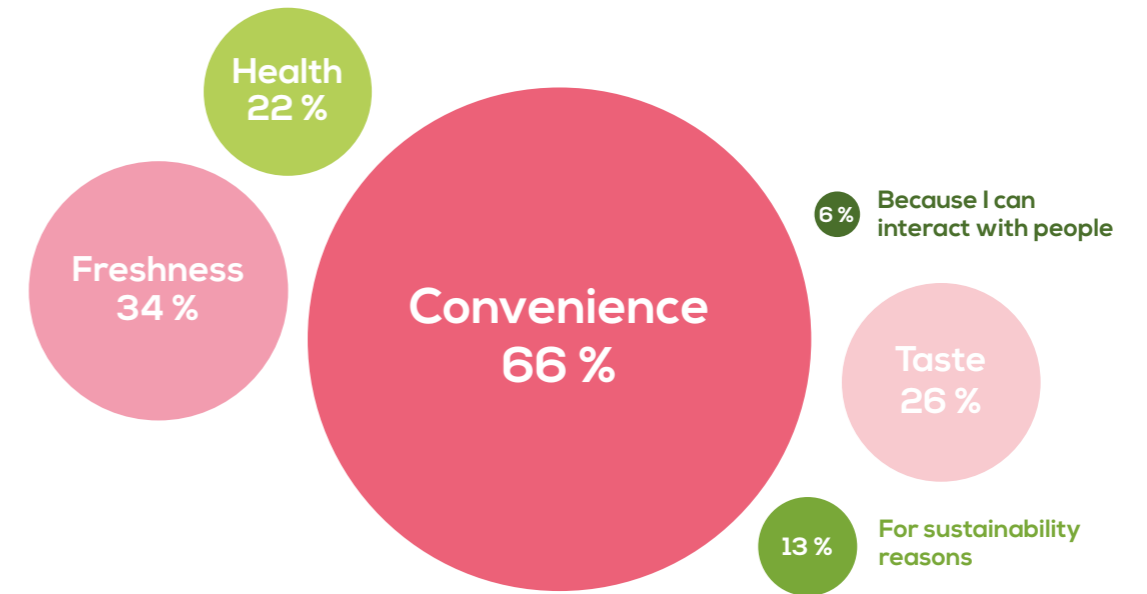
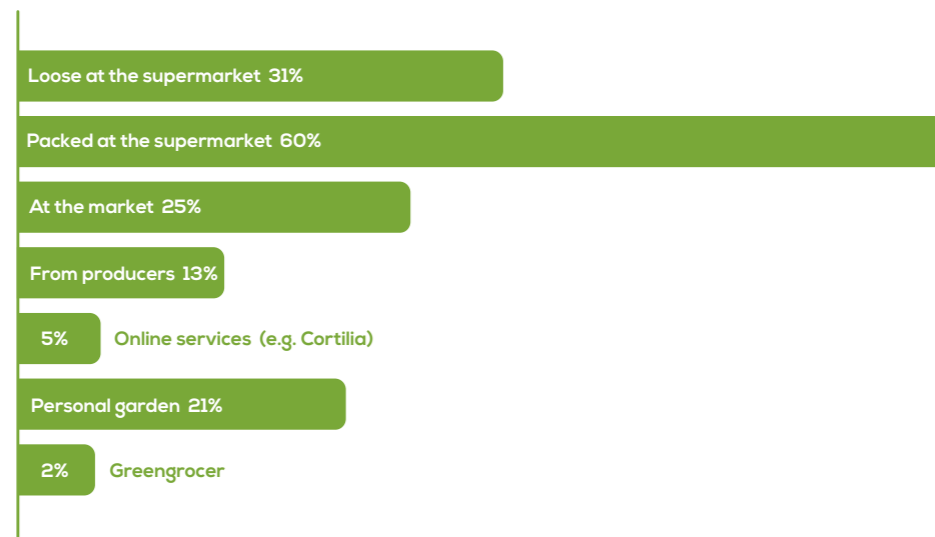


Figure 57



All the evidence collected through the survey was considered as a first step to understand from a quantitative perspective what are the most frequent consumers' opinions and perceptions about vertical farming, especially detecting what are (if there are) the negative attitudes or preconceptions. These insights worked as a baseline to structure the interview script for the consumers' interviews and also provided a list of people available for such interviews: by cross-checking data it was possible to identify potential interviewees based on the recruiting criteria.

Figure 56







## 4.4 Interviews

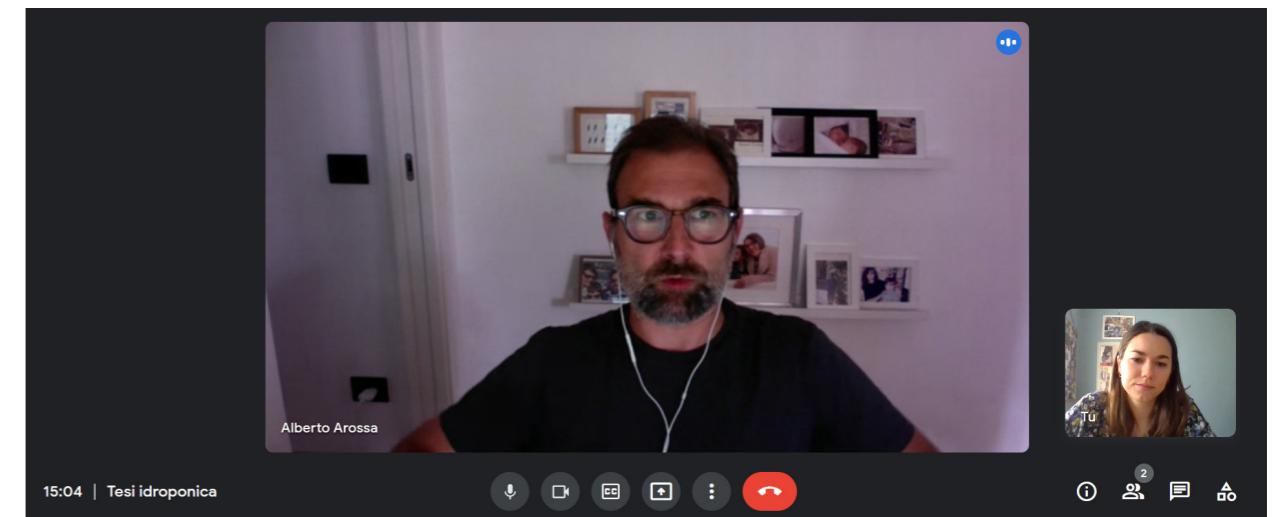
The total number of interviews conducted was 11, involving one renowned entity and two main stakeholders:

- ▶ **1 interview with Alberto Arossa**, one of **Slow Food** leading exponents, to understand Slow Food's opinion on vertical farming, which was not very positive a few years ago.
- ▶ **2 interviews were organised with Agricola Moderna** to understand entrepreneurial perspectives, difficulties and ambitions of a new-born vertical farm: one with Luca Bigi, the **Head of Marketing**, and another one with Pierluigi Giuliani, **Co-founder** of Agricola Moderna.
- ▶ **8 interviews with the consumers** to dig deeper into the insights collected with the survey focusing on the motivations, reasoning behind people's behaviour, needs and desires.

### Interview with Alberto Arossa - Slow Food

The first interview with Alberto Arossa from Slow Food Italia (Figure 58) revealed a major interest for vertical farming and its potential, if interpreted and implemented consciously and in a modern way able to respond to society's challenges and needs. Slow Food is not expressly against this new farming method, they just never tackled this topic as it is something not relevant for what they are interested in: Slow Food cares about traditional farming and how it has impacted territories, by modelling landscapes and creating local identities while developing in harmony with the environment and prospering new biodiversities. Therefore vertical farming is not something that belongs to their field of interest, but they acknowledge the potential it has, especially in modelling cities and offering new opportunities for citizens.

*[The full interview can be found at page 222]*



### Interviews with Agricola Moderna

Agricola Moderna provided precious information about more technical and practical aspects of vertical farming, from how the whole process works to the business implications of this farming method. The interview with Pierluigi, the co-founder, was quite brief due to the limited time he had available, but still very insightful.

*[The full interview can be found at page 225]*

Luca, the Head of Marketing, who also guided me during the visit at their vertical farm in Melzo, provided a few more details about their vertical farming system, the process and also about their communication strategy.

*[The full interview can be found at page 226]*

## Interviews with consumers

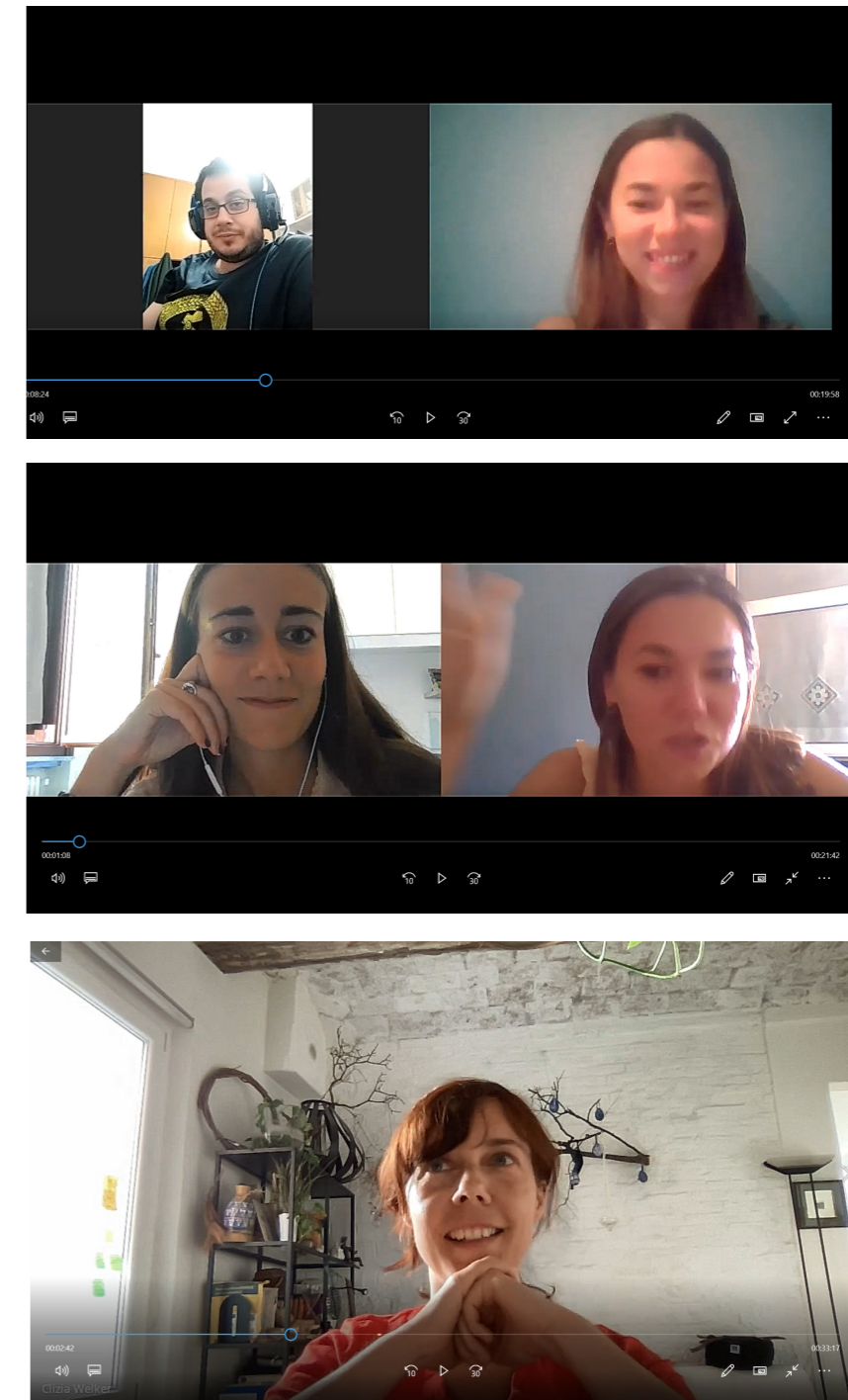
Finally the consumers' interviews were considerably important for gaining qualitative insights about their habits, needs and goals, based on their relationship with food. The survey served as a first step to give a clearer direction to these interviews and helped in identifying what to investigate deeper through precise yet open questions that could provide interesting insights. More specifically, the aim of the interviews, based on the survey's data, were:

- ▶ **Investigate more deeply people's grocery habits:** where, how and especially why they buy certain products in certain places. Convenience is the main driver of purchase: understand what convenience means, why it's a determinant of purchasing habits.
- ▶ **Investigate more deeply on people's perceptions about vertical farming,** especially focusing on those who wouldn't buy vertically grown products: why traditional products are perceived as more natural, understand what makes a product "natural" and what it means "natural" for them.

The consumers who accepted to be interviewed were 8, identified among a larger list that was created based on the recruiting criteria previously mentioned in chapter 3.4.1. The selected interviewees were diversified in terms of age, place of residence, occupation, family unit, grocery habits and opinions about vertical farming. (Figure 59) [\[The full interviews can be found at page 228\]](#)

Some of the interviews with consumers

Figure 59









5.

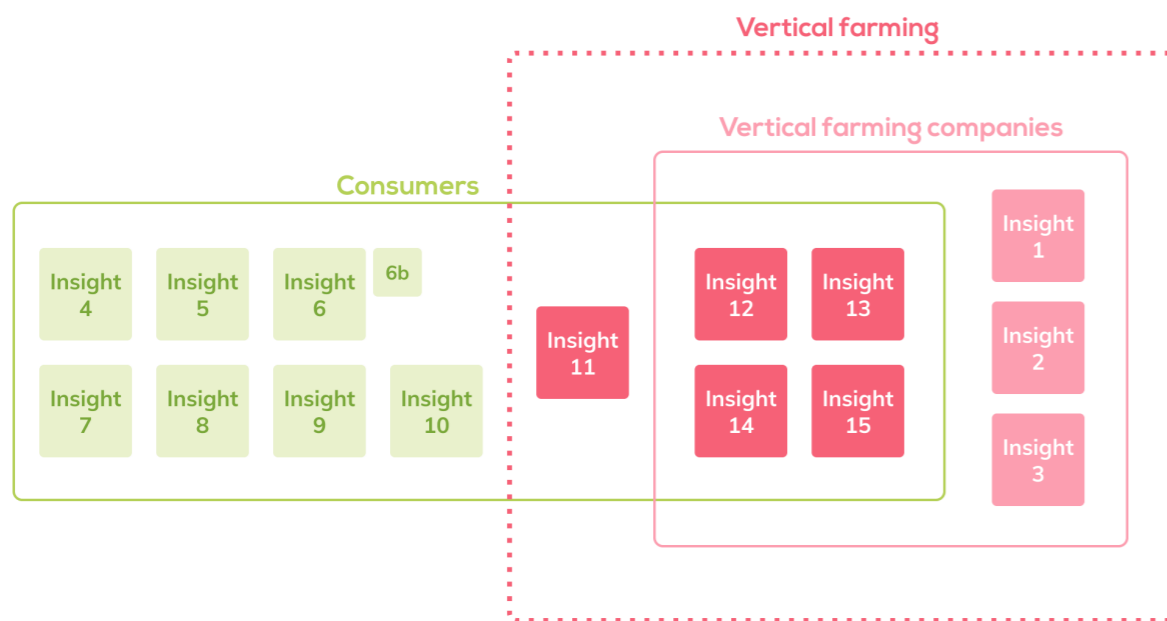
Define.  
Framing the  
challenge

## 5.1 Insights analysis and synthesis

By looking at the whole picture and analysing all the **insights** collected through diverse research methods, a synthesis was made. The insights were clustered based on the specific topic and meaning, which in turn were organised in bigger, intersecting groups that refer to the two stakeholders considered for the research: vertical farming companies and consumers (Figure 60). Finally, **15 insight statements** were formulated.

Insights synthesis schematic representation

Figure 60



The major insights strictly related to **vertical farming companies** are three:

### ► Insight 1 - High initial costs

Startup costs are high as initial assets and capital is needed, especially within this new field that needs research and experimentation, requiring therefore skilled labour and adequate technical expertise and knowledge. Moreover, producing in city centres is expensive and the land and space are difficult to obtain, so urban suburbs result to be more convenient as they're also near logistic centres.

### ► Insight 2 - High energy consumption and expenses

The highest running costs are the ones related to the energy consumption, impacting both the viability of the business and the environment if non-renewable resources are used. However, many years of technological advances have contributed in developing LED lighting systems that are more and more energy-efficient.

### ► Insight 3 - Lack of regulations

The existing regulations are not suitable for vertical farming products, therefore, from a company perspective, it is not clear how vertical farming products should be commercialised and distributed. Moreover, there are no regulations certifying vertical farming products, impacting consumers' awareness and choices upon purchase.

Consumers insights are distinguished between those that relate to vertical farming and those that more generally pertain to food-related behaviours.

The ones that refer to **consumers general behaviours** are:

### ► Insight 4 - Growing own food

Growing a garden is appreciated for several reasons, not only because it gives access to fresh food that tastes better or it is satisfying to see their plants growing: by growing their own food, people feel reassured by the fact that they know what they eat and where it comes from. By looking deeper at this feeling, a more general, yet punctual insight shines through it: people feel reassured when they have control on what they eat, when they know how it's grown and where it comes from.

### ► Insight 5 - Human interaction

Direct human interaction is appreciated by some consumers because it allows them to fulfil their requirements and build relationships, which ultimately increases the level of trust towards the seller/producer and his products.

### ► **Insight 6 - Visual component**

The visual component is fundamental since something to be noticed must catch consumers' attention: consumers tend to be intrigued by what they see, especially if it looks odd or new. **(6b)** The visual component is also fundamental for evaluating products' freshness (look, colour), which is one of the main purchasing drivers, as it gives consumers an idea of how long the product would last.

### ► **Insight 7 - Customisable purchase**

The previous insight is also linked with the need many consumers expressed, especially those who live alone, to have the possibility to purchase only an exact amount of fresh products to be able to eat them all without them getting old.

### ► **Insight 8 - Convenience**

Convenience is the most common factor that determines people's choice when it comes to grocery shopping (66% of the survey respondents): they tend to do the grocery shopping where it's more convenient for them, in terms of proximity, time or, in the specific case of supermarkets, because it has all in one site.

### ► **Insight 9 - Packaging**

Generally, plastic free packaging is preferred for sustainable reasons and because it affects the perception of the product's freshness, as paper gives the idea that products are more fresh. Some consumers, mainly those who avoid supermarkets, prefer to use their own packaging.

### ► **Insight 10 - Perception of good and genuine**

People tend to consider organic and "natural" products as more genuine, wholesome and with a higher quality. Natural and authentic is often linked with the image of the countryside and natural elements, and also with the concept of local food ("km0"), which is considered better in terms of taste and nutrients since it respects seasonality and doesn't come from afar.

The perception of what is good and genuine is strictly linked with the **perceptions and attitudes towards vertical farming** methods and products:

### ► **Insight 11 - Perceptions and attitudes towards vertical farming**

Those who prefer traditional farming methods are mostly those who have more interest in food and agriculture, and have more negative attitudes towards vertical farming, perceiving vertical products as something fake, artificial and surgical. More generally, even those with more positive attitudes towards vertical farming, see it as something futuristic and unfamiliar, which may be translated in lack of trust towards these kind of products. This is also linked with some doubts they have about the taste and about the nutritional and health-related aspects, which lead them to wonder if vertically grown products are as healthy as conventional ones. Those who are used to seeing and eating vertical farming products, don't have any concern.

The intersection between the insights related to vertical farming companies and consumers include the **insights that affect or that potentially could have an impact on both stakeholders**. For this reason these insights are the most relevant ones and they include potential project directions.

### ► **Insight 12 - Lack of knowledge and visibility**

A major challenge for vertical farms is to gain visibility and create awareness about vertical farming products and methods. The research revealed that on average Italian people have a vague knowledge about vertical farming and despite they don't have a clear idea of what it is, the greatest majority of people (88%) are willing to purchase vertical farming products, showing interest and curiosity. However, they never bought them because 50% state that they don't know where to find them and 43% state they didn't know this kind of products.

Therefore, it is important to talk about the right aspects and give the right information to allow consumers to make conscious choices.



## 5.2 Personas

### ► Insight 13 - Differentiation and added value

The artificial nature of vertical farming doesn't make products "unique". Vertically grown products should characterise and differentiate themselves from the other traditional products in the market: vertical farming products need an added value, something to tell beyond the product itself that would justify the higher price and people's motivation to buy it.

### ► Insight 14 - Integrating vertical farming in the city

Diffusing vertical farming through the city structure would embrace several opportunities both for the citizens and the city itself: it's a chance to remodel abandoned parts of the city and guarantee access to healthy food for all, encompassing Milan Food Policy's priority guidelines for a more sustainable food system as well as embracing the 15 minutes city model that focuses on the concept proximity.

### ► Insight 15 - Fostering communities

Vertical farming may offer a wide range of social opportunities, either providing new jobs for vulnerable people or reintroducing them in the labour market, or enabling the creation of communities through new collaborative services.

To have a clearer representation of the different types of consumers identified during the research, **two personas** were built: they served as a tool to communicate and effectively represent a synthesis of all the insights related to the consumers, especially to have a clear definition of the needs, goals and motivations of people while clearly describing their relationship with food.

The two personas were shared with Agricola Moderna, giving them a clear idea of the different types of consumers and in this way fulfilling their need to identify a possible target which they should refer to for their marketing and communication activities.

**Stefania, the conscious eater**, strongly believes that organic, natural and genuine food are better products for both her health and the planet's health, therefore she spends time and effort in getting her food in places where she knows she can get organic local food. For this reason she goes to the farmers' market to buy her usual grocery, but sometimes she wonders if what she buys is actually organic: she wishes to have her own garden to be sure that what she eats is good and authentic. As she's interested in food and sustainability led her to discover vertical farming but she perceives vertically grown products too artificial and weak, as it is not loaded with all the elements the natural world gives to the food we eat.

**Matteo, the curious eater**, has a general knowledge about food and its link with our health and planet: what he knows comes from the collective imagery that good food is often organic and linked with the image of the countryside. However, convenience and good taste are fundamental for him, and he is often intrigued by unusual food that sometimes he buys just to see if it tastes good. He always goes to the nearest supermarket where he can effortlessly find anything on one site, but sometimes he has also tried to do his grocery on Cortilia, which gives him the chance to buy fresh, genuine and more sustainable products in a convenient way. However, the quantities are too large for him living alone, so he turned back at the supermarket. He wishes that adopting more sustainable habits and having access to more fresh food without giving up on convenience was easier. He doesn't know much about vertical farming, he has just heard of it but he would be curious to try vertically grown food, however he has some doubts about how the food can actually grow with this method, and has some bias towards the taste and the nutritional value.

# Stefania

## The conscious eater

43 years old professor living in Monza with her husband

"I think that things are perfect the way they are in nature, and that is the way they should be. Growing plants out of the soil is like feeding them with a drip"

### Relationship with food

She's interested in the way food is produced and how it impacts on the planet, as well as on our health: she strongly believes that organic, natural and genuine food are better products in terms of quality and nutrition. For this reason she strives to dedicate proper time and effort in getting good food and eat well.

### Purchasing behaviours

Before purchasing some food that she's not used to buy, she gets informed about how and where it was grown or produced.

### Grocery habits

#### Farmers' market

She is used to buy directly from the producers for different reasons:

- ▶ **interacting** with the farmers allowed her to increase the level of **trust** towards them and the food they sell
- ▶ she can **fulfill her requirements** and curiosity more easily
- ▶ she can totally avoid plastic **packaging** and reuse her own packaging

### Pain points

Sometimes she wonders if the food she buys is actually organic or is it "just a label".

#### Food consciousness

Low ● ● ● ● ● High

#### Purchasing habits

Habitual ● ● ● ● ● Like to change

#### Purchasing decisions

Impulsive ● ● ● ● ● Reasoned

### Divers of purchase

#### Organic

She only buys organic food because it's more natural as it avoids chemicals and pesticides

#### Km0

She only buys local food from farmers of the nearby area to avoid unnecessary long food miles

### Goals and needs

In the future she would like to have her own garden to have full control on what she eats and to be sure that it is good and authentic

### About vertical farming

#### Willingness to buy

Low ● ● ● ● ● High

#### Knowledge about VF

I don't know ● ● ● ● ● I know well

She perceives them as something fake and artificial, surgical and weak: not loaded with all the elements that the natural world gives naturally to our food

Her interest for food led her to learn something about this method

# Matteo

## The curious eater

27 years old designer living in Milan

"When I see something unusual, like a product that I'm not used to eat or it looks "strange" I immediately feel curious and I want to try it!"

### Relationship with food

He has a general and superficial knowledge about food and its relation with our health and on the planet: what he knows comes from the collective imagery that good and genuine food is linked with the image of a countryside field, and that buying organic is better for us and the environment. Yet, his buying choices are most of the times not dependent on this criteria, as taste and convenience prevail.

### Purchasing behaviours

He doesn't have specific requirements when he does the grocery, he's always open to try new products if they are unusual and look different: he likes to give it a go and see if they taste good.

### Grocery habits

#### Supermarket

He's not used to spend much time on grocery shopping, so he prefers going to the nearest supermarket where he can find anything in one site and buy everything there. As he lives alone he tries to buy small quantities of fruit and vegetables and check how they look, hoping that they don't get old soon.

#### Cortilia

He's done the grocery a few times through Cortilia as he likes the idea of getting local products from the fields nearby: he sees it as a chance to get good and genuine food in a more sustainable yet convenient way, as he gets the grocery delivered at home.

### Pain points

- ▶ Many times he can't deal with the large quantities of packed food
- ▶ Getting good fresh food at the market means putting too much effort and time in it

#### Food consciousness

Low ● ● ● ● ● High

#### Purchasing habits

Habitual ● ● ● ● ● Like to change

#### Purchasing decisions

Impulsive ● ● ● ● ● Reasoned

### Divers of purchase

#### Convenience

He tries to minimize time and effort when it comes to doing the grocery

#### Freshness

The look, color and expiry date are fundamental as he expects that the products last a few days and taste good.

#### Origin

He prefers italian products as the origin is linked with seasonality: seasonal products have a better taste.

### Goals and needs

He would like to be facilitated to adopt more sustainable habits and have access to more fresh food without giving up on convenience

### About vertical farming

#### Willingness to buy

Low ● ● ● ● ● High

#### Knowledge about VF

I don't know ● ● ● ● ● I know well

He just heard of it but he wouldn't be able to explain what it is

He's curious about it but he doesn't know this new method and this generates some bias towards the taste and the nutrient. Since it's a brand new way to grow food which is totally different from what we're used to, he wonders how food can actually grow.

## 5.3 HMW and project directions

After summarising the whole research in 15 insight statements, a final evaluation was made, mainly focusing on the last insights, that include the core challenges and opportunities for a service design project in relation to the initial research question. Acknowledging that there's general acceptance and curiosity, both people that demonstrated willingness to buy vertically grown products and people who did not show a positive attitude towards them, have doubts, concerns or bias towards vertical farming because it is still not substantially present, nor normal, in people's daily life. Especially for those who expressed willingness to buy vertically grown products but do not know where to find them, the key should be to diffuse vertical farming products in a way that reaches people and captures their attention. As a result, the following How Might We question was formulated:

### HMW bring vertical farming products into people's daily life?

This question represents the major direction that will guide the next steps of the design process leading to a service idea able to address the identified challenge. This major direction is then supported by minor directions that are additional perspectives that must be taken into consideration when generating the service concepts, working as guidelines on how to fulfill the challenge effectively. These minor directions are:

- ▶ **Transfer the right information and knowledge about vertical farming to help consumers make informed choices.**
- ▶ **Expand the meaning of what is "genuine" and "good", both in terms of taste and nutrient.**
- ▶ **Load vertical farming products with an added value that differentiates them from traditional products, by uncovering the potential of vertical farming.**
- ▶ **Reassure consumers that what they eat is good by enabling them to have control on it (as if they had their own garden).**

- ▶ **Increase the level of trust towards vertical farming products by giving the possibility to interact and build a relationship with the seller/producer.**
- ▶ **Use the visual component to catch consumers' attention and interest**

By considering, combining and integrating the main project direction with the minor, more specific directions, the final service solution will effectively respond to stakeholders' needs and fulfill the main challenge of bringing vertical farming products into people's daily life.



**Develop.**  
Towards the  
service solution

## 6.1 Case studies

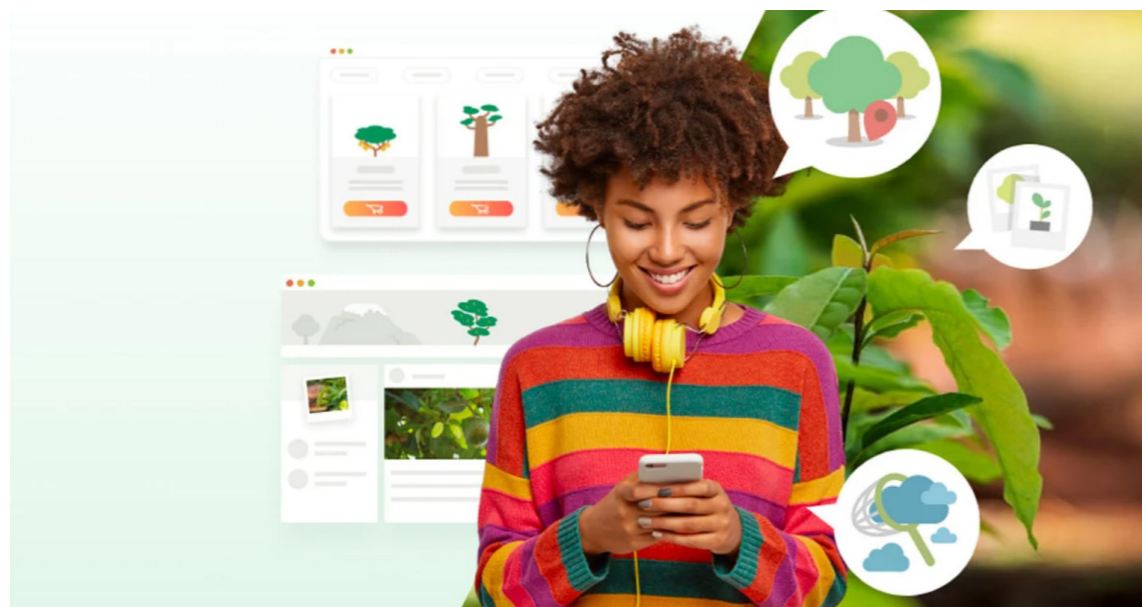
After defining project directions, a few **case studies** were researched and analysed in order to have tangible examples that could provide inspirations for the next stage of the design process. All the following examples embody, in different ways, one or more of the minor directions previously identified.

### Treedom

Treedom is an online platform that allows people to plant a tree from a distance in different countries around the world. By choosing a tree online and giving it a name, a farmer will plant the tree in his country and will take care of it. The plant can be monitored remotely as it will be photographed and geocalised, allowing the user to follow its growth through the dedicated online page that also provides additional information such as the meaning of the plant and its features. Through the website it is also possible to find out how much CO2 the user emits and how much is absorbed by his plant. The service also allows people to gift the plants to someone else and to customise it with his/her name and a message (Figure 61) (Treedom, 2021).

Treedom (Treedom, 2021)

Figure 61



### Biorfarm

Similarly to the previous example, Biorfarm is an online platform that allows people to adopt an organic fruit plant and receive its harvest once it is ready. Through the website it is possible to choose the plant type among those proposed by the local farmers and create a digital orchard. People can then monitor the plant's growth and once the fruit is ready to be picked, the harvest can be either received at home, or be picked directly in the orchard. The service is based on an annual subscription model and the price is based on the amount of fruit wanted. The fruit plant can also receive a name and be gifted to someone else. The service becomes a unique experience for consumers, who are able to monitor their plant, know what they eat and support local organic farmers while shortening the supply chain with no intermediaries in between (Figure 62) (Biorfarm, 2020).

Biorfarm (Biorfarm, 2020)

Figure 62



Treedom and Biorfarm are two examples of online services that have an impact on consumers, local producers and the environment more broadly. The underlying business model that characterises both of them constitute a very effective example on how to **convey the right information through unique experiences for consumers, enabling them to have control on what they will eat and in this way reassuring them on the quality of their food.**

## Infarm

Infarm is a German company that produces “climate machines”, namely modular vertical farming systems that can be located anywhere and linked to a main control farming platform. They can be found in some big retailers in just a few countries so far, such as Germany, United Kingdom, Denmark, etc. In Italy Infarm is still not present. Each Infarm is a controlled ecosystem with the perfect amount of light, air and nutrients, depending on the crop it hosts. All Infarms are controlled remotely through a cloud-based farming platform, which learns, adjusts and improves itself continuously, so each plant grows better than the last (Figure 63) (Infarm, 2021).

Infarm (Infarm, 2021)

Figure 63



This example is relevant as it brings vertical farming into people's daily lives leveraging the **visual component**, in this way **catching people's attention that will wonder what is that unusual system**.

## Mòn Orxata

Mòn Orxata is a service that recovers a 16th century tradition of the city of València, Spain, famous for a plant-based drink called horchata made of tigernut milk. The service is based on little carts that can be found around the city where people can purchase a glass of horchata. The carts are 100% sustainable and ecological pushcarts as they use ice through an autonomous cooling system patented with the UPV (Universidad Politécnica de Valencia), therefore no energy is consumed and no gases are emitted. Moreover, the services involves the “horchateras”, the horchata sellers, a group of women that are over 45 years old and in many case are affected by social exclusion (Figure 64) (Mòn Orxata, 2012; Agronews Comunitat Valenciana, 2021).

Mòn Orxata (Mòn Orxata, 2012)

Figure 64



In this case, Mon Orxata, represents an example of how a **social inclusion project can bring added value to the products sold**, especially considering that the same product is sold at the supermarket. The carts capture people's attention and the possibility to **interact with the horchata sellers may result in increased trust towards the product which is unknown by many people**, especially tourists that visit the city and never heard of this valencian product.

## L'Alveare che dice Sì!

L'alveare che dice sì is a service based on a purchasing group model: the person is in charge of managing the "alveare", meaning a group of people that purchase products from local producers selected by the manager of the "alveare". Each "alveare" has its own producers which may vary over time. Through the online platform people can join the closest "alveare" and can do the grocery by choosing the available products from the local farmers. Once a week, people will have to collect their groceries at the "alveare" location where all the farmers gather with all the orders of the week. This model represents an opportunity for local farmers to set their own price and distribute directly to final consumers, allowing them to get a fair profit from their work. The "alveare" manager receives 20% of the entire profit made by each sale (Figure 65) (L'Alveare che dice Sì!, n.d.).

L'Alveare che dice Sì! (L'Alveare che dice Sì!, n.d.)

Figure 65



The service is interesting for the underlying model based on a **collaboration and community approach** that makes the service possible: without a group of consumers that join the "alveare", or the "alveare" manager that manages the work as the only intermediary among the consumers and the producers, the service doesn't work. Moreover, the human interaction and the community feeling plays an important role, as **people can build relationships among each other or with the producers**. As a result, **stronger relationships based on loyalty and trust towards the producers and their products are forged, and the grocery becomes a ritual and a social activity**.

## 6.2 Brainstorming

The next phase was about **generating ideas** that could answer the main HMW question while considering the other minor directions. A solo brainstorming led to the generation of eight rough concepts, which were then evaluated and combined when possible. **Four ideas** out of those eight first concepts were selected and further implemented and finally more robust and forceful service concepts were crafted. For each concept a description and a moodboard were organised on a card-format element: this helped in defining more accurately the concept, and especially to better communicate and convey the idea to other people in the following step of the design process, the co-design sessions.

### Concept 1 - On the way UP

#### The moving farm

On the way UP is a **"moving farm"** enabled by an e-bike / e-truck that distributes vertical farming products around the city. The e-bikes can be found in the most strategic spots where consumers can easily step by and purchase vertically grown products while they're on their way, or can also buy ready-to-eat salads that can be assembled freely with the ingredients they prefer (other VF products or other products from local producers). Both the products and the ready-to-eat salads can be booked and the consumers can just pick up their order in the nearest moving farm.

The service is an opportunity to involve and integrate marginalised people: e-bike riders will be young unemployed and vulnerable people that face difficulties in finding a job.

The product-service system could also be the chance to extend this concept in the events realm: the e-bikes can be moved anywhere and events can be organised around them, arranging unique set ups that are suitable for any occasion (e.g.: UPeritivo).

On the way UP concept card

Figure 66

#### CONCEPT 1

##### On the way UP

###### The moving farm

**On the way UP** è una **"moving farm"** che grazie a una bicicletta (o truck) elettrico distribuisce e diffonde i prodotti coltivati in Vertical Farming nel tessuto urbano. Queste moving farms si possono incontrare nei punti nevralgici della città, dove i consumatori possono fermarsi e acquistare i prodotti mentre sono per strada e di passaggio, o possono acquistare delle insalate pronte che possono assemblare liberamente con gli ingredienti a disposizione (vari prodotti coltivati in Vertical Farming dove possibile, oppure altri prodotti locali coltivati con metodi tradizionali).  
Sia i prodotti che le insalate pronte possono essere "prenotati" e acquistati online e ritirati alla moving farm precedentemente selezionata.  
Il servizio è anche un'opportunità per coinvolgere e facilitare l'integrazione di persone in situazioni precarie che hanno difficoltà a trovare lavoro, coinvolgendole nella guida e gestione delle moving farms e donando così anche un valore aggiunto ai prodotti venduti.  
La natura stessa del servizio, inoltre, permette anche di essere esteso all'ambito degli eventi: le moving farms possono muoversi ovunque, e intorno a queste possono essere organizzati eventi con diversi set-up adatti a varie occasioni (es. "Vertical Aperitivo" -> UPERITIVO).




Figure 67

**CONCEPT 2**

**UP TO YOU**  
Farms for (and by) the community

UP TO YOU è un sistema di "hub verticali" distribuiti sul tessuto urbano e connessi con la Vertical Farm principale. Il servizio incoraggia i cittadini a diventare "vertical farmers" e permette l'accesso a cibo fresco attraverso una fonte di approvvigionamento sicura e vicina: una persona può richiedere liberamente di aprire e gestire un hub verticale nel proprio quartiere così da permettere anche agli altri abitanti di avere accesso a cibo "m0". Il servizio permette loro di "adottare" un metro quadrato dello spazio del vertical hub in modo da poter ricevere il suo raccolto ogni settimana e anche di monitorare quello che mangiano: un'applicazione permette loro di controllare i propri prodotti che crescono e scoprire il funzionamento di questo nuovo metodo di coltivazione grazie al fatto che hanno un occhio costante sull'intero processo, dal seme al piatto.



## Concept 2 - UP to you

### UP to you

UP to you is a system of "vertical farming hubs" spread around the city and connected with the main vertical farm, that empowers citizens to become vertical farmers and get access to a reliable source of food: a person can freely request to open and manage a vertical hub in their neighborhood so that the inhabitants can benefit from "m0" fresh food. The service allows them to adopt a square meter of the vertical hub to be able to get their products on a weekly basis and also to monitor what they eat: an app allows consumers to check their food while it grows and learn about this new farming method having an eye on the entire process, from the seed to the fork.

Figure 68

**CONCEPT 3**

**OPEN FARMS**  
Tasting, learning, networking

OPEN FARMS is a service-event that wants to welcome consumers inside the vertical farm: it's an opportunity to shorten the relationship with the consumers that get the chance to visit the place where what they eat grows, to learn from it and gain awareness about this new farming method. The visit comes with tasting experience and cooking shows by some chefs that invent dishes with vertical farming products. People can eventually purchase and bring home what they have tasted. Open farms is also a chance to gain visibility and to forge new B2B relationships chefs or restaurant owners.



## CONCEPT 3 - Open Farms

### Tasting, learning, networking

Open Farms is a service-event that wants to welcome consumers inside the vertical farm: it's an opportunity to shorten the relationship with the consumers that get the chance to visit the place where what they eat grows, to learn from it and gain awareness about this new farming method. The visit comes with tasting experience and cooking shows by some chefs that invent dishes with vertical farming products. People can eventually purchase and bring home what they have tasted. Open farms is also a chance to gain visibility and to forge new B2B relationships chefs or restaurant owners.

## Concept 4 - Vertical Restaurants

### Get a taste of it


Vertical Restaurants is a service that ensures chefs to get access to local and fresh food for their dishes: they can choose to install a modular, small vertical farm in the restaurant and, in addition, get their harvest on a weekly basis directly from the nearest vertical farm through a fidelity program. Once a restaurant "goes vertical" people can come and taste the vertical farming products from a dedicated menu. If they wish, they can purchase the same products together with the recipe to prepare the same dish at home.

Figure 69

**CONCEPT 3**

**VERTICAL RESTAURANTS**

VERTICAL RESTAURANTS è un servizio che assicura agli chef un accesso sicuro a cibo fresco e locale per la preparazione dei piatti del loro ristorante: installando dei piccoli sistemi modulari possono coltivare i prodotti di cui hanno bisogno direttamente all'interno dei loro ristoranti. Nel momento in cui un ristorante "goes vertical" le persone possono provare e assaporare i prodotti coltivati in vertical farming grazie a un menu dedicato. Alla fine del pasto i clienti hanno anche la possibilità di acquistare, direttamente al ristorante, gli stessi prodotti che hanno provato, e questi gli verranno venduti insieme alla ricetta al fine di permettere loro di ripreprire la stessa pietanza a casa.



After delineating the core ideas and features of each concept, another evaluation was made. By taking a step back and looking at the four ideas with the main direction in mind, the third concept *Open Farms* resulted a bit weaker than the others for mainly two reasons:

- ▶ It doesn't properly answer the main question "HMW bring vertical farming products into people's daily lives?": the concept is not about bringing vertical farming to people, it's either leading people to vertical farming.
- ▶ The potential of this concept could be fully exploited only once people become aware of what vertical farming is, and consequently some people would be actually interested in discovering more about it and in experiencing something like Open Farms.

As a consequence of this additional analysis, the concept Open Farms was eliminated, while the other three concepts would have gone through the next steps of the design process: the co-design sessions.



## 6.3 Co-design sessions

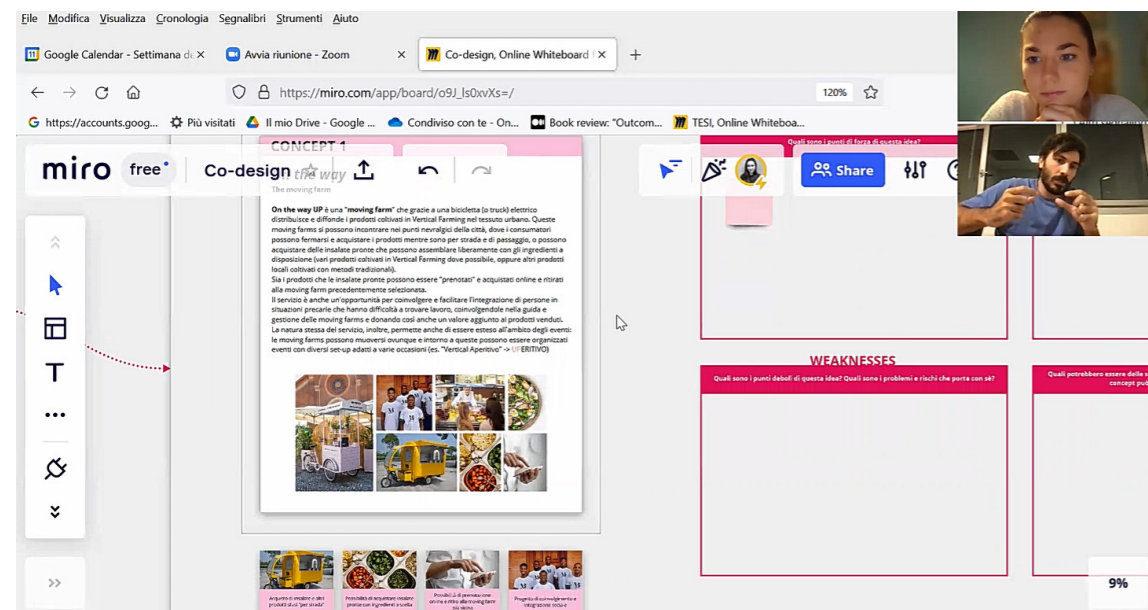
The co-design sessions, at this stage of the process, were organised with the aim to **understand the stakeholders' perceptions and opinions about the different service ideas** and, more specifically, the underlying motivations.

### Co-design with Agricola Moderna

The first co-design session (Figure 70) was held with Pierluigi Giuliani, co-founder of Agricola Moderna, with the aim of detecting both positive and negative aspects of each idea from an entrepreneurial point of view: with the intention of understanding the possible barriers that could hamper the implementation of each idea, as well as the potential and opportunities they might unveil, two main tools were designed. The first tool, the SWIF tool, was the main activity that helped initiating the conversation and collecting information and insights about the strengths and weaknesses of each idea, while brainstorming on possible alternatives to fix the weaknesses. The second tool was an Evaluation matrix which served as a final reflection and comparison among each idea based on three key aspects: desirability, viability and feasibility.

Co-design with Agricola Moderna's co-founder

Figure 70



### Key findings

- ▶ About the first concept *On the way UP*, the main insight lies in the value proposition of the concept, as the idea of "selling a dish" was considered valuable, compared to just "selling the product". However the idea is not innovative for the concept itself, it's either innovative for the product and a "food-truck" style can be interesting for vertical farming products because it could differentiate them from competitors that distribute lettuce and have a more "home food" approach. It was anyway perceived as a "one-shot marketing idea" that is nice if the intention is to make the brand more visible, but it cannot be conceived as a continuous distribution channel.
- ▶ About the second concept *UP to you*, the participatory approach was very much appreciated but this kind of service would compromise the quality of the products compared to the ones grown in the main vertical farm, as the products wouldn't undergo its linear and controlled process. More precisely, the final product would just be a different product, and the lack of packaging and "hygienic measures" would require the consumer to eat the products where they are and in a short time to not lose quality and freshness. This idea, therefore, must be considered as a new and different business model, which would require more effort in producing food for a smaller and limited market.
- ▶ About the third concept *Vertical Restaurants*, the idea was perceived less valuable although the idea of "0 steps", meaning the possibility to grow, trim and cook the product in the same place, was considered interesting. However, as in the first concept, this idea was mainly conceived as a marketing activity aimed at making the brand and the products more visible thanks to the media attention it could receive. Similarly to the second idea, the products sold would be different and with a lower quality, as the supply chain is not "clean" and linear as it is in the main vertical farm. Moreover, this idea of "bringing production into specific places" is in contrast with the production method itself: it would make sense to do something like a "catering hub" where chefs doing caterings have a large production system where they could get the products for their catering services.
- ▶ By looking at the three ideas together, the idea with a maximum score in terms of desirability, feasibility and viability was the first concept. However, the second idea *UP to you* was appreciated the most as it was considered the idea that could bring more value and a real impact, despite the higher effort and investment its implementation might require.

## Co-design with Consumers

Later, two more co-design sessions were organised with **two different groups of consumers**: one session (Figure 71) was held online with two consumers that relate more to the persona "the curious eater", while the other session (Figure 72) was held in presence with two other people that would relate more to the persona "the conscious eater". The intention was to organise one single co-design session, but for timing and managing reasons the sessions was split to also accommodate one participant's request to not use any digital device to make her feel more comfortable. Both co-design sessions with consumers aimed at understanding their point of view as end-users, what they like and what they dislike and the underlying reasons of their opinions.

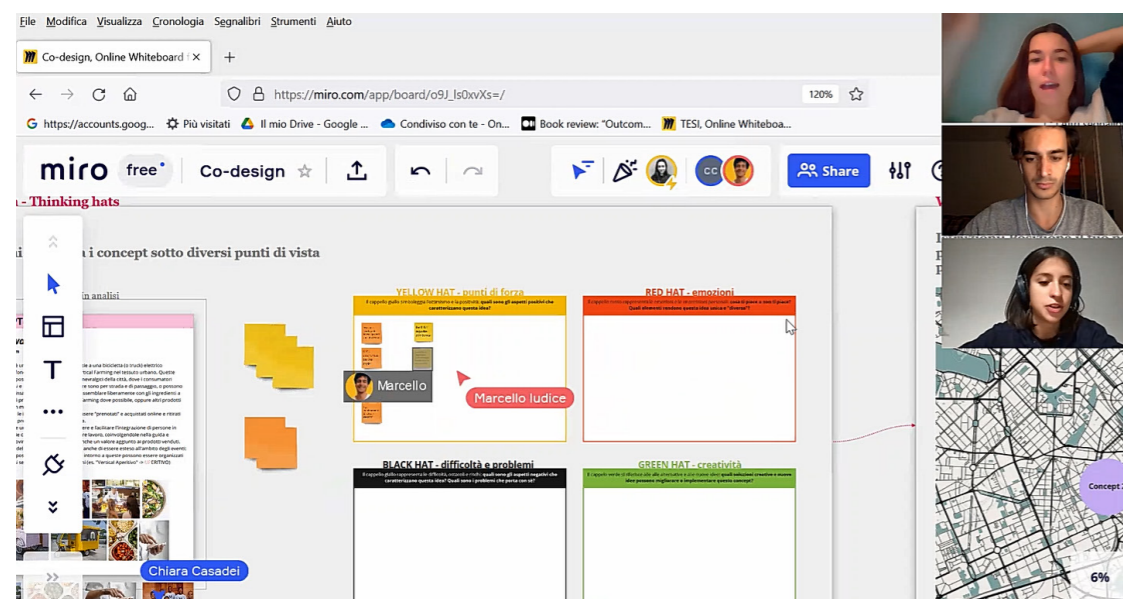
Co-design with second group of consumers

Figure 72



Co-design with first group of consumers

Figure 71





- ▶ About the second concept *UP to you*, the most appreciated aspect was the community feeling that this service solution fosters, by making people “feel part of an advanced green environment” and helps them learn about vertical farming methods. However, this was not well received by one participant, who was frightened by the digital component of this service idea and perceived it as something too distant from her. Nevertheless, they both agreed on the fact that this service concept brings them emotionally to the idea of a vegetable garden, making them think of something more fresh and genuine.
- ▶ The third concept *Vertical Restaurants* was perceived more as an “expensive eating experience in a ristorante bottega”, and something more relaxed and maybe based on a self-service model could be better accommodated. Moreover, the idea of receiving a recipe was not perceived as valuable, but personalised proposals based on the client's choices and tastes, together with a “ready to cook kit” could bring something more to the service concept, making it more appealing.

## Concepts evaluation

At the end of all co-design sessions it was clear that one concept was perceived less attractive and weaker than the others, both from an entrepreneurial perspective and from consumers' point of view: *Vertical Restaurants* did not receive meaningful feedback and was therefore put aside. The insights related to the other two concepts, instead, revealed more potential in generating more desirable and impressive service solutions in different ways.

The **second concept** *UP to you*, however, unveils more meaningful prospects within this project's purpose: the service idea was considered **more impactful and the intrinsic value for the stakeholders involved was perceived higher and more visible**, as it's a brand new model of distributing vertical farming products. On the other hand, this requires major effort and resources in terms of management and economic expenses compared to the first concept *On the way UP*, which could be considered as a guerrilla marketing project to make the brand more visible and cannot be considered as a continuous distribution channel. This may require less effort in implementing the concept, but would result in less innovative and impacting effects, especially from a social and cultural perspective. Hence, **the second concept *UP to you* was selected as the one to implement and further develop.**

Before moving forward a brief summary of the main key findings from the co-design sessions was defined, taking into account the insights related to all concepts, not only those of the selected concept. The clear definition of the key findings served as a guideline or reminders for the concept implementation.



## 6.4 Concept implementation

For the implementation of the service concept a step back was taken to better **frame the context** in which the service solution should be developed: **Milan**. As previously mentioned in chapter 4.1, Milan is actively engaged in food system innovation through its food policy that gained international recognition becoming an exemplary model to look at. Hence, the food sector represents a pillar for Milan's enhancement and ambitions, and it often plays a central role for innovation and experimentation. This is also true considering the latest **regulations promulgated by Regione Lombardia about urban farming and innovative farming methods**, that acknowledges vertical farming potential from an economical, environmental, social and cultural point of view. Among others, one aspect of these regulations unveils unique opportunities for vertical farming expansion: the law fosters the placement of **vertical farms within the urban context and exclusively in existing buildings** with any intended use, especially those in need for restoration, with the aim of regenerating urban areas and recovering abandoned degraded buildings.

This opportunity increases its potential if cross-checked with other data related to Milan's 2030 plan that regulates territorial governance of the urban and suburban areas of the city.

Within the Piano di Governo del Territorio for Milano 2030, urban regeneration is a central thematic area, considering the significant number of abandoned buildings disseminated in each neighborhood, especially in suburban areas, that represent elements of physical and social decay of the city. For this reason the Municipality has developed mechanisms and incentives for their recovery by penalising inert owners who do not provide requalification of their properties: if building owners do not start reconstruction works of within 18 months from the identification of their property or from the entry in force of the given regulation, the building area will be subjected to a lower building index of only 0,35 mq/mq.

Moreover, subsidies from the government have been allocated to incentive buildings recovery: 1 million euros in 2020 and likewise in 2021 have been assigned to the "**Urban Regeneration**" fund, destined to organisations or associations, with the aim to support the actualisation of public interventions, even within the scope of private-public partnerships, and support urbanistic and economical feasibility studies and demolition expenses in case of high levels

of criticality. To promote the involvement of private entities in urban regeneration interventions, the Region might also set up or participate in one or more real estate funds, set up a guarantee fund to facilitate access to credit for financing interventions, and resort to the co-financing of bank loans (Teknoring, 2019).

These are very interesting data if combined with the urban agriculture legislation that fosters the integration of vertical farms within existing properties: by conceiving *UP to you's* vertical hubs as **vertical farms placed in abandoned buildings in Milan's neighborhoods**, it becomes immediately evident the potential of vertical farming in coping with structural and social challenges of the city. In addition, the concept becomes a great opportunity for building owners, who are offered a realistic scenario on how they can find a new intended use for their buildings, in compliance with the existing regulations and Municipality ambitions.



7.

**Deliver.**  
**The GrowMi**  
**project**

## 7.1 What it GrowMi

**GrowMi is a new and engaging urban farming experience for Milan city dwellers that enables them to access fresh and healthy food within short distances through a network of vertical farms rising in abandoned buildings disseminated throughout Milan's neighborhoods.**

GrowMi wants to be a realistic example in the path towards the implementation of sustainable food systems, where food is produced and distributed without depleting resources and without harming the environment and human health. By contributing to Milan's urban regeneration plan, GrowMi introduces vertical farms within the city fabric through the recovery of abandoned and degraded buildings diffused in many residential areas of the city, in this way facilitating citizens to access fresh and healthy food. It is therefore a project of "**vertical regeneration**" that helps reviving disused areas by uncovering vertical farming's potential in generating value and enhancing the growth of the city on a structural, environmental, social and economical level. This concept is expressed by the name of the service "GrowMi" which emphasises on the idea of growth that links the plant's natural development and the idea of urban regeneration and ultimate growth for the city of Milan. It is also a wordplay that is related to the farming experience component of the service that enables citizens to become "vertical farmers" and have access to their own food.

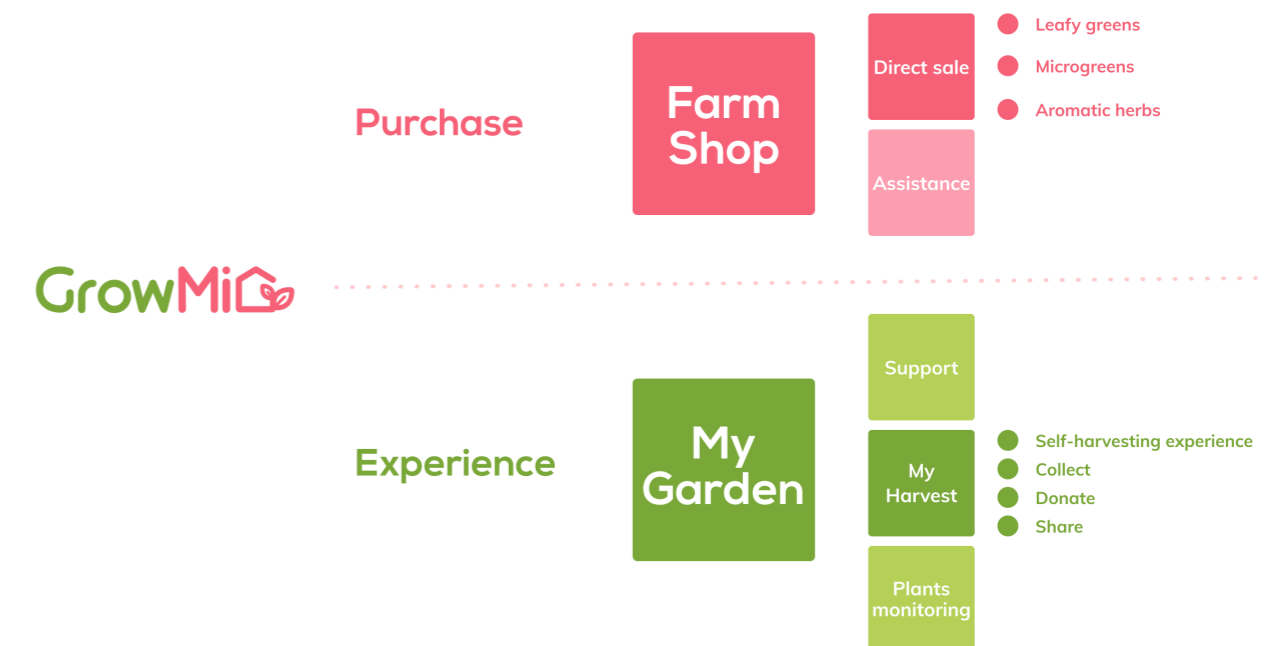
GrowMi is indeed a service that keeps the **urban consumers** at its core as they represent the main target users of the service. With the aim of bringing vertical farming into people's daily life, understanding urban consumers' needs, behaviours and perceptions about vertical farming was fundamental for the development of this project. Hence, while still understanding and considering the context and the other stakeholders that influence and are impacted by the service solution, GrowMi has a strong focus on end-users acting as clients of the service.

GrowMi involves two main service offers (Figure 73) that enable consumers to discover and purchase vertical farming products through a direct sale service inside the vertical farm, and to live an engaging farming experience by taking on an active role throughout the service delivery.

In the following pages the two service offers are described more in detail.

GrowMi offering map

Figure 73





- ▶ The **Farm Shop**, inspired by the “bakery” model where food is produced and sold in the same structure. The Farm Shop is located in a visible part of the building that people can access easily: the shop works as a primary physical touchpoint for consumers that get in contact with vertical farming and with the service for the first time, where people actually get to discover vertical farming methods and products. By making it structurally and conceptually similar to a bakery or a greengrocer, the intention is to give it a “normal” appearance creating an environment that recalls traditional and deep-rooted services that consumers are used to and are already part of their daily lives (Figure 74).

- ▶ **My garden** can be defined as “farm as a service” that consumers can join to live the actual urban farming experience: by subscribing to the service, people can create their own garden and participate in the plants’ growth process by monitoring the plants and finally pick their harvest on the harvesting day. My garden involves, therefore, both a physical and digital experience that enables consumers to learn about vertical farming in an engaging way and, most importantly, to have control on the food they will eat by knowing how it’s produced and where it’s from, while creating a closer bond with it (Figure 75).

GrowMi Farm Shop

Figure 74



GrowMi MyGarden - Harvesting room

Figure 75



## 7.2 The User Experience

To better imagine the ideal user experience and how customers interact with the service, a user journey map was developed. The journey map describes the service step by step from a user perspective, specifying what happens at each stage of the process, what touchpoints are involved and the emotional flow and thoughts performed by the user throughout the overall experience (Service Design Tools, n.d.).

The user experiencing the service for the first time is **Matteo**, a **young worker living alone** in his own apartment in Dergano, Milan. He's used to do his grocery at the supermarket but many times he complains about the quality of fresh food he buys there, which is often tasteless and doesn't really know where it's from or how it's produced: sometimes he buys organic food because he knows it should be better but actually he doesn't know much about it. He has also tried Cortilia once, but the quantities of food for him living alone was excessive. **He would like to be facilitated to adopt more sustainable habits and have easy access to more fresh food without giving up on convenience in terms of proximity, time and effort.** He wishes to **get the exact quantity of fresh food he needs** to avoid food getting old and throw it away, and would like **to be sure that what he buys is actually good and healthy.** He doesn't know much about vertical farming, but he's always attracted by "strange" and different things, so he would like to try vertically grown products. However, he has some doubts about this new farming method that looks quite futuristic: he would like to understand **how vertically grown products actually grow** and **if they are as good as traditional ones in terms of taste and nutrient.**

On a night after work, Matteo remembers that his fridge is empty and needs to buy some fresh food for dinner.

A brief description of the user experience is given, highlighting location and touchpoints that characterise each phase of the journey, followed by the complete user journey map (Figure 76).

### ► Discovery

Matteo discovers the service while walking back home and decides to buy some vegetables for dinner at the GrowMi shop. He had only heard of this new service but had never tried its products.

---

📍 On the way home - GrowMi street

📄 GrowMi adv

### ► Decision

Once inside, he reads something more about vertical farming and while discovering those strange "fridges" and noticing fresh looking lettuce, the farm assistant gives him some advice and informs him about the subscription service. He finally decides to buy the baby lettuce and the farm assistance gives him a flyer with info about the "My garden" service.

---

📍 GrowMi Farm Shop

📄 VF modules, products, check-out desk, flyer, payment receipt

### ► Dinner

Once home he enjoys his dinner and he's pleasantly surprised by how good is the lettuce he bought.

---

📍 Home

📄 Lettuce

### ► Register

He decides to subscribe to the "My garden" service motivated by the possibility to have constant access to such good fresh food very close to his apartment, and to live a stimulating farming experience: he downloads the app and registers.

---

📍 Home

📄 App, flyer

### ► Garden creation

He selects the GrowMi farm in Dergano, goes through all the different products and creates his garden with a species of lettuce and broccoli microgreens for one person only. He gives his garden a name and finally pays the subscription.

- 
- 📍 Home
  - 🚩 App, confirmation email

### ► Monitoring

The day after he receives a notification stating that his plants have been planted by the farm's agronomists and over the next few days he checks his plants learning a lot more about vertical farming and how the plants can actually grow using this farming method. The week after he gets notified that his microgreens are ready to harvest.

- 
- 📍 Workplace, home
  - 🚩 App

### ► Harvesting

The day after he goes to the farm and reaches his garden, by following the instructions on the app, and finally picks his little microgreens.

- 
- 📍 GrowMi Harvesting room
  - 🚩 App, personal garden (tag name), plants, packaging

### ► Collecting

After a few days he gets notified again that his lettuce is also ready to harvest. However, since he's finishing work later that day, he expressed his preference to just collect his harvest from the farm locker, which is always accessible at any time. So after work he steps by the farm and collects his lettuce very quickly.

- 
- 📍 Workplace, GrowMi lockers area
  - 🚩 App, lockers, lettuce

### ► Dinner

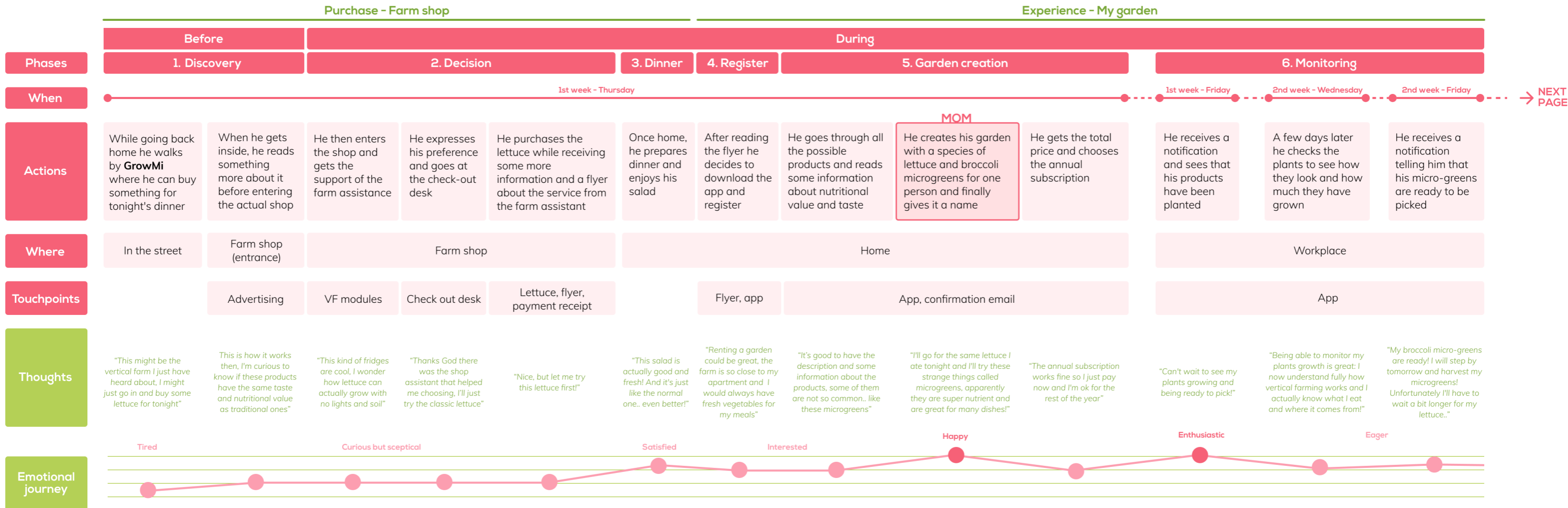
He finally gets back home and makes himself a good, fresh salad with broccoli microgreens.

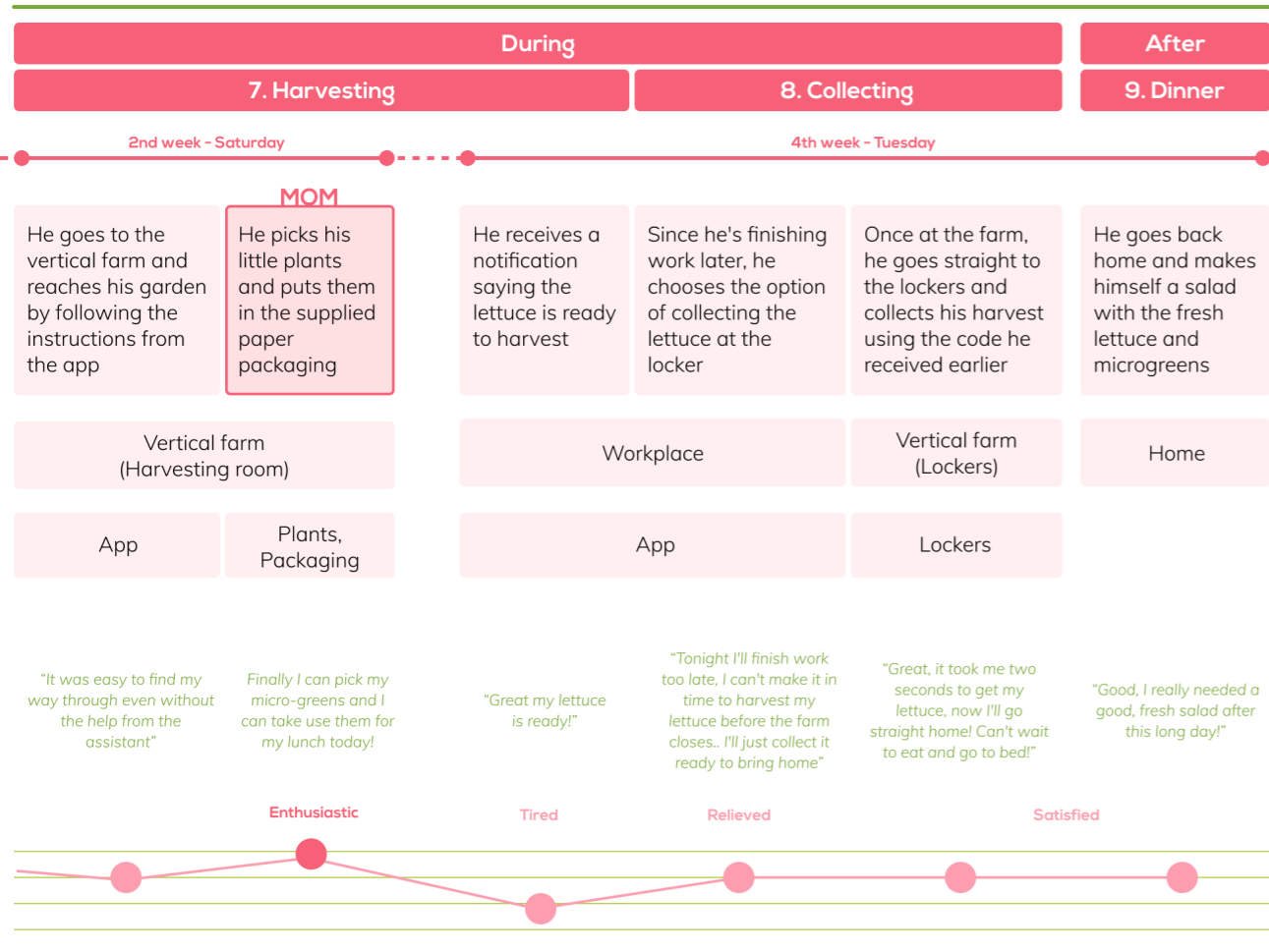
- 
- 📍 Home
  - 🚩 Lettuce, microgreens

Within this journey, two were considered the most impressive moments for the user, representing the moment of meaning of the user experience: when the user creates his own garden and gives it a name, and when the user harvests his crop.

# User Journey Map

Figure 76





## 7.3 How GrowMi works

GrowMi, as most of the services, involves different actors that enable the service delivery by cooperating and performing actions simultaneously. In order to describe each stakeholder's task, contribution and motivations, a service blueprint, a system map, a stakeholders map and matrix were developed. Additionally, an economic and financial overview of the service was provided through the design of a business model canvas.

### 7.3.1 Service delivery

To better understand how the user experience is enabled by the service provider, a service blueprint describing the actions played by the user and the service provider was developed. The service blueprint is a diagram describing all the simultaneous actions performed by the different actors involved in the system that are required to deliver the service: it is divided between the actions the user can see, happening above the visibility line, and those actions the user cannot see and happen in the back office (Service Design Tools, n.d.). In the next pages the complete and detailed service blueprint is shown (Figure 77).

To facilitate comprehension, a brief explanation of the key steps of the service blueprint is given by using colours to identify **front-end actors and elements** and **back-end actors and systems**.

#### ► Decision

While Matteo is in the GrowMi farm shop, the front end involves the **farm assistant** who is in charge of assisting clients when they enter the shop and purchase products. The sale of the products is enabled by the **payment system**.

- 
- 📍 GrowMi Farm Shop
  - 🚩 VF modules, products, check-out desk, flyer, payment receipt
  - 👤 Farm assistant
  - 💬 Payment system

#### ► Garden creation

Similarly, when a customer subscribes to My garden service, the payment is possible thanks to an online **payment system**, which is also linked to the **automatic email system** that sends confirmation emails to the customers.

- 
- 📍 Home
  - 🚩 App, confirmation email
  - 💬 Payment system, confirmation email system

#### ► Garden creation

The monitoring activity through the app is made possible thanks to the **monitoring system** inside the different rooms where the plants' growth happens: through the app, customers have access to the cameras that are normally used by the farms' engineers and agronomists to monitor their health and development. **Agronomists**, moreover, are in charge of moving plants from one room to another according to their growing phase and of signaling any change of location of the plants through the platform, whenever plants are moved from seeding, to germination and to growing rooms. This is connected with the **notification system** that enables notifications that inform users about the plants' state.

- 
- 📍 Workplace, home
  - 🚩 App
  - 👤 Agronomists
  - 💬 Monitoring system, notification system

#### ► Collecting

In case users are not able or do not want to participate in the harvesting activity, they are asked to express other options concerning their plants through the app. In this specific case, the user chooses to collect his harvest at the farm's lockers: the **farm**

**assistant** has visibility on customers' requests and is in charge of bringing the user's products from the harvesting room to the right locker, where the user can easily access through a **code** generated by the system.

- In addition to the collection option, there are two other possible ways of managing the plant's harvest: the app allows the user to share his garden's details and instructions to a friend or family allowing them to live the farming experience and harvest his plants; alternatively, if the user has no other possibility of collecting his harvest, he can donate his products to the Food Waste Hub, partner of GrowMi, to prevent food to be wasted. In this case, the **farm assistant** is also in charge of managing the products that will be collected by the Food Waste Hub operators.

---

 Workplace, GrowMi lockers area

 App, lockers, lettuce

 Farm assistant

 Code generator

# Service blueprint

Figure 77

FRONT END

BACK END

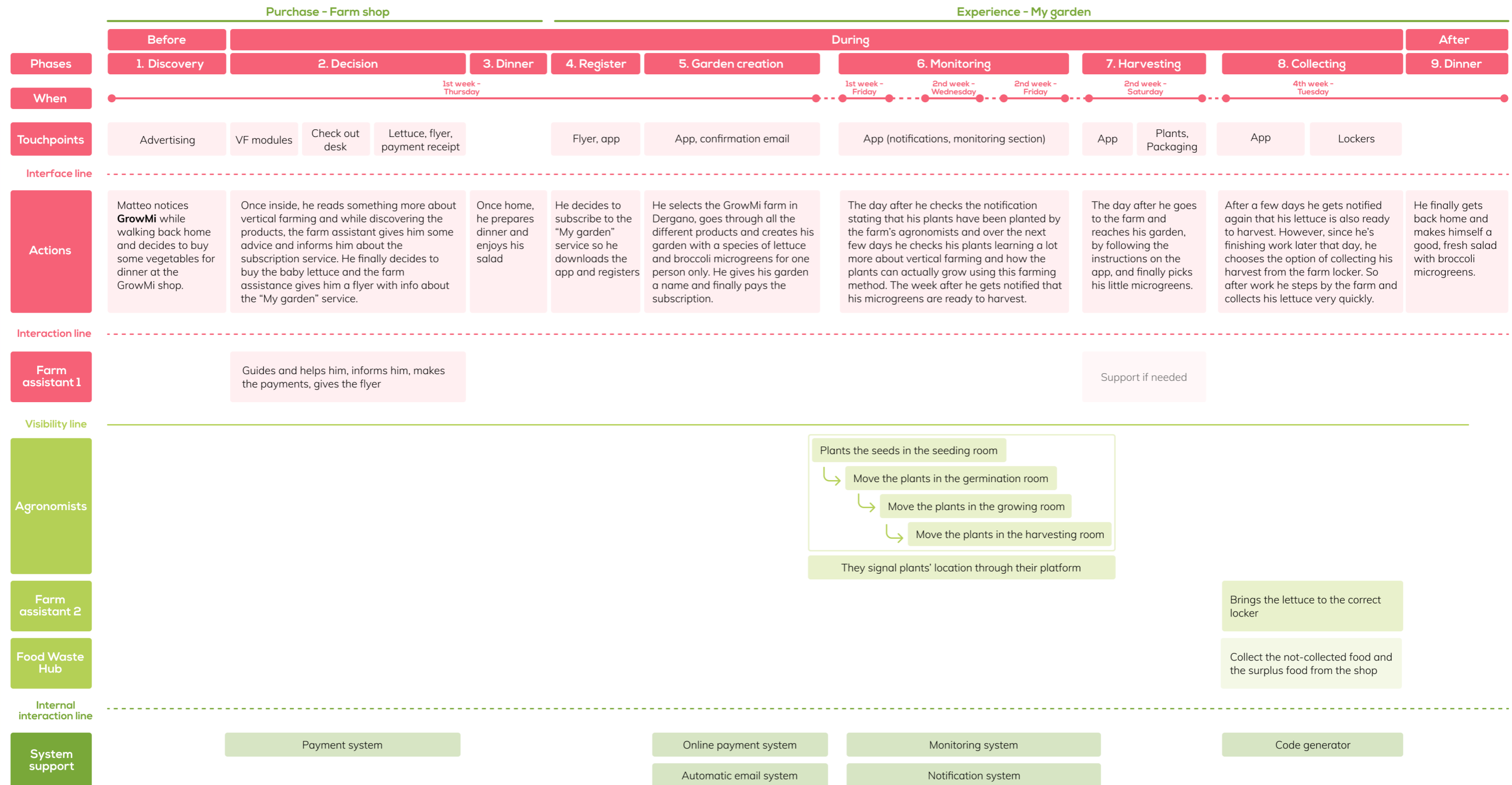




Figure 78

### 7.3.2 Service system and stakeholders

To have a clear idea of the actors involved in the service system and their interrelation, a system map was built. The system map can be considered as a synthetic representation of all the different actors involved in the service delivery and the mutual links and flows that exist among them, highlighting the value they exchange (Service Design Tools, n.d.).

Fundamental actors that make the service possible are the **owners of abandoned buildings**: by establishing a relationship with them, they provide a place for the **GrowMi** vertical farm to be settled and the service to be delivered. Within this project, it is expected that GrowMi pays for the building rental, however such relationships can be managed in different ways.

**Comune di Milano** plays a "glue" role, as it has interests in incentive building recovery and the implementation of vertical farming activities within the urban fabric: financing and incentives are given to GrowMi and the building owner, as well as to Food Waste Hub. The **Food Waste Hub** is another actor involved in the system that contributes by collecting and redistributing the surplus food and not-collected food by the clients of the service to charities and other entities in Milan. By adhering to this initiative which is supported by the Comune di Milano itself, GrowMi receives waste taxes reduction. GrowMi, as any other newborn vertical farm in the area of Milan, receives monetary contributions from investors who believe in the project.

**Components and raw material suppliers** are also fundamental actors enabling the production: components supplier are determinant at the very beginning when the vertical farm has to be equipped, and occasionally when components need maintenance; raw material suppliers provide constantly seeds, nutrient solutions, growing medium, etc, allowing the agronomists and other farm's operators to grow plants optimally.

Last but not least, **consumers** represent the clients of the service, who can interact with it either by purchasing products directly at the Farm Shop, or by subscribing to My Garden service, in this way receiving their own products and information about their growth on a constant basis.

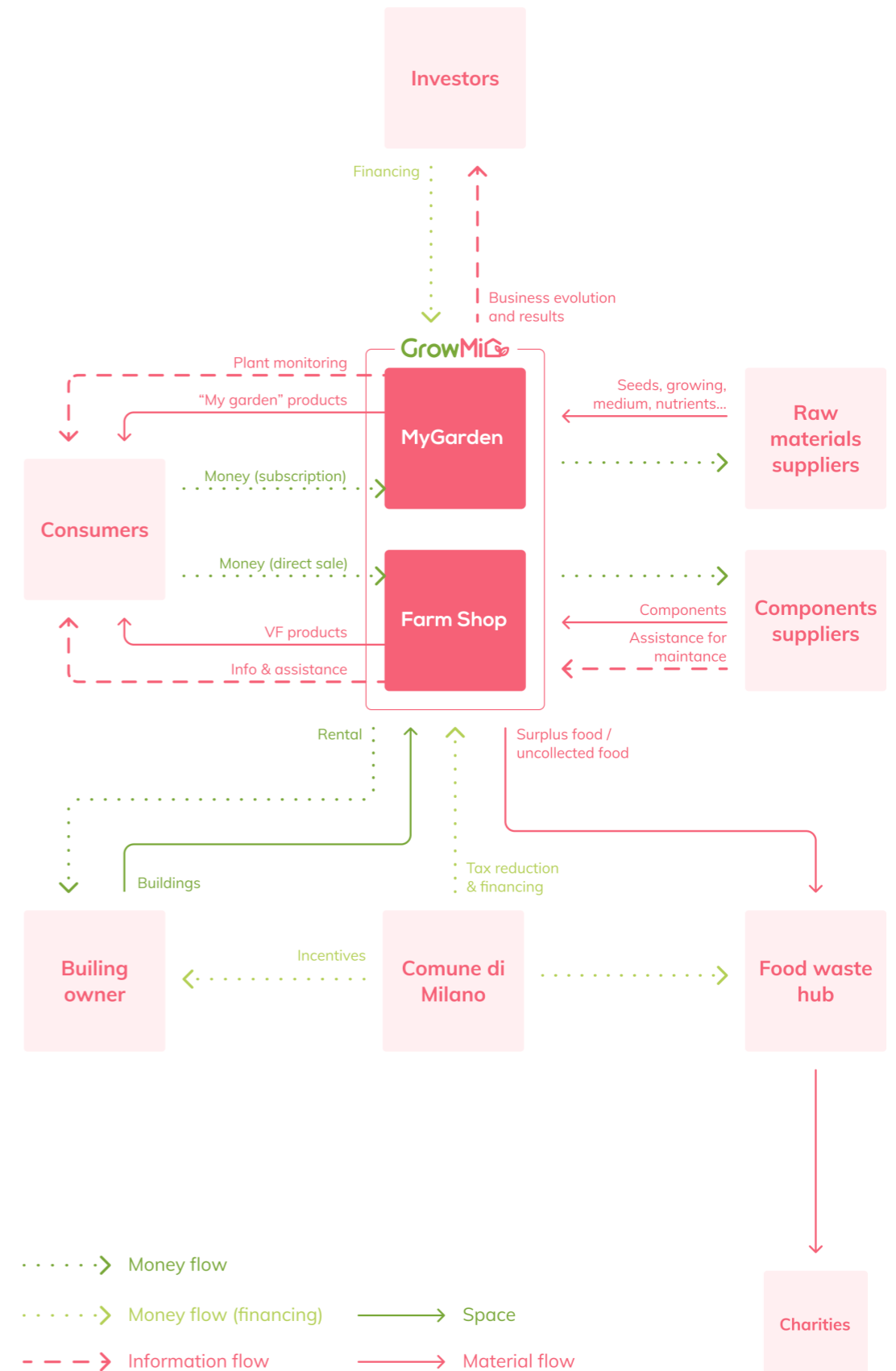
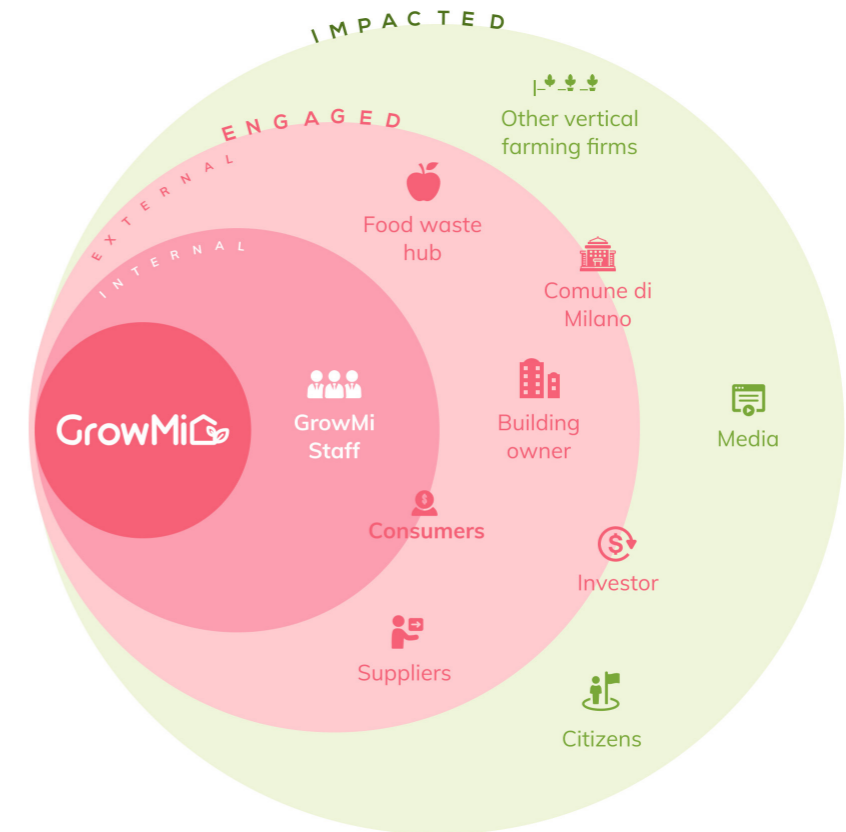


Figure 79

In the following diagrams, a stakeholder map clearly shows the engaged stakeholders, both internal and external, and the impacted stakeholders (Figure 79). The **GrowMi staff** represents the core of the service as the farm's operators are the most important actors in the service delivery. **Consumers** are **on the edge between the internal and external** as they are actively engaged in the service, especially within the My Garden service offer. Other **engaged yet external stakeholders** are the **materials' suppliers**, the **building owner** and the **Food Waste Hub**. **Investors** and **Comune di Milano** are both **engaged and impacted stakeholders**, as they somehow contribute to the service but are also impacted by its success. Finally, the **impacted stakeholders** would be other **vertical farming firms**, that see the birth of a new competitor, the **media outlets**, that will share information and communication material about GrowMi, and finally **citizens**, that will see the rise of vertical farms throughout the city.



A stakeholder matrix (Figure 80) was then developed to highlight the main stakeholders' motivation in participating in the service, and their mutual contribution to one another.

Through this service GrowMi wants to differentiate in the market while getting closer to consumers and ultimately scale the activity. For the Municipality, it provides realistic solutions for the actualisation of the PGT ambitions, the 15 min model and Milan Food Policy priorities, while for abandoned building owners GrowMi offers them a new life and intended use for their buildings in compliance with the existing regulations. By partnering with Food Waste Hub, GrowMi gives them the unsold food that would otherwise be thrown away allowing them to strengthen existing actions by cooperating with another business. By providing the structure, the building owners find a realistic and auspicious use for the abandoned building, endorsing Municipality's urban recovery plan and ambitions. For this reason the Municipality gives incentives and financing to restore their abandoned buildings, and by supporting the service through financing and public tenders and bids, the city may respond to the city challenges while accommodating new businesses' requests and needs. The Municipality also supports the Food Waste Hub, being itself a public initiative, as it provides effective solutions for the reduction of food losses and waste, which is one of the Milan Food Policy priorities. By adhering to this initiative, GrowMi also receives from the Municipality a 20% reduction on the waste tax (Magarini, 2019).

Figure 80

brings to	GrowMi	Abandoned building owner	Comune di Milano	Food Waste Hub
GrowMi	Differentiate in the market while getting closer to consumers and scale their activity	Offer a new life and intended use for their buildings in compliance with the existing regulations	Provide realistic solutions for the actualisation of the PGT ambitions, the 15 min model and Milan Food Policy priorities	Unsold food that would otherwise be thrown away
Abandoned building owner	Building	Find a realistic and auspicious use for the abandoned building	Endorse Municipality's urban recovery plan and ambitions	/
Comune di Milano	Financing and subsidies + Waste tax reduction of 20% (food waste hub)	Incentives and financing to restore their buildings	Respond to the city challenges while accommodating new businesses' requests and needs (vertical farms)	Support and public space for managing food redistribution
Food Waste Hub	Collect surplus food	/	Provide effective solutions for the reduction of food losses and waste (Milan Food Policy priority)	Strengthen existing actions by cooperating with another business

Figure 81

### 7.3.3 Business Model

From the economic and financial perspective, a business model canvas (Figure 81) was developed to describe how the service generates value and its revenues. The business model canvas provides an overview of the service in terms of value proposition, infrastructure, types of customers and financial model, helping to spot what activities are needed in order to build and deliver a service (Service Design Tools, n.d.).

The **value proposition** is an expression of what GrowMi wants to offer to the customer segments, that in this case are, generally speaking, the urban consumers: *GrowMi offers city dwellers an engaging urban farming experience while enabling them to access fresh and healthy food within short distances through a network of vertical farms rising in abandoned buildings disseminated throughout the city's neighborhoods.* The **key resources** for the service development are those that enable production and distribution of the products, which are: renovated abandoned building, vertical farming system, raw materials (seeds, nutrients...), team of agronomists, engineers and other farms' operators, payment and selling system. This is made possible also thanks to **key partners**: the building owner, the materials' suppliers, and also the Municipality and Food Waste Hub that provide support and financing in different ways. The **revenue streams**, indeed, are partially from the Municipality funds, investors financing and equity, while part of the streams come from the direct sale of the Farm Shop and from the subscriptions to My Garden. Concerning the **cost structure**, the costs are divided into initial costs and continuous costs. The former involves all the set up costs: building improvement, vertical farming system set-up (lighting, sensors etc), the Farm Shop set-up and the platform development. The continuous costs are general running costs, that involve: the building rental, bills (electricity, water etc), taxes, human resources, raw materials, packaging, maintenance.

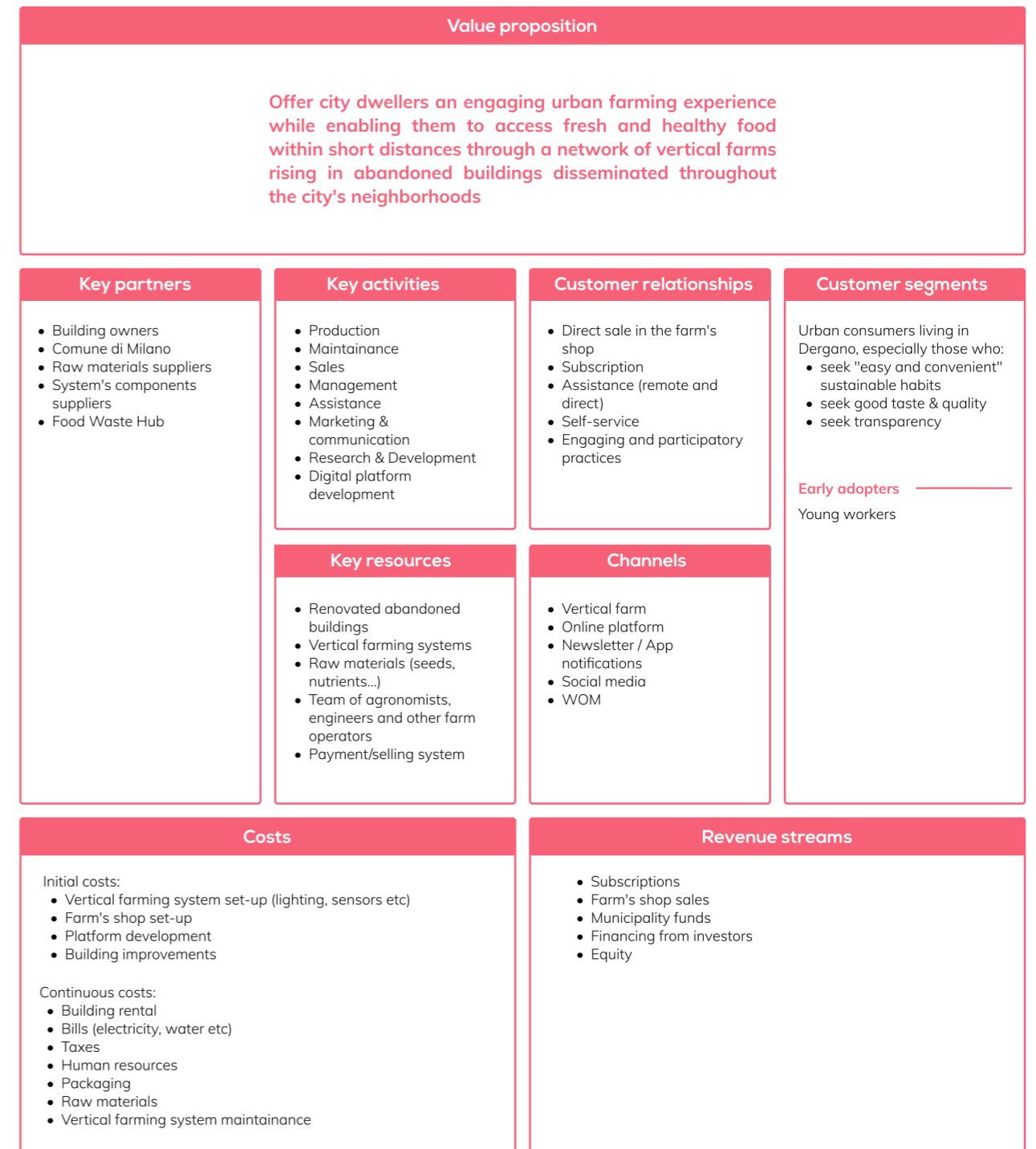


Figure 82


## 7.4 GrowMi app and brand identity

As previously described, the name of the service GrowMi wants to express the service concept through wordplay. GrowMi is the conjunction of the word grow, related to the concept of growth and development, and **Mi**, which sounds as the objective complement "me" and also represents a shortcut for "Milan": the name GrowMi, therefore, refers both to the "self-farming" experience concept which involves the active participation of the consumers, as well as the idea of **growth for the city of Milan, through a "vertical regeneration"**. This concept is also embodied by the **logo**, which represents a building growing from a plant. The colours selected for the brand identity are the ones that characterise the most vertical farming, which are green shades, reminding of plants, and the pink shades, that recall the artificial lighting. Concerning the font, the outlines and strokes characterising the visual and aesthetic component of the service, a simple and rounded style, was preferred to give a more "friendly" appearance together with a friendly and attentive tone of voice.


While defining the service and the **brand identity** (Figure 82), the design of the app received greater attention as it constitutes a staple all along the user experience. For the purpose of this thesis project, the design of the **app** (Figure 83) was carried out only partially, developing only the most important and meaningful flows and functions for the storytelling.

The design of the app consisted into three main stages: first, the information architecture of the app was identified by structuring and organising the content of the application; second, two main flows were identified, together with some key interfaces, and developed into low-fidelity wireframes; finally, through the creation of a simple design system with a library and components, the wireframes were transformed into mockups.

### Logo



### Icons



---

### Brand colours

- HEX 79A839  
R 121, G 168, B 57
- HEX B4D056  
R 180, G 208, B 86
- HEX E8FFC1  
R 232, G 255, B, 193
- HEX F66177  
R 246, G 97, B 119
- HEX FC9EB0  
R, 252, G 158, B 176
- HEX FFCBCF  
R 255, G 203, B 207
- HEX 000000  
R 0, G 0, B 0
- HEX FFFFFFFF  
R 255, G 255, B 255

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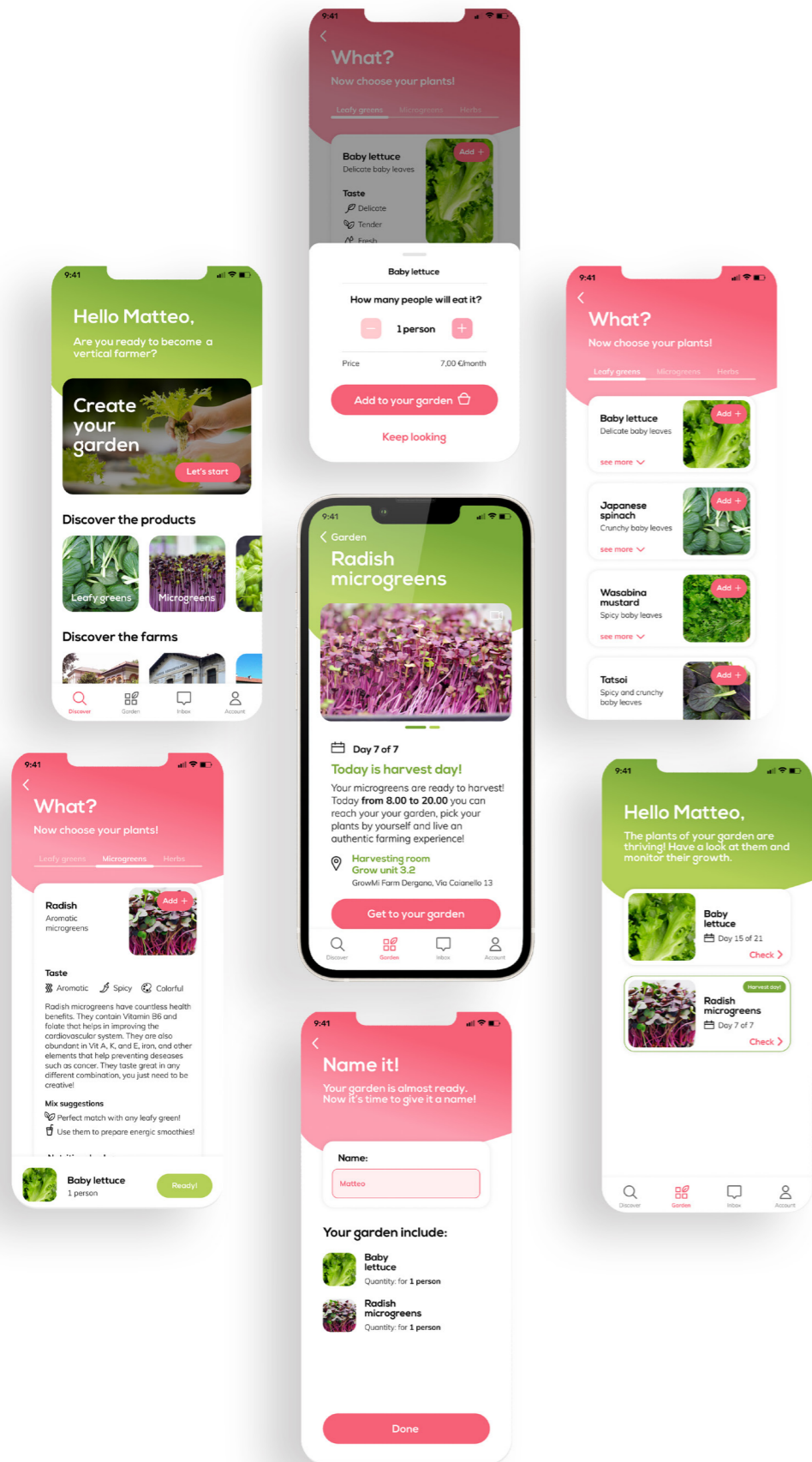
### Typography

Headings	<div style="background-color: #79A839; color: white; padding: 10px; border-radius: 10px; display: inline-block;"> <p><b>Nexa Bold</b> 36 pt</p> <p><b>Nexa Bold</b> 18 pt</p> </div>	<div style="background-color: #FC9EB0; color: white; padding: 10px; border-radius: 10px; display: inline-block;"> <p><b>Nexa Bold</b> 20 pt</p> <p><b>Mulish</b> 14 pt</p> </div>	<p><b>Nexa Bold</b> 24 pt</p>
Body	<p><b>Mulish Bold</b> 18 pt</p>	<p>Mulish Light 18 pt</p>	<p>Mulish Light 14 pt</p>
Menu	<p>Muli Light 10pt</p>	<p><b>Muli Light</b> 10pt</p>	

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### UI components

<p>Primary</p> <p>Active</p> <div style="background-color: #F66177; border-radius: 15px; padding: 5px; text-align: center; margin-bottom: 5px;">Button</div> <p>Disabled</p> <div style="background-color: #FFCBCF; border-radius: 15px; padding: 5px; text-align: center; margin-bottom: 5px;">Button</div>	<p>Tertiary</p> <p>Big</p> <div style="background-color: #79A839; border-radius: 15px; padding: 5px; text-align: center; margin-bottom: 5px;">Button</div> <p>Small</p> <div style="background-color: #79A839; border-radius: 15px; padding: 2px; text-align: center; margin-bottom: 5px;">Button</div>	<p>Controllers and selectors</p> <p>Default</p> <div style="border: 1px solid #FFCBCF; width: 40px; height: 15px; margin-bottom: 5px;"></div> <p>Selected</p> <div style="border: 1px solid #F66177; width: 40px; height: 15px; margin-bottom: 5px;"></div> <p>Default</p> <div style="border: 1px solid #FFCBCF; width: 40px; height: 15px; margin-bottom: 5px;"></div> <p>Focus</p> <div style="border: 2px solid #F66177; width: 40px; height: 15px; margin-bottom: 5px;"></div> <p>− +</p>
<p>Secondary</p> <p>Active</p> <div style="border: 1px solid #F66177; border-radius: 15px; padding: 5px; text-align: center; margin-bottom: 5px;">Button</div> <p>Disable</p> <div style="border: 1px solid #FFCBCF; border-radius: 15px; padding: 5px; text-align: center; margin-bottom: 5px;">Button</div>		



## 7.5 Prototyping and testing

In order to have a more tangible prospect of the service idea and its effective implementation potential, a final prototyping and testing phase was planned. First, an **abandoned building in Milan was identified** as a possible **location for the GrowMi vertical farm and annexed service**, and all the calculations about the surface, dimensions and the related **costs** were made referring to it. The building served also as a reference point to based considerations on and an element for the storytelling during the testing moment with Pietro from Buono Farm, a recently born vertical farm in the centre of Milan: the building and the user experience were presented to describe the service and give him tangible elements upon which he could share his considerations and knowledge, and ultimately understand feasibility and viability issues.

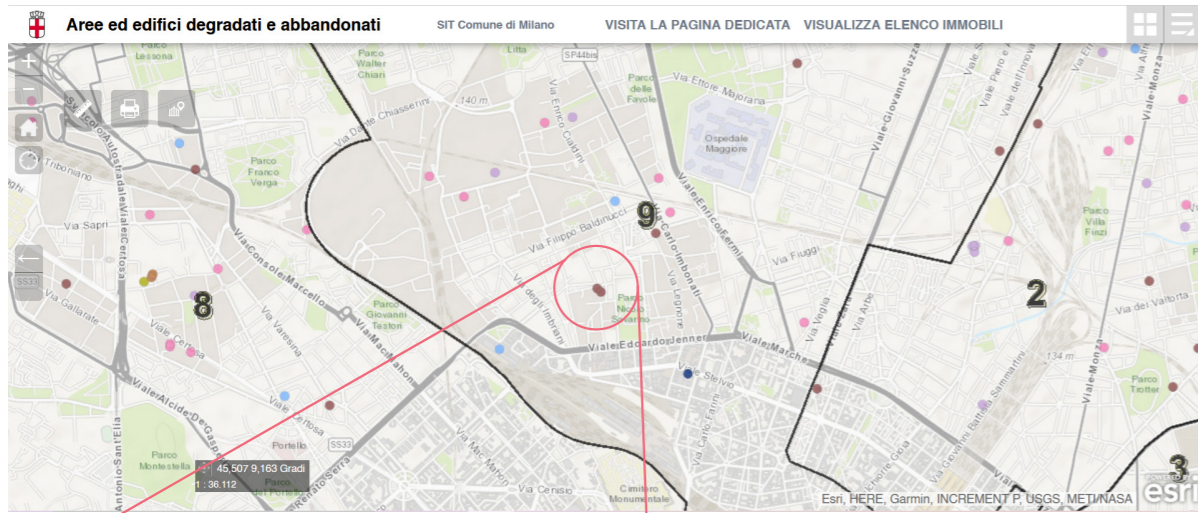
Later, a final test was performed with the target user using the concept walkthrough technique in order to gain feedback about the service idea and inform the next implementation phases.

### 7.5.1 The building

The Municipality of Milan has launched in 2014 a mapping activity aimed at detecting and giving visibility to the amount of abandoned and unused buildings in Milan. Through the Geoportal "Map of degraded and abandoned areas and buildings" (Comune di Milano, 2021), a **building in Via Caianello 13 in Dergano** was identified as the reference building for this project (figure 84). Since the urban agriculture law fosters the placement of vertical farms in existing buildings with any intended use, recognising then the buildings as agricultural use, the choice of the building was not guided by the building itself, it was rather determined by the neighborhood in which it rises. Dergano was chosen and was preferred among the others for a few reasons:

- ▶ It is a residential neighborhood that has recorded a very significant growth in the resident population over the past few years, and it is located in one of the districts identified as an area in need of urban regeneration in the Piano di Governo del Territorio (Comune di Milano, 2020c; Comune di Milano, 2020d).
- ▶ It is right next to Bovisa, an area of Milan populated by universities and startup incubators, symbols of research and innovation.

Figure 84



Via Caianello, 13  
Dergano

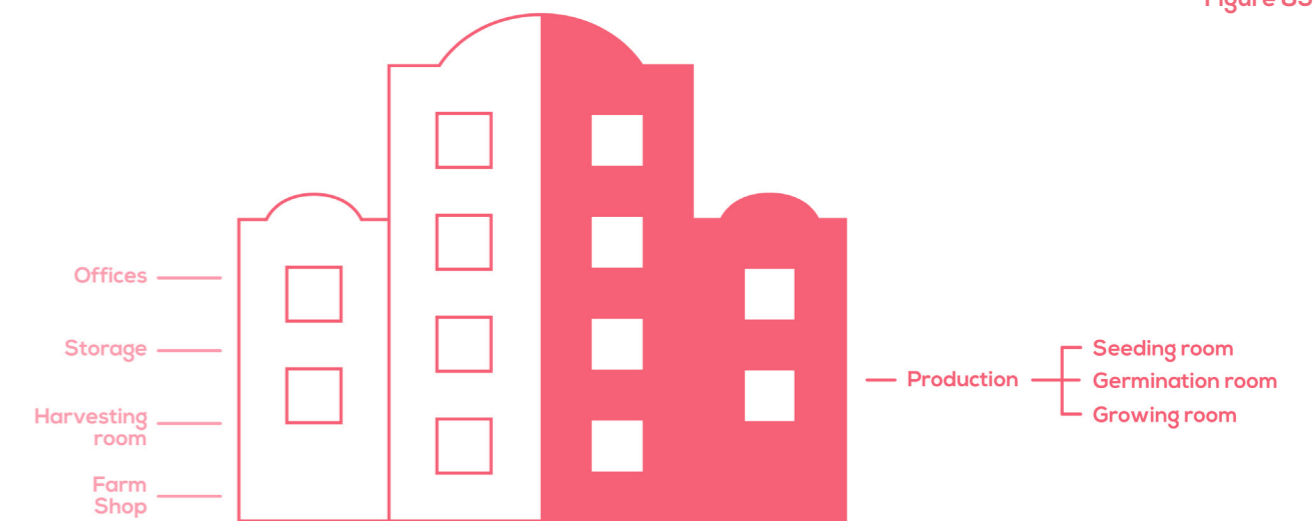


By measuring the building in Via Caianello, the surface of the area occupied and the total surface of the building were identified: the longest side measures 38m while the shortest is 15m, occupying an area of 570 mq. By analysing the structure of the building and its height, another calculation was carried out to get the real usable surface within the building: the two parts on the sides, characterised by two floors each, are 570 mq, while the central part, consisting of 3 usable floors, has a surface of 855 mq. Totally, the building provides an area of approximately **1400 mq**.

To give realistic dimensions of the surface dedicated to each purpose, it was estimated that roughly a **half of the building's available surface, 700 mq, would be dedicated to production**, and the rest would be divided among the offices, such as administration, logistics, management, etc, and the GrowMi service offering for customers (figure 85).

These estimations intended to give a tangible base upon which to calculate costs and deduce the viability and feasibility of this prototype version of the service. To gather this information and understand potential barriers that could hinder the implementation of the service, a co-design-like meeting with Pietro from Buono Farm was organised.

Figure 85



## 7.5.2 Testing

### Testing session with Buono Farm

The **testing session with Pietro** started with a very brief summary about the research to help him understand the project direction and underlying motivations. Then, a short presentation of the service in terms of value proposition and offering was done before briefly explaining and illustrating the building's dimensions and structure (Figure 86).

To be able to understand GrowMi's feasibility on an operational and management level, a prototype of the user experience structured in a form of storyboard was developed to help Pietro discover and imagine the service. In order to understand critical moments from the operational point of view, the storyboard was integrated in a simplified blueprint: in this way it was possible to have a clear understanding of the actors involved and their tasks all along the service process and delivery, and to help the discussion about it. Finally, a moment of reflection was planned to allow Pietro spot the elements that could compromise the viability of the project and to spot more general feasibility considerations.

In general, the test resulted to be effective and **validated the feasibility of the service despite some limitations**. To be able to assess costs and the viability of the service, a more detailed list with an estimation of the initial and continuous costs of a generic vertical farm was developed (Figure 87). To simplify calculations the costs are therefore limited to the strictly necessary costs a vertical farming business would have to face in setting up the production system in the identified building in Dergano. The calculations are further simplified by considering the costs implied for the production of just leafy greens products.

Assuming that reconstructions and building improvements' costs are borne by the building owner, the initial cost of the vertical farming system constituted by **116 grown units** in an area of **700 mq**, would be amortised in 12 years at a rate of 24 530 € per year.

The other fixed costs of a vertical farm include: overheads, meaning the general costs such as rental, electricity, water, internet bills etc; headcounts, that relate to all the employees expenses.

In order to calculate a simplified break even point, the costs were defined on a monthly level to be able to calculate it according to the monthly production volumes. By considering overheads, headcounts and equipment costs (including amortisation), the total fixed costs monthly is 22 000 €. The costs related to raw materials, such as seeds, growing medium, water, light etc required to enable production are considered variable costs, meaning that depend on production volumes. They are estimated to be 2 €/kg and on a maximum production output of 1856 kg/month (made possible by the given production system), total variable costs would be 3 712 €. Estimating a sale price of 18 €/kg and a contribution margin per unit of 16 €/kg, the total contribution margin considering the maximum production output would be 29 696 €/month. Finally, a simplified break even point was calculated to understand the production volume required to equal fixed costs: **by selling 100 g of leafy greens at 1,80 €, the total amount of leafy greens that would need to be produced and sold is 1375 kg/month**.

To give meaning to this data, it was compared with the average quantity of baby lettuce consumed in Milan: the city of Milan is characterised by the largest consumption rate of packed lettuce,

Testing session with Pietro from Buono Farm

Figure 86

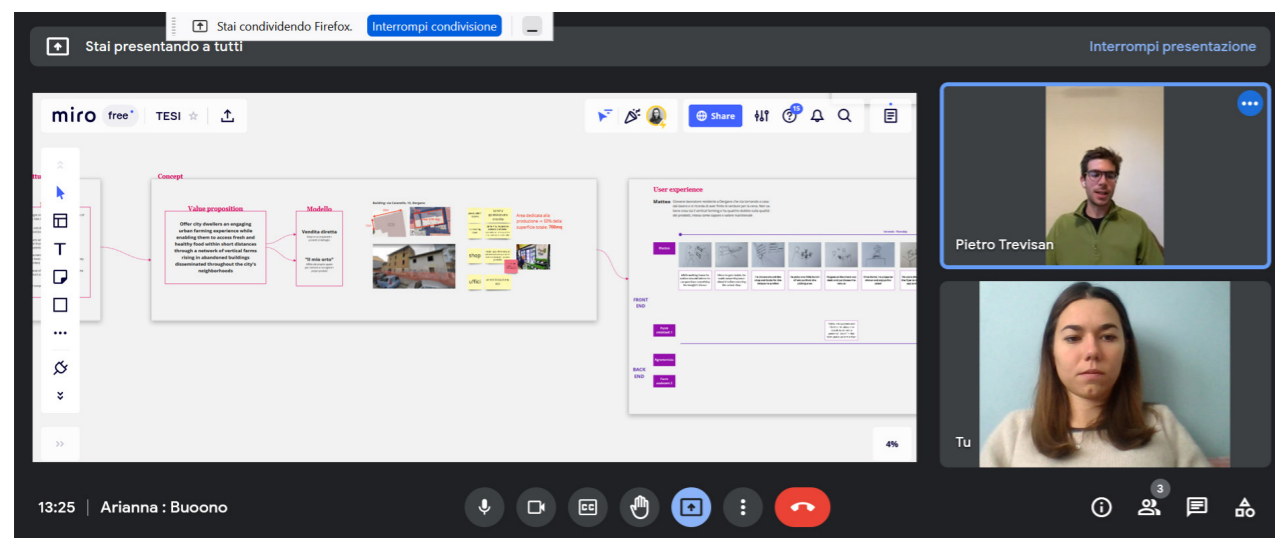


Figure 87

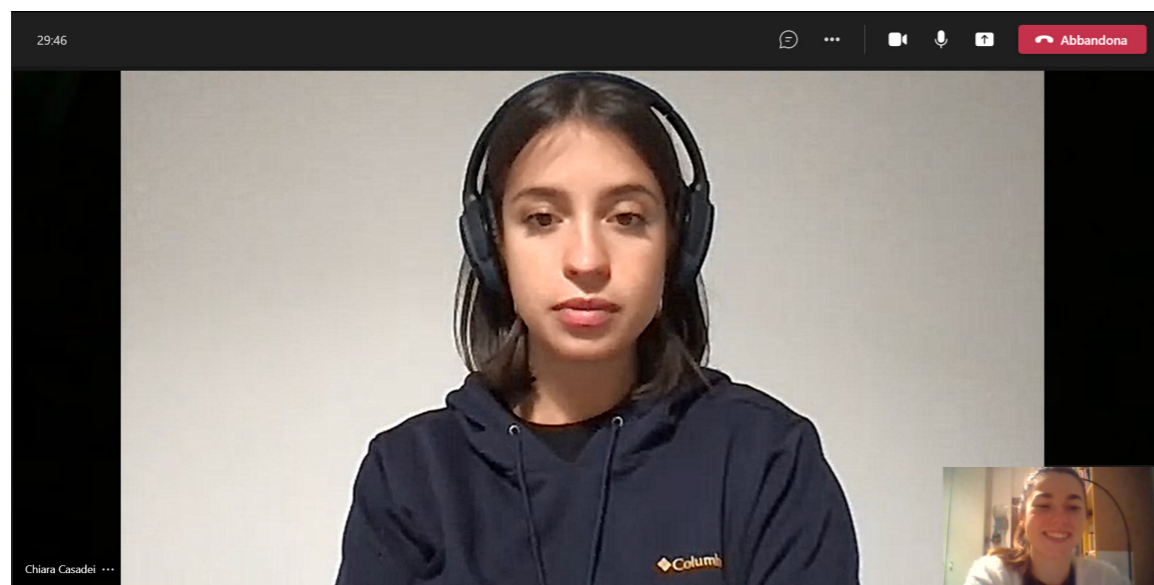
especially baby lettuce, that accounts for 1000 tons per year consumed by Milanese citizens (Redazione MyFruit, 2019). According to the Comune di Milano (2020c) census in 2019, Milan has 1 404 431 inhabitants, and 23 474 of those live in Dergano. Through a rough calculation it can be estimated that if 1 000 000 kg of baby lettuce are consumed in Milan each year, 16 714 kg are consumed in Dergano. This means 1393 kg/month and this data, if compared to 1375 kg/month required to reach the break even point, suggests the likelihood for the vertical farm in achieving the break even.

### Testing session with target user

The final testing session with the target user (Figure 88) involved Chiara, a young worker living in Milan and who struggles to balance her needs and preferences for convenience, when doing the grocery, with more sustainable habits. By "walking" her in the service experience through the use of the visuals and app developed, Chiara provided interesting feedback about the overall experience, **validating the service** and expressively declaring that "a service like GrowMi would definitely improve her fresh food-grocery experience".

Testing session with target user Chiara

Figure 88



#### Production volume

Fresh produce output x grow unit (weekly)	4 kg
Production area	700 mq
Total grow units x production area (n)	116
Total production output (weekly)	464 kg/week
Total production output (monthly)	1856 kg/month

#### Annual costs

	Year 1	Year 2	Year 3	...	Year 12	Notes
<b>Building improvements and equipments</b>						
Location improvements	30 000 €					Borne by the building owner
Cold storage and loading equipments	18 000 €					
Distribution equipment	10 000 €					
HACCP compliance	5 000 €					
HVAC system	16 000 €					
<b>Total</b>	<b>79 000 €</b>					
<b>Grow units (2 x 3 m)</b>						
Construction and design	1 170 €					
Macro climate control	200 €					
Irrigation	3 000 €					
LED lights	2 000 €					
Racking / plant support	500 €					
Components total (per unit)	6 879 €					
Components total (per production area)	294 370 €					Plant supports and LED lights costs were multiplied for the number of grow units
<b>Amortisation</b>	<b>24 530 €</b>	<b>24 530 €</b>	<b>24 530 €</b>	<b>24 530 €</b>	<b>24 530 €</b>	
<b>Overheads</b>						
Rental	96 000 €	96 000 €	96 000 €	96 000 €	96 000 €	
Bills	24 000 €	24 000 €	24 000 €	24 000 €	24 000 €	
<b>Total</b>	<b>120 000 €</b>	<b>120 000 €</b>	<b>120 000 €</b>	<b>120 000 €</b>	<b>120 000 €</b>	
<b>Headcounts</b>						
Employees	120 000 €	120 000 €	120 000 €	120 000 €	120 000 €	

#### Simplified BEP

##### Monthly costs

<b>Fixed costs (monthly)</b>	
Overheads (rental, bills)	10 000 €
Headcounts (employees)	10 000 €
Equipment (maintenance, amortisation)	2 000 €
<b>Total</b>	<b>22 000 €</b>
<b>Variable costs (monthly)</b>	
Per unit	2 € / kg
Total (for max output)	3 712 €
<b>Price per unit</b>	<b>18 € / kg</b>
<b>Contribution margin per unit</b>	<b>16 € / kg</b>
<b>Total contribution margin</b>	<b>(18 €/kg x 1856 kg/month) - 3712 € = 29 696 €</b>
<b>BEP</b>	<b>22 000 €/month / 16 €/kg = 1375 kg</b>







8.

**Conclusions**

## 8. Conclusions

The overall research and project journey has significantly contributed in exploring and detecting challenges and opportunities of vertical farming on a global level and especially within the Italian context, providing significant data about its current development, its opportunities and future prospects as well as its limitations and impediments.

Generally, the thesis research and project confirmed the **low-medium viability of vertical farms**: the path to profitability looks long as costs for most of the product categories are higher than traditional agriculture, resulting in low contribution margins and high production volumes for profitability. Farms can reach profitability in 12-24 months after creating a strong network of partners and retailers and amortisation costs that apply to production system equipment are quite high and are characterised by long periods of time. However, vertical farming has the prerequisites for its development and expansion, which appears to be imminent: as vertical farming expands to higher value crops, tech costs decline, and margins increase, it will become **more and more feasible to produce in high tech urban farms**. In the specific case of the city of **Milan**, the recent law about urban agriculture has laid the foundations for the integration of vertical farms within the urban areas, by recognising its economical value and by regulating and incentivising the placement of vertical farms in existing buildings. This is an index of **vertical farming's potential and suggests promising growth prospects in the upcoming years**. Nevertheless, one thing might still represent a challenge for vertical farms: the high **energy consumption** and related cost remains the main issue for vertical farms, especially in the last months after the rise of 30% in electricity price, impacting the business viability even more.

Moreover, from the **environmental point of view** the high energy consumption still represents a major issue and, due to the nature of vertical farming, it will always be. To address or at least limit this issue, vertical farms should rely on **renewable sources**, ideally by integrating autonomously produced energy from solar or photovoltaic panels while partnering with energy suppliers that produce electricity from

renewable sources. To give tangible solutions, some suggestions to limit energy consumption and costs are provided:

- ▶ In Italy a few **energy cooperatives** provide interesting tariffs and opportunities for citizens who can become members and contribute actively to the projects and mission. One example is ènostra, an Italian cooperative in the energy sector that produces and supplies 100% renewable, sustainable and ethical energy to its members through a participatory-based model. The members are indeed actors that participate actively in the transition towards renewable energy sources by becoming members and adhering to ènostra Production Fund that aims at the development of renewable energy plants. Members can participate either by investing in stocks or by becoming "prosumers" which refers to a specific tariff that involves the consumer as a producer: by choosing the prosumer tariff, the energy cost stable over the year and will be fair, as it reflects the ènostra production plant's performances only depending on the climatic meteorological conditions and/or extraordinary interventions. The tariff also includes a monthly energy bonus with free kWh, based on the share of investment (ènostra, 2016).  
By becoming members of ènostra, vertical farms could have economic benefits from different points of views, including the possibility to have **stable and constant energy bills** that facilitate business costs predictions and calculations as well as an **energy bonus each month**. Not less importantly, by **sharing the vision and values** of a similar cooperation, vertical farms ethically address the high energy consumption issue related to environmental sustainability, which could also result in excellent benefit for the firm's image on a communication and marketing level.
- ▶ Another way to mitigate the energy consumption issue could be choosing and **producing crop varieties that do not require much light for their growth**: it's the case of microgreens and mushrooms that are characterised by a faster life cycle compared to leafy greens and, by requiring less light, **energy consumption per unit is far less**.

Regarding the research and the project, the process and the final outcomes **validated the service design potential in generating knowledge, value and innovation within the vertical farming domain in Italy.**

First, service design methods helped answer the research question and understand that **consumers' resistance is not likely to be a potential barrier in preventing vertical farming to expand, it's rather the lack of knowledge and visibility of vertical farming methods and products that represent critical aspects and are responsible for consumers' doubts and preconceptions.** Secondly, but not less important, **the GrowMi project validated the role of service design in innovating an entire field by developing new service and business models while generating value for all the stakeholders involved in the service system.** Service design provides effective methods, tools and participatory practices that help: understanding the context and the stakeholders' needs and goals; defining and framing the project directions; generating creative solutions; and finally developing and implementing the service solution that answers the project challenge systemically and bringing value to all the stakeholders involved. The final output, the GrowMi project, was indeed very well received by the stakeholders engaged all along the process, including the consumers, as target users of the service, and the entrepreneurs, who provided their business perspective and expertise.

Regarding the project itself, the design process and the final testing sessions especially validated the service idea and its value and highlighted some limitations and barriers.

- ▶ **Integrating vertical farms within existing buildings in urban areas**, in this way bringing production and distribution in the same place, is **not so complex** for the reasons previously described. Moreover, by expanding production from leafy greens to higher value crops such as microgreens or mushrooms, GrowMi could generate higher profits in limited production areas since these crop varieties, compared to leafy greens, have faster life cycles and require less light to grow and be ready for distribution.
- ▶ The **software and hardware** development for the app and the automatisations of production and operational processes that

enable the user experience **might be expensive and complex** to implement, but not impossible. It might require some more time to implement this service offer.

- ▶ The **market reach is very limited**: offering a service that is limited to vertically grown products is **limiting in terms of people's needs and dietary requirements**, as the human diet is and must be diversified. This is a limit of the service which also relates to the a limit of vertical farming itself: to date, only a **limited variety of products** can be grown in vertical farming and further experimentation, research and development is therefore required to expand crop varieties. Moreover, on a more practical level, consumers base their purchases on their dietary needs and preferences, ensuring themselves **constant access to certain products**: accessing a limited range of products that doesn't ensure constant acquisition of the given products, on a weekly basis for example, represents a critical barrier that would prevent users from choosing the service.

GrowMi's validation and limits identification confirm vertical farming potential but also reveal the **unlikelihood of this farming method in coping with systemic challenges alone: the transition towards sustainable food systems necessarily requires a hybridisation of the food system itself and its farming methods**, resulting in the diversification of food production systems to be able to fully achieve sustainability and resilience. Vertical farming, therefore, plays only a part in the transition to a more sustainable food system, meaning that **vertically grown products should be integrated with products from traditional farming methods.** However, it's important to underline that full sustainability can only be achieved once **traditional farmers shift to regenerative agriculture practices**, namely farming methods and techniques that increase soil health and protect the environment and biodiversity.

In conclusion, the designed service has the right prerequisites to foster the transition towards sustainable food systems, but its potential and effectiveness could be fully exploited by integrating the current offer with a larger variety of products and services.

## Future directions

Based on the conclusions just described, the **GrowMi service offer could be enhanced by enriching it with a larger variety of products coming from regenerative agriculture**. The service could involve local farmers, keeping the "local" component as well as the transparency over the supply chain as key aspects of the service values and offer. By allowing consumers to trace the products they buy, to know the farmers, their fields and their farming methods, for example, it's possible to **extend the core concept of the service by giving consumers access to a larger variety of fresh, healthy and locally grown products grown with traditional and regenerative farming methods. This would ultimately favor the shift to sustainable food systems more effectively**.

Specifically to the subscription-based service offering, "hybrid bundles" could also respond to consumers' needs more effectively: **personal garden's products could be integrated with a recurrent set of diverse products from the farm and the partnering farmers**, which could be received in the form of a "box" according to consumers' needs and preferences.

**GrowMi** can be considered as a **first prototype** version of the service that could be **scaled up to other neighborhoods in Milan**, or in other cities, creating a network of GrowMi vertical farms disseminated throughout the city. By scaling the project, GrowMi can help the actualisation of the **15 minutes city model** by translating the concept of proximity and the priorities of Milan Food Policy on a tangible level: GrowMi guarantees citizens access to fresh and healthy food within short walking distances and enables **neighborhoods** to become more and **more self-sufficient** and the **city more resilient**.

# Annex

# Survey

## PART 1

### Anagraphic data

<b>Genere</b>	<b>Età</b>	<b>Occupazione</b>	<b>Dove vivi?</b>
<input type="radio"/> Femmina	<input type="radio"/> U18	<input type="checkbox"/> Studente	<input type="radio"/> In una città grande (più di 250 000 abitanti)
<input type="radio"/> Maschio	<input type="radio"/> U18-25	<input type="checkbox"/> Lavoratore	<input type="radio"/> In una città media (tra i 50 000 e i 250 000 abitanti)
<input type="radio"/> Altro	<input type="radio"/> 26-35	<input type="checkbox"/> Non occupato	<input type="radio"/> In una città piccola (più di 10 000 abitanti)
	<input type="radio"/> 36-50	<input type="checkbox"/> Pensionato	<input type="radio"/> In un paese (meno di 10 000 abitanti)
	<input type="radio"/> 51-65		
	<input type="radio"/> Over 65		

### Purchasing habits and drivers

Dove e come sei solito comprare insalate?

- Sfusa al supermercato
- In busta al supermercato
- Al mercato
- Tramite vendita diretta presso produttori locali
- Tramite servizi online (es. Cortilia)
- Ho il mio orto
- Un altro le acquista per me
- Altro (specifica)

Quando acquisti l'insalata a cosa presti maggior attenzione?

- Prezzo
- Qualità (freschezza, sapore, croccantezza)
- Origine
- Sostenibilità del prodotto e del packaging
- Marca
- Metodo di coltivazione (tradizionale, bio, vertical farming ecc)
- Comodità di approvvigionamento
- Altro (specifica)

Perchè?

- Per comodità
- Perchè è più buona
- Perchè è più fresca
- Perché è più sana
- Perchè posso interagire con il produttore/venditore
- Altro (specifica)

### Vertical farming - free word association

Cosa credi che sia il vertical farming (o agricoltura verticale) e quali elementi lo caratterizzano secondo te?

Campo aperto

Quali parole, frasi o pensieri ti vengono in mente se pensi a "insalata coltivata con luce a led"?

Campo aperto

Quali parole, frasi o pensieri ti vengono in mente se pensi a "insalata coltivata in idroponica"?

\*Tecnica di coltivazione fuori suolo

Campo aperto

## PART 2

### Vertical farming

Il vertical farming (o agricoltura verticale) è un innovativo metodo di coltivazione indoor dove ortaggi o piccoli frutti crescono in ambienti controllati, al riparo dai fattori meteorologici avversi e da patogeni esterni, e per questo motivo non avvengono sprechi e non si usano pesticidi. Il vertical farming sfrutta tecniche di coltivazione fuori suolo, come l'idroponica: la terra viene usata solo per proteggere le radici, ma queste sono immerse in acqua che viene riciclata alla fine del ciclo di irrigazione, generando un risparmio idrico del 95%. L'uso dell'idroponica unito alla coltivazione in verticale permette anche di essere più produttivi in meno spazio, salvando il 98% di suolo e coltivando così a km0, vicino al punto di consumo. Grazie a questo viene accorciata la filiera, con conseguenze positive sulla qualità del prodotto e sull'impatto ambientale.



Rispetto a questa breve spiegazione, quanto ritieni di conoscere già riguardo il vertical farming?

Poco       Molto  
0 1 2 3 4 5

Hai già acquistato dell'insalata o altri prodotti coltivati in vertical farming?

Sì  No

Al momento dell'acquisto, potendo scegliere tra l'insalata coltivata con metodi tradizionali e quella coltivata in vertical farming, quale acquireresti?

L'insalata coltivata con metodi tradizionali  
 L'insalata coltivata in vertical farming  
 E' indifferente, non farei distinzioni

In che modo definisci se un prodotto è "di qualità"?

Controlli che abbia un aspetto fresco  
 Deve avere un buon sapore e consistenza  
 Fai riferimento a quanto è sano  
 Fai riferimento a come è stato prodotto  
 Controlli che sia certificato (es. bio)  
 Altro (specifica)

Rispetto alla sostenibilità del prodotto, che cosa per te è più rilevante?

La filiera corta (km0)  
 Il fatto che non vengano utilizzati pesticidi o fitofarmaci  
 Il basso consumo d'acqua  
 Il fatto che il suolo non venga sfruttato e/o inquinato  
 un packaging green  
 Altro (specifica)

Acquisteresti dell'insalata o altri prodotti coltivati in vertical farming?

Sì  No

C'è un motivo particolare per cui non hai ancora mai acquistato insalate o altri prodotti coltivati in vertical farming?

Non so dove trovarli  
 Non conoscevo questi prodotti  
 Altro

Quali elementi ti creano scetticismo e ti preoccupano maggiormente rispetto a questo metodo di coltivazione?

Il fatto che i prodotti non crescano nel terreno  
 Il fatto che venga utilizzata luce artificiale  
 Il fatto che i prodotti crescano in un ambiente controllato e "innaturale"  
 I prodotti crescono vicino alle città: quindi sono inquinati.  
 Altro (specifica)

Fino a quanto sei disposto a spendere per un'insalata (busta da 100g)?

<1 euro  
 1-1,50  
 1,50-2  
 2-2,50  
 >2,50

Se ti va di aiutarmi a portare avanti questa ricerca e sei disponibile per una breve intervista, ti chiedo gentilmente di lasciare il tuo nome e un tuo recapito telefonico e/o email. I dati e verranno utilizzati esclusivamente a fini di ricerca per la mia tesi e nel rispetto del Regolamento UE 2016/679 (GDPR). Grazie mille!

Campo aperto

# Interviews

Please note: only the most relevant parts of the interviews have been reported

## Interview with Alberto Arossa - Slowfood

[...]

*La Professoressa Meroni mi ha anche detto che ha avuto modo di parlare con lei di idroponica e che è un tema che secondo lei vale la pena approfondire. Che cosa ha destato il suo interesse per questo tema?*

Io di formazione sono laureato in Scienze Naturali e arrivo all'agricoltura per vie traverse però la questione ambientale ed ecologica è una cosa che mi appartiene abbastanza e da lì anche il mio interesse e coinvolgimento in Slowfood. **Per quanto riguarda la questione colture protette, diciamo che anni fa l'idea era quella di una realtà che comunque voleva occuparsi di agricoltura per salvare il territorio, per salvare le tradizioni, per tutelare la biodiversità e i paesaggi. In questo contesto diciamo che le colture protette quindi idroponica, aeroponica, colture sottomarine ecc queste colture protette non erano viste benissimo. Quando invece avevamo iniziato ad approfondire il tema dell'agricoltura in città abbiamo visto l'altra faccia della medaglia, quindi come certe tipologie di coltura possano tornare utili in un territorio non destinato all'agricoltura come la città.**

*Scusi se la interrompo, ma come mai non erano viste benissimo queste colture protette?*

Ma perchè tu considera il fatto che parliamo almeno di una decina di anni fa o più e la coltura protetta è una coltura che ha bisogno di specializzazione, tecnologia, di grandi input energetici e di materiale. **E' interamente creata dall'uomo.. in realtà anche l'agricoltura è creata dall'uomo ma in un contesto comunque naturale, che affonda le sue radici nella tradizione, che ha modellato il paesaggio.. Slowfood era interessata a questi aspetti, era interessata a preservare questo aspetto dell'agricoltura, cioè ciò che di buono ha fatto, modellando paesaggi, creando identità territoriali, sviluppandosi in equilibrio con l'ambiente, individuando comunità, evolvendo una certa biodiversità come varietà orticole, frutticole, razze animali ecc. questo tipo di agricoltura è quella classica, che si svolge nel campo e che ci viene tramandata dalle generazioni passate e quella che in Italia ha disegnato buona parte di bell'Italia che molti ci invidiano. In questo contesto quindi è chiaro che l'impronta super tecnologica e molto scientifica delle colture fuori suolo veniva vista un po' così.. come se adesso volessimo dare un parere sulla carne in vitro. Sono due cose molto distanti tra di loro eh... però come ti dicevo affrontare il tema delle colture protette in territori molto marginali che magari non hanno accesso all'acqua o hanno condizioni climatiche pedologiche particolarmente avverse, è comunque interessante perchè sono tecniche che consentono di avere prodotti freschi di un certo tipo in condizioni ambientali che non lo consentirebbero.. in uno scantinato, in una fabbrica dismessa, in un parcheggio sotterraneo.. in aree urbane non più utilizzate, potrebbe essere un buon modo per coltivare prodotti sani, buoni e che viaggiano pochissimo. Talvolta possono essere anche non solo ortaggi, ma si può fare allevamento di pesci e cose così.. quindi questo aspetto aveva incuriosito e avevamo anche organizzato qualche incontro, qualche convegno e queste tecnologie destavano sempre curiosità. Poi non abbiamo approfondito più di tanto perchè non possiamo occuparci di tutto, abbiamo risorse e tempo limitati e queste tematiche col tempo le abbiamo messe un po' in disparte, ma io sono interessato, se trovo articoli o ho del tempo da spendere online ci guardo.. e **ci sono esperienze molto belle, secondo me è un tipo di agricoltura che può avere e che sta avendo successo, e potrebbe avere qualche chance in più se riuscisse ad avere un approccio ancora più sostenibile per quanto riguarda l'utilizzo di acqua o se va incontro a esigenze alimentari particolari, quindi intolleranze per esempio ai metalli pesanti. O appunto il riutilizzo di spazi industriali abbandonati. E' un'agricoltura che ha bisogno di competenze, che può avere un risvolto interessante anche in ambito educativo anche per quanto riguarda la capacità di creare lavoro anche a più livelli, dall'operaio semplice a chi progetta le strutture. E' un bel mondo da scoprire.****

*Io per la mia tesi mi sto esplorando il contesto industriale/commerciale e per ora ho avuto modo di visitare una Vertical Farm a Melzo. Loro sono in una zona industriale, non sono in un contesto di riutilizzo di spazi abbandonati.. secondo lei questo tipo di realtà ha comunque delle potenzialità?*

Il mio parere è chiaramente improntato alle mie esperienze passate ed è di parte.. **secondo me per evitare di mettere in difficoltà chi realizza gli stessi prodotti in pieno campo, che nella zona di Milano sono tanti, bisognerebbe sempre di più differenziarsi, differenziare e qualificare la propria offerta. Per quanto mi riguarda un prodotto non è solo quel prodotto lì ma racconta una storia, un'idea, un futuro, racconta qualcosa. Chi sceglie un prodotto lo sceglie spesso e volentieri perchè c'è anche altro. In questo senso il mio parere è di parte. Quindi se scelgo una passata di pomodoro, ne scelgo una che so che non ha avuto coinvolgimento di operai sottopagati.. preferisco tutto il discorso no cap. In questo senso quindi secondo me una produzione di quel tipo lì, che è dispendiosa, deve avere qualche argomento in più da spendere per il proprio prodotto.. quindi secondo me sarebbe meglio venderlo vendendo il fatto che sono prodotti che hanno magari un valore oltre al prodotto stesso e che si portano dietro qualcosa di più. In questo senso una storia di riqualificazione urbana, una storia di salubrità perchè magari non contengono metalli pesanti, una storia di riallocazione di persone che lavoravano altrove... sono tutti argomenti che aiuterebbero a vendere quei prodotti diversamente.. altrimenti perchè dovrei scegliere dell'insalata coltivata fuori suolo piuttosto che dell'insalata coltivata in pieno campo al Parco Sud Milano? Se è solo per la facilità di produrre non so alla fine cos'è più semplice. Aldilà della questione sostenibilità, le colture protette sono comunque sostenibili per quanto riguarda l'acqua, ma in una situazione come Milano che ha l'acqua a 2 m di profondità questo problema non esiste. In quella situazione lì è più vincente un discorso concreto che vende quel prodotto con qualcosa di più. Poi può esserci anche la ricerca delle varietà per mantenere gusti e profumi, del fatto che viaggia poco, può esserci il discorso di una programmazione più facile rispetto a una programmazione agricola che dipende dalla meteorologia. **Quindi ti ribadisco quanto ti ho detto, per veicolare certi prodotti secondo me dovrebbero avere qualcosa in più da raccontare.****

*Qual è invece la posizione di Slowfood rispetto a questo metodo di coltivazione?*

Su questo tema specifico non abbiamo mai elaborato un position paper, non abbiamo fatto un lavoro di disamina così approfondita da dirti come la pensa Slowfood, quindi mi limito a raccontarti quelle che sono le finalità di Slowfood oggi. Slowfood lavora su 3 pilastri, organizza le sue iniziative su:

- tutela della biodiversità
- educazione alimentare
- stile di vita e advocacy

[...]

Il terzo pilastro è quello dell'**advocacy**, cioè come noi possiamo attraverso le tematiche del cibo influenzare le politiche in questo caso più prettamente europee, legate al discorso della sostenibilità, della biodiversità, dell'educazione alimentare al gusto, del dare il giusto valore al cibo, di raccontare ai bambini come si fa un cibo.. Mettere il cibo all'interno dello sviluppo delle nazioni non perché si deve solo parlare di cibo ma perché essendo una delle pratiche più impattanti sull'attuale sistema é ovvio che ha delle ricadute imponenti. In questo terzo pilastro di slow food l'agricoltura protetta potrebbe essere un po' più affrontata perché potrebbe avere delle ricadute positive, come ti dicevo prima nel creare lavoro che possa essere anche specializzato.

É comunque vero però che per salvare la biodiversità non la salviamo con l'agricoltura protetta, ma la salviamo in campo. Quindi non c'è un parere chiaro e sviluppato perché in effetti ce ne stiamo occupando troppo poco e dunque non ha nemmeno senso dare un giudizio su una cosa così ampia, quindi in questo momento ci limitiamo a vedere aspetti positivi e aspetti meno positivi, e dove richiesto possiamo dare un nostro parere. Che é un po' quello che ti riassumevo prima, é sicuramente un ottimo modo per produrre cibo ma deve essere un cibo che si differenzia. Così come l'agricoltura biologica secondo noi, si é già differenziata ma dovrebbe differenziarsi di più rispetto al corrispettivo sistema agricolo tradizionale oppure la lotta integrata.



[...]

*Considerando che esistono già diversi player sul mercato che producono e distribuiscono frutta e verdura coltivata in vertical farming, secondo lei ad oggi qual è l'ostacolo più grande per loro?*

Al di là delle difficoltà legate agli investimenti iniziali e quindi all'acquisto di strumentazione c'è la parte legata all'ideazione del progetto, quindi lì ci vogliono delle competenze. Probabilmente c'è difficoltà a trovare persone competenti nel portare avanti la coltura, la gestione delle strumentazioni informatiche che anche per la somministrazione dei nutrienti, all'acqua ecc. Vedo meno difficoltà legate alla raccolta e distribuzione.

**Tra l'altro una cosa interessante è che non è un campo totalmente nuovo perché tanti prodotti si fanno in colture protette, come i funghi Champignon o le colture invernali nei paesi del nord. Quindi in realtà è nuovo ma nemmeno così tanto, la novità sta nel leggerlo in chiave attuale e attualizzarlo per quanto riguarda la produzione e distribuirlo.** E poi c'è il discorso che non si sta tanto facendo di trovare le varietà giuste da coltivare, cioè quelle varietà che nonostante la coltura protetta riescano a sviluppare quelle caratteristiche di consistenza e ricchezza aromatica che sono quelle a cui noi siamo abituati.. Insomma i pomodori devono avere il gusto del pomodoro. In realtà questo è un discorso di 15 anni fa (pomodoro) ma per altri ortaggi potrebbe essere una sfida interessante.

*Secondo lei ci sono meno difficoltà riguardo la distribuzione..*

Sì perché una volta che metti in piedi il sistema produttivo bene o male sei indirizzato verso uno sbocco commerciale, i canali distributivi ci sono, non c'è da inventare nulla di nuovo.. **Forse la difficoltà sta nel descrivere il prodotto, dare valore aggiunto, nel creare info utili affinché la scelta sia consapevole e magari possa spuntare un prezzo maggiore.**

*Secondo lei i consumatori sono pronti a prodotti coltivati con questo metodo?*

in realtà non saprei dirti.. Non ho dati a disposizione per avere un'opinione in merito. **Secondo me non è un argomento controverso come può essere l'OGM, sicuramente sono più facili da raccontare rispetto ad altri prodotti se si toccano le corde giuste. Ad esempio l'assenza di metalli pesanti (salubrità del prodotto), assenza di fitofarmaci e pesticidi.. Sono armi potentissime perché il consumatore soprattutto negli ultimi anni col discorso che gli insetti stanno morendo, l'operazione sul controglifosate, i neocotinoidi.. Forse c'è una sensibilità maggiore. A favore c'è anche il discorso dell'acqua, del minor prelievo e minor scarto.** Sono tutti argomenti vincenti rispetto al discorso di una coltura che non prende sole.. Perché non ha bisogno di tutta questa potenza, può essere alimentata da fonti rinnovabili. E se i prodotti non viaggiano molto c'è anche il discorso della filiera corta. Quindi non la vedo così complicata come altri temi più controversi legati all'agricoltura. Rispetto agli insetti, le colture protette secondo me verrebbero accolte meglio. Sono abbastanza ottimista. [...]

*Secondo lei questo nuovo metodo di coltivazione avrà un impatto sulla società? In che modo?*

**Sulla società il discorso bello è proprio nella loro eventuale apertura alla società, quindi: se sono un'occasione per rimodellare pezzi di città che sono stati abbandonati o che vengono sotto utilizzati, se sono un modo per impiegare persone che magari non hanno più un lavoro, se possono essere utili per riqualificare dei quartieri che possono essere veicolati diversamente. Se si pensa di distribuire con le biciclette direttamente a casa in modo super sostenibile, possono diventare esperimenti interessanti. Da qui a rimodellare la società il passaggio non è cortissimo ma qualche novità positiva sicuramente potrebbero portarla.**

Potrebbero anche diventare se non così concentrate come esempi che mi hai fatto che sono esempi di imprenditori, le colture protette visto che possono essere strutture più piccole, possono anche essere più diffuse sul territorio cittadino, e potrebbero anche diventare presenti nei luoghi di lavoro, ristoranti, nelle botteghe, potrebbero diventare più di uso comune e questo potrebbe farle sentire più di uso comune e meno lontane dalla quotidianità e in città potrebbero avere decisamente un valore trasformativo. Qualche buon cambiamento in positivo lo vedo.

## Interview with Pierluigi, co-founder of Agricola Moderna

*Che cosa ti ha spinto a scegliere di avviare Agricola Moderna?*

Agricola Moderna nasce a Milano nel 2018. Io e Benjamin ci conoscevamo da tempo e durante una vacanza abbiamo avuto questa idea. Abbiamo unito le nostre competenze facendo incontrare il mondo food, grazie alla mia esperienza nel settore, e il mondo dell'innovazione, con il PhD in ingegneria energetica di Benjamin. **Abbiamo scelto Milano perché è il centro del consumo di insalate di quarta gamma e ci sembrava il luogo più adatto per iniziare.** Nel 2019 dopo aver sperimentato e fatto test per un anno in un laboratorio di ricerca in via Col di Lana, nel centro di Milano, abbiamo aperto il nuovo e più grande stabilimento produttivo a Melzo.

*Quali sono le maggiori difficoltà che avete incontrato quando avete avviato Agricola Moderna?*

Una difficoltà è stata sicuramente partire durante il lockdown. Pensare adesso che a gennaio 2019 ci siamo trasferiti a Melzo, a febbraio e marzo abbiamo fatto i test e a fine aprile i nostri prodotti erano negli scaffali di carrefour sembra quasi impossibile. **Del resto le difficoltà sono state quelle di avviare un'azienda innovativa "inedita" in Italia.** Dal punto di vista dei capitali non è stato facile per noi all'inizio né lo sarà in futuro. **Ci siamo mossi finora con un po' di bandi, di finanziamenti agevolati e di equity.** Alcuni bandi li abbiamo avuti grazie al fatto che siamo classificati come una azienda innovativa avendo diversi ricercatori nel team.

*Avete un modo per valutare la sostenibilità ambientale dei prodotti? Se sì, quale?*

Non abbiamo ancora applicato per certificazioni esterne specifiche su di noi, se intendiamo questo. Sicuramente verrà fatto nel nuovo impianto. Molte informazioni sul basso impatto del vertical farming si trovano in ricerche e studi di Università prestigiose, in più collaboriamo noi stessi con alcune università per studiare i valori nutrizionali delle piante (non sostenibilità).

*Avete pensato di avere uno stabilimento di produzione in città? (ad esempio adattando l'impianto produttivo in edifici dismessi.. è possibile? ci sono dei limiti/difficoltà per cui avete preferito stabilirvi a Melzo?)*

**Abbiamo iniziato in un laboratorio di ricerca a Milano, dove abbiamo fatto i primi test e ottimizzato prodotti e processi. Ma l'idea di andare in centro città per produrre ortaggi e consegnarli ai supermercati è fuorviante. Un conto è fare piccoli moduli per l'autoconsumo o moduli all'interno dei supermercati, ma per servire i mercati bisogna considerare che occorre consegnare ai centri logistici che sono fuori città e poi i centri smistano ai punti vendita. In centro, inoltre, il costo a metro quadro è molto più alto.**

**La scelta di Melzo è dovuta a due motivi: era adatto come infrastrutture essendo a pochi chilometri dai centri di smistamento e come amministrazione, il che ha facilitato molto l'avviamento rapido delle nostre attività.**

*Quali sono i vostri obiettivi a breve termine? A lungo termine invece?*

Nel breve termine continuiamo a ottimizzare sistemi e prodotti in vista del grande salto: stiamo raccogliendo i finanziamenti per un impianto di circa 20 volte più grande rispetto a quello attuale. L'idea è iniziare i lavori entro fine 2021 per diventare operativi entro i successivi 12, 16 mesi. Si tratterà di una vertical farm da un ettaro produttivo che sorgerà sempre a Melzo.

## Interview with Luca, Head of Marketing of Agricola Moderna

*Mi puoi raccontare brevemente la storia di AM? Come mai avete scelto di avviare questo tipo di attività?*

[...] [Pierluigi e Benjamin] hanno pensato di avviare questo laboratorio in Col di Lana a Milano, hanno assunto subito due agronomi, poi sono arrivato io e l'head of Data Science. Poi siamo venuti qua [Melzo] ed è stato un anno di test su semi, luci ecc... hanno cominciato a ottimizzare i sistemi e si sono buttati in questo impianto commerciale, in pochissimo tempo l'hanno costruito, in ancora meno tempo col Covid siamo andati sul mercato: nei carrefour da maggio, Cortilia a settembre. **Forse non dovrei dirlo ma stiamo pensando anche alla ristorazione, ci stiamo guardando intorno per espanderci anche a livello B2B, canali diversi.. vedremo. Stiamo raccogliendo dei finanziamenti per costruire un impianto 20 volte più grande di questo tutto automatizzato. Con finanziamenti di investitori.**

*Quali sono le maggiori difficoltà nella quotidianità?*

Tante cose da fare, ottimizzare i sistemi, mettere a punto la tecnologia.. cose normali di un'impresa.

*Da dove provengono le vostre revenue? cioè come vi sostenete economicamente?*

Ancora siamo in fase di start up, non so se si può dire ma non è che siamo a break even, ma normale eh. Ma comunque grazie agli investimenti che vengono dai fondi e dalla vendita dei prodotti.

*Costi principali che dovete fronteggiare?*

**Sicuramente i costi dell'energia elettrica, personale, materie prime, packaging. Il più grosso di costo è sicuramente l'energia elettrica e poi il terzo se non sbaglio è il packaging, è un costo grosso perchè è in plastica riciclabile..** adesso stiamo passando a questo in carta. Anche il fatto che non è automatizzato. Quando ci sposteremo e sarà automatizzato il personale rimarrà, però chiaramente la scala sarà diversa. Non è che licenziamo la gente, dovremo assumerne di più.. però invece che avere 20 persone a gestire un impianto che fa 500 pacchi al giorno, ne avremo 30 che ne gestiscono un impianto che fa 25000 pacchi al giorno.. quindi in scala stai spendendo meno di personale.

*Avete delle partnerships? (oltre che con università)*

Carrefour e Cortilia. Poi sì con le università, in 3 ambiti che sono il core business: agronomia (Polimi e UniBo), ingegneria (Poli), data science (La Sapienza).. o la Statale. **Poi Recup (croce rossa fa parte di Recup).. Poi con Recup, la Croce Rossa -che fa parte di Recup- passa a raccogliere i pacchi di insalata che avanza.** Poi delle partnerships con dei fornitori dalla parte dei data scientists delle luci e delle telecamere iperspettrali, che sono sostanzialmente computer di intelligenza artificiale.

*Ma quell'insalata lì che è stata data alla Croce Rossa, perchè gli viene data?*

Sono le rimanenze della settimana, sono quelle invendute. Poi a volte ce le portiamo a casa noi.

*In che cosa si distingue AM rispetto agli altri player del mercato?*

Innanzitutto noi siamo stati i primi sul mercato, poi c'è un altro player che è Local Green che è una vertical farm. **Rispetto a Bonduelle e tutti quelli ci distinguiamo perchè noi siamo vertical farm. Rispetto alle altre vertical farms per ora siamo quelli che hanno più prodotti in filiera, e ci distinguiamo per la cultura aziendale.**

*Quali sono gli attori/stakeholder coinvolti in AM?*

Tutti quelli che abbiamo citato fino adesso, quindi la parte industriale di fornitori.. impianto, luci, substrato, semi ecc.

*Ma le luci ad esempio dove le avete prese? So che la Philips le produce*

Ci sono pochissimi player che fanno questa roba qua, abbiamo anche Philips sì, ma il principale penso sia Valoia. Poi chiaramente c'è la parte commerciale, Carrefour, Cortilia e quello che ci porta la merce là. Il fornitore di packaging, etichette. Consumatori.

*Quindi il target chi è?*

**Vorrei che fossi tu a dircelo. Abbiamo qualche dato ma poca roba, da social e ricerche.** Comunque un consumatore urbano, soprattutto donne (in Italia è triste dirlo ma sono soprattutto donne che fanno la spesa), fascia di età tra 25 e 45 anni. **Abbiamo fatto una stima, ma non abbiamo fatto nulla, dai social è questo ma chi va nei social non è che va al supermercato.**

*Ma comunque l'intenzione in generale di una Vertical Farm e penso anche la vostra, è di vendere a km 0 giusto?*

**Sì, anche se il raggio di km non è limitato al km 0 perchè anche se devo consegnare a Roma il risparmio di risorse e di impatto sarebbe minore. La cosa migliore sarebbe aprire nuove Vertical Farm in giro per l'Italia e all'estero, ma comunque vicino a metropoli perchè se no non ha senso, sia a livello di consumatori che a livello di principio. Questo modello nasce per nutrire le grandi città.**

*Rispetto allo scetticismo dei consumatori?*

**Se chiedi in giro quanta gente conosce il Vertical Farming, ti aspetteresti secondo me che molta più gente dica di no, dica "ah si ho visto, ho sentito".** L'altro giorno ero in Blablacar e il tizio mi ha detto "ah ho capito chi siete vi ho visto la TG", ci siamo fatti tutti i TG e alla fine serve. Col tempo, soprattutto su Milano, si sta molto spargendo questa awareness su cos'è il vertical farming. **Detto questo molti dicono "ah si lo conosco" ma non lo conoscono, il problema è che di quelli che lo hanno sentito nominare, molti pochi sanno effettivamente cos'è e comunque in molti hanno molte bias. Chiaramente le bias grosse arrivano da quello che non sanno neanche cos'è e che vedono le luci rosa.** Quelli che sanno cos'è capiscono bene o male cos'è ma poi non sanno bene le cose esatte per cui siamo su due discorsi diversi. **Chi non sa cos'è il vertical farming ne è super spaventato, chi lo sa ne è attratto però gli mancano delle info, i dettagli. Poi comunque la grande paura a livello di consumatore è quella dell'artificialità, le luci rosa, vedi il fuorisuolo, la plastica e il ferro, la gente con il camice.** Adesso ci sono diverse incognite, adesso con il covid la gente si informa di più quindi è più predisposta a cercare di capire di cosa si tratta. Per questo vorrei capire anche se mettendo una spiegazione dettagliata sul packaging la gente poi se la legge. **Con il covid e con la conferma dei trend che c'erano anche prima, che erano un approccio più consapevole al cibo, sia a livello di sostenibilità e salute del prodotto (privo di, nichel free), la gente è più predisposta a indagare di più sul prodotto.**

*Adottate qualche strategia per comunicare efficacemente (sia metodo che come comunicare)?*

Come metodo, la piramide che ti ho fatto vedere prima quindi qualità in primo luogo, ci concentriamo sul prodotto, che è più buono, più sano e più fresco. In secondo luogo la sostenibilità, che è una delle cose che interessa di più il consumatore italiano in questo momento. Questo sia sul packaging che online. La terza è l'innovazione, che forse è la cosa che ci contraddistinguono di più. Qualità e sostenibilità dipendono dall'innovazione, ma l'innovazione la mettiamo meno sul packaging, la comunichiamo sui social che è un canale dove le persone stanno più tempo e dove puoi mandare messaggi diversi nel tempo. **Siamo partiti comunicando in modo molto umano la tecnologia: nelle foto delle tecnologia spesso e volentieri non sono mai dei close up sugli elementi tecnologici, sono sempre elementi naturali (terra, acqua..) oppure ci sono sempre delle persone.. ci sono sempre persone che scaldano le cose fredde. Cerchiamo di scaldare la tecnologia con le persone pur mantenendo la verità, i camici bianchi ecc. C'è chi in America mette le magliette, noi no. La sostenibilità la comunichiamo non parlando sempre di noi, ma di di sostenibilità in generale in questo modo passa il messaggio che io sono sostenibile.**

[...]

*Quali sono gli aspetti di AM (valori, prodotti ecc) che volete preservare/sono importati da mantenere e che vengano anche comunicati efficacemente nella mia soluzione?*

Tutto quello che abbiamo detto. **Noi vorremmo capire come comunicare, oltre a sostenibilità e qualità, soprattutto l'innovazione, e come distinguerci. Qual è quell'elemento che può caratterizzarsi come Agricola Moderna.**

## Interviews with consumers

### PO1

[...]

*Sei tu che acquisti prodotti vegetali?*

In casa mia la spesa la fa mia mamma e facciamo due tipi di spesa: una spesa la fa all'Alveare che è un sito dove prendiamo tutte le cose che riusciamo: formaggio, verdura, carne.. tutto quello che lo prendiamo lì, dopo di che tutto quello che loro non hanno lo compriamo al supermercato. La spesa all'Alveare la faccio con lei, ci mettiamo lì insieme a ordinare poi lei paga e va a ritirare una volta a settimana. Anche l'altra spesa una volta a settimana, poi se manca il latte per esempio si va e si prende. Per quanto riguarda le insalate, sono un po' schizzinosa io.. mangio solo insalate come la valeriana o il songino, quelle piccole.. e quelle lì all'Alveare non ce l'hanno quasi mai, quindi quando non c'è la prendiamo al supermercato. All'Esselunga mi pare che abbiano quelle nella busta biodegradabile, quella specie di bio plastica, se no c'è quella con la busta di plastica. Se no quelle dell'Alveare te le portano nella busta di carta. A volte prendo anche quelle insalate ma non mi piacciono tanto perchè sono quelle miste di diversi tipi. Invece i miei prendono sempre l'insalata dell'Alveare perchè a loro piacciono quelle grosse del ceppo. Comunque la varietà di insalate non è tanta e dipende dai produttori che sceglie l'Alveare, il raggio di distanza è quasi sempre ristretto. A volte ci sono anche produttori siciliani con gli avocado o pesce dell'adriatico.. ma penso che i produttori piccoli di verdure ce ne sono così tanti che li cercano vicini.

*Motivo per cui fate la spesa all'Alveare e motivo per cui la fate al supermercato?*

Allora all'Alveare avevamo iniziato qualche settimana prima del Covid perchè mia mamma voleva provare/trovare qualcosa di più a km0, più sostenibile e con packaging non pieni di plastica. E anche per la qualità, qualcosa di coltivato in modo più naturale, a mano e qua vicino. Poi con il covid abbiamo continuato perchè era la cosa più comoda, una volta a settimana dovevi andare lì e non dovevi girare per il supermercato dove c'era altra gente, specialmente all'inizio non era il top. Poi d'estate non c'è l'Alveare perciò andiamo al supermercato. Poi al supermercato andiamo per convenienza, perchè è comodo, hai tutto subito lì poi nella mia città abbiamo l'Esselunga che è bella grande, due Gigante vicini, molto comodo e soprattutto trovi cose che non trovi da questi km0 locali.

*Mi hai detto che comprate all'Alveare per principi di sostenibilità e per qualità.. ma cos'è per voi la qualità?*

Qualità nel senso dei prodotti che non sono quelli coltivati nei filari in modo industriale, qualità nel senso di prodotto più autentico, più naturale.. più genuino ecco.

*Qual é l'aspetto fondamentale che ti porta ad acquistare un prodotto vegetale (insalata principalmente) piuttosto che un altro?*

**Tipologia** perchè mi piace quel tipo di insalata, a mia mamma piace qualcos'altro, a mio papà piace la rucola perciò se non c'è all'Alveare comunque la va a prendere al supermercato. Io guardo molto al **packaging, cerco di prendere cose sfuse e non incartate nella plastica, ma se è l'unica opzione prendo quello.**

Quello che ti dicevo della **qualità: se posso scegliere tra quello bio e quello non bio, prendo quello bio.**

*Perchè il bio?*

All'Alveare a volte si trovano le cose bio, che poi è certificazione. **Alla fine anche se non sono bio sono comunque cose naturali. Il bio soprattutto per le cose con la buccia, cerchiamo di prenderle bio, così possiamo mangiarle senza problemi.** Poi molto spesso bio e fair trade vanno di pari passo quindi ad esempio le banane se prendo Dolè stanno sfruttando i sudamericani mentre se prendi quelle di Altro Mercato magari no.

*Cosa speri/desideri quando acquisti un prodotto vegetale?*

Per l'insalata non ho chissà che aspettative, una volta che ho scelto il tipo so già il sapore,

**consistenza** ecc. songino voglio che sia croccante e non amaro. Per la frutta vorrei che sia dolce, saporita, matura, poi ogni vegetale ha le sue caratteristiche, tipo l'avocado vorrei che sia bello maturo. **L'insalata è quella per cui ho un po' meno requirements.. che non sia marcia ecco. Che sembri fresca, perchè specialmente quelle nelle buste dopo un po' tendono a marcire, le foglie diventano scure. Quindi ecco che l'insalata sembri bella fresca.**

All'Alveare non la scegli tu, visto che te le preparano prima le cose l'insalata ad agosto ovvio che ti arriva un po' appassita. Per questo motivo a un certo punto avevamo smesso di prendere certi prodotti all'Alveare, tipo l'insalata e il pane: se è il cespo di insalata tutto a posto, ma quelle con le foglioline piccole ti arrivano già staccate e quelle tendono a morire, poi te le devi mangiare in un giorno. Dopo le prime volte che l'ho presa e non era il tipo che di base non piaceva a me, poi andava a male subito.. torno al mio songino o valeriana dell'Esselunga.

*Sei solito comprare sempre le stesse cose o a volte provi e acquisti qualcosa di diverso?*

**Super abituarini noi, per quanto riguarda l'insalata e verdure abbiamo proprio una checklist.** Cambiamo un po' per la carne, cambiamo tipo o anche posto, non sempre lo stesso macellaio. O anche prodotti da forno proviamo molte cose diverse ma frutta e verdura sono sempre quelle. **Ma a te comunque è mai capitato di voler provare un prodotto?**

**A me capita di provare cose nuove: all'Alveare magari vedo qualcosa di diverso, tipo scalogno o aglio fresco.. poi magari rimane nel frigo per 2 mesi e dici ok non lo proverò più. Però capita di voler provare cose nuove magari quando vedi quella cosa che cattura la tua attenzione.**

*E cosa cattura la tua attenzione di solito?*

Se è un prodotto che normalmente mi piace e mi sembra una versione migliore o diversa. Ad esempio lo scalogno fresco piuttosto che quello nella busta.. oppure qualcosa di strano, che dico magari lo proviamo. Mi ricordo tipo un prodotto che sembravano un sedano rapa e aveva sapore di ravanello, allora ho voluto provarlo. o magari qualcuno te ne ha parlato.

Mi capita anche al supermercato.. ad esempio vai per comprare le pesche e trovi le perocche.. dai le provo. Anche al ristorante una volta ci hanno portato questo piatto con gli spinaci che però erano diversi, erano dei ciuffetti cucinati al forno con del limone. Quindi abbiamo scoperto questi spinaci e poi li abbiamo ritrovati all'Alveare e li abbiamo presi. Però comunque è più raro al ristorante.

*Parliamo ora del vertical farming. Prima di rispondere al questionario ne avevi sentito parlare? Avevi mai avuto la possibilità di acquistare dei prodotti coltivati in VF?*

**Ne avevo sicuramente sentito parlare, non saprei darti una definizione. So che sono metodi innovativi di agricoltura. Non ho mai acquistato prodotti.** Però questo semestre ho fatto un progetto con l'università cinese e ho scoperto questa azienda che fa frigoriferi e ti permette di comprare la roba che cresce: aprivi il frigo (o c'erano addetti) e ti prendevi quello che volevi. Fondamentalmente cambiava dal "vado a comprarmi l'insalata al supermercato cresciuta da un'altra parte" a "vado a comprarmi l'insalata al supermercato cresciuta al supermercato". (Infarm) **Sapevo di questa cosa appunto ma non lo avevo collegato al vertical farming. Perchè vertical farming è un termine un po' così, ti suggerisce molte cose diverse. Magari quelli che arrivano all'attenzione del pubblico sono le cose più strane, tipo il frigo con le insalatine nel supermercato.**

*Hai dubbi o perplessità al riguardo? Se sì, quali aspetti ti fanno storcere il naso?*

**Ho molti dubbi! Se io penso all'agricoltura, ho varie esperienze al riguardo:** ho fatto dei corsi all'università come Design for Sustainability in cui ho trattato anche l'agricoltura, vivo vicino ai campi, ho fatto anche esperienze di volontariato in un'azienda agricola dove fanno "permaculture", un metodo per cui tu rinforzi il terreno (volontariato con Workaway in Marocco, ci sono stata per 3 anni di fila ma ormai è due anni che non vado). Era bello perchè vedevi il progresso anno dopo anno, c'erano cose nuove che stavano crescendo, si fonda su principi come "cresci il basilico con i pomodori perchè vanno d'accordo", sono un po' quelle cose lì.

Poi anche all'università ho visto temi tipo carbon sequestration: c'è troppa anidride carbonica, se fai bene l'agricoltura l'anidride carbonica rimane nel terreno e non c'è nell'atmosfera, oppure se tu fai il "tilling" (arare) questo CO2 va nell'atmosfera. **Quindi io penso: il modo migliore è lato permaculture, bio perchè c'è attenzione verso questi problemi, stai cercando di rafforzare il terreno, non solo sfruttarlo. Quindi perchè è meglio coltivarla in un capannone con energia elettrica? Perchè l'agricoltura se viene fatta in un certo modo va bene, perchè non andare in quella direzione e basta? Mi viene in mente qualcosa di finto, di tecnologico ma per quale motivo? Dobbiamo vivere sotto terra e non possiamo vivere in modo normale? va bene per le colonie sulla luna.**

*Mi spieghi meglio finto?*

**Finto nel senso: luce led, non ce l'abbiamo il sole? qualcosa di simulato, artificiale ecco. Tecnologia e innovazione bella, ma quando ha senso. Un po' come tutte quelle cose come ingegneria delle piante per modificarle geneticamente. Tecnologia e innovazione sulla natura ma che lascia sempre un po' perplessi, mancanza di fiducia. Alieno, non familiare, sospetto. MANCA LA COMUNICAZIONE DI QUESTE COSE, RIMANE COME LA COSA CHE SENTI PARLARE che forse l'unico modo per cui stanno cercando di farlo conoscere è farlo diventare una moda, senza spiegare perchè è meglio, quali sono i vantaggi. Tutta questa parte di conoscenza viene un po' ignorata e secondo me è importante. Tipo questa cosa di infarm, è figo l'insalatino che ti vai a prendere tu, ma non ti dà delle risposte.**

**Un'altra cosa che non è ben chiara: quando lo considero vertical farming? Vertical farming cos'è esattamente? Qual è il problema che stiamo cercando di risolvere?**

## P02

[...]

*Portando la nostra attenzione sul tema del cibo adesso.. quando parlo di prodotti fai sempre riferimento a prodotti vegetali, e prevalentemente all'insalata. Fai la spesa per te stessa? Per chi acquisti? O chi acquista per te?*

**Faccio la spesa per me stessa, a me non piace per niente andare al supermercato e cerco proprio di non andarci perchè proprio non mi piace: non mi piace perchè.. intanto non trovo mai le cose velocemente -problema mio eh-, e poi mi viene un po' di ansia perchè vedo troppe cose non riesco a essere focalizzata su quello che voglio, e poi perchè nell'ultima anno sono diventata più consapevole di quanto non lo fossi prima sul tema della sostenibilità e mi viene l'orticaria a vedere tutta quella plastica.**

**Adesso faccio la spesa in diversi mercati biologici o anche non necessariamente biologici. Io abito in centro a Modena e a pochi metri in giorni diversi ci sono i mercati dei contadini. Io vado preferenzialmente allo stand bio a comprare le verdure, tra l'altro sono una di quelle che si porta i sacchetti di carta, ho uno zaino con tutti i sacchetti e le confezioni delle uova e uso quelli finchè non si rompono. Lì compro verdure, formaggi, frutta e devo dire che quasi vivo di quello.**

**Poi essendo celiaca ho questo credito del servizio sanitario quindi per quello vado in un negozio specializzato così so che la spesa celiaca la faccio solo lì, e anche lì mi viene l'orticaria a vedere le schifezze che ci sono dentro i prodotti per celiaci però un po' mi fa comodo averli gratis, un po' prendo le cose che mi sembrano migliori.**

*Mi spiegheresti un po' meglio le motivazioni per cui ti piace andare ai mercati contadini?*

**Per un fattore pratico, che sono molto vicini a casa mia ma non determinante perchè anche quando abiterò in collina e anche se non saranno vicini, mi prenderò la briga per andare al mercato più vicino. Un po' poi coltiverò io quando ho la casa in campagna.**

**Mi piacciono perchè: allora la prima bancarella da cui vado è quella biologica e mi piace il fatto che coltivino nella terra e l'elemento terra mi piace. Il fatto che non usano pesticidi... a volte mi chiedo ma sarà vero? cosa significa esattamente biologico? ma io in questa bancarella a volte ho visto delle lumache, delle foglie mangiucchiate e ho detto "vai tranquilla mi posso fidare", e quindi penso che sia una cosa migliore da mangiare. Il fatto che ci siano meno attori della**

**filiera, meno passaggi, meno spreco, il fatto che sia direttamente il contadino a dare a me, meno packaging, il fatto che io possa decidere la quantità, prendere i miei sacchetti, prendere esattamente quello che voglio. E non da ultimo mi piace la relazione che si crea, mi piace andare lì e vedere le persone, parlare con il bancarellante.. è una dimensione che specialmente durante il lockdown, nei mesi in cui si poteva, a me piaceva.. era quasi un momento di relax, di riappropriarmi di una relazione un po' umana e un po' naturale.**

*Come mai ti piace questa relazione che si crea?*

Se penso al momento in cui vado là vado.. mentre **se penso a quando vado al supermercato, intanto devo prendere la macchina, devo andare là, devo trovare parcheggio, devo entrare in queste corsie, questa luce brutta e tutti i rumori, questa radio..** Mentre quando vado dal bancarellante vado giù con il mio zaino, coi miei sacchetti, il più delle volte ho questo ricordo che c'è il sole, poi magari non è vero perchè vado anche quando piove.. e vedo tutte le persone in fila, le vedo più rilassate che quando sono al supermercato. Poi **vedo un bel clima tra i bancarellanti, si prestano le cose quando hanno bisogno... loro mi sembrano felici quando sono lì e sono sempre gentili.** E ci sono anche dei tempi un po' diversi, rispetto alla cassiera che va alla macchinetta e che non ti guarda neanche in faccia: **c'è più rapporto umano di qualcuno che ti vende, c'è più autenticità.. ti stanno vendendo dei prodotti della terra che hanno fatto loro, loro sono lì e ti vendono ciò di cui hai bisogno e ti danno qualche consiglio. Ah un altro elemento è che hanno stagionalità, e appaga la mia curiosità nel dire "a cavolo questa cosa la scopro adesso perchè c'è adesso, quella cosa che ho preso nei mesi scorsi non c'è più"** e quindi capisco che non è sempre tutto presente o disponibile in natura e quello che non è disponibile magari in realtà magari in quel momento non è quello di cui il tuo corpo ha bisogno. Ad esempio la bancarellante mi aveva detto che dei frutti rossi che c'erano in quel momento avevano un forte apporto di non mi ricordo cosa, forse vitamina C.. che è quello di cui il nostro corpo ha bisogno in questi mesi. Mi è piaciuto imparare questa cosa.

*Quello che mi hai detto: che ti piace il fatto che si coltivi con la terra? Mi spieghi un po' meglio?*

Perchè credo che tutti noi essere viventi abbiamo bisogno degli elementi della natura, che tradizionalmente in diversi approcci sono l'aria, l'acqua, il fuoco, la terra: hanno un significato naturale e anche energetico. **Io penso che le cose come sono in natura sono perfette e come devono essere. Il fatto di togliere le piante dalla terra è un po' come essere alimentate attraverso una flebo, non è nostro modo naturale di essere alimentati.** Poi chimicamente puoi bilanciare tutto perchè ci sia tutto l'apporto nutritivo, magari ci siano anche caratteristiche diverse perchè vuoi correggere determinati parametri... vuoi controllare. Ecco per me nell'intervenire sulla natura, cioè è chiaro che interveniamo sulla natura, alla fine in natura ci sono tantissime creature che interagiscono tra loro quindi il loro interagire è un intervenire gli uni sugli altri... **però intervenire in modo così invasivo perchè addirittura la pianta e la coltivo in modo diverso perchè a me fa più comodo è per me un impoverimento a livello nutrizionale non so, ma per me è un impoverimento a livello energetico.** Ma dall'altra parte mi rendo conto che questo permette una coltivazione maggiore più efficace, a minor spreco da un certo punto di vista e che quindi permette una coltivazione più vicina ai centri urbani e va incontro al fabbisogno urbano in maniera più diretta, in quanto puoi coltivare in idroponica anche in centro città probabilmente. Nonostante ciò io preferisco di no, per me proprio io preferisco coltivare la terra, proverò e ti dirò... **ma in prima istanza preferisco i metodi tradizionali perchè più aderenti a come funziona in natura.**

*Rispetto al fatto che tu vuoi avere un orto, che cosa ti piace del fatto di averne uno?*

**Allora sono molto curiosa di vedere come crescono le piante, che cosa imparerò magari da piante che possono stare vicine o meno, cosa imparerò quando arriveranno i parassiti e cercherò di debellarli in una maniera che non sia chimica.** Sono proprio curiosa di questa parte che non conosco. Qualcosina la so e intuitivamente la so per osmosi perchè sono cresciuta in campagna e ho osservato molto però non so quasi niente, quindi mi sento affine a questo mondo ma sento di imparare tutto. **Poi a me piace raccogliere cose, mi piace osservare, vedere come cambiano e raccogliere le piante, e magari anche raccogliere i semi e poi seminare, oppure raccogliere**

**le piante nei boschi.** Andrea invece mi compensa perchè lui è bravo a cucinare, è bravo e molto attento e io mi immagino questa visione bucolica in cui io raccolgo le piante dell'orto, glielie porto e lui cucina qualcosa di buono. **E poi dal punto di vista economico pensare di avvicinarmi all'autosufficienza e poter risparmiare sulle verdure e potermi avvicinare al discorso produco io quello che mi serve e magari offrirlo ad altri.. mi piace questa idea di non dover dipendere.**

*Quali sono i fattori fondamentali che ti portano ad acquistare un prodotto (insalata principalmente) piuttosto che un altro?*

Oltre a quelli che ti ho detto ti posso dire anche... adesso mi è venuto in mente un'insalata che mi piace molto e non trovo spesso.. non mi ricordo mai se si chiama cicoria o cicorino, io lo chiamo cicorino... comunque è della famiglia dei radicchi e sono delle foglioline piccole rosse e verdi e sono dure dure e amare e a me piace moltissimo.. **a me piacciono le cose rustiche nel gusto e nella forma. E quando vedo nella bancarella questo che non trovo spesso oppure la cicoria con la foglia lunga, mi sembrano rustici e li prendo. Viceversa, le foglioline carine, giovani, chiare, non le prendo e devo dire che nelle bancarelle le trovo anche meno, magari quelle foglioline lì le trovo al supermercato in cui c'è la foglia super giovane, io la associo alla roba che non sa di niente, perchè è troppo giovane e delicata ed è una roba finta da supermercato.** Quindi questo è un altro criterio, ma è un caso molto specifico dell'insalata.

Sto pensando... **Il fatto di determinare io la quantità, mentre invece se compro il sacchetto che già c'è il packaging e quindi ha la confezione piccola... io mangio un casino di insalata da sempre.. e quindi la confezione è piccola e quindi devo prendere 800 confezioni per riuscire ad andarci avanti tre giorni.** Poi magari delle volte sono dei misti al supermercato, e a volte i misti che ci sono vanno bene, mi può piacere.. mentre altre volte mi è capitato che ci fossero troppe cose insieme e che magari mi sono sbagliata e ho comprato anche quelle con le fettine di cipolla e non mi andava proprio di mangiare tutta quella cipolla

*Cosa spero/desidero quando acquisti un prodotto vegetale?*

**Che comunque mi duri perchè vado a fare la spesa una volta a settimana.**

Poi qua c'è un po' una contraddizione: **mi piacciono le cose rustiche, biologiche e sono tranquillizzata dal fatto che ci trovo le lumache perchè so che è biologico, dall'altra parte mi rompo a lavarle e quindi spero di non fare troppa fatica a lavarle, ed è un po' una contraddizione perchè quelle cose sono sempre un po' sporche di terra.** Tendenzialmente comunque spero che mi duri.

*Sei solito comprare sempre le stesse cose o a volte provi e acquisti qualcosa di diverso? In questo caso che cosa ti incuriosisce/perché lo vuoi provare? (pensa a un esempio)*

**Mi capita, se lo compro e mi piace poi continuo a prendere sempre quello. Tipo c'è la bancarella di formaggi caprini, che io prima non compravo perchè al supermercato non ci sono tanto ma magari non ci fai caso perchè sono annegati insieme ai prodotti bovini.** L'ho preso, mi piace e.. 'è anche vero che c'è quella bancarella lì siccome hanno solo capre e prendo solo quello tutte le settimane, cerco un po' di comprare formaggi diversi e li ho provati un po' tutti ma alla fine prendo solo quello perchè mi piace. **Ho le mie cose che mi piacciono e prendo sempre quelle, sono abitudinaria.. anche nei vestiti, ho poche robe che mi piacciono e prendo sempre quelle.**

*Quando vuoi provare qualcosa quindi è perchè lo vedi esposto quindi?*

Fammi pensare un attimo.. Sì, è perchè lo vedo, perchè nelle bancarelle tutto quello che c'è è esposto.. allora **magari quando vedo qualcosa che non avevo visto prima allora chiedo "che cos'è quello?" "che gusto ha?" e se non mi va lo lascio lì.. poi puoi anche provare lì per lì, ci sono gli assaggi.** Non lo faccio anche perchè con questa storia del Covid non metto le mani in bocca così a gratis però magari in un altro momento storico lo farei.

*Parliamo ora del vertical farming. Prima di rispondere al questionario ne avevi sentito parlare? Avevi mai avuto la possibilità di acquistare dei prodotti coltivati in VF?*

Sì ne avevo sentito parlare e tra l'altro **siccome ho un terrazzo avevo anche provato a coltivare**

**anche qui e avevo fatto una piccola costruzione verticale per provare a coltivare qualcosa.** Adesso è rimasta solo l'erba aglina perchè tutto il resto è morto e per un po' ho pensato anche che fosse una gran figata e molto bello da vedere, aldilà del contesto di produzione per il fabbisogno delle persone, anche esteticamente in un cortile, dove non c'è molto spazio, o su un terrazzo fosse anche molto bello esteticamente. **Poi mi son resa conto nell'esperimento che ho fatto che è difficile da mantenere. Come anche in vaso in realtà.. meglio in terra. Di nuovo. Non saprei neanche dove acquistare questi prodotti, al supermercato non ho mai visto prodotti coltivati in vertical farming e neanche nei mercati.**

*Hai dubbi o perplessità al riguardo? Se sì, quali aspetti ti fanno storcere il naso?*

Mi viene in mente un'altra cosa, visto che seguivo la pagina Facebook di Agricola Moderna, e ora non seguo più... Ho avuto un senso di non trovarmici per niente, quasi di rabbia nel vedere il mood che loro propongono che **se dovessi esprimere in una parola chiave "sterile". Sterile perchè vedi queste foto di loro con i quantini, con la piantina cioè sembrano delle cose di laboratorio. Sono cose di laboratorio.** Questo è il look and feel che loro propongono ed è quello che mi è arrivato. **Stiamo parlando di cose che si coltivano e che si mangiano e per me il fatto che dicano che sono coltivate in sicurezza, ambiente sterile e pulito, non è la cosa che fa leva su di me. Mi ha dato quasi fastidio.. una cosa quasi clinica, chirurgica e io dico, non abbiamo bisogno di questo. Oltre al fatto che vedo la foto di questi con i guanti e penso altra plastica, altro silicone!** **Il fatto che rischi di portare patogeni, è perchè come quando io vado in ospedale che vado a trovare una persona che non sta bene ed è alimentato con una flebo e devo fare attenzione a non portare dei patogeni, così il fatto di alimentare le piante in questo modo le rende magari perfette dal punto di vista nutrizionale ma deboli e quindi le depaupera e devi avere un sacco di accortezze ulteriori per fare in modo di non ammalarle ulteriormente.**

Poi c'è un altro concetto che vorrei provare a spiegarti.. visto che sto studiando per coltivare anche io per capire come farlo al meglio: ho letto e imparato che il modo in cui coltiviamo, l'agricoltura contadina dove tu ti immagini il campo arato ecc. La natura fa molte cose che la coltura tradizionale di adesso.. il contadino normale fa più lavoro e fatica per immettere ciò che la natura farebbe naturalmente.. cioè il fatto di arare la terra in realtà impoverisce il terreno, lo secca, fa uccidere quei batteri ed esseri che aiutano la decomposizione, trasformano le sostanze del terreno. Quindi il contadino deve metterci degli additivi, dei concimi per fare tornare buona la terra.. e queste sono tutte cose che non sono sostenibili, perchè tu stai togliendo e dai, togli e dai. Fai più fatica tu perchè ci metti più energie ma dall'altro lato fai meno fatica perchè ci metti meno tempo visto che puoi usare il trattore e coltivare superfici più grandi. Però in realtà sono interventi umani che scombuscolano l'ecosistema naturale che rendono più soggetto a problemi e devi per forza re integrare. **E secondo me l'idroponica è questa cosa.. fa questa cosa all'ennesima potenza, tu togli per poi rimettere. L'unica cosa che vedo di positivo è di rifornire ai centri urbani a km0. Mi chiedo quindi se ne possa valere la pena o se approvvigionarsi di cibo, verdure dei contadini delle campagne limitrofe sia forse meglio.** Ho un dubbio su questa cosa.. nel senso che siamo in tanti che vogliamo mangiare quindi più vicina è questa coltivazione meglio è però non mi piace la modalità.

## P03

[...]

*Mi diresti dove e come acquisti il cibo? In particolare la frutta e verdura (insalata principalmente)*

**Di solito vado nei mercati dei contadini oppure nei supermercati un po' più di qualità (non discount). Dove vado io si chiama Irma, è molto bello e hanno un sacco di cose italiane come la pasta Rummi e anche la verdura è verdura decente ma costa un sacco.**

*Ma a Copenaghen la frutta e verdura come la producono?*

**Allora tantissimo di importazione principalmente dalla Spagna, o Italia, Grecia. Hanno anche cose prodotte qui nelle Vertical farms oppure verdura locale come patate e cipolle.**

*Hai provato quei prodotti coltivati nelle Vertical farms?*

Sì ho provato un po' di insalate, il basilico e tutte le erbe aromatiche.

*Cosa ne pensi? Sono buoni?*

Sì sono molto buoni e secondo me risultano più freschi di altri prodotti che hanno importato perché comunque sono prodotti vicini e le vendono subito.. La supply chain è molto più corta. Anche a livello di sapore io mi sono trovata molto bene, perché in genere qui le cose non sanno di niente perché secondo me le fanno maturare nelle celle frigorifere.. Quindi le cose come insalate ed erbe aromatiche che ho provato secondo me erano buone, si sente che sono più fresche e coltivate diversamente.

*Quali sono i motivi per cui vai dai contadini e motivi per cui vai nei supermercati di un certo tipo?*

Supermercati perché mi viene più comodo, perché il mercato contadino c'è una volta a settimana nel weekend quindi è un po' più difficile. Quindi al supermercato faccio la spesa un po' più grossa poi nel weekend magari vado al mercato del contadino e prendo le cose un po' più particolari, più buone che trovo.

Vado dai contadini perché secondo me la verdura è più buona, è coltivata con metodi naturali ed è comunque un mercato organico. Perché è roba locale ed è più sostenibile.

*Cosa è per te naturale?*

Qualcosa che non è coltivato con pesticidi, non è imballato in kg di plastica e in generale cose che non vengono dall'altra parte del mondo.

[...]

*Qual è l'aspetto fondamentale che ti porta ad acquistare un prodotto vegetale (insalata principalmente) piuttosto che un altro?*

Quanto è fresco, se vedi che è fresco o meno. La provenienza. E il prezzo ormai non lo guardo più soprattutto per la verdura. Anche per 3 pomodori magari pago 5 euro però la verdura è importante che sia decente altrimenti ne faccio a meno.

*Come valuti la freschezza?*

Dall'aspetto, dal colore o anche da dove viene secondo me fa tanto.

*Cosa speri/desideri quando acquisti un prodotto vegetale?*

Spero che sia buono, che la qualità sia alta.. Quindi dato che è coltivato in questo modo, lo paghi un po' di più e quindi speri che ne valga la pena. Sicuramente il sapore ma anche il fatto che si conservi un po' di più essendo fresco. Però è anche vero che prendendo prodotti senza aggiunta di sostanze potrebbe anche durare di meno.. Non so.

*Sei solito comprare sempre le stesse cose o a volte provi e acquisti qualcosa di diverso? In questo caso che cosa ti incuriosisce/perché lo vuoi provare? (pensa a un esempio)*

Cambio spesso. A volte voglio cucinare cose un po' particolari perché mi annoio a mangiare sempre le stesse cose perciò provo anche cose nuove. Anche per l'insalata cambio spesso. Non scelgo sempre la stessa.

Cucinando qualcosa di diverso provo nuovi ingredienti ma a volte prendo nuove verdure perché mi incuriosiscono e basta.

*Quando vuoi provare un nuovo prodotto cosa fai?*

Di solito compro al supermercato e trovo un modo di cucinarlo e vedo cosa esce.

Molto spesso vado al supermercato e in base a quello che vedo poi decido cosa cucinare. Raramente ho già idea di cosa voglio cucinare e poi vado a comprare le cose, cioè magari ce l'ho però poi magari vado al supermercato, vedo tutte le cose e cambio idea.

[...]

*Parliamo ora del vertical farming. Prima di rispondere al questionario ne avevi sentito parlare? Avevi mai avuto la possibilità di acquistare dei prodotti coltivati in VF?*

Sì ne avevo sentito parlare e avevo già acquistato dei prodotti.

*Dove li hai comprati? Raccontami un po'*

Di solito qui si trovano nei supermercati di un po' più alta qualità, non discount, che costano di più e appena entri c'è il reparto di frutta e verdura e su una parete ci sono tutti i ripiani di queste verdure coltivate nelle Vertical farm. Io penso che non le coltivino lì ma che le prendano dalla vertical farm e le portino lì però rimangono "dentro l'acqua"

*Sono tipo frigoriferi con dei "vassei" giusto?*

Sì sì esatto. Ci sono i ripiani più alti dove non puoi prendere la roba perché magari non so, puoi acquistarli dopo 2 o 3 giorni. Mentre nei ripiani più bassi puoi aprire e prendere quello che vuoi. Di solito col fatto che continuano a crescere lì, li vendono in delle specie di coni di carta con le radici un po' volanti.. Infatti io la prima volta ho preso il basilico che era tutto bagnato.. e ho detto "ma che strano" poi però ho scoperto che era normale. Praticamente c'era questo ripiano con le luci un po' neon rosine e ho detto "che bello questo basilico" visto che era molto bello e rigoglioso. Ho tirato su pensando che fosse un mazzetto già tagliato, invece era una piantina.. Infatti sono arrivata a casa e l'ho piantata. Io l'ho presa e messa nel carrello.. Sono tornata a casa in bici con il basilico che gocciolava!

È stato un po' un disagio perché all'inizio non capivo, poi però comunque è molto intelligente perché tu arrivi a casa e pianti la piantina, così ti dura di più rispetto al mazzo già tagliato. E se quello non lo usi subito poi lo devi buttare.

Invece la mia piantina poi è durata un paio di mesi, poi lì fa un po' freddo ed era pure inverno forse.

*Anche l'insalata puoi trapiantare?*

Sì perché anche in quel caso prendi il tuo cono con le radici e quindi puoi piantarla. Però non so quanto abbia senso perché il basilico usi 2 o 3 foglie quindi ci sta che tu abbia la piantina, mentre l'insalata la compri e la usi tutta quindi dovresti tagliarla e aspettare che ricresca.. Che puoi anche farlo, hai lì la pianta e che ne so, dopo un mese ti ricresce.

*Ma tu coltivi anche qualcosa oltre al basilico?*

Sì, sono sempre stata abituata con le mie nonne e mio papà ad avere l'orto quindi per me avere la verdura schifosa del supermercato è proprio triste. Quindi se te la coltivi tu sai che è tua.. Poi in un appartamento non so quanto senso abbia. Poi mi piace proprio che sia mio, mi dà soddisfazione, ti crescono le tue piantine. Sono buone di sapore.

*Hai dubbi o perplessità al riguardo? Se sì, quali aspetti ti fanno storcere il naso?*

Mmm no. Qui ci sono tante aziende che fanno questo e vedo che nei supermercati vendono queste cose mentre in Italia non mi è mai capitato di vedere questi prodotti.

Dei Frigoriferi o celle dove ognuno si tira su la sua piantina sono interessanti. Secondo me se quell'insalata fosse stata in busta io non mi sarei neanche messa lì a leggere. Il fatto di avere dei "frigoriferi" o cose come quello che c'è a Irma, mi cattura l'attenzione e mi incuriosisco.. e poi posso prendermi la mia piantina e comprarmela.

## PO4

[...]

*Mi diresti dove e come acquisti il cibo, in particolare la frutta e verdura? (insalata principalmente)*

Principalmente al supermercato, quasi esclusivamente all'U2 perché secondo me è di qualità.. non sto tanto a guardare qualità-prezzo ma è vicino a casa più che altro e secondo me rispetto ad altri supermercati secondo me è di qualità migliore.

*Come definisci la qualità?*

Come gusto e anche quanto dura. A volte quando prendi frutta e verdura all'Esselunga dura veramente poco, poi tende subito a marcire. Qualità più che altro è il gusto, il fatto che sia buona. Cerco sempre di comprare prodotti che arrivino dall'Italia, non compro mai o quasi mai prodotti che vengono dall'estero.. Penso sia giusto mangiare ciò che è di stagione e se compro qualcosa che so che viene dall'estero è sicuramente fuori stagione e poi per un motivo etico, che i prodotti non devono farsi tutti quei km.

*Qual é l'aspetto fondamentale che ti porta ad acquistare un prodotto vegetale (insalata principalmente) piuttosto che un altro?*

La provenienza, se vedo che magari è un prodotto un po' più particolare.. tipo se vedo due pacchi di insalata magari non prendo la Bonduelle che è super pubblicizzata o molto commerciale ma tendo a prendere l'insalata a km0 se c'è, magari di un produttore locale o vicino comunque. Di solito all'U2 sono segnalati i prodotti km0, oppure sulla confezione vedo il produttore dov'è.

*Tu acquisti le insalate confezionate?*

Sì normalmente in busta per comodità.

*Cosa speri/desideri quando acquisti un prodotto vegetale?*

Che non vada a male presto e che sia buono. Perché principalmente vivo da sola e un pacco di insalata non me lo mangio tutto in una volta, quindi vorrei che mi duri qualche giorno in più.

*Sei solito comprare sempre le stesse cose o a volte provi e acquisti qualcosa di diverso? In questo caso che cosa ti incuriosisce/perché lo vuoi provare? (pensa a un esempio)*

Principalmente compro sempre le stesse cose, raramente mi capita di acquistare qualcosa di diverso. Acquisto qualcosa di diverso se è una cosa che magari non ho mai visto.

*In che situazioni ti capita? Mi fai un esempio?*

Se sto girando al supermercato e vedo questo prodotto che non ho mai visto magari mi avvicino, controllo, guardo e se mi incuriosisce lo prendo.

*Che cosa ti incuriosisce?*

Se ha una provenienza particolare, o è un prodotto un po' particolare. Metti che trovo l'insalata del contadino di Bregnano che è qua dietro casa mia allora dico "dai proviamola!".

*Parliamo ora del vertical farming. Prima di rispondere al questionario ne avevi sentito parlare? Avevi mai avuto la possibilità di acquistare dei prodotti coltivati in VF?*

No non ne avevo mai sentito parlare prima di rispondere al tuo questionario, e non li ho mai trovati nei supermercati. Magari li acquisterei per provarli.. in quel caso sarebbe la curiosità di voler provare un prodotto particolare.

*Hai dubbi o perplessità al riguardo? Se sì, quali aspetti ti fanno storcere il naso?*

L'unica cosa che magari mi allontanerebbe dal scegliere sempre quel tipo di prodotto è che non abbia una coltivazione a terra e non assorba quelle che sono le qualità del terreno in cui è coltivato, mi lascia un po' dei dubbi rispetto a quello che potrebbe essere il valore nutrizionale del prodotto. O comunque viviamo in un paese che ha una biodiversità a livello di ortaggi elevata, soprattutto per la diversità dei territori. Però è sempre un territorio, non è un ambiente protetto, chiamiamolo "sotto teca".

*Che cosa ti lascia un po' perplessa?*

Mi sembra molto artificiale, poco naturale, che abbia poco contatto con quello che è il territorio e quelle che possono essere le caratteristiche di un territorio, diverse da un posto rispetto a un altro.

*Questo artificiale e poco naturale lo intendi in modo negativo?*

Mmmm, più che altro non lo vedo come qualcosa di particolare.. nel senso, se devo scegliere

tra 10 diversi pomodori magari scelgo quelli di un territorio particolare, come può essere un pomodoro cresciuto sul Vesuvio o... perchè comunque quel terreno presumo dia caratteristiche particolari a quel prodotto. A livello di sapore o anche di valore nutrizionale.. quello non lo so perchè non l'ho analizzato ma presumo che sia comunque diverso. Quindi fare un pomodoro in Vertical Farming a Barletta e farlo a Bolzano è sostanzialmente uguale, non cambia le sue caratteristiche quindi non lo vedo un valore aggiunto.

*Cosa potrebbe essere per te un valore aggiunto?*

Un valore aggiunto è una specificità del territorio in cui cresce.. per me è questo, o comunque è quello che mi fa dire è un prodotto buono rispetto ad un altro, o comunque che condizionerebbe la mia scelta nell'acquisto.

## P05

[...]

*Mi diresti dove e come acquisti il cibo, in particolare la frutta e verdura? (insalata principalmente)*

Non sono un grande appassionato di insalata ma soprattutto verdure a foglia verde, ma comunque l'acquisto sì, nella grande distribuzione per comodità. Quest'anno non lo abbiamo fatto però fino all'anno scorso facevamo un piccolo orto che magari durante il periodo estivo ci permetteva di portare a casa qualcosina. Vado anche dai fruttivendoli, solo che per comodità ti ripeto vado nella grande distribuzione.. Quando capita vado anche dal fruttivendolo o al mercato.

*Quando ti capita di andare dal fruttivendolo o al mercato?*

Generalmente quando ho un po' più di tempo, tipo al sabato che sono a casa dal lavoro. O magari ci va mia mamma per esempio il mercoledì che c'è il mercato a Vanzago, lì va lei direttamente.

*Per quale motivo comprate al mercato?*

Perché magari va già al mercato e allora acquista alla bancarella. Oppure magari la sera che vuole i pomodori da mangiare con la bistecca allora va a prenderli. Anche per la qualità, ma penso che in fin dei conti la comodità vince su tutto, anche sulla qualità del prodotto, sulla freschezza, anche sulla stagionalità.

*Prima mi dicevi che avevate un piccolo orto, mi racconti un po'?*

Da quando sono piccolo facciamo l'orto, ma negli ultimi due anni non lo abbiamo più fatto perché avevamo dei lavori da fare in casa.

*Come mai lo facevate?*

Era una grande passione di mio padre che ha cercato di trasmettermi ma ci è riuscito poco. E poi perché i prodotti generalmente hanno un sapore diverso, più buoni sì e magari ne mangi di meno. Cioè ti faccio un esempio: se io metto giù 3 piante di pomodori.. Non è che 3 piante mi fanno i pomodori, può morire una perché ho dato poca o troppa acqua o perché è arrivato il merlo a mangiare quei quattro pomodori.. Mi ricordo un anno che avevamo messo giù la lattuga ma di lattuga non ne avevamo mangiata perché le lumache l'avevano mangiata tutta.. Ma a quanto pare era buona perché l'hanno mangiata tutta! Buon per loro.

Nasce come passione ecco. Perché poi se stai a fare il conto di quanto tempo ci perdi e tutto quello che gli devi dare, vince il supermercato per convenienza e costi. Dipende un po' perché mangi la frutta o verdura, se la mangi perché è buona ti conviene fare l'orto o cercare un posto dove sai che è buona..

*Qual é l'aspetto fondamentale che ti porta ad acquistare un prodotto vegetale (insalata principalmente) piuttosto che un altro?*

Tolta la necessità, devo dire che sono tornato dopo un anno e mezzo a comprare il prodotto sfuso. Ma non so perché.. ah perché nel periodo Covid ne veniva prodotto di più e lo sfuso lo avevano un po' rilegato perciò compravo roba confezionata. Cerco di comprare stagionale il più possibile, cerco di ridurre al minimo prodotti extra europei (banana, mango ananas, frutto del drago).. Cerco sempre di seguire la stagionalità, eccetto i pomodori... per quello in casa mia non c'è stagionalità.

*Come mai scegliete di seguire la stagionalità?*

Perchè sono più buone le cose di stagione piuttosto che quelle fuori stagione, ed essendo stagionali ti lavi anche un po' la coscienza andando a prendere il discorso dell'inquinamento.

*Cosa speri/desideri quando acquisti un prodotto vegetale?*

Che sia buono, che sia fresco, sarei stupido ad acquistare delle insalate che vedo già che sono marce.

*Cosa speri/desideri quando acquisti un prodotto vegetale?*

Beh ma come faccio ad acquistare altrimenti? Via telefono? Ahhh ma forse in servizi come Amazon non puoi vedere quello che ti arriva.. Ma in realtà da noi si va ancora al supermercato e vedo ciò che acquisto... **se ad esempio, anche con la carne, se la carne non mi ispira non la prendo.**

*Sei solito comprare sempre le stesse cose o a volte provi e acquisti qualcosa di diverso? In questo caso che cosa ti incuriosisce/perché lo vuoi provare? (pensa a un esempio)*

Compro anche roba strana. In generale le stesse cose, come tutti penso che quando fai la spesa prendi bene o male sempre le stesse cose.. ma se c'è la patata dolce, o il cavolfiore magari viola visto che vanno di moda i cavolfiori colorati ora, compro i ciuffettini se ci sono, oppure qualche frutto che vendono sotto Natale tipo il pomelo. Oppure quelle mele colorate piccole.. perchè mi piace cambiare.

*Quando vuoi provare un nuovo prodotto cosa fai?*

Generalmente vado al supermercato, vedo qualcosa di strano, lo porto a casa e poi tentiamo di farlo. Una volta ho preso il Jackfruit ma non so se si chiama così.. Una roba asiatica che mangi solo la roba bianca.. Ce l'ho lì ancora da due mesi ma è sottovuoto, ma mia mamma non sa come farlo perciò penso che finirà nella spazzatura. Se no mi viene in mente l'anguria quadrata che ho visto una volta e quindi se la trovo la compro.. Solo per aver comprato un'anguria quadrata!

*Parliamo ora del vertical farming. Prima di rispondere al questionario ne avevi sentito parlare? Avevi mai avuto la possibilità di acquistare dei prodotti coltivati in VF?*

Vertical farming no, ho sentito parlare dell'idroponica. Ho collegato le due cose ma non me avevo mai sentito parlare. Mi sono interessato perché avevo visto in tv e poi sono a leggere. Che so io no, non ho comprato, non ho acquistato consapevolmente dei prodotti in Vertical farming. ... manca una specifica del prodotto, cosa ne so io che un'insalata in busta di insalata sia stata fatta in vertical farming o no? so solo che è bio o no, che è stato prodotto in italia o francia ma non so esattamente che tipologia hanno usato.

Io sono convinto che i pomodori tutti uguali dell'Esselunga olandesi siano coltivati in idroponica. E da piccola persona che va a fare la spesa, non c'è scritto la tipologia di coltivazione sui prodotti e questo può essere un problema. Mentre sulla pasta sono obbligati a scrivere grano proveniente da EU o non EU, sul pomodoro scrivono solo che proviene dal Marocco, dalla Spagna, dall'Olanda o dall'Italia ma non scrivono come è stato coltivato.. Magari lo scrivono in quelli confezionati, ma se prendi lo sfuso per esempio non c'è.

Pomodori Esselunga olandesi: prima cosa che faccio guardo la provenienza. Se ci fai caso ci sono anche al Tigros, sempre dall'Olanda. Sono "pomodori ramati grappolo" e sono perfettamente uguali, ce ne sono sempre 5 o 6 per grappolo, e sono pomodori perfettamente rossi e rotondi, acquosi che fanno schifo, la mia esperienza non è stata positiva. Se tu pianti dei pomodori non ti usciranno mai dei pomodori così uguali, ne avrai uno piegato da una parte un altro dall'altra. Per questo penso che quelli siano coltivati in idroponica.

*Hai dubbi o perplessità al riguardo? Se si, quali aspetti ti fanno storcere il naso?*

Fanno schifo. Sapore schifosi, sanno di acqua quelli, sembrano pomodori fuori stagione. Se li mangiassi a gennaio ha senso, dico beh sono stati coltivati in una maniera così.. Ma quelli di serra

a gennaio sono più buoni anche se costano 6 volte tanto.. **Magari hanno dentro tutte le qualità di un pomodoro normale ma che trovassero anche un modo di dargli sapore!**

Però con l'idroponica posso fare prodotti tutto l'anno, tutto il giorno.. È una coltura intensiva sviluppata. Poi dimmi se sbaglio. Ti dico va bene.. **Però non sanno di niente. Non so neanche se il sapore deriva dalla terra, magari cambia visto che è fatto sulla lana di cocco.**

**A livello di concetto sono ultra favorevole. L'idea di riuscire ad abbattere la natura nella produzione intensiva non è così malvagia, poi può essere usata male come lo si fa coi polli. Se è vero che continueremo a crescere e più gente ne avrà bisogno, dovremo purtroppo produrre di più. Di conseguenza sistemi come questi che permettono di produrre di più e consumare il meno possibile. E possiamo permettere a paesi sottosviluppati come il Chad di coltivare con energia elettrica e acqua, riuscendo a dare anche a loro di mangiare.**

**Sono favorevole ma che provino a dargli un po' di sapore.**

## PO6

[...]

*Motivo per cui acquisti al supermercato e motivo per cui vai dal fruttivendolo?*

Principalmente le compro quando vado a fare la spesa e quindi **le compro nei supermercati** però **delle volte le acquisto anche dal mio fruttivendolo di fiducia.** In entrambi i casi in busta.

*Motivo per cui acquisti al supermercato e motivo per cui vai dal fruttivendolo?*

Allora io vado a fare la spesa in due tempi diversi, siccome noi mangiamo tanta insalata prima vado al supermercato e compro l'insalata che mi serve per qualche giorno poi di solito vado a prendere la frutta e la verdura dal mio fruttivendolo a fine settimana e se mi manca qualche busta la compro dal fruttivendolo. Io ne compro tanta, e siccome le insalate hanno sempre un tot di scadenza io guardo sempre l'insalata, perchè io non guardo solo la scadenza guardo anche l'insalata, la foglia com'è... allora se può durare qualche giorno in più ok se no ne compro poca e poi attingo praticamente al mio fruttivendolo.

*Ma come mai alcune cose dal fruttivendolo e altre al supermercato?*

Perchè io dal fruttivendolo compro solo la frutta che voglio io, perchè guarda da dove arriva, com'è.. poi il fruttivendolo dove vado io ci vado da tantissimi anni, ha tantissimo smercio e quindi le cose sono freschissime. Io di solito al supermercato la frutta non la compro mai.

Poi dipende sempre che cosa guardi.. Ti dico, io vado 99% delle volte dal mio fruttivendolo, poi magari o la finisco o sono lì e compro qualcosina, scelgo sempre in base a da dove arriva, cosa costa, la maturazione della frutta.. perchè sai magari arrivano che sono acerbe e maturano nella cassetta e poi fanno schifo.. sai dopo un po' di anni che compro frutta e verdura...

**Siccome vado dal mio fruttivendolo da più di 20 anni, lui sa cosa voglio,** sa che non mi deve fregare perchè io la settimana dopo sono capace di portargliela indietro.. io non ti chiedo cosa costa, **a me piace questo dialogo, questo rapporto che c'è con lui perchè sa benissimo che se mi frega una volta, la volta dopo gliela riporto indietro.** Come la cosa buona io la rivoglio. Non ti chiedo cosa costa, se ti chiedo le pesche buone, non ti chiedo le pesche che costano poco buone, io ti chiedo le pesche buone. E tu le pesche buone mi devi dare. Io sono così... io compro ma tu mi devi dare le cose che voglio, mi freggi una volta e poi son cacchi tuoi, ti faccio il ca\*\*\*\*\*e. **Si perchè io lo conosco, è troppo bella questa cosa capito? Ti farei vedere il messaggio che gli ho mandato ieri, gli ho chiesto "dei pomodori per fare la salsa li hai?", lui mi ha detto di sì e io sono andata a prenderli capito? Infatti ti dico ieri ho preso questa cassetta di pomodori ed erano tutti buoni, non ce ne era uno marcio. Loro vanno al mattino al mercato poi è tanti anni che c'è.. lui prende le cose e le cose sono fresche, lo vedi perchè durano. Ed ecco questo è il rapporto con il fruttivendolo, ci conosciamo da 20 anni. Le cose sono buone di sapore, io ho dei gusti particolari, ma tutta la famiglia. Ad esempio in questo periodo che c'è l'uva, a noi l'uva piace soda, l'uva molle a me non piace. Lui sa cosa piace a me, poi nel possibile io posso anche toccare l'acino e se è buono io lo prendo se no non la prendo, perchè se è molle io a casa mia la butto via.. posso comprarne 2 kg ma poi la butto via, io so i gusti della mia famiglia. E le mele devono fare croc, devono essere sode, dure.. a noi quelle gialle farinose non piacciono.. capito? **quindi in base alle mie esigenze, io mi trovo e prendo la frutta lì.****



*Qual è l'aspetto fondamentale che ti porta ad acquistare un prodotto vegetale (insalata principalmente) piuttosto che un altro?*

Innanzitutto io non mangio tutte le insalate, **una volta che ho scelto l'insalata che piace a noi io guardo il colore dell'insalata, se ha dentro delle muffe, com'è la foglia dell'insalata. Un minimo di controllo io lo faccio.** Io compro solo insalate in busta a foglia intera, perchè io so che quando compri l'insalata spezzettata tanti nutrienti se ne vanno e se hai la foglia intera praticamente è meglio, tipo la rucola, il songino. A mio figlio ne piace un'altra invece. Comunque prendo sempre insalate con foglie intere perchè appunto altrimenti perde sali minerali e valori nutrizionali insomma.. questo era un consiglio che mi avevano dato tempo fa. **Quindi prima cosa tipologia di insalata, e un minimo di ispezione visiva perchè devi vedere se l'insalata è marcita, se è bagnata.. marcisce se è bagnata. Guardo quelle cose lì, guardo quando scade, quando è stata imbustata. La marca non è fondamentale.**

*Cosa speri/desideri quando acquisti un prodotto vegetale?*

**Spero sempre che sia fresca, che abbia un buon sapore. Ecco una cosa che faccio quando apro la busta di insalata è annusare perchè si sente sempre se c'è qualcosa di marcio.** Quindi io spero sempre che quando apro il sacchetto non esca quell'odore che mi dice "ahia questa insalata è vecchia", spero sempre questo.

*Ma compri anche quelle sfuse?*

**Sì sì compro anche quelle, di solito il ceppo lo compro dal fruttivendolo** perchè al supermercato perchè l'insalata che compro io, la scarola, di solito al supermercato la vendono aperta tipo fiore e una volta ho chiesto "come mai la vendete così?" e mi hanno detto "guardi signora non siamo noi che la mettiamo così, arriva proprio così" e siccome a me fa abbastanza schifo e io l'insalata la lavo sempre con il bicarbonato anche se mio figlio dice che non serve a niente, ma io ho la sensazione che quando lavi l'insalata col bicarbonato perda più terra, io comunque la lavo. E un conto è avere la scarola tutta chiusa e un conto è averla tutta aperta. Io la compro sempre quando vado dal fruttivendolo il sabato e poi compro anche quella nel sacchetto.. a casa mia va molto l'insalata.

*Sei solito comprare sempre le stesse cose o a volte provi e acquisti qualcosa di diverso? In questo caso che cosa ti incuriosisce/perché lo vuoi provare? (pensa a un esempio)*

**Compro sempre le stesse cose perchè è una cosa più che altro di gusto..** ogni tanto cambio qualcosa ma nella verdura non nelle insalate.. perchè poi io non amo altre insalate, alcune non le digerisco quindi per l'insalata cerco sempre di rimanere su quella qualità lì. Sono molto abitudinaria comunque sulla verdura.. poi beh ho provato anche a cambiare e comprare qualcosa che mi diceva mia figlia ogni tanto, però devo dire che mangiamo tante verdure, non sono limitata a due verdure, ne mangiamo talmente tante che comunque vario a seconda della stagione. Sono poche le verdure che non compro o che non conosco, sono poche le cose che non mangio. Sono abbastanza abitudinaria però piuttosto varia.

*Parliamo ora del vertical farming. Prima di rispondere al questionario ne avevi sentito parlare? Avevi mai avuto la possibilità di acquistare dei prodotti coltivati in VF?*

**No non ne avevo mai sentito parlare e quindi non le ho neanche mai comprate, mai viste al supermercato. Ma tu pensi che siano diverse? Come le propongono?**

**Ne avevo sentito parlare, però secondo me è proprio la stessa cosa per come la penso io.. che siano in orizzontale o che siano in verticale..**

Poi dipende dai punti di vista.. perchè se magari vai a prendere l'insalata dal contadino o da mio papà che ha l'orto grande come tutta questa stanza, oddio secondo me anche lui usa prodotti chimici.. per forza. Ti dico io quest'anno ho messo giù un'aiuola con i pomodori, mi ha fatto tantissimi pomodori e non ho messo su niente. Sono andata via tre settimane e sono tornata,

pieno di pomodori e pieno di cimici, come tiravi su questi grappoli ce ne erano a migliaia. Allora abbiamo strappato e buttato tutto, e poi mio papà ha detto "me lo dovevi dire altrimenti venivo e spruzzavo lì qualcosa". Poi mi ha detto che non avrei potuto mangiare i pomodori per 5 giorni ma poi dopo sarebbe andato bene. Ho mangiato pomodori per 2 mesi e poi basta, ho dovuto buttare via tutto.

**Io ti dico la verità, io non avrei problemi. Se mi dicono "questa insalata è stata seminata già e questa insalata su", io per come sono fatta io ti dico "io la assaggio" e ti dico se è gustosa come quella giù e poi ti dico posso pensare se magari c'è una sostenibilità eccetera.. io sono aperta a tutto però non le ho mai viste, io pensavo quasi fossero già in giro in commercio senza magari neanche dirti la differenza tra una e l'altra.**

**Devono fare un po' di propaganda per questa cosa in modo che anche la semplice massaia che va al supermercato, che posso essere io di 50 anni ma anche un'altra di 70 anni, e dice "ho visto questa nuova insalata, proviamola" e invece proprio non è pubblicizzata. Nel senso, perchè ho fatto il tuo test l'altra volta e spiegavi cosa fosse questa cosa, ma io non l'avevo proprio mai sentita quindi qualcosa in questo senso dovrebbero farlo, perchè scusa fanno pubblicità per tutto! Però io sono propensa, ok la provo, poi sta a me giudicare.. però se è buona io non avrei nessuna cosa che mi fa dire "preferisco quella a terra, preferisco quella così".**

Poi ovvio che se mi dicono su questa a terra mettiamo 5 pesticidi, su quest'altra ne mettiamo 10 allora dico "aspetta un attimo", allora prendo la prima. Poi se mi dicono "su questa ne mettiamo 5 su quell'altra ne mettiamo 5" ma è sostenibile per vari motivi e posso aiutare nel mio piccolo a fare una scelta così io la faccio perchè comunque io ci penso, alle nuove generazioni e quello che troveranno.

Ti ripeto non ho ancora visto niente, ma se li vedessi li proverei.

Le insalate in busta poi sono comodissime, io le rilavo eh, perchè tutte le persone che compra quelle in busta non le lava, ma io le rilavo con il bicarbonato perchè se no mi fa schifo, e poi le mangio tranquillamente.

## P07

*Potresti raccontarmi brevemente chi sei, quanti anni hai, cosa fai e dove vivi, con chi vivi ecc?*

[...] abbiamo anche una proprietà in un paesino non lontano da qui dove abbiamo una casetta di legno e dove abbiamo un orto che coltiviamo secondo i principi della biodinamica.

*Acquistate verdura o mangiate solo verdura del vostro orto?*

**A parte le carote non prendiamo altro perchè nel nostro terreno non crescono, è un terreno sassoso, perciò quelle le acquistiamo dal fruttivendolo.**

*Come mai andate dal fruttivendolo?*

**Perchè lo conosciamo da tanti anni, è una questione di fiducia.** Lì troviamo le carote buone.

*Qual è il metodo che utilizzate e i principi che seguite nel coltivare la verdura?*

Noi abbiamo fatto parecchi corsi, abbiamo iniziato col biologico, poi siamo andati un po' avanti e ci siamo fermati sul biodinamico, non facciamo tutto il biodinamico ma i principi basilari li teniamo sempre a mente.. non siamo talebani, se dobbiamo dare acqua diamo acqua capito?

**Mi potete spiegare in linea di massima in cosa consiste il metodo biodinamico?** dinamico, non Allora, intanto abbiamo un cumulo di letame che teniamo fermo un anno inserendo dei preparati biodinamici, lo spalmiamo sul terreno e facciamo delle irrorazioni con il cornoletame, il cornosilice.. con tutti i vari prodotti della biodinamica che ci fornisce una ditta. Poi abbiamo un calendario delle semine, per cui **in base al periodo di dove si trova la luna rispetto ai pianeti seminiamo, zappiamo, innaffiamo, muoviamo la terra.. hai capito?**

**Nella biodinamica la pianta è un essere vivente collegato al cosmo, la pianta è in un ecosistema.. è tutto questo scatolone diciamo, per cui è condizionata da tutto, sia dall'aria, dal sole ecc. Non è una pianta fisica solo a sè.**

*Perchè vi siete avvicinati a questo metodo e lo avete scelto?*

**Perchè secondo noi, essendo parte del cosmo, anche il nutrimento che dovremmo avere dovrebbe essere in linea con il nostro essere. Se mangiamo un determinato cibo, questo nutre corpo e mente, hai capito? Non è solo fisicamente una pianta. Il cibo non è solo energia per il corpo, è energia per tutto, anche il modo di pensare.**

*Ho capito, chiaro. Quei preparati biodinamici di cui mi parlavate, cosa sono nella pratica?*

Allora il letame lo prendiamo in una azienda agricola qui vicino che tra l'altro ha anche le mucche che vanno anche al pascolo, non sono solo in spalla.. per cui il letame è molto più sano perchè non danno i silati, si nutre di ?(ercal?), mentre i preparati biodinamici li fornisce una ditta perchè noi non possiamo farceli. Sono delle erbe messe, ad esempio.. l'ortica viene messa in una scatola sotto terra per sei mesi mentre la camomilla viene inserita dentro nel budello di una mucca e messo al sole. Il cornosilice, che è silice, viene messo all'aria.. ci sono 7 preparati biodinamici, e in pratica sarebbero tutti gli elementi della terra e del cosmo inseriti dentro il letame per dare sia il cosmo e sia il nutrimento della terra in questo essere che mettiamo nella terra noi. E ci sono tutti questi 7 elementi.. non è facile spiegare. Sono tutte sostanze naturali che vengono messe al sole o sotto la terra in base a quello che devono fornire loro all'elemento che sviluppano nel terreno dopo.

*Motivo per cui avete un orto?*

**Intanto ci piace coltivare la terra proprio, ci piace seminare, ci piace vedere le piante che crescono, è una soddisfazione. Non è una cosa di guadagno. E poi sappiamo cosa mangiamo.. però appunto è una passione innata che abbiamo dentro.**

*Coltivate solo per voi stessi o date i vostri prodotti ad altri?*

Se abbiamo una bella produzione di pomodoro come quest'anno li offriamo, ma non coltiviamo per un profitto.

*Siete soliti piantare e coltivare sempre gli stessi prodotti?*

Beh dobbiamo tenere conto del terreno, ad esempio non possiamo coltivare gli asparagi perchè nel nostro terreno non vengono.. dovremmo usare altre tecniche per poterli fare perciò non lo facciamo. Cambiamo colture perchè non andiamo solo dai biodinamici a comprare questo questo e questo, ci rechiamo anche dai garden, quello che abbiamo piantiamo.

**Cerchiamo tenere conto di quelle tecniche che prevedono di piantare determinate piante vicino ad altre.. ad esempio per i parassiti, quando ci sono i pidocchi sulle piante che vengono quando c'è caldo umido, noi mettiamo due piante di fava una ogni tanto e i pidocchi vanno su quelle piante lì, poi strappiamo le piante.. sono quei piccoli accorgimenti per evitare di usare qualcosa di chimico. Usiamo zeolite, quella sì perchè abbiamo visto che le piante crescono molto bene, e un po' di rame biologico.**

*Conosceate il Vertical Farming?*

**Noi abbiamo visto qualcosa all'EXPO, e qualcosa alla televisione che facevano vedere che l'Olanda aveva qualcosa.. ma solo a livello visivo e non abbiamo mai approfondito la cosa.**

Che io sappia non abbiamo mai acquistato prodotti in vertical farming, non ho mai notato nulla però sai compriamo solo le carote dal fruttivendolo.

*Avete dubbi o opinioni riguardo il vertical farming?*

Per noi è una cosa... anche se metteranno elementi nell'acqua e non usano pesticidi... **non è un po' artificiale la cosa? Noi siamo un po' critici verso questa coltivazione.. capisco che possano coltivare per la fame nel mondo ma non è "nutrimento", ma è "riempimento" dal nostro punto di vista.** Piante che vanno a 15-20 m di altezza secondo te che pompa ci vuole per portare il nutrimento fino in cima là? Sono quelle cose che la natura non la conosciamo del tutto, la conosciamo poco, mentre la scienza crede di conoscere tutto.. e per me non è logica questo.

**La potranno anche fare biologica ma sempre artificiale è per noi, non fanno trattamenti eccetera ma è un ambiente modificato.. è come se ci mettessero noi dentro in una grotta, è la stessa cosa capito? Stamattina camminando abbiamo visto sul marciapiede una pianta di granoturco**

che era cresciuta.. uno si domanderà ma questo come fa a nascere su una fessura di cemento? la forza della natura.

**Pensa al lavoro degli uccelli, pensa un po' al lavoro che svolge qualsiasi animale.. come le formiche che si dice che portano i pidocchi ma non è mica tanto vero.. ci fermiamo solo lì, ma in realtà hanno un ruolo ben preciso.**

*Potreste definirmi in poche parole il concetto di naturale?*

E' il concetto stesso di naturale che non esiste.. perchè nel momento che esiste un cosmo, esiste tutto e tutto deve essere integrato, non può essere solo una parte. E' come se avessi una goccia da una parte e l'oceano dall'altra, ma l'oceano è formato da migliaia e migliaia di gocce quindi io esamino una goccia ma mi così esamino un'altra cosa.

## PO8

[...]

*Portando la nostra attenzione sul cibo adesso.. Mi diresti dove e come acquisti il cibo, in particolare la frutta e verdura? (insalata principalmente)*

**Vivo da sola quindi faccio la spesa per me stessa. A milano ahimè mi piacerebbe tanto andare al sabato mattina al mercato però vado al supermercato per un discorso di comodità. Poi io non ne consumo tanta quindi magari mi va a male e allora preferisco prendere quella al supermercato e non il cespo. Bio dai.**

*Come mai non riesci ad andare al mercato?*

**Per un discorso di voglia perchè io al sabato dormo. Ma poi il problema vero è che essendo una volta a settimana se io la prendo poi mi dura tre giorni. Io la mangio tutti i giorni l'insalata.. tra l'altro io seguo una dieta, ho carenza di vitamine B12 soprattutto e devo mangiare verdure crude e quindi per forza mangio insalata, finocchi, carote ecc.**

**Al supermercato prendo quelle tipo lattuga, songino, iceberg.. quelle lì insomma. La rucola no perchè non mi piace. Cerco di prendere non quelle giganti perchè poi mi vanno a male subito, questo è il mio problema con la verdura: essendo da sola me ne basta poca e quindi quando è sfusa ok, però anche le buste... me ne servirebbe meno.**

*Qual è l'aspetto fondamentale che ti porta ad acquistare un prodotto vegetale (insalata principalmente) piuttosto che un altro?*

La data di scadenza, se è bio.. guardo un po' queste cose qua, poi però io non so quanto sia vero.. magari scrivono che è bio ma non ho effettivamente... però di base è quello. Quando vado dal fruttivendolo di base me lo scelgono loro... Poi al supermercato quando le prendo al banco (sfuse) prendo le cose più piccole perchè quelle più grosse penso abbiano l'OGM. E poi cerco di prendere quelle di stagione soprattutto, ho un calendario che guardo ogni tanto.

*Bio perchè?*

Beh perchè **agricoltura biologica, fa meglio, rispetto per il territorio, rispetto per il campo coltivato, meno pesticidi.. però ripeto non so se è vero.**

*Cosa spera/desidera quando acquisti un prodotto vegetale?*

Spero che sia **buona, fresca, saporita.**

*Come valuti la freschezza?*

**Beh, si vede dalla foglia. Se è scura o moscia allora no. Mi è capitato di fare la spesa su Amazon quando non ho tempo di fare la spesa e ti arriva tutta schiacciata oppure la vedi che è vecchia, che la apri e puzza. Lì non ci puoi fare niente, perchè non la puoi scegliere.**

*E con Cortilia invece? hai mai comprato?*

**Sì ma con Cortilia è diverso, c'è un tipo di garanzia diversa. Ho preso l'insalata su Cortilia una volta sola ed era più bella, più fresca.. si vedeva. Anche perchè ti arriva nel sacchetto di carta quindi comunque fa anche meno effetto bagnato. Anche il packaging vuol dire comunque. Mi**

fido di più con Cortilia.. c'è una percezione differente, hai dei presupposti diversi come tipo di brand perchè dovrebbe essere la "la campagna a casa tua" quindi mi immagino che arrivi la campagna, che siano prodotti selezionati, non della grande distribuzione. Mi dà l'idea che siano prodotti genuini.

Ho comprato solo un paio di volte per vari motivi: allora innanzitutto io lavorando ho anche i buoni pasto quindi la spesa la faccio con i buoni pasto e Cortilia non li accetta. Poi perchè le quantità sono troppo grandi! Ho preso dei finocchi e mi danno 50 finocchi.. secondo me sono quantità pensate più per famiglie e davvero risulta difficile per me finirle. Quindi a quel punto preferisco andare al supermercato dove prendo due zucchine e quello è. Poi anche il prezzo, non è particolarmente economica Cortilia però come prodotti mi sono trovata bene.

Però appunto avendo un piano mio nutrizionale devo seguirlo.. mi piacerebbe fare le box mensili o settimanali ma io da sola non riesco.

Io preferisco come idea l'Alveare che dice sì.. essendo meno standardizzato, è una realtà un po' meno standardizzato.. tu scegli la quantità che vuoi c'è più possibilità di scelta, vai lì e ci sono i produttori, parli... c'è più contatto diretto, è più bello. A me in questo periodo piace! Mi piace di più l'idea dell'Alveare però oggettivamente è più comodo che te lo portino a casa come con Cortilia. Però sai solo la fascia oraria in cui consegnano, non l'ora precisa. Anche Amazon fa così. Di Cortilia comunque mi piacciono le proposte, le box sono un'idea carina. Mi piace l'idea di avere accesso a dei cibi più a km0, sono prodotti un po' più ricercati e genuini. Io l'ho usato perchè mi piaceva come idea.

*Sei solito comprare sempre le stesse cose o a volte provi e acquisti qualcosa di diverso? In questo caso che cosa ti incuriosisce/perché lo vuoi provare? (pensa a un esempio)*

Con questa dieta devo comprare le stesse cose, prima no. Cioè in realtà poi compro sempre le stesse cose perchè so fare solo quelle, non ho una grande inventiva.. e non ho tempo nè voglia. Quando si ha tempo di cucinare?

*Quando vuoi provare un nuovo prodotto cosa fai?*

Allora, mi salvo molte ricette su instagram oppure boh.. mi lascio ispirare da quello che vedo. Oppure se ho voglia di cucinare quella sera mi cerco "ricette stagionali" poi quello che trovo faccio.. perchè preferisco prendere verdure di stagione.

*Come mai preferisci i prodotti di stagione?*

Perchè sono più buone, seguono la stagione giuste.. se le prendi fuori stagione probabilmente non vengono dall'Italia, non sai da dove vengono.. Principalmente perchè sono più buone comunque.

*Parliamo ora del vertical farming. Prima di rispondere al questionario ne avevi sentito parlare? Avevi mai avuto la possibilità di acquistare dei prodotti coltivati in VF?*

Sì beh è sempre stata una tematica piuttosto trattata, ma non ho una grande conoscenza di base. Non ho mai comprato prodotti. Dove si comprano? Non li ho mai visti. Poi qualcuno non sa neanche cos'è magari. Sembra anche una cosa futuristica.

*Hai dubbi o perplessità al riguardo? Se sì, quali aspetti ti fanno storcere il naso?*

Allora penso di avere dei dubbi, nel senso che vorrei avere modo di conoscere studi o cose che verifichino che effettivamente quello che mangiamo è tanto sano quanto quello che cresce nel campo. Quindi sicuramente più un discorso di qualità del cibo.. non ho le conoscenze necessarie. Mi sorge il dubbio perchè è una coltivazione diversa, senza luce del sole ma con luce artificiale e comunque non c'è la terra, noi siamo abituati a pensare al genuino legato all'immagine della campagna verde col sole e le mucche. E' un'idea nuova di genuinità che faccio fatica a capire, che non conosco.

Ma se io avessi una cosa così in condominio, io la vorrei! Ti gestisci tu il tuo orticello, mi prendo le 5 foglie che mi servono e via. Io sono una super fan di queste cose.

*Perchè ti piace l'idea di avere un orto?*

Beh non devo andare a comprare la roba in giro che non so da dove viene, non so chi l'ha fatta, non so niente. E poi perchè non sprechi il cibo di base.. purtroppo a me capita di buttare via un po' di cose.. non lo faccio con superficialità ma davvero ti vendono troppa roba! Poi a maggior ragione se seguo una dieta per cui devo mangiare una verdura una volta a settimana.

# App flows/wireframes

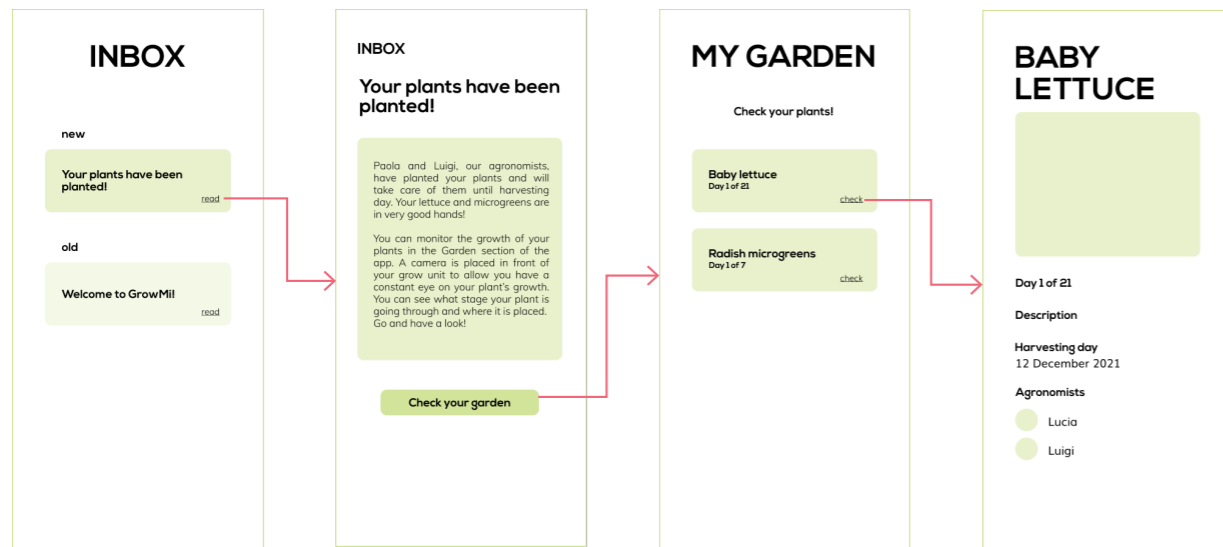
## Flow 1 - Create your garden



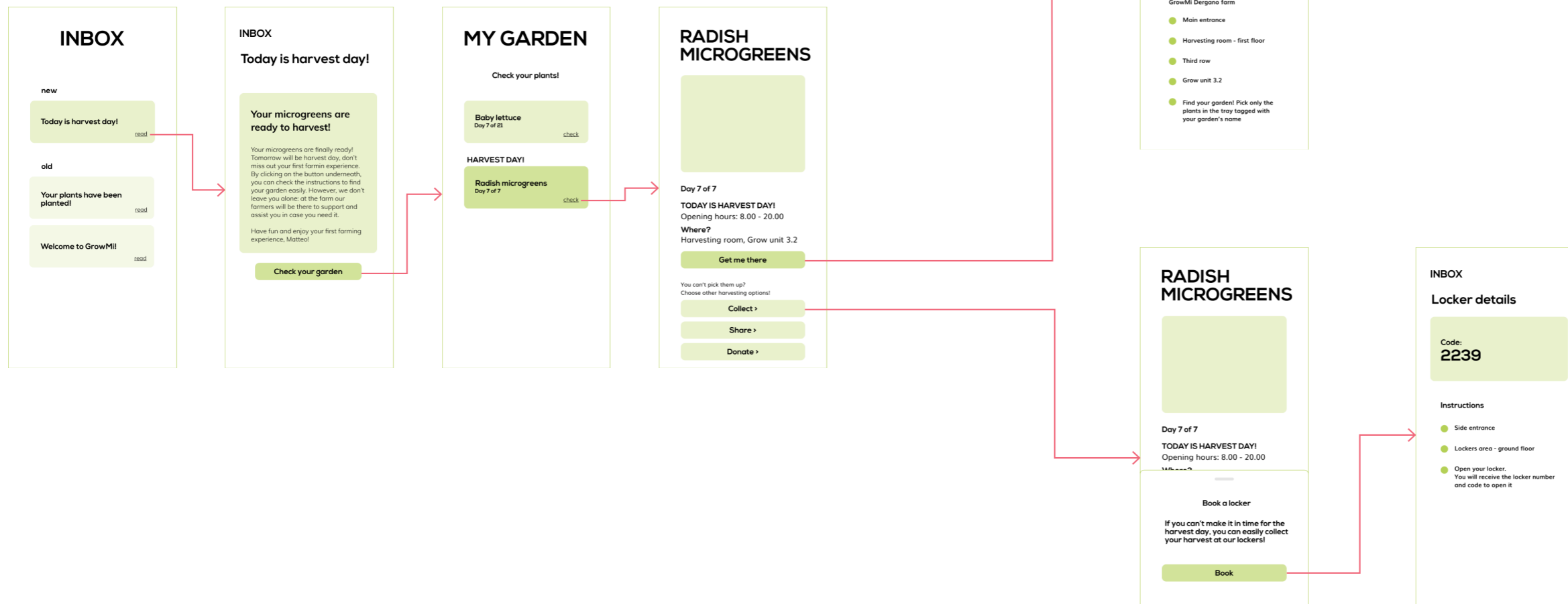
# Architecture

- Discover** → Products, Vertical farms, CTA create your garden, CTA what is GrowMi
- MyGarden** → Personal products
  - ↳ Product's page → Image/video, growth day, description, harvest day, agronomists
- Inbox** → Personal, General → Notifications list
  - ↳ Notification
- Account** → Personal information, Assistance, My harvests

## Flow 2 - Plants' monitoring



## Flow 3 - Harvest day



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Average annual global temperatures (NOAA, 2021)  
Retrieved from <https://www.ncdc.noaa.gov/sotc/global/202013>

### Figure 2 [p.17]

Co2 concentrations over 800 000 years (NOAA, 2021)  
Retrieved from <https://www.climate.gov/news-features/climate-qa/how-do-we-know-build-carbon-dioxide-atmosphere-caused-humans>

### Figure 3 [p.19]

Global GHG emissions by gas (EPA, 2021)  
Retrieved from <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

### Figure 4 [p.19]

Global GHG emissions by economic sector (EPA, 2021)  
Retrieved from <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

### Figure 5 [p.20]

Global land use for food production (Ritchie, 2019)  
Retrieved from <https://ourworldindata.org/global-land-for-agriculture>

### Figure 6 [p.22]

Annual population growth rate estimates (United Nations, 2019)  
Retrieved from <https://population.un.org/wpp/>

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Sustainable food future by 2050 (elaborated from World Resources Institute, 2018)  
Retrieved from <https://www.wri.org/insights/how-sustainably-feed-10-billion-people-2050-21-charts>

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Circular Design for Food (Ellen MacArthur Foundation, 2021)  
Retrieved from <https://ellenmacarthurfoundation.org/resources/food-redesign/overview>

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Hanging Gardens of Babylon (National Geographic, 2020)  
Retrieved from <https://www.nationalgeographic.co.uk/history-and-civilisation/2020/07/we-know-where-the-7-wonders-of-the-ancient-world-are-except-for>

### Figure 10 [p.35]

Dickinson Despommier and his book The vertical farm (Inhabitat, 2014)  
Retrieved from <https://inhabitat.com/review-amp-interview-the-vertical-farm-by-dick-despommier/2/>

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Retrieved from <https://doi.org/10.5772/intechopen.90438>

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Retrieved from <https://doi.org/10.31080/ASAG.2020.04.0858>

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Retrieved from <https://doi.org/10.31080/ASAG.2020.04.0858>

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Retrieved from <https://doi.org/10.31080/ASAG.2020.04.0858>

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Retrieved from [https://doi.org/10.1007/978-3-030-15943-6\\_5](https://doi.org/10.1007/978-3-030-15943-6_5)

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Design and layout of aquaponic systems (Su et al., 2020)  
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Philips vertical farming LED lights (Philips, n.d.)  
Retrieved from <https://www.lighting.philips.com/main/products/horticulture/vertical-farming-led-lights>

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Retrieved from <https://doi.org/10.1515/jlecol-2017-0016>

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Retrieved from <https://heated.medium.com/these-vertical-farmers-claim-theyre-revitalizing-agriculture-ca94fce3891b>

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Retrieved from <https://duurzamekost.nl/>

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Retrieved from <https://www.atlasobscura.com/places/the-plant-chicago-illinois>

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Retrieved from <https://www.atlasobscura.com/places/the-plant-chicago-illinois>

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Retrieved from <https://www.aerofarms.com/>

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Retrieved from <https://www.aerofarms.com/>

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Retrieved from <https://doi.org/10.3390/su11154124>

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Retrieved from <https://doi.org/10.3390/su11154124>

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Retrieved from <https://doi.org/10.13140/RG.2.2.27830.40002>

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Retrieved from <https://www.designcouncil.org.uk/news-opinion/what-framework-innovation-design-councils-evolved-double-diamond>

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# Bibliography

## A

AeroFarms. (2021). AeroFarms. Retrieved October 15, 2021, from <https://www.aerofarms.com/>

Agricola Moderna [agricolamoderna]. (2020, May 4). Vertical Farm Made in Italy [Instagram profile]. Instagram. Retrieved from [https://www.instagram.com/agricolamoderna/?utm\\_medium=copy\\_link](https://www.instagram.com/agricolamoderna/?utm_medium=copy_link)

Agricola Moderna. (2021, April 23). Agricola Moderna | Prodotti. Retrieved October 23, 2021, from <https://agricolamoderna.com/prodotti/>

Agronews Comunitat Valenciana. (2021, April 13). Món Orxata recibe el prestigioso premio Mujer Agro a la mejor empresa estatal. Retrieved 27 October 2021, from <https://www.agronewscomunitatvalenciana.com/mon-orxata-recibe-el-prestigioso-premio-mujer-agro-la-mejor-empresa-estatal>

Alexandratos, N., & Bruinsma, J. (2012). WORLD AGRICULTURE TOWARDS 2030/2050 The 2012 Revision (ESA Working Paper No. 12–03). FAO Agricultural Development Economics Division. Retrieved from <http://www.fao.org/global-perspectives-studies/resources/detail/en/c/411108/>

Al-Kodmany, K. (2018). The Vertical Farm: A Review of Developments and Implications for the Vertical City. *Buildings*, 8(2), 24. <https://doi.org/10.3390/buildings8020024>

## B

BCFN & MUFPP (2018). Food & cities: The role of cities for achieving the sustainable development goals. Barilla Center for Food and Nutrition and Milan Urban Food Policy Pact. retrieved from: [https://www.barillacfn.com/media/material/food\\_cities.pdf](https://www.barillacfn.com/media/material/food_cities.pdf)

Benke, K., & Tomkins, B. (2017). Future food-production systems: Vertical farming and controlled-environment agriculture. *Sustainability: Science, Practice and Policy*, 13(1), 13–26. <https://doi.org/10.1080/15487733.2017.1394054>

Best, K. (2006). *Design Management: Managing Design Strategy, Process and Implementation*. AVA Academia.

Besthorn, F. H. (2013). Vertical Farming: Social Work and Sustainable Urban Agriculture in an Age of Global Food Crises. *Australian Social Work*, 66(2), 187–203. <https://doi.org/10.1080/0312407X.2012.716448>

Biorfarm. (2020). Biorfarm | Adotta il tuo Albero e crea il tuo campo digitale. Retrieved 27 October 2021, from <https://www.biorfarm.com/>

Birkby, J. (2016). Vertical Farming. NCAT.. Retrieved from: <https://attra.ncat.org/product/vertical-farming/>

Bradford, C. D., & Ellison, B. (2017). Will Consumers Find Vertically Farmed Produce "Out of Reach"? *Choices*, 32(1), 1–8. <https://doi.org/10.22004/ag.econ.253382>

Buono Farm. (2021a, September 6). Cosa sono i microgreens? [Instagram post]. Instagram. [https://www.instagram.com/p/CTeUd\\_zsD7w/?utm\\_medium=copy\\_link](https://www.instagram.com/p/CTeUd_zsD7w/?utm_medium=copy_link)

Buono Farm. (2021b, October 21). Box Microgreens & Superfoods Milano. Buono Farm Società Benefit. Retrieved October 21, 2021, from <https://buono.org/en/>

Burlingame, B., Dernini, S. (2012). Sustainable diets and biodiversity: Directions and solutions for policy, research and action: proceedings of the international scientific symposium Biodiversity and sustainable diets united against hunger, 3-5 november 2010. FAO headquarters, Rome. FAO. Retrieved from: <https://www.fao.org/3/i3004e/i3004e00.htm>

## C

Chatterjee, A., Debnath, S., & Pal, H. (2020). Implication of Urban Agriculture and Vertical Farming for Future Sustainability. In S. Shekhar Solankey, S. Akhtar, A. Isabel Luna Maldonado, H. Rodriguez-Fuentes, J. Antonio Vidales Contreras, & J. Mariana Márquez Reyes (Eds.), *Urban Horticulture—Necessity of the Future*. IntechOpen. <https://doi.org/10.5772/intechopen.91133>

Clatworthy, S. (2017). Service design thinking. In M. Lüders, T. Andreassen, S. Clatworthy, & T. Hillestad, *Innovating for Trust* (pp. 167–182). Edward Elgar Publishing. <https://doi.org/10.4337/9781785369483.00020>

Claydon, S. (2021, March 10). Health Effects of Pesticides. Pesticide Action Network UK. Retrieved on October 10, 2021, from <http://www.pan-uk.org/health-effects-of-pesticides/>

Colombo, D. (2021, August 30). LocalGreen, la vertical farm che vuole svecchiare la quarta gamma #vocidellortofrutta. *Fresh Point Magazine*. Retrieved from <https://www.freshpointmagazine.it/vocidellortofrutta/localgreen-la-giovane-vertical-farm-che-vuole-svecchiare-la-quarta-gamma-vocidellortofrutta/>

Comune di Milano. (2015). Linee di indirizzo della Food Policy di Milano 2015-2020. Retrieved from <https://foodpolicymilano.org/wp-content/uploads/2019/03/FoodPolicyMilano.pdf>

Comune di Milano. (2020a). PGT Documento di Piano. Milano 2030: Visione, Costruzione, Strategie, Spazi. Relazione Generale. Retrieved 30 October 2021, from <https://www.pgt.comune.milano.it/pgt-previgente/pgt-milano2030-approvato-05022020/documento-di-piano-approvato-05022020>

Comune di Milano. (2020b). Milano 2020. Adaptation strategy. Open document to the city's contribution. Retrieved from: <https://www.comune.milano.it/aree-tematiche/partecipazione/milano-2020>

Comune di Milano (2020c). Milano e i suoi quartieri anno 2020. Retrieved from <https://www.comune.milano.it/documents/20126/2313917/MILANO+QUARTIERI+2020.pdf>

Comune di Milano. (2020d). Tav. D01 Progetto Piano. Retrieved from <https://www.pgt.comune.milano.it/pgt-previgente/pgt-milano2030-approvato-05022020/>

Comune di Milano. (2021). Edifici degradati e abbandonati. Retrieved 30 October 2021, from <https://www.comune.milano.it/servizi/edifici-degradati-e-abbandonati>

Confagricoltura (2021). Decreto-Legge 22 marzo 2021, n.41 (Sostegni)- Proposte emendative. Retrieved from [https://www.senato.it/application/xmanager/projects/leg18/attachments/documento\\_evento\\_procedura\\_commissione/files/000/322/001/Audizione\\_Confagricoltura\\_EMENDAMENTI.pdf](https://www.senato.it/application/xmanager/projects/leg18/attachments/documento_evento_procedura_commissione/files/000/322/001/Audizione_Confagricoltura_EMENDAMENTI.pdf)

Crumpacker, M. (2018, October 19). A Look at the History of Vertical Farming - Mark Crumpacker. Medium. <https://medium.com/@MarkCrumpacker/a-look-at-the-history-of-vertical-farming-f4338df5d0f4>

Crutzen P.J., Stoermer E.F. (2000). The 'Anthropocene'. In the "The International Geosphere–Biosphere Programme (IGBP): A Study of Global Change of the International Council for Science (ICSU). *Global Change Newsletter*. 2000 May; 41:17–18. Available from: [www.igbp.net/download/18.316f18321323470177580001401/1376383088452/NL41.pdf](http://www.igbp.net/download/18.316f18321323470177580001401/1376383088452/NL41.pdf)

Crutzen P.J. (2006). The "Anthropocene". In: Ehlers E., Krafft T. (eds) *Earth System Science in the Anthropocene*. Springer, Berlin, Heidelberg. [https://doi.org/10.1007/3-540-26590-2\\_3](https://doi.org/10.1007/3-540-26590-2_3) retrieved from [https://link.springer.com/chapter/10.1007/3-540-26590-2\\_3#citeas](https://link.springer.com/chapter/10.1007/3-540-26590-2_3#citeas)

## D

Davis, D. R. (2009). Declining Fruit and Vegetable Nutrient Composition: What Is the Evidence? *HortScience*, 44(1), 15–19. <https://doi.org/10.21273/HORTSCI.44.1.15>

Design Council. (2007a). 11 Lessons: managing design in eleven global brands. A study of the design process. London: Design Council. Retrieved from [https://www.designcouncil.org.uk/sites/default/files/asset/document/ElevenLessons\\_Design\\_Council%20%282%29.pdf](https://www.designcouncil.org.uk/sites/default/files/asset/document/ElevenLessons_Design_Council%20%282%29.pdf)

Design Council. (2007b). 11 Lessons: managing design in eleven global brands. Desk Research Report.. London: Design Council. Retrieved from [www.designcouncil.org.uk/Documents/About%20design/Eleven%20Lessons/Desk%20Research%20Report.pdf](http://www.designcouncil.org.uk/Documents/About%20design/Eleven%20Lessons/Desk%20Research%20Report.pdf)

Design Council. (2015). Design methods for developing services. An introduction to service design and a selection of service design tools. Retrieved from [https://www.designcouncil.org.uk/sites/default/files/asset/document/DesignCouncil\\_Design%20methods%20for%20developing%20services.pdf](https://www.designcouncil.org.uk/sites/default/files/asset/document/DesignCouncil_Design%20methods%20for%20developing%20services.pdf)

Design Council. (2019). What is the framework for innovation? Design Council's evolved Double Diamond. Retrieved October 18, 2021, from <https://www.designcouncil.org.uk/news-opinion/what-framework-innovation-design-councils-evolved-double-diamond>

Despommier, D. (2009). The Rise of Vertical Farms. *Scientific American*, 301(5), 80–87. <https://doi.org/10.1038/scientificamerican1109-80>

Despommier, D. D. (2010). *The Vertical Farm: Feeding the World in the 21st Century* (1st ed). Thomas Dunne Books.

Despommier, D. (2013). Farming up the city: The rise of urban vertical farms. *Trends in Biotechnology*, 31(7), 388–389. <https://doi.org/10.1016/j.tibtech.2013.03.008>

Dubbeling, M., & de Zeeuw, H. (2011). Urban Agriculture and Climate Change Adaptation: Ensuring Food Security Through Adaptation. In K. Otto-Zimmermann (Ed.), *Resilient Cities* (pp. 441–449). Springer Netherlands. [https://doi.org/10.1007/978-94-007-0785-6\\_44](https://doi.org/10.1007/978-94-007-0785-6_44)

Dubbeling, M., Veenhuizen, van R., Halliday, J. (2019). Urban agriculture as a climate change and disaster risk reduction strategy. *Field Actions Science Reports*. In *Urban Agriculture: another way to feed cities* (pp. 32-39). Institut Veolia. Retrieved from <https://journals.openedition.org/factsreports/5650>

Duurzame Kost. (2019, August 21). Duurzame Kost. Retrieved October 15, 2021, from <https://duurzamekost.nl/>

## E

Ellen MacArthur Foundation (2019). *Cities and Circular Economy for Food*. Retrieved from <https://www.ellenmacarthurfoundation.org/publications>

Ellen MacArthur Foundation. (2021). The big food redesign: Regenerating nature with the circular economy. Retrieved from <https://ellenmacarthurfoundation.org/resources/food-redesign/overview>

Encyclopaedia Britannica. (n.d.). Hydroponics | horticulture. Encyclopaedia Britannica. Retrieved October 11, 2021, from <https://www.britannica.com/topic/hydroponics>

Encyclopaedia Britannica. (n.d.). Word-association test | psychology. Retrieved 20 October 2021, from <https://www.britannica.com/science/word-association-test>

ènostra. (2016). *Energia Rinnovabile e Sostenibile. ènostra*. Retrieved 19 November 2021, from <https://www.enostra.it/>

EPA United States Environmental Protection Agency. (2021). *Global Greenhouse Gas Emissions Data*. Last Updated on September 26, 2021. Retrieved from <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

## F

FAO & PAR (2011). *Biodiversity for Food and Agriculture, Contributing to food security and sustainability in a changing world*. Retrieved from <http://www.fao.org/family-farming/detail/en/c/284748/>

FAO (2011a). *The state of the world's land and water resources for food and agriculture (SOLAW). Managing systems at risk*. Food and Agriculture Organization of the United Nations, Rome and Earthscan, London.

FAO (2011b). *Global food losses and food waste - Extent, causes and prevention*. Retrieved from <http://www.fao.org/3/mb060e/mb060e00.htm>

FAO. (2014, October 30). *What is hidden hunger?* [Video]. YouTube. <https://www.youtube.com/watch?v=Sgm4gzc3B8U>

FAO. (2017). *The future of food and agriculture: Trends and challenges*. Food and Agriculture Organization of the United Nations. Rome. Retrieved from <https://www.fao.org/publications/fofa/en/>

FAO. (2018). Sustainable food systems: Concept and framework. Retrieved from: <https://www.fao.org/3/ca2079en/CA2079EN.pdf>

FAO, IFAD, UNICEF, WFP and WHO (2021a). The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome, FAO. Retrieved from <https://doi.org/10.4060/cb4474en>

FAO. (2021b). Land use statistics and indicators statistics. Global, regional and country trends 1990–2019. FAOSTAT Analytical Brief Series No 28. Rome. Retrieved from <https://www.fao.org/food-agriculture-statistics/data-release/data-release-detail/en/c/1417427/>

Fassio, F., & Tecco, N. (2017). The Circular Economy for Food: A Systemic Interpretation Of The Circular Economy Through The Holistic View Of The Gastronomic Sciences. Proceedings of Relating Systems Thinking and Design (RSD6) 2017 Symposium, 1–15. Retrieved from <http://hdl.handle.net/2318/1664637>

Fassio, F., & Tecco, N. (2019). Circular Economy for Food: A Systemic Interpretation of 40 Case Histories in the Food System in Their Relationships with SDGs. *Systems*, 7(3), 43. doi: [10.3390/systems7030043](https://doi.org/10.3390/systems7030043)

Felice, E. (2020, February 28). Planet Farms, a Cavenago (MB) la più grande e avanzata vertical farm d'Europa. *Fruitbook Magazine*. Retrieved October 21, 2021, from <https://www.fruitbookmagazine.it/planet-farms-a-cavenago-la-piu-grande-e-avanzata-vertical-farm-in-europa/>

## G

Giordana Ferri & Ezio Manzini. (2020). *Abitare la prossimità: La città dei 15 minuti non è la città dei borghi*. 4.

Goddek, S., Espinal, C., Delaide, B., Jijakli, M., Schmutz, Z., Wuertz, S., & Keesman, K. (2016). Navigating towards Decoupled Aquaponic Systems: A System Dynamics Design Approach. *Water*, 8(7), 303. <https://doi.org/10.3390/w8070303>

Goddek, S., Joyce, A., Kotzen, B., & Burnell, G. M. (Eds.). (2019). *Aquaponics Food Production Systems: Combined Aquaculture and Hydroponic Production Technologies for the Future*. Springer International Publishing. <https://doi.org/10.1007/978-3-030-15943-6>

Gooley, G. J., & Gavine, F. M. (2003). *Integrated Agri-aquaculture Systems: Vol. no. 03/012*. RIRDC publication. [https://www.vgls.vic.gov.au/client/en\\_AU/VGLS-public/](https://www.vgls.vic.gov.au/client/en_AU/VGLS-public/)

von Grebmer, K., Saltzman, A., Birol, E., Wiesmann, D., Prasai, N., Yin, S., Yohannes, Y., Menon, P., Thompson, J., Sonntag, A. (2014). *2014 Global Hunger Index: The Challenge of Hidden Hunger*. Bonn, Washington, D.C., and Dublin: Welthungerhilfe, International Food Policy Research Institute, and Concern Worldwide. Retrieved from <https://www.ifpri.org/publication/2014-global-hunger-index>

Growing Underground. (n.d.). *Growing Underground*. Retrieved October 15, 2021, from <https://growing-underground.com/about/>

## H

Hallikainen, E. (2019). *Life Cycle Assessment on Vertical Farming*. Aalto University. Retrieved from <https://aaltodoc.aalto.fi/handle/123456789/36351>

Healy, R. G., & Rosenberg, J. S. (2013). *Land use and states (2nd Edition) [E-book]*. RFF Press. <https://doi.org/10.4324/9781315064406>

Holmlid, S. (2012). Designing for resourcefulness in service. Some assumptions and consequences. Miettinen S, Valtonen A, eds. *Service Design with Theory* (Lapland University Press, Vantaa, Finland), 151–172. Retrieved from [https://www.academia.edu/2456605/Designing\\_for\\_Resourcefulness\\_in\\_Service\\_Some\\_Assumptions\\_and\\_Consequences](https://www.academia.edu/2456605/Designing_for_Resourcefulness_in_Service_Some_Assumptions_and_Consequences)

## I

IFOAM. (2008). *Definition of Organic Agriculture*. IFOAM Organics International. Retrieved October 12, from <https://www.ifoam.bio/why-organic/organic-landmarks/definition-organic>

Infarm. (2021). *Infarm | About us*. Retrieved 27 October 2021, from <http://www.infarm.com/about-us/>

IPCC. (2007). *Climate Change 2007: The Physical Science Basis. Summary For Policymakers*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Retrieved from <https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-spm-1.pdf>

IPCC. (2021). Climate Change 2021: The Physical Science Basis. Summary For Policymakers. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Retrieved from <https://www.ipcc.ch/report/ar6/wg1/#SPM>

## J

Jane, I. [imenjane]. (2021, April 28). Vertical Farming [Instagram post]. Instagram. [https://www.instagram.com/p/COOPoevjTSK/?utm\\_medium=copy\\_link](https://www.instagram.com/p/COOPoevjTSK/?utm_medium=copy_link)

Junge, R., König, B., Villarroel, M., Komives, T., & Jijakli, M. (2017). Strategic Points in Aquaponics. *Water*, 9(3), 182. <https://doi.org/10.3390/w9030182>

## K

Kalantari, F., Tahir, O. M., Joni, R. A., & Fatemi, E. (2018). Opportunities and Challenges in Sustainability of Vertical Farming: A Review. *Journal of Landscape Ecology*, 11(1), 35–60. <https://doi.org/10.1515/jlecol-2017-0016>

Khan, F. A., Kurklu, A., Ghafoor, A., Ali, Q., Umair, M. S. (2018). A Review on Hydroponic Greenhouse Cultivation for Sustainable Agriculture. *International Journal of Agriculture, Environment and Food Sciences*, 2(2), 59–66. <https://doi.org/10.31015/jaefs.18010>

Kimbell, L. (2009). Insights from service design practice. Paper presented at the 8th European Academy of Design Conference, Robert Gordon University, Scotland. Retrieved from [http://www.lucykimbell.com/stuff/EAD\\_kimbell\\_final.pdf](http://www.lucykimbell.com/stuff/EAD_kimbell_final.pdf)

Kumar, A., Shukla, S., Dixit, P., Thupstan, T., & Kumar, K. (2020). Vertical Farming Promising Cultivation for Horticultural Crops. *International Journal of Current Microbiology and Applied Sciences*, 9(6), 2491–2494. <https://doi.org/10.20546/ijcmas.2020.906.302>

## L

L'Alveare che dice Si! (n.d.). L'Alveare che dice Si! Retrieved 27 October 2021, from <https://alvearechedicesi.it/it>

Lakhiar, I. A., Gao, J., Syed, T. N., Chandio, F. A., & Buttar, N. A. (2018). Modern plant cultivation technologies in agriculture under controlled environment: A review on aeroponics. *Journal of Plant Interactions*, 13(1), 338–352. <https://doi.org/10.1080/17429145.2018.1472308>

Lennard, W., & Goddek, S. (2019). Aquaponics: The Basics. In S. Goddek, A. Joyce, B. Kotzen, & G. M. Burnell (Eds.), *Aquaponics Food Production Systems* (pp. 113–143). Springer International Publishing. [https://doi.org/10.1007/978-3-030-15943-6\\_5](https://doi.org/10.1007/978-3-030-15943-6_5)

LettUs Grow. (n.d.). LettUs Grow. Retrieved October 15, 2021, from <https://www.lettusgrow.com/about-us>

LettUs Grow. (2015). DROP & GROW Aeroponic Container Farm System. Retrieved 17 October 2021, from <https://www.lettusgrow.com/container-farm>

Local Green. (2021). PRODOTTI | Localgreen. Localgreen Website. Retrieved October 21, 2021, from <https://www.localgreen.it/prodotti>

## M

Maffei, S., Mager, B., Sangiorgi, D. (2005). Innovation Through Service Design. From Research And Theory To A Network Of Practice. A Users' Driven Perspective. *Joining Forces*. Retrieved from [https://www.academia.edu/942580/Innovation\\_through\\_Service\\_Design\\_](https://www.academia.edu/942580/Innovation_through_Service_Design_)

Magarini, A. (2019). Milan tackle Food Waste. Milan Food Policy actions on food losses and waste management. CircE Interreg Europe. Retrieved from [https://www.interregeurope.eu › file\\_1561017431](https://www.interregeurope.eu › file_1561017431)

Magwaza, S. T., Magwaza, L. S., Odindo, A. O., & Mditshwa, A. (2020). Hydroponic technology as decentralised system for domestic wastewater treatment and vegetable production in urban agriculture: A review. *Science of The Total Environment*, 698, 134154. <https://doi.org/10.1016/j.scitotenv.2019.134154>

Maldonado, A. I. L., Reyes, J. M. M., Breceda, H. F., Fuentes, H. R., Contreras, J. A. V., & Maldonado, U. L. (2019). Automation and Robotics Used in Hydroponic Systems. In *Urban Horticulture. Necessity of the Future*. IntechOpen. Retrieved from <https://doi.org/10.5772/intechopen.90438>

Manzini, E. (2009). A Cosmopolitan Localism: Prospects for a Sustainable Local Development and the Possible Role of Design. In Clark, H., Brody, D. (eds). *Design Studies: A Reader*. New York (NY): Berg.

Manzini, E. (2021). *Abitare la prossimità: Idee per la città dei 15 minuti*. EGEA spa.

Mariyappillai, A., Arumugam, G., & Raghavendran, V. B. (2020). The Techniques of Hydroponic System. *Acta Scientific Agriculture*, 4(7), 79–84. <https://doi.org/10.31080/ASAG.2020.04.0858>

Martin, M., & Molin, E. (2019). Environmental Assessment of an Urban Vertical Hydroponic Farming System in Sweden. *Sustainability*, 11(15), 4124. <https://doi.org/10.3390/su11154124>

Meroni, A., Selloni, D., & Rossi, M. (2018). MASSIVE CODESIGN. A Proposal for a Collaborative Design Framework. Franco Angeli Design International. Retrieved from [https://www.researchgate.net/publication/337286186\\_MASSIVE\\_CODESIGN\\_A\\_Proposal\\_for\\_a\\_Collaborative\\_Design\\_Framework](https://www.researchgate.net/publication/337286186_MASSIVE_CODESIGN_A_Proposal_for_a_Collaborative_Design_Framework)

Miličić, V., Thorarinsdottir, R., Santos, M., & Hančič, M. (2017). Commercial Aquaponics Approaching the European Market: To Consumers' Perceptions of Aquaponics Products in Europe. *Water*, 9(2), 80. <https://doi.org/10.3390/w9020080>

Miller, M. E. (2015, December 15). How many service designers does it take to define Service Design? Medium. Retrieved October 18, 2021, from <https://blog.practicalservicedesign.com/how-many-service-designers-does-it-take-to-define-service-design-6f87af060ce9>

Milliken, S., & Stander, H. (2019). Aquaponics and Social Enterprise. In S. Goddek, A. Joyce, B. Kotzen, & G. M. Burnell (Eds.), *Aquaponics Food Production Systems* (pp. 607–619). Springer International Publishing. [https://doi.org/10.1007/978-3-030-15943-6\\_24](https://doi.org/10.1007/978-3-030-15943-6_24)

Mòn Orxata. (2012). Mòn Orxata | Tigernut Street Carts. Retrieved 27 October 2021, from <http://monorxata.com/en/tigernut-street-carts/>

## N

NASA. (n.d.). Climate Change Adaptation and Mitigation. *Climate Change: Vital Signs of the Planet*. Retrieved October 8, 2021, from <https://climate.nasa.gov/solutions/adaptation-mitigation/>

NEAA. (2010). Rethinking Global Biodiversity Strategies: Exploring structural changes in production and consumption to reduce biodiversity loss. Netherlands Environmental Assessment Agency (PBL). Retrieved from [https://www.pbl.nl/en/publications/Rethinking\\_Global\\_Biodiversity\\_Strategies](https://www.pbl.nl/en/publications/Rethinking_Global_Biodiversity_Strategies)

NOAA National Centers for Environmental Information (2021). State of the Climate: Global Climate Report for Annual 2020. Published online January 2021. Retrieved on October 6, 2021 from <https://www.ncdc.noaa.gov/sotc/global/202013>

## O

Olsen, N. V. (2015). Design Thinking and food innovation. *Trends in Food Science & Technology*, 41(2), 182–187. <https://doi.org/10.1016/j.tifs.2014.10.001>

## P

Pirog, R., T. Van Pelt, K. Enshayan, and E. Cook. (2001). Food, fuel, and freeways: An Iowa perspective on how far food travels, fuel usage, and greenhouse gas emissions. Ames, IA: Leopold Center for Sustainable Agriculture.

Planet Farms. (2021, September 14). Arrivano le insalate da vertical farming di Planet Farms [LinkedIn post]. LinkedIn. [https://www.linkedin.com/posts/planet-farms\\_arrivano-le-insalate-da-vertical-farming-activity-6843860538745724928-irGK](https://www.linkedin.com/posts/planet-farms_arrivano-le-insalate-da-vertical-farming-activity-6843860538745724928-irGK)

Plant Chicago. (2020). Plant Chicago | History. Retrieved October 15, 2021, from <https://www.plantchicago.org/history>



Porkka, M., Gerten, D., Schaphoff, S., Siebert, S., & Kummu, M. (2016). Causes and trends of water scarcity in food production. *Environmental Research Letters*, 11(1), 015001. <https://doi.org/10.1088/1748-9326/11/1/015001>

## R

Rai, P. K., Lee, S. S., Zhang, M., Tsang, Y. F., & Kim, K.-H. (2019). Heavy metals in food crops: Health risks, fate, mechanisms, and management. *Environment International*, 125, 365–385. <https://doi.org/10.1016/j.envint.2019.01.067>

Rakocy, J. E., Masser, M. P., & Losordo, T. M. (2006). Recirculating Aquaculture Tank Production Systems: Aquaponics—Integrating Fish and Plant Culture. 17. Retrieved from <https://www.semanticscholar.org/paper/Recirculating-Aquaculture-Tank-Production-Systems-%3A-Rakocy-Masser/7db4a54e7ffab14830af2551e84d87959bd230d4>

Redazione MyFruit. (2019). Bonduelle svela la classifica delle insalate preferite dagli italiani. Myfruit. Retrieved 17 November, 2021, from <https://www.myfruit.it/reparto-ortofrutta/2019/10/bonduelle-svela-la-classifica-delle-insalate-preferite-dagli-italiani.html>

Regione Lombardia. (2021). Agricoltura urbana, periurbana e metropolitana. Retrieved 29 October 2021, from <https://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioRedazionale/servizi-e-informazioni/Imprese/Imprese-agricole/agricoltura-urbana-periurbana-metropolitana/agricoltura-urbana-periurbana-metropolitana>

Reynolds, J. (2019, November 3). These Vertical Farmers Claim They're Revitalizing Agriculture. *Medium*. <https://heated.medium.com/these-vertical-farmers-claim-theyre-revitalizing-agriculture-ca94fce3891b>

Ritchie, H., & Roser, M. (2018, June 13). Urbanization. *Our World in Data*. Retrieved October 11, 2021, from <https://ourworldindata.org/urbanization>

Ritchie, H. (2019, November 11). Half of the world's habitable land is used for agriculture. *Our World in Data*. Retrieved October 7, 2021 from <https://ourworldindata.org/global-land-for-agriculture>

## S

Sanders, E. B.-N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *CoDesign*, 4(1), 5–18. <https://doi.org/10.1080/15710880701875068>

Sangiorgi, D., Pacenti, E.. (2008). Emerging practices of Service Design driven innovation. 4. SDN Network Amsterdam.

Sangiorgi, D. (2009). Building Up A Framework For Service Design Research. Paper presented at the 8th European Academy of Design Conference, Aberdeen, Scotland.

Sangiorgi, D. (2012). 'Value co-creation in design for services'. In S. Miettinen and A. Valtonen (eds), *Service Design with Theory*, Lapland University Press, pp. 96–104.

Sangiorgi, D., & Prendiville, A. (2017). *Designing for Service. Key Issues and New Directions*. Bloomsbury.

Sardare, M. D., & Admane, S. V. (2013). A Review On Plant Without Soil - Hydroponics. *International Journal of Research in Engineering and Technology*, 02(03), 299–304. <https://doi.org/10.15623/ijret.2013.0203013>

Schnell, S. M. (2013). Food miles, local eating, and community supported agriculture: Putting local food in its place. *Agriculture and Human Values*, 30(4), 615–628. <https://doi.org/10.1007/s10460-013-9436-8>

Searchinger, T., Waite, R., Hanson, C., & Ranganathan, J. (2018). CREATING A SUSTAINABLE FOOD FUTURE A Menu of Solutions to Feed Nearly 10 Billion People by 2050. *World Resources Institute*. <https://www.wri.org/research/creating-sustainable-food-future>

Senato della Repubblica (2021). Disegno di legge S. 2191—18a Legislatura. Parlamento Italiano. Retrieved 22 October 2021, from <https://www.senato.it/versionestampa/stampa.jsp?url=/leg/18/BGT/Schede/Ddliter/53985.htm&thispage#>

Service Design Tools. (n.d.). Tools | Service Design Tools. Retrieved 21 October 2021, from <https://servicedesigntools.org/tools.html>

Sharma, N., Acharya, S., Kumar, K., Singh, N., & Chaurasia, O. P. (2018). Hydroponics as an advanced technique for vegetable production: An overview. *Journal of Soil and Water Conservation*, 17(4), 364. <https://doi.org/10.5958/2455-7145.2018.00056.5>

Shimek, L. (2018). Design Thinking for Food: An Overview and Potential Application for Grains. *Cereal Foods World*. <https://doi.org/10.1094/cfw-63-6-0245>

Short, G., Yue, C., Anderson, N., Russell, C., & Phelps, N. (2017). Consumer Perceptions of Aquaponic Systems. *HortTechnology*, 27(3), 358–366. <https://doi.org/10.21273/HORTTECH03606-16>

Specht, K., Siebert, R., Hartmann, I., Freisinger, U. B., Sawicka, M., Werner, A., Thomaier, S., Henckel, D., Walk, H., & Dierich, A. (2014). Urban agriculture of the future: An overview of sustainability aspects of food production in and on buildings. *Agriculture and Human Values*, 31(1), 33–51. <https://doi.org/10.1007/s10460-013-9448-4>

Specht, K., Siebert, R. & Thomaier, S. (2015). Perception and acceptance of agricultural production in and on urban buildings (ZFarming): a qualitative study from Berlin, Germany. *Agric Hum Values* 33, 753–769 (2016). <https://doi.org/10.1007/s10460-015-9658-z>

Steen, M., Manschot, M., & Koning, N. D. (2011). Benefits of Co-design in Service Design Projects. 9. Retrieved from: [https://www.researchgate.net/publication/254756409\\_Benefits\\_of\\_Co-design\\_in\\_Service\\_Design\\_Projects](https://www.researchgate.net/publication/254756409_Benefits_of_Co-design_in_Service_Design_Projects)

Stickdorn, M., Hormess, M. E., Lawrence, A., & Schneider, J. (2018). *This Is Service Design Doing: Applying Service Design Thinking in the Real World*. O'Reilly Media, Inc.

Su, M. H., Azwar, E., Yang, Y., Sonne, C., Yek, P. N. Y., Liew, R. K., Cheng, C. K., Show, P. L., & Lam, S. S. (2020). Simultaneous removal of toxic ammonia and lettuce cultivation in aquaponic system using microwave pyrolysis biochar. *Journal of Hazardous Materials*, 396, 122610. <https://doi.org/10.1016/j.jhazmat.2020.122610>

## T

Teknoring. (2019, December 13). Edifici abbandonati, in Lombardia incentivi per il recupero. Teknoring | Il Portale Delle Professioni Tecniche. Retrieved November 8, 2021, from <https://www.teknoring.com/news/riqualificazione-urbana/edifici-abbandonati-lombardia-incentivi-recupero/>

The Plant. (n.d.). Atlas Obscura. Retrieved 15 October, 2021, from <http://www.atlasobscura.com/places/the-plant>

The Royal Society & National Academy of Sciences. (2020). *Climate Change Evidence and Causes Update 2020*. Washington, DC. The National Academies Press. <https://doi.org/10.17226/25733>  
<https://www.nap.edu/catalog/25733/climate-change-evidence-and-causes-update-2020>

Treedom. (2021). Treedom | Let's Green the Planet. Retrieved 27 October 2021, from <https://www.treedom.net/en/>

Turnsek, M., Joly, A., Thorarinsdottir, R., & Junge, R. (2020). Challenges of Commercial Aquaponics in Europe: Beyond the Hype. *Water*, 12(1), 306. <https://doi.org/10.3390/w12010306>

## U

Udovichenko, A., Fleck, B. A., Weis, T., & Zhong, L. (2021). Framework for design and optimization of a retrofitted light industrial space with a renewable energy-assisted hydroponics facility in a rural northern Canadian community. *Journal of Building Engineering*, 37, 102160. <https://doi.org/10.1016/j.jobbe.2021.102160>

UNCCD. (2017). *Global Land Outlook*. First Edition. Retrieved from <https://knowledge.unccd.int/glo/global-land-outlook-glo>

UNFCCC (1992). Article 1: Definitions. United Nations Framework Convention on Climate Change. <https://unfccc.int/resource/ccsites/zimbab/conven/text/art01.htm>

United Nations. (2015). THE 17 GOALS | Sustainable Development. United Nations, Department of Economic and Social Affairs, Sustainable Development. Retrieved October 8, 2021, from <https://sdgs.un.org/goals>

United Nations. (2019). World Population Prospects 2019: Highlights. United Nations, Department of Economic and Social Affairs, Population Division. Retrieved October 8, from <https://population.un.org/wpp/>

## V

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a New Dominant Logic for Marketing. *Journal of Marketing*, 68(1), 1–17. <https://doi.org/10.1509/jmkg.68.1.1.24036>

Vertical Farming. (n.d.). Vertical Farming. Retrieved October 15, 2021, from <https://www.verticalfarming.com/food-crops/>

## W

Wetter-Edman, K., Sangiorgi, D., Edvardsson, B., Holmlid, S., Grönroos, C., & Mattelmäki, T. (2014). Design for Value Co-Creation: Exploring Synergies Between Design for Service and Service Logic. *Service Science*, 6(2), 106–121. <https://doi.org/10.1287/serv.2014.0068>

## Y

Yano, Y., Nakamura, T., & Maruyama, A. (2015). Consumer Perceptions toward Vegetables Grown in Plant Factories Using Artificial Light- An Application of the Free Word Association Method. Focusing on Modern Food Industry, 4(0), 11. <https://doi.org/10.14355/fmfi.2015.04.002>

## Z

Zampollo, F., & Peacock, M. (2016). Food Design Thinking: A Branch of Design Thinking Specific to Food Design. *The Journal of Creative Behavior*, 50(3), 203–210. <https://doi.org/10.1002/jocb.148>

Zampollo, F. (2017). The four Food Design pillars. 2. <https://doi.org/10.13140/RG.2.2.27830.40002>

Zampollo, F. (2021). Food Design Thinking. What is Food Design Thinking? Retrieved October 18, 2021, from <https://www.fooddesignthinking.org/>

Zordan, A. (2020, April 14). Agricola Moderna. La vertical farm che produce ortaggi alle porte di Milano. *Gambero Rosso*. Retrieved October 23, 2021, from <https://www.gamberorosso.it/notizie/agricola-moderna-la-vertical-farm-che-produce-ortaggi-alle-porte-di-milano/>



