YRKESHÖGSKOLAN NOVIA

Exploring customer perceptions of trolley-based microgreen growing systems in Helsinki supermarkets.

customer perceptions of trolley-based microgreen growing systems in supermarkets: case study K-Supermarket Mustapekka, Helsinki.

Presented

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Mbaringong Brian Andu

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Author: Mbaringong Brian Andu
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Supervisor(s): Stefan Heinänen

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Abstract

Microgreen products are amongst the newly discovered food sources to help increase food security. Their fast-growing nature provides a constant supply of high nutritional value that makes one classify them as a supper food.

This research work aimed at obtaining a good understanding of customers' perception towards the implementation of a trolley-based system placed inside supermarkets. For the growth of microgreen products.

Mustapekka K-Supermarket which is our case study is located in Helsinki, has this system implemented. Customer feedback from the use of this system in the supermarket was the focus of our research. Data for the analysis was obtained through questionnaires administered to customers of the supermarkets in the Helsinki metropolitan area. The results from the analysis were used to test our hypothesis. The outcome of this research was to act as an impetus to project the use of this trolley-based microgreen production system in many other supermarkets in Helsinki metropolitan areas and Finland at large.

Language: English
Key Words: Microgreen, Trolley-based system, food security, sustainable development, customer perception.

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1 Introduction

Over the last few years, the introduction of new technology to agriculture has proven to be a great success story, which has seen an increase in food production and sustainability (Armanda et al., 2019; Seong et al., 2023; Tavan et al., 2021). Paying a close look at recent technological gains in sectors such as greenhouse farming systems and vertical farming (Ng & Mahkeswaran, 2021), one can confidently move a step closer by applying similar technology in a trolley-based system for microgreen production. This trolley-based system will serve as an ideal system to help deliver fresh produce to the surrounding metropolitan area of Helsinki. This system is designed for the cultivation of a variety of microgreen crop types in a closed setup that grows very fast, hence providing customers with nutrient-rich plants immediately at their purchasing doorsteps (Teng et al., 2023).

Finland's Capital city Helsinki has been considered as a hub for the introduction of new technology in urban agriculture (Dahal & Niemelä, 2016). The main driving force towards new technologies in agriculture is mainly to attain environmental sustainability and sufficient food supply. Trolley-based systems for the growing of microgreen products in the urban area of Helsinki are fast growing with many supermarkets considering the idea of applying this setup with some few of them already implementing these systems. It is high time an in-depth analysis is done based on how customers perceive and interact with this new way of food production (Michell et al., 2020).

This research work commences on the idea of the exploration of customer perceptions towards the trolley-based system for the growing of microgreen products within the supermarket premises of the Helsinki metropolitan area. The study investigates customer viewpoints, tastes, and motivations about this idea. In general, the focus is to give a clearer rundown on the potential benefits and challenges related to the implementation of this microgreen trolley-based system in the urban setup (Turner et al., 2020). Also, this research work helps to position itself as a valuable source of information to supermarkets, policymakers, and urban planners to better understand the role of this technology in fostering agriculture, and in decision-making. Applying the methods of Observation, interviews, and surveys, we shall get a full understanding of the perception of the inhabitants of Helsinki towards this trolley-based system for microgreen cultivation.

1.1 Background of study

This research unfolds from the fact that the Finnish culture favors the consumption of vegetables, whereby based on the Finnish national statistics show that as of the year 2017, 20.20% of the population consuming food and non-alcoholic beverages of households depend on fruits and vegetables (Niemi & Väre, 2019). In Urban areas, there is a greater population and the need to find more ways to ensure sustainable food production and supply. Urban cities like Helsinki with populations that are growing constantly are no exception to finding the need to identify solutions to solve the uprising problems of the high demand for freshly home-cultivated microgreen products.

The young seedlings of edible herbs and vegetables that are harvested at full cotyledon expansion are termed microgreens (Xiao et al., 2012; Xu et al., 2020). These categories of green food substances are highly nutritive and for this reason, many associate them with the term superfoods. Microgreens could be used in diverse circumstances, either as flavor to food, salad or even eating them on their own (Verlinden, 2019). Couple with the fact that these are green products and taste best when they are freshly harvested. It is important to devise a means of delivering these products to customers in their best state possible. The trolley-based microgreen cultivation system placed in supermarkets is the best way possible to ensure that this product remains fresh before the purchase by customers.

Combining agriculture with technology nowadays is the best route to take in the future. Trolley-based system for growing microgreens is a good example of a mix between agriculture and technology where the system is built on the concept of a controlled environment. Lighting, water, and temperature inside the enclosed glass system are all being controlled (Lanoue et al., 2022).

Helsinki being the capital city of Finland is positioned as the pioneer in activities related to sustainable urban agriculture. The government encourages the need for startups to help foster environmental conservation and ensure food security in urban areas (Dahal & Niemelä, 2016). Helsinki has in no way shied away from grabbing such advantages in exploring urban farming methods like vertical farming, backyard, balcony, and rooftop farming processes. Looking into the future customers will love to buy products in which they have had a glance of the growing process (Michell et al., 2020). Trolley-based microgreen cultivation system has been set up in many places in Helsinki, with the most recent one being the Mustapekka K-supermarket.

In a nutshell, the background of these studies is to portray a picture of how the future of sustainable agriculture is evolving, which includes the use of technology and in this case a trolley-based system for the growing of microgreens. The quest to meet the constantly growing food demand of the urban population in a sustainable manner that has little or no damage to our surrounding environment is one of our main goals (Tukes, 2018). Hence these systems are placed in Helsinki supermarkets and the customer's perception of this technology is vital for a long-term and more holistic deployment of this technology in the future (Michell et al., 2020).

1.2 Research Problem

Looking at the hype this trolley-based microgreen cultivation technology has brought over the years, which is considered a better solution to enhance urban food production and sustainability, we still lack the understanding of how customers rate this innovation in Helsinki supermarket premises. A good understanding of customer perceptions and preferences towards the use of this agricultural technology is vital for an effective long-term introduction into the urban food milieu. Hence the problem of research is focused on exploring the factors that affect customer perceptions, behaviors, and attitudes towards the trolley-based microgreen cultivation systems in Helsinki supermarkets, with the notion of discovering its ups and downs for a better implementation and subsequently long-term adoption.

1.3 Research Questions

This research turns to look at the main factors affecting the perception of customers towards this new technology of a trolley-based microgreen growing system in the supermarkets situated in Helsinki, with a closer look at how these factors could either project or change the course of implementation of this new agricultural-technology to many other parts in future.

Q1) How will customers feel about this trolley-based microgreen growing technology place in supermarkets in Helsinki?

Q2) Will customer's purchasing power towards this product change because of the technology being used?

1.4 Hypothesis

Q1)

H_0: Customers will have a good feeling about the trolley-based microgreen growing system placed in supermarkets in Helsinki.

H_1: Customers have a bad feeling about the trolley-based microgreen growing system placed in supermarkets in Helsinki.

Q2)

H_0: Customers will buy more of these microgreen products due to the trolley-based microgreen cultivation system being used.

H_1: Customers will not be able to buy this microgreen product because of the technology being used.

2 Literature Review

2.1 Theoretical framework

2.1.1 Introduction

In this section, we will carry out a foundational review of existing theories and then establish connections to our work. Our main aim is to present as many reviews as possible that are related to our work to showcase our mastery of knowledge in our current field of research. Also, we shall define some key terms we used in our research so that from here onwards everyone should have a clear understanding of what these terms mean to our research. By doing all this we create a road map for building on our research.

2.1.2 Customer perception

Applying to customer perception in our studies, we are referring to the ways customers will feel about the new system of production. The production method in our research is the trolley-based microgreen production system. It is important to find out about customers perceptions before applying a new technology because by doing so you will get valuable feedback if customers accept or reject the new Agrifood Technology (Frewer, 2017). Trolley-based growing systems of microgreens placed in supermarkets will help provide a constant supply of fresh microgreen products which are very high in nutritional value, with little impact on the surrounding environment (Turner et al., 2020). Furthermore, an in-depth look into why this trolley-based system could be considered by customers because, on the site of greenhouse emissions, buildings are great sources of greenhouse emissions to the atmosphere (Zamorano, 2022). With the application of this technology, we turn to reduce the number of buildings that will be constructed for the building of greenhouse farms by simply placing the systems in supermarket buildings. In addition, we can see that trolley-based systems can perform the task with high precision which will lead to a better yield of microgreen products with the use of little water, hence contributing to a sustainable farming system (Tavan et al., 2021). Also, the city of Helsinki which is part of the metropolitan areas of Finland has been involved in the quest for attaining carbon neutrality through the one climate strategy adoption to cut down the amount of carbon emission to the surrounding atmosphere(Dahal & Niemelä, 2016).

2.1.3 Nutritional Profile of Microgreens

Nutritional composition microgreen: Microgreens are highly nutritive with recent studies showing that they are good sources of essential nutrients such as amino acids, vitamins, and minerals, also including nonessential health-beneficial phytonutrients such as phenolics and glucosinolates. Microgreens have different nutrient composition than fully matured plants. i.e., parsley which is one of the microgreens has less amounts of calcium, magnesium, sulfur, and sodium but higher amounts of phosphorous and potassium than baby greens(El-Nakhel et al., 2021). Microgreens such as fenugreek and roselle contain larger amounts of α-tocopherol but same time low levels of β-carotene when compared to its grown plants (Ghoora et al., 2020). Generally, Microgreens show higher levels of total phenolic content (TPC) than grown-up plants while we have exceptions such as the Chinese basil (Dimita et al., 2022), reddish, jute, and water spinach portray higher TPC levels at maturity. Many factors can influence the nutritional value of microgreens such as the environment where it is grown and most especially the nutrients applied for its growth.

Antiproliferative and antidiabetic qualities of some microgreens

Microgreens have been tested to show great results in the treatment of cancerous cells by broccoli, kale, mustard, radish, green pea, soybean, barley, beetroot, and amaranth microgreens (Fuente et al., 2020; Truzzi et al., 2021). Recent studies show that two main factors contribute to the antiproliferative nature of microgreens, which are simply antioxidants such as vitamins A, C, and E coupled with their phenolic attributes. These components help get a ride or reduce the reactive oxygen species (ROS) and in turn, help maintain normal signaling, hence preventing the cell from being killed by cancerous cells (Carmo et al., 2018). Also, studies carried out show that some pro-oxidants can kill cancer cells without causing any harm to normal tissue which is called epigallocatechin-3-gallate (EGCG) (D’Angelo et al., 2017; León-González et al., 2015).

2.1.4 The Role of Microgreen in the Mental and Physical Well-Being

Microgreen plays an important role in the physical and mental well-being of humans since the growing process of these plants can take away stress. Since the growth cycle is short and easy to manage by many individuals, they usually prefer this for home gardening activities to a fully grown plant. Two studies have been carried out in the past to show the positive effect of growing microgreens on physical and mental health in the United Kingdom (Gittins & Morland, 2021) and one in the United States (Kelley et al., 2017).

2.1.5 The Role in Food Security

Microgreen is seen as a supper food because it provides the body with tons of important nutrients, and most importantly it has a very short growth cycle which makes it suitable for supplying the household with constant food supply in situations of emergency (Di Gioia et al., 2017). Also, the use of little space to farm this microgreen with relatively high-cost yield, coupled with the fact that they are suitable for growth under a larger range of temperatures makes it suitable for all-year-round cultivation. Looking at these advantages mentioned above with many others make microgreens a main food product in global urban farming according to recent research (Armanda et al., 2019). It is important to note that microgreen cultivations require higher amounts of seeds with relatively low yield per seed concerning our mature plants.

2.1.6 Cultivation Systems for Microgreen

Microgreens have quite a few systems that could be used in their cultivation. These systems ensure a precise climate, light, and nutrient intake in all areas and seasons. This will lead to a more nutritious, high-quality, energy-efficient, and all year-round microgreen (Shamshiri et al., 2018).

Soilless Substrate-Based Farming

This is a form of farming that is done without the use of soil. A common example of this type of farming is the use of peat moss as the soilless substrate. Apart from peat moss, we can use coconut coir, hemp mat, Rockwool, and many other spongy materials (Di Gioia et al., 2017; Hoang & Vu, 2022) where water is then applied from under or above either by spraying or dripping. Over the years many growing kits have been made for the growing of microgreens. A good example of such a system is the Microgreen Growth Kit™ by Hamama. This can be seen in Figure 1.

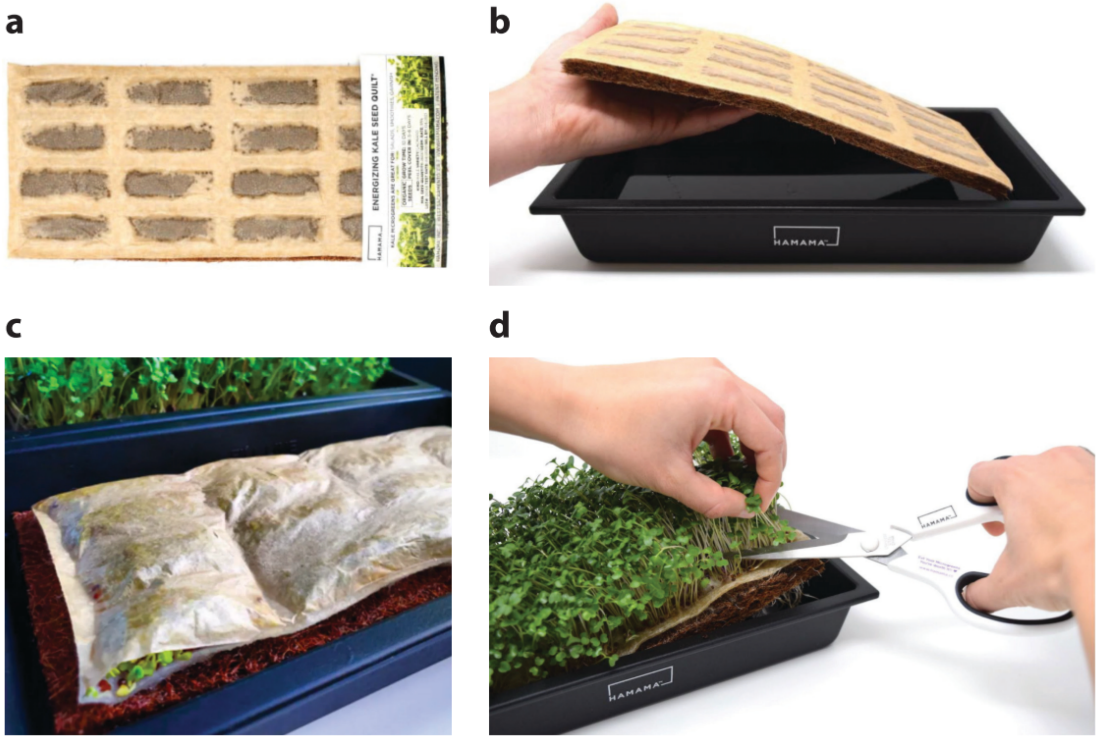

Figure 1: Microgreen growth kit for home use (Teng, 2023). https://doi.org/10.1146/annurev-food-060721

Figure 1 above shows the various stages in the growth process whereby, (a) shows the system with an enclosed germination mat with seeds packed in pockets. (b) shows the placing of the one-time watered seeds inside a tray for them to germinate. (c) shows the germination of the young seedlings from the various pockets. (d) shows the harvesting process of the microgreens (Figure 1).

Hydroponic Farming System

This is a method used in growing microgreens that uses water-based nutrient solution and not soil. It could also contain a growing substrate such as vermiculite, coconut coir, or perlite. This method is usually used in small-scale production by farmers, urban farms, and commercial enterprises (Teng et al., 2023). A hydroponic method such as the deep-water culture (DWC) where the plant's roots emerge into the nutrient-rich solution and the rest of the plant body is supported above water by the help of polystyrene or wood (Gong et al., 2022). DWC needs an aeration device that constantly supplies air into the nutrient-rich water reservoir. Recent studies show that hydroponic systems with good aeration will lead to higher yields of microgreen than systems with poor aeration which may result in root hypoxia (Grishin et al., 2021).

Aeroponic Systems

This form of microgreen growing system is a little costly since it needs more precision and types of equipment. The system functions in a way whereby the nutrient-rich solution is sprayed onto the plant's root section in the form of aerosol droplets (10 – 100 µm) using various atomization techniques (Eldridge et al., 2020). This system with the use of tiny water droplets provides the best supply of water and minerals to the microgreens as well as enough quantity of oxygen necessary for effective growth.

Aquaponic systems

Aquaponics is a system whereby they grow the fish at one end and the mineral-rich water from them is then used to grow the microgreens at the other end. The transformation of the fish's toxic waste to valuable nutrients that are need by the plants for their growth is done with the help of naturally occurring microbes (Yep & Zheng, 2019).

2.1.7 Components for building an automated trolley

For the building of automated trolley-based systems, these major components must be put in place such as the hardware component (VertiGrow, 2023). This system is made up of a shelving unit made of metal steel consisting of 4 wheels. We are going to have the rack trays which fit on the shelves. At the bottom shelves, we are going to place our water reservoir with a thermoplastic submersible pump placed inside. We are going to have an aeration system with pipes connected at the bottom of the water reservoir at one end and the other end into the device itself. Still with regards to the water system, we are going to have pipes that flow into each shelve compartment connected to a drainage system that moves back into our reservoir at the bottom shelve. On all compartments of our shelves, we are going to have LED lighting placed for the lighting of the trolley. At the side of all shelves, we are going to connect double fan systems to keep the temperature inside the trolley constant. We are going to have a surge protective in which we connect all our power cables to the various compartments. Automation of the system We are going to use a smart plug with the WIFI capability of connecting to our mobile phones and controlling with a mobile app. This same system is being used in smart houses that can work with voice to completely automate the lighting, water system, temperature, and CO2 systems inside our trolley just to have the optimum temperature suitable for the growth of our microgreen product.

Figure 2: Assembling some components for building an automated trolley-based system.

The lighting of the trolley: Lighting of the various compartments of the trolley is very important since the microgreen plants need light to grow and build up a rich nutritional value (Figure 2). Studies have shown that the use of LED lights is good and consumes less when left on constantly(Lanoue et al., 2022).

Water system: water plays a very important part in the growth of microgreen plants since all green plants need water in other to grow. The efficient use of water in this irrigation system whereby water is being recycled and used back makes it a good water regulatory and sustainable system (Tavan et al., 2021).

Growing substrate: Selection of the perfect growing substrate is very important in the adoption of this technology since studies over the years have seen that the type of substrate in the cultivation of microgreens can influence the mineral richness of these plants and can play a great role in decreasing plastic waste in our environment (Hoang & Vu, 2022). Also choosing a soilless system could prove advantageous in the fact that there will be little or no work in terms of maintenance and cleaning of the system while soil base substrate will require you to perform manual cleaning of the system each time after every harvest (Fussy & Papenbrock, 2022).

Adoption: For the adoption of a trolley-based system for microgreen production many internal and external factors should be taken into consideration.

Ease of use: Due to the automated nature of this system it is considered very easy to use simply by voice or using a software application on your smart devices. We can alter the fan turning speed to control the temperature inside the trolley which is covered with class to get the optimal temperature for the microgreen growth. Also, we will experience a reduction of activities since the system does everything hence the workers in the supermarket can focus on the business side of things (Pfeiffer et al., 2021).

Customer trust: Customers will be able to experience how the microgreen products in the trolley grow hence developing the feeling of being part and parcel of the growing process which can significantly build on the trust for this product (Jürkenbeck et al., 2019). Hence an effective adoption.

Cost of setting up: The initial cost of setting up this system is very costly which could be easily transferred to the customers by an increase in the pricing of these microgreen products (Lindell, 2023). However, our research is focused on understanding how customers will feel even if the growth of this product in the automated trolley system could come with high prices early on in its deployment phase in the supermarkets.

The Justice system: Paying a closer look at the justice system already in place to see if it supports the adoption of this technology in Helsinki will be important in the long run instead of setting up systems that do not tie in with the rules and policies currently put in place (Puupponen et al., 2023).

Summing up everything under the adoption of an automated trolley-based microgreen growing system will eventually need to take into consideration the efficiency and cost-effectiveness of the lighting system, The growing substrate use since it will influence the quality of the product, and the workload required in the maintenance of such system. The water system shows how economical it can be which turns to promote sustainable water use that is greatly encouraged by Helsinki being an urban city in the Nordic zone. We also have to look at the customer trust pattern to the adoption of this system and not leave out the present rules and legislation to see if the adoption of such a system is acceptable in the City of Helsinki (Figure 2).

2.2 Conceptual framework:

2.2.1 Introduction

In this section, we are going to come out with a conceptual framework that gives us a clear picture of the direction we are tilting to in the carrying out of our research. Here we want to use and cite as many references as possible of past, similar work to our research which gives us a good knowledge on how to proceed with our research. Based on our topic of research which is exploring customer perception of a trolley-based system for microgreen production in Helsinki supermarkets. We shall start by identifying our variables. We have one dependent variable which is customer perception. Our independent variables are year-round supply, growing substrate, water use in the system, trolley lighting, system trust, Legislation and laws, Freshness, Carbon footprint, manual workload reduction, and cost of implementation. After this, we shall draw a diagram with arrows relating the various variables as seen in Figure 3 below.

Conceptual Framework of a trolley-based system for microgreen production.

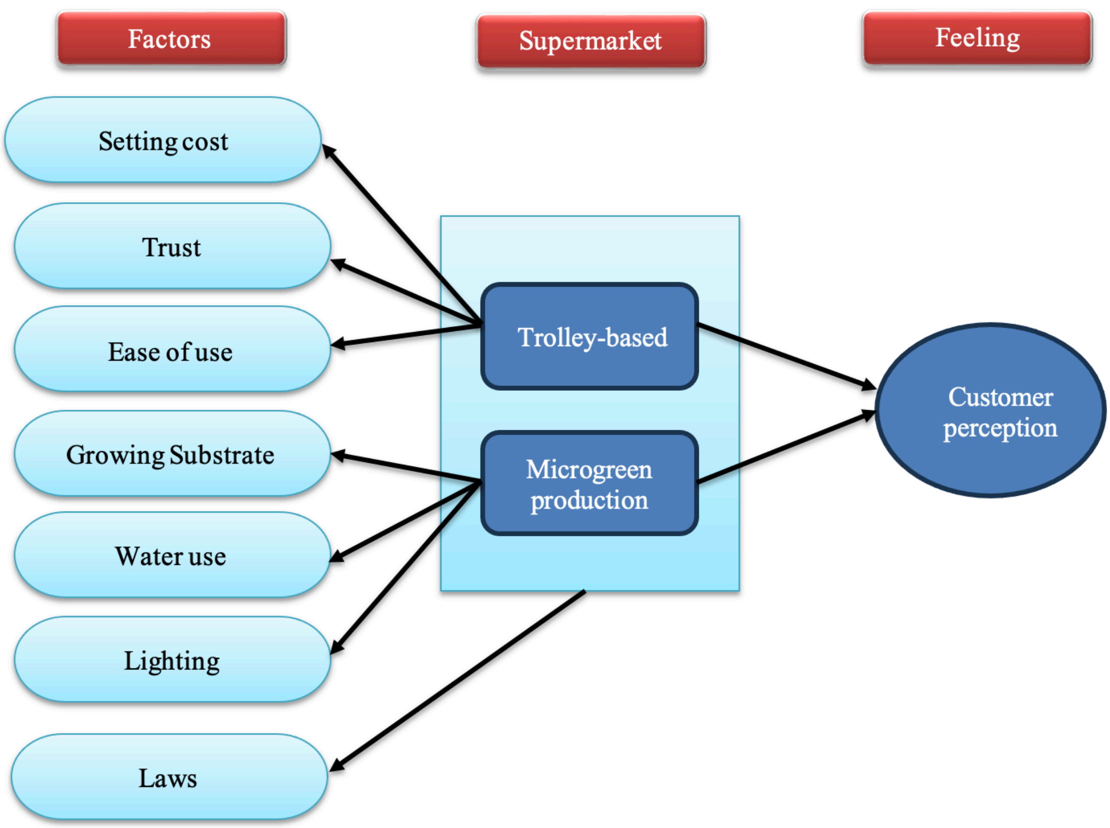

Figure 3: Conceptual Framework of trolley-based system for microgreen production

The conceptual framework (Figure 3) is to enable us to investigate customer perception towards the use of trolley-based systems for microgreen production. the following factors should be studied in detail.

2.2.2 Laws in support of this technology

The regulations that are already put in place permit the implementation of this system inside a supermarket setting. Urban farming policies were set up in the European Union to help encourage new technology methods of farming to achieve food security and a more sustainable way of farming (EU regulations of organic products, 2018). Finland is a good promoter of urban farming for carbon-neutral living in areas such as Helsinki. The Finland CircularHoodFood is part of Finland’s 6Aika Strategy put in place to encourage sustainable urban development in six large cities with Helsinki being one of them. Also, we have the Finnish National Action Plan which helps set up rules for the sustainable use of plant safety products (Tukes, 2018). One of the actions is the restriction on the use of chemical pesticides. The laws that encourage the implementation of this technology extend beyond that. It should be by the laws of food safety in Finland (Ruokavirasto, 2021). The Law in our conceptual framework applies to both the technology made to produce microgreen as well as the microgreen plant properties.

2.2.3 Setting cost

Our conceptual framework shows that at one point our work diverges towards finding out the cost of establishing the system and examining if there is any transfer cost of production towards the customers. Usually, the cost of setting up a system rich with technology such as this trolley-based microgreen growing system is very high compared to our traditional farming system but the overall cost in the long term is low (Enssle, 2020). Questions will be asked of customers to find out more about the cost at this early stage of development.

2.2.4 Trust

Trust is one of the factors that is hard to observe and quantify but it is very important in every production process. Trust is seen as an individual disposition, a psychological state, or behavior (Wang et al., 2015). This research will capitalize on this aspect of trust simply by investigating how customers' trust in the system influences their purchasing ability of these microgreens. The system is made like that of a greenhouse system where customers buying in the supermarket can see through the transparent glass the growing process of the microgreen. When customers buy this product, they are confident that the products are what they observed.

Ease of use: Systems that are made easy to use are usually more sustainable over a long time. The trolley-based system we are focusing on in this research is not fully automatic since watering of the plants still must be done manually, sowing of seeds and harvesting are all dependent on the farmer. This farming system being deployed on a small scale may seem easy to manipulate but if extended to a larger one, hence a need for all automated activities from sowing to harvesting of these microgreens (Tavan et al., 2021). Questions related to the ease of use of the system will be asked to find out if that is the case.

2.2.5 Growing substrate

Here we are looking at the material that we use in growing our microgreens. Peat is used in our case instead of some other different types of growing media simply because it produces a highly nutritive microgreen product (El-Nakhel, Pannico, Graziani, Kyriacou, et al., 2021). Our research will be out to investigate the effect the growing media has on the growth of our microgreen plants.

2.2.6 Water use

Water use in our case are interested in getting a better understanding of how this system uses water in a more efficient way which minimizes the amount of water utilized for plant growth. The system looks at the hydroponic method applied to our trolley-based system for a more effective water management system (Gong et al., 2022). Question will be asked that relates to the water use of our system and to get from customers how they think this is useful or not to them.

2.2.7 Lighting

Plants need light to grow, and in our trolley-based system how well the microgreens grow is greatly dependent on the type of lighting used (Lanoue et al., 2022). we use LED lights placed above each compartment of our trolley systems. A series of questions will be asked to find out how light use in a controlled manner can affect the growth and richness of our microgreens.

3 Research Methodology

3.1 Introduction:

A mixed method approach will be used, which blends both qualitative and quantitative research methodologies to better understand customer's perceptions of a trolley-based microgreen production system placed in Helsinki supermarkets (Torka, 2007).

The quantitative research part of this work will consist mainly of surveys and questionnaires developed and administered randomly to some supermarket customers.

The qualitative research part of this work will be looking at ways to review publicized articles and many other areas that have materials talking about the opinions of these automated trolley-based microgreen systems distributed in supermarkets across the Helsinki metropolitan area (Rowley, 2014).

Data analysis is going to be performed with the use of a data analysis tool pack which is included in the Microsoft Office software. Data analysis is going to enable us to analyze the data we have gotten from the administered questionnaires to customers about the trolley-based microgreen systems distributed across the Helsinki metropolitan landscape. From the results derived from the analysis coupled with that gotten from our qualitative research, we will be able to have a better understanding of customers' perception of this new technology. We are going to use charts and graphs to be able to disseminate and convey the portrayed results.

3.2 Questionnaire design

In Designing these questionnaires, we included questions from two sections, mainly the demographic section and the section for questions focusing on our research topic. The questionnaire was made up of 14 questions which were short and easy to understand. We use multiple choice response questions in some, yes or no in a few, and Likert scale questions in some of them. Our questions were structured in these ways such that in the Likert scale questions we could perform descriptive statistics to find out the level of perception of variables.

The Likert scale questions were structured to gather the important factor variables for our research. One of the Likert scale questions was question 10 in our questionnaire which talks about “How likely will customers encourage growing microgreen inside the supermarket knowing fully well that the following situations such as smell; Pest; Less market space; Less water use; Less energy use; and Less waste use might result from its implementation”. The responses listed for customers to answer were either Very Likely (VL); Somewhat likely (SWL); Neither likely nor unlikely (NLU); Somewhat unlikely (SWU); and Very unlikely (VU). The following were coded as shown in the table below.

Table 1: Coding of Likert scale responses

	Response	**Code**
VL	Very Likely	5
SWL	Somewhat likely	4
NLU	Neitherlikely nor unlikely	3
SWU	Somewhat unlikely	2
VU	Very unlikely	1

When coding our variables, Very likely (VL) is given the code 5 since this is the response that highly validates customers perception positively. Somewhat likely (SWL) is given the code 4 because it validates customers perception positively but not as high as in the case of Very likely. We have Neitherlikely nor unlikely which gives a neutral viewpoint on the validation of customers likelihood and is assigned a code of 3. Then, we have Somewhat unlikely (SWU) which validates customers perception negatively and it is assigned a code of 2. Lastly, we have Very unlikely which highly validates customers perception negatively and is equated the code 1 (Table 1). These coded responses are going to be of great importance in performing our analysis in Excel and the results of our analysis are going to help us answer our research questions at the end of our research.

3.3 Administering of questionnaire

The research made use of a population size of 50 participants for answering the questionnaire. The questionnaire was designed with Microsoft Forms which made it easy to distribute online. The barcode feature of Microsoft Forms helps us randomly distribute these questions to supermarket customers. I administered this questionnaire to targeted audiences located in Helsinki, Espoo, and Vantaa which all made up the Helsinki Metropolitan area. In Helsinki, I stood in front of the K-Supermarket Mustapekka which has this trolley-based system for microgreen production already implemented. Also in Espoo, I stood in front of the K-Supermarket Matinkyla. Lastly in Vantaa, I stood in front of the Tikuri Shopping Mall entrance in Vantaa. In these three locations, I gave the questionnaires to more than 200 persons, and only 50 persons completed the questionnaires and submitted their responses which we will analyze in the analysis section. The barcode feature was used for the distribution of these questionnaires because most supermarket customers did not like the idea of sharing their emails or phone numbers. With this method, you just need to show the barcode for customers to scan it and anonymously answer the questions which means I do not have any customer's personal information. Also, the barcode method helps me to meet the customers face to face, hence being able to assist them in answering any of the questions that seem to be problematic for them to understand. When I started the distribution of my questionnaires, I had a problem convincing the younger Finnish girls and older mothers to answer. Since I was getting more responses coming in from younger school boys and adult men, At a certain point I had to change from a random mode of distribution to adopt a more selective approach just to ensure that I had a more balanced population of both men and female. It should be noted that I initially carried out pilot testing of my questionnaires with 5 respondents just to ensure that my questions were all clear and well understood by all respondents. I included a comment section that allowed me to get their feedback in which I was able to make some slight modifications before administering my final questionnaires.

3.4 Interview with a worker of the microgreen growing system

Several visits were made at the K-Supermarket Mustapekka in Helsinki where I had a good discussion with the worker of this microgreen growing system placed inside the supermarket. He made me understand that the Management of this system is easy to perform but the most difficult part is the business-making part, which is difficult to find the right store owner who is interested in the implementation of this system. Presently, they have implemented this system in three different locations. One in Tripler, Espoo and Mustapekka. He also revealed that a big enough production space for sowing the seeds before being transported to the trolley-based system in the supermarket is needed. The sowing of the seeds usually takes 4-5 days based on the microgreen variant and when placed under light in the trolleybased system inside the supermarket, it can take 3 days to be ready for harvest. Both the harvesting and packaging are done inside the supermarket. Over the past years, the sowing space has been changed a couple of times because it did not have sufficient tables for the sowing of seeds, shelves for placing the sowed seeds in the dark, and good washing options. He also faced the problem of covering long driving distances to bring the sowed seeds to the supermarket to be placed in the trolley-based system. The cost of the microgreens sold in the supermarket after harvest is not determined by the cost spent on its production, simply because the supermarket agrees on a set amount that is being paid to the producers irrespective of the cost incurred during production. One good thing is that the money paid to the producers covers the cost buying of the seeds, peat, labor, transportation, and many others, but the rent for the separate building for the sowing of seeds and the actual supermarket is being taken care of by the store owners. He also made emphasis on the fact that they do not use any additional supplements in the growing of these microgreens apart from the peat and watering a few times. This makes the system very cost-effective. He made me understand that the peat and the seeds are easy to get by ordering at the moment but might face challenges of scarcity in the future. He assured me that the system has little or no impact on the surrounding environment since it does not use any chemicals such as fertilizers in its cultivation. The system uses less electricity with the use of LED lamps, minimal water used on the microgreens, and washing of equipment. The highest cost comes during the setting up of the greenhouse system where our trolleys are being placed inside. To get the optimal temperature for the growth of the microgreens was mainly by luck since the system does not have any temperature regulating device like the AC but uses an open window-up ventilation system that makes use of the temperature inside the supermarket. The situation of pest occurrence is not frequent in the system but had experienced one kind of pest variant from pisweed which was contracted from one of the previous places where they did the sowing of seeds. After changing the venue and with good washing these pest flies were eliminated. The pest did not affect the growth of the microgreens. Getting smell from the system is not that much only when the moisture is very high after watering the microgreens, but when the peat starts to dry up the smell goes away. Redish and Sunflower microgreens do not have much smell. The trolley-based microgreen is good at the moment but will be possible in the future especially when they face the challenge of higher demands. The automated system will be quite expensive to set up and will only be profitable in the long run coupled with the fact that it will take away the manual labour though sowing, harvesting, and packaging automation capabilities will cost so much based on the various machines required to perform this task. The main goal now for the future is to apply automation and also have many supermarket owners who are willing to apply this system inside their supermarkets with the main aim of having freshly produced microgreens at the doorsteps of customers.

4 Result or findings

4.1 Introduction

In this section, we shall present the results obtained from our research in a nonbiased manner. We shall use graphs constructed in Microsoft Excel to help us represent this information.

4.2 Presentation of research results

Figure 4 below shows the results from our first question on the questionnaire which refers to the age of the respondents.

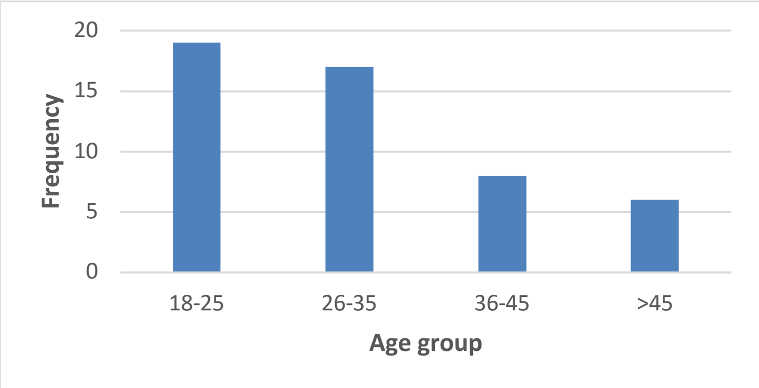

Figure 4: Shows the population range of respondents.

The first question was asked about the age of the respondent. We can see that (Figure 4) 19 persons were between the range of 18-25 years, between the range of 26-35 were 17 persons, 8 persons were between the range of 36-45, and 6 persons were above the ages of 45 and above.

The distribution of respondents by gender is shown in the figure below.

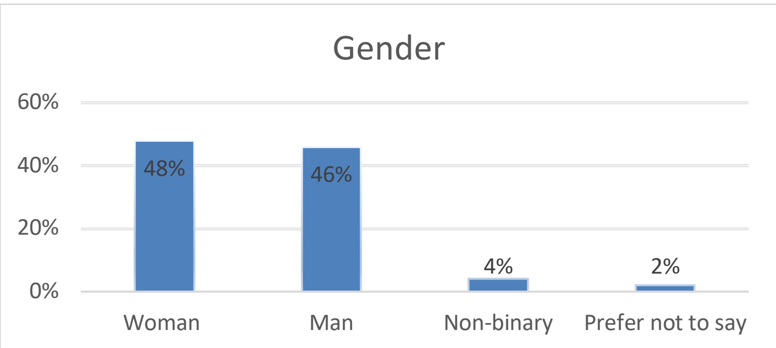

Figure 5: Gender distribution of respondents.

The figure above shows the age frequency of respondents in the survey questionnaires. The women population was made up of 24 respondents, making up 48% of the total population. Also, 23 of the respondents who made up 46% of the total population were men. non-binary respondents were 2 which made up 4% of the total population. One of the respondents preferred not to say anything based on his gender, making up 2% of the total population (Figure 5).

The distribution of the respondents is based on their location as in the figure below.

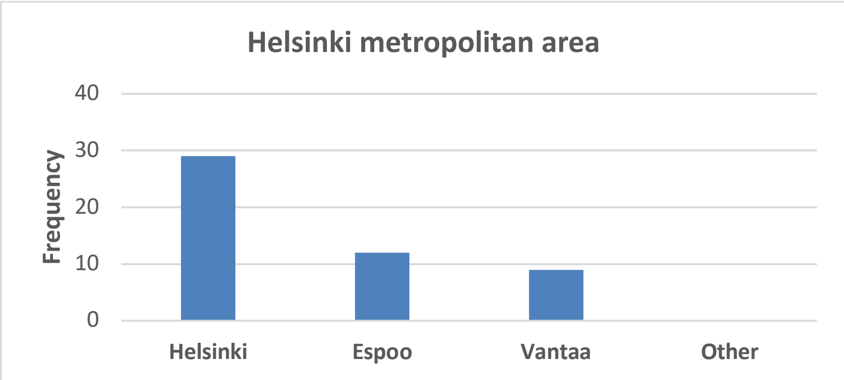

Figure 6: Distribution of respondents based on their location.

The distribution of respondents to the questionnaire shows that 29 persons who answered the questionnaires were from Helsinki. 12 of the respondents were from Espoo and the remaining 9 of the respondents were from Vantaa (Figure 6).

The figure below shows the distribution of the respondents by profession.

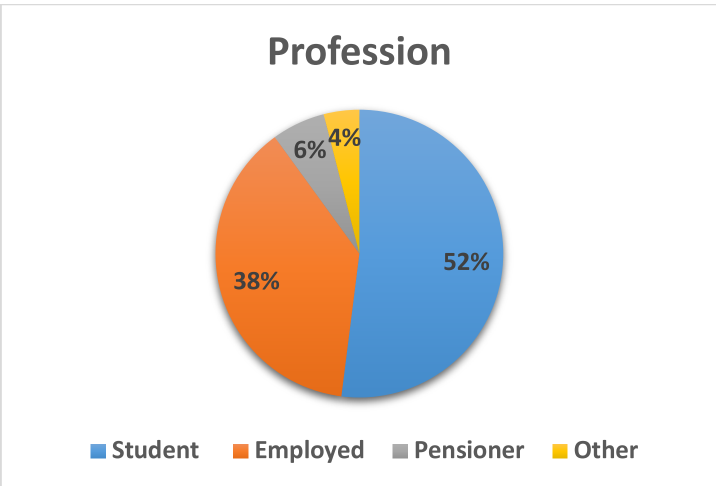

Figure 7: Distribution of the respondents based on their profession.

The figure above shows the distribution of the respondents based on their profession whereby 26 of them making up 52% of the population were students. Employed persons were 19 making up 38% of the population of respondents. Pensioners were 3, making up 6% of the population of respondents and 2 of them were from other professional categories making up 4% of the total population (Figure 7).

The figure below shows the nationality of the various respondent based on their countries of origin.

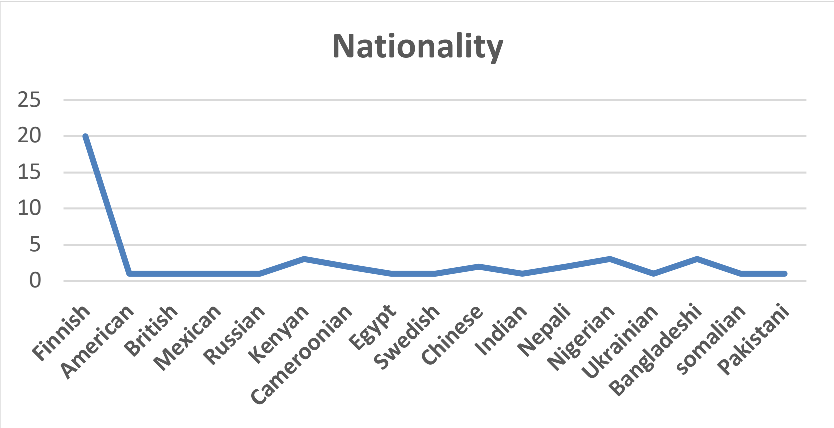

Figure 8: Distribution of the respondents based on their nationality.

This figure shows that most of the respondents were Finnish nationals who were 20 in number. We had Nigerians, Kenyans, and Bangladeshi who all had 3 persons taking part in this survey. We had persons from Cameroon, China, and Nepal who all had 2 representatives. All the other remaining countries had 1 person who took part in responding to the survey questionnaires (Figure 8).

The next part of our survey questions focuses on our actual research topic whereby the figure below shows how often the respondents visit the supermarket.

Figure 9: This figure shows how often the customers visit the supermarket.

Based on (Figure 9) we can see that 14 of the respondents visit the supermarket daily which makes up 28% of the total population of respondents. We had 26 of the respondents who answered weekly, making up 52% of the total population. Also, 7 of the respondents answer monthly which makes up 14% of the population. two persons answered Seasonal which made up 4% of the population. Lastly, one person said he had never visited the supermarket which made up 2% of the total population of respondents.

The figure below shows the distribution of responses from customers if they buy microgreens when visiting the supermarket.

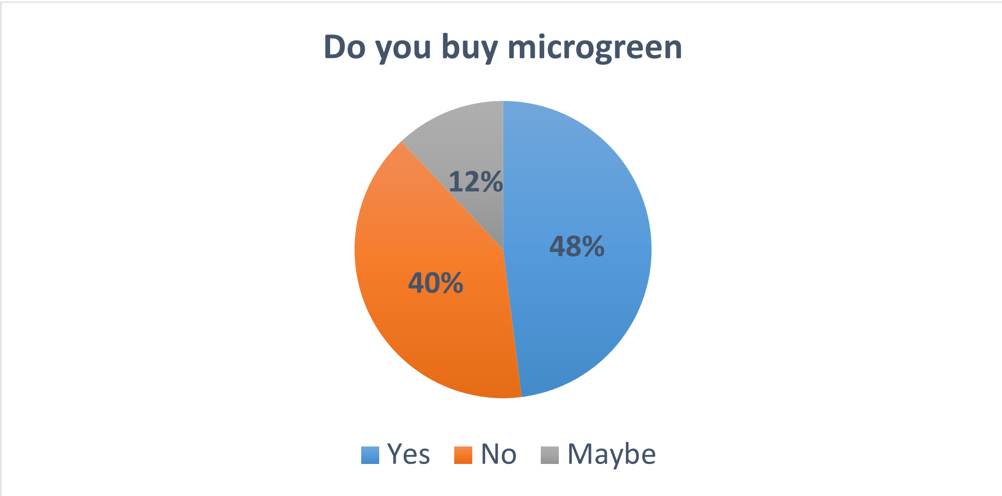

Figure 10: Distribution of respondents based on how they shop for microgreens in supermarkets.

The distribution above shows that 24 persons answered yes to the question if they buy microgreens in the supermarket, making up 48% of the total population. twenty persons answered no to the question if they buy microgreens in the supermarket which represents 40% of the population and lastly, six persons answered maybe to the questions which shows that they are unsure if they buy or do not. This represents 12% of the total population of respondents (Figure 10).

Figure below shows if customers prefer to buy microgreens in the supermarket.

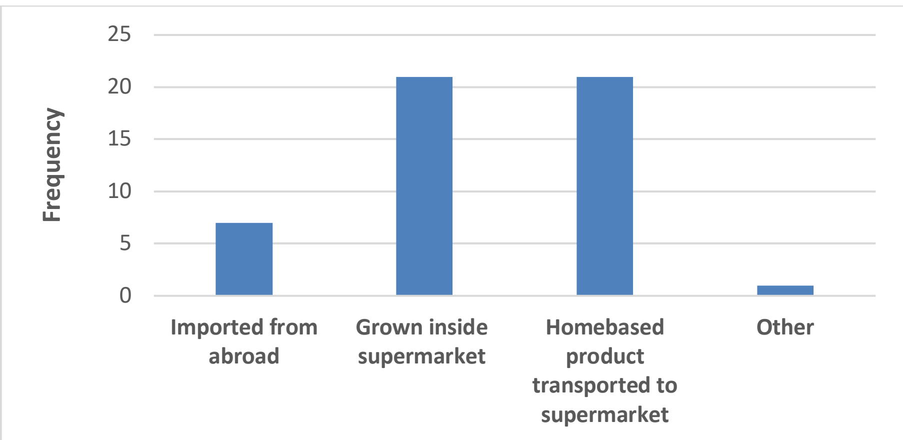

Figure 11: Distribution of respondents based on the type of microgreen they prefer to buy.

The distribution shows that 7 persons prefer to buy microgreens imported from abroad which makes up 14% of the total population. Microgreens grown inside the supermarket was preferred by 21 persons which amounts to 42% of the respondents. Similarly, 21 persons prefer to buy microgreens which are home-based products transported to the supermarket equally making up 42% of the respondents. Lastly, one person prefers to buy microgreens from other methods to the supermarket which makes up 2% of the population (Figure 11).

Figure 12 is based on the question which was to find out what aspect of growing microgreens inside the supermarket's greenhouse system customers cherish the most.

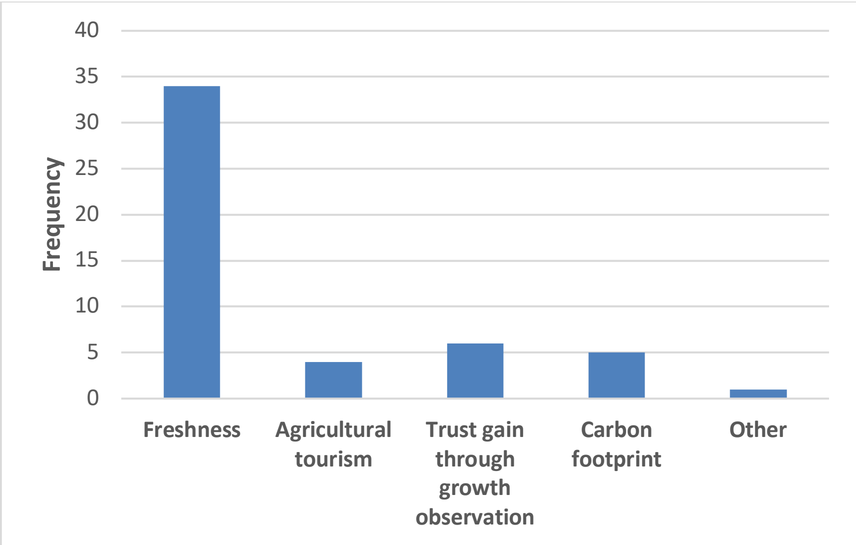

Figure 12: Aspect customers most cherish growing microgreens inside the supermarket.

Based on the respondents in (Figure 12), we observed that 34 of the participants selected freshness as the reason why they will cherish this technology of operating a farm inside the supermarket. This made up 68% of the respondents. four persons chose agricultural tourism as the reason why they like this technology which made up 8% of the respondents. six persons selected trust gain through observation as the reason why they developed an interest in this technological system of growing microgreens inside a supermarket making up 12% of the total respondent population. five persons selected carbon footprint as the idea behind this technology which they love greatly, making up 10% of the respondents. One person chooses others implying that they have other reasons different from the ones listed that made them like this technology. This made up 2% of the respondents.

Figure 13 shows how likely customers will encourage growing microgreens inside the supermarket knowing fully well that the following might result from it.

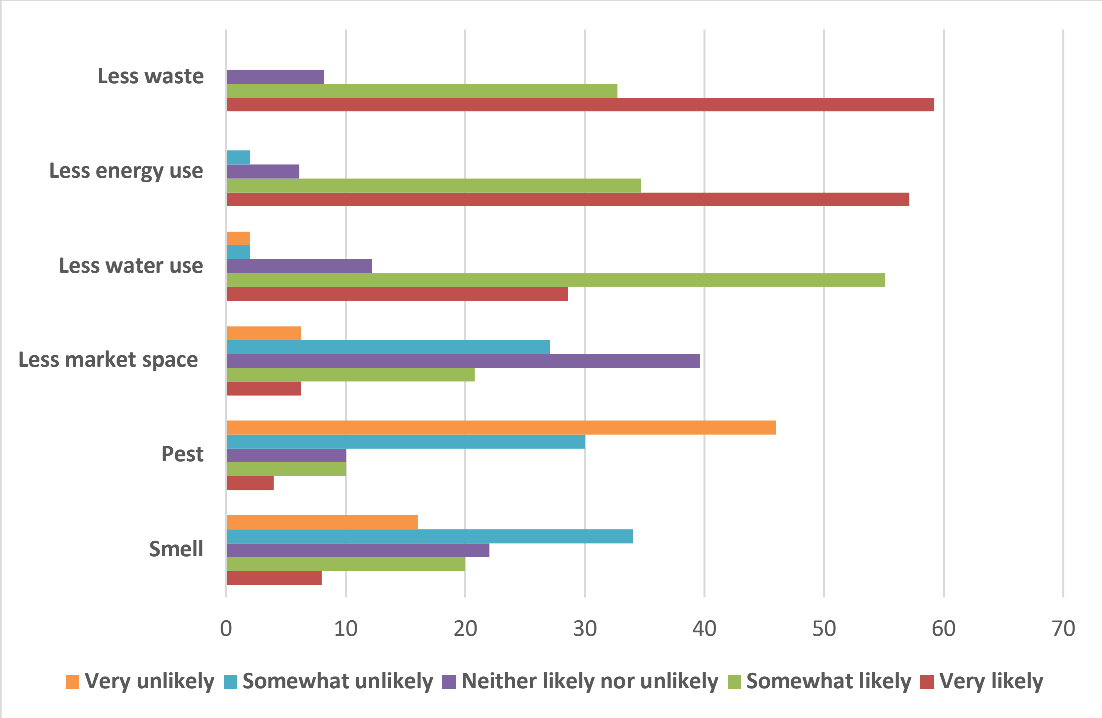

Figure 13: How likely customers will support this technology despite the presence of these factors.

Based on Figure 13 figure above, we can observe that based on smell factor, 34% of the respondents considered this event to be somewhat unlikely to encourage the growth of microgreens inside the supermarket. 22% of the respondents answered neither likely nor unlikely. 20% answered somewhat likely to implement this technology despite the smell. 16% answered very unlikely and 8% answered very likely to adopt this technology. Based on Pest action, 46% of the respondents considered this very unlikely to continue with this technology. 30% considered it somewhat unlikely, and 10% considered it Neither likely nor unlikely. 10% considered it somewhat likely and 4% considered it very likely. For less market space 39.6% answered neither likely nor unlikely to set up this trolley-based microgreen growing system inside a supermarket. 27.1% answered somewhat likely to set up this technology despite creating a situation of less market space. 20.8% answered somewhat likely. 6.3% answered very likely and similarly, 6.3% answered very unlikely. Applying this technology which might result in less water use, 55.1% answered somewhat likely. 28.6% answered very likely. 12.2% answered neither likely nor unlikely. 2% answered somewhat unlikely and 2% answered very unlikely. This technology brings less energy use as a result, 57.1% answered very likely. 34.7% answered somewhat likely.6.1% answered Neither likely nor unlikely. 2% answered somewhat unlikely. Implementing this technology will result in less waste, 59.2% answered very likely to go for this technology. 32.7% answered somewhat likely. 8.2% answered neither likely nor unlikely (Figure 13).

The next question was meant to find out how customers think about setting up this trolley-based system inside a supermarket, and if it is following the laws of the area.

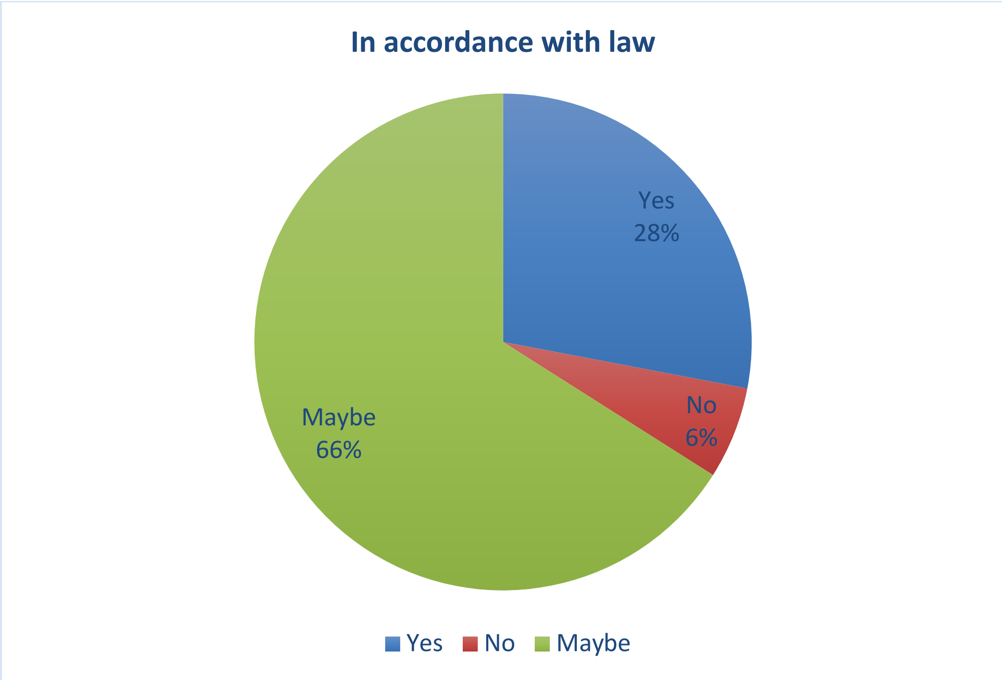

Figure 14: Response from if the trolley system in supermarkets is under law.

Figure 14 shows that 33 respondents answered maybe when asked if this trolley-based system placed inside the supermarket was following the law of the area making up 66% of the population. Similarly, 14 of the respondents answered yes making up 28% of the respondent's population. three persons answered no, making up 6% of the population.

The next question was meant to get responses from customers if they feel that the cost of setting up this trolley-based technological system of microgreen production has a significant influence on the prices of microgreen.

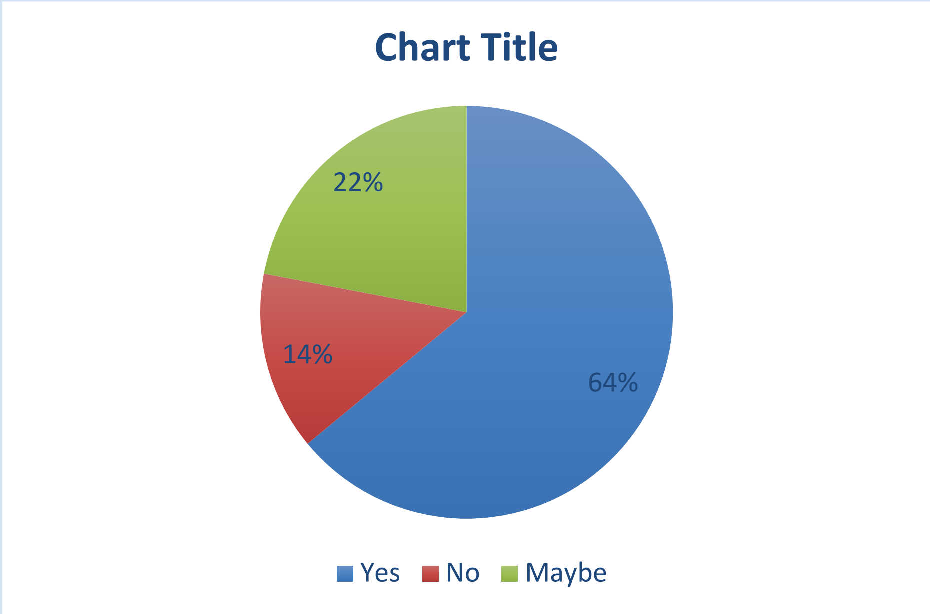

Figure 15: Distribution of how customers feel if the cost of production is transferred to them.

Based on the figure above, we can observe that 33 of the respondents answered yes making up 64% of the population. Maybe was selected by 14 of the respondents, making up 22% of the population. Lastly, seven of the respondents answered No, making up 14% of the population (Figure 15).

The following question was to find out if the trolley-based growing system is made completely automated (from sowing to harvest), how likely will customers be willing to pay for it.

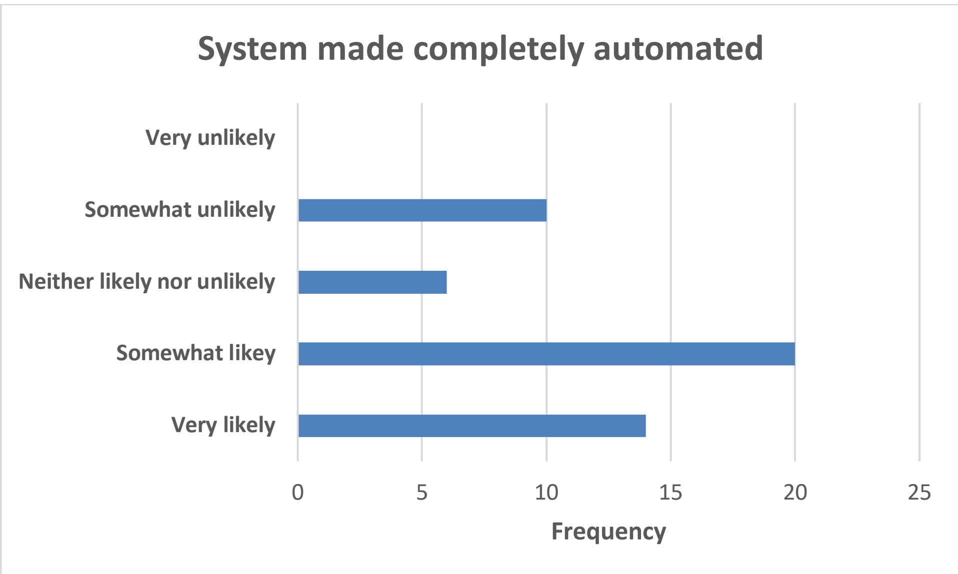

Figure 16: Customer's willingness to pay more if the system is made completely automated.

Based on the figure above, we can observe that 20 persons answered somewhat likely to purchase this product making up 40% of the total respondents even if the prices are increased due to the high cost of making it completely automated. Also, 14 respondents answered very likely which sums up to 28% of the respondents. Ten persons answered somewhat unlikely which means that they were not very convinced about the automation of the trolley-based system for microgreen production going fully automated. This made up 20% of the total respondent population. Six persons answered neither likely nor unlikely which made up 12% of the population (Figure 16).

Figure 17 shows the overall rating given by customers about the trolley-based microgreen production system implemented inside a supermarket.

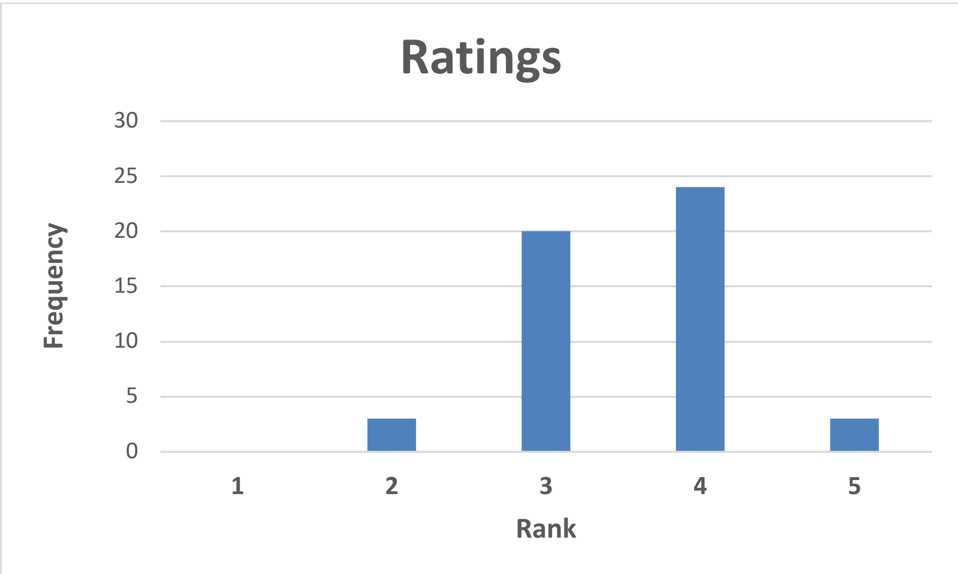

Figure 17: Customers rating of trolley-based microgreen growing system inside a supermarket.

Based on (Figure 17), we can observe that 24 persons rated it 4 out of 5 showing their interest in the technology. This was made up of 48% of the respondent population. Also, 20 persons gave it a rank of 3. This made up 40% of the respondent population. In addition, 3 persons gave it a 5. Similarly, 3 persons gave it a 2 which contributed to 6% of the total respondent population respectively.

4.3 Perception decisions based on the research question.

Table 2: Perception decision for our Likert scale questions.

Question	Factor	VL(%)	SWL(%)	NLU(%)	SWU(%)	VU(%)	Mean	Standard Error	Decision
How likely will you encourage growing microgreen inside the supermarket knowing fully well that the following might result from it	**Smell**	4 (8)	10 (20)	11 (22)	17 (34)	8 (16)	2.7	0.17	**Low perception**
	Pest	2 (4)	5 (10)	5 (10)	15 (30)	23 (46)	1.96	0.16	**Low perception**
	Less market space	3 (6.3)	10 (20.8)	19 (39.6)	13 (27.1)	3 (6.3)	2.93	0.14	**Low perception**
	Less water use	14 (28.6)	27 (55.1)	6 (12.2)	1 (2)	1 (2)	4.06	0.12	**High perception**
	Less energy use	28 (59.2)	17 (34.7)	3 (6.1)	1(2)	0 (0)	4.46	0.1	**High perception**
	Less waste	29 (59.2)	16 (32.7)	4 (8.2)	0 (0)	0 (0)	4.51	0.1	**High perception**
If the trolley-based growing system is made completely automated (from sowing to harvest), how likely would you be willing to pay for it?	**Willingness to pay**	14 (28)	20 (40)	6 (12)	10 (20)	0 (0)	3.79	0.15	**High perception**
		Grand mean					**3.5**		

Based on Table 2 table above, we can observe that from the question of how likely customers will encourage the use of the trolley-based microgreen growing system placed inside the supermarket knowing fully well that it could bring about an unpleasant smell inside the supermarket, Had low perception. The low perception is derived from the fact that the mean of smell factor 2.7 is less than the grand mean of 3.5 (Table 2).

Looking at the second factor (pest) in (Table 2), it can be observed that customers have a low perception of implementing this technology because of pests. The low perception is derived from the fact that the mean of pest factor 1.96 is less than the grand mean of 3.5.

Observing the factor for less market space in (Table 2), respondents have a low perception of it being implemented. The low perception is derived from the fact that the mean of less market space item 2.93 is less than the grand mean of 3.5.

Looking at the less water use factor we can see that the perception of customers is high, meaning that they support the implementation of this technology knowing fully well that its presence may lead to degree levels of water used in the cultivation of microgreens. The high perception is derived from the fact that the mean of less water use item 4.06 is greater than the grand mean of 3.5 (Table 2).

Moving over to the next factor in (Table 2) above which is less energy use. We can observe that the perception of customers towards the implementation of this trolley-based system knowing fully well that its creation will result in a reduction in energy use is High. The high perception is derived from the fact that the mean of less energy use item 4.46 is greater than the grand mean of 3.5.

For the Less waste factor, the customer perception is high. This implies that many customers will favor the implementation of this trolley-based microgreen growing system since it reduces the amount of farming waste generated. This was assumed from the fact that the mean of less waste of 4.51 was greater than the grand mean of 3.5 (Table 2).

The last factor is to find out how likely customers will be willing to pay more for the microgreens grown in the trolley-based system placed inside the supermarket if the system is made completely automated. The high perception is derived from the fact that the willingness to pay factor mean of 3.79 is greater than the grand mean of 3.5 as seen in (Table 2).

5 Discussion and interpretations

5.1 Introduction

In this section, we are going to discuss the results which we derived from our studies. we are going to analyze and interpret our results in such a manner that fully tests our hypothesis and answers our research questions in the best way possible.

5.2 Findings

Our research was focused on studying the main factors affecting the perception of customers towards the acceptance of this new technology of a trolley-based microgreen growing system in the supermarkets situated in Helsinki. Based on Table 2, smell had a low perception towards acceptance of this technology. This result does not support our hypothesis. Hence, we reject H_0: which states that Customers will have a good feeling about the trolley-based microgreen growing system placed in supermarkets in Helsinki and accept H_1. Previous studies such as (Lockeretz, 1986)that tell us that customers will have a good feeling about the ambient smell coming from the microgreens does not seem to be the case here. Other studies such as (Michell et al., 2020) tell us that microgreens, the young edible shoots do not have much smell. Hence, Accepting the alternative hypothesis may simply be because customers do not support the farming smells which may generate a result of bad washing of growing equipment inside the supermarket environment. Looking at Table 2, customers have a low perception of this system about the existence of pests at any point in time. concerning our first hypothesis we accept the H_1 and reject the H_0. This aligns with past research such as (Deepak Kumar et al., 2023) which portrays the negative impact of peat flies around the supermarket environment and the harmful use of pesticides too humans. Based on interviews with the workers of this system, there is a very slight chance for pests to occur. The less space factor in Table 2, had a low perception which was the justification for rejecting H_0 and accepting H_1. Previous research such as (Luck & Benkenstein, 2015) tells us that customers have both positive and negative feelings towards the lack of space inside the supermarket. The positive aspect is that customers are emotionally happy to be close to one another when shopping. The negative aspect is that free navigation between shopping shelves might pose a problem for customers. The less water use factor has a high perception based on Table 2. This answers our first hypothesis whereby we accept the null hypothesis H_o and reject the alternative hypothesis H_1. Previous research studies such as (Senevirathne et al., 2019; Tavan et al., 2021) explain the fact that less water is used because of the short growing life cycle of microgreens. also, discussions with workers of the trolley-based systems which are designed to maximize water loss in the cultivation of microgreens seem to support our research results. Looking at the less energy factor in Table 2, the results show a high perception by customers to accept this technology. Our research question one answers this factor where we accept the null hypothesis H_o and reject the H_1. Past research studies like (Lanoue et al., 2022) tells us about the use of continuous LED lighting for the growing of microgreen at a much-reduced cost of about (8-38%). This means a good reduction in electricity use which supports our research. Still on Table 2, looking at the less waste factor. we can observe that it has a high perception of customers to feel good about this technology. Our hypothesis one answers this factor where we accept H_o and reject H_1. Recent studies like (Du et al., 2022) explain the need to substitute peat-based substrate for microgreen cultivation with other forms like hydroponic and aeroponic microgreen systems since peat produces more waste and acts as a source of buildup of nitrates in the soil. This does not seem to apply to our research since our trolley-based systems use peat as substrates for microgreen which greatly improves the yield based on discussions I had with workers of this system. Lastly, based on Table 2, we can see that the willingness to pay factor has a high perception by the customers, which means that customers are ready to pay more for the microgreen technology if it is made completely automated. Our hypothesis question 2 answers this factor whereby we accept the null hypothesis H_o and reject the alternative hypothesis H_1. Similar research studies such as (Ares et al., 2021) tell us that customers are willing to pay more for the automated trolley-based systems which will help maintain a constant temperature in a closed system setup which prevents pests, and smells that are some of the factors in this research having low perception towards acceptance by customers.

5.3 Limitations

Our research work was not entirely perfect. We had some limitations which prevented us from drawing certain conclusions. Firstly, our sample size might not depict the entire population, since our selection of respondents at some point in our research was not random. Hence it was selection bias. Also, our research had problems finding existing literature that fits our area of study. most of the literature was from studies carried out outside of Finland. Hence perception of persons considers the cultural background of persons too which was lacking in this research. Lastly, I had time constraints in finalizing this work since the method of distribution of my questionnaires initially through email was not effective, hence I had to derive an alternative method of using a barcode that required face-to-face interaction and more time.

5.4 Implication of Research

Our research results could be looked at from a broader perspective. This research work could act as a tool to convince supermarket owners to adopt and implement this system inside their supermarkets in many areas in Finland.

5.5 Recommendations

This research work seeks to get the perception of supermarket customers on the implementation of a trolley-based system for microgreen production in the Helsinki metropolitan area still has many research areas that could be covered in the future.
Studies could be done to show what measures the government of Finland puts in place to prevent such systems from failing. Also, the present research could be improved upon by initially adopting the perfect method of data collection at the start of the research which will help save time and get a non-biased sample for interpretation.

5.6 Conclusion

Generally, our research work shows that the perception of customers towards the adoption and implementation of this trolley-based microgreen cultivation system in supermarkets is positive. Customers love the innovative idea of bringing fresh grown microgreen products close to their purchasing doorsteps. The research also highlighted some factors that were perceived negatively by customers and how they could be eliminated with the introduction of a completely automated trolley-based microgreen cultivation system in the future.

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Appendix

Customers perceptions of trolleybased microgreen growing systems in Helsinki supermarkets

Dear respondents:

Greetings!
I am a fourth year student at Novia University of Applied Science, currently taking up Bachelor of Natural Resources in Coastal Resource Management. I will like to invite you to be part of my research titled "Exploring customers perceptions of trolleybased microgreen growing systems in Helsinki supermarkets".

The young seedlings of edible herbs and vegetable are termed microgreen. These categories of green food substance are highly nutritive. An example of microgreen is sunflower shoots (Auringonkukan versot). Microgreens could be use in diverse circumstances, either as flavor to food, salad or even eating them on their own. Couple with the fact that these are green products and taste best when they are freshly harvested. The trolley-based microgreen cultivation system placed in supermarkets is a good way to ensure that this product remain fresh and made available at the door steps to customers. Customers can observe how these plants grow by looking through the transparent greenhouse.

This research work aimed at obtaining a good understanding of customers perceptions towards the implementation of this trolley based microgreen growing systems inside the supermarket setting in the Helsinki metropolitant area.

Your participation in this research is of great importance towards the realization of my project and has the potential to significantly contribute towards the implementation and adoption by supermarket owners in many other parts of Finland.

The questionnaire is anonymous, and the information is handled confidentially.
Thank you and while waiting for your response, i remain your humble partner.

* Required

1. How old are you? *

- ○ 18-25
- ○ 26-35
- ○ 36-45
- ○ >45

2. By what gender do you identify? *

- ◯ Woman
- ◯ Man
- ◯ Non-binary
- ◯ Prefer not to say
- ◯ Other

3. Where are you located? *

- ◯ Helsinki
- ◯ Espoo
- ◯ Vantaa
- ◯ Other

4. Profession *

- ◯ Student
- ◯ Employed
- ◯ Pensioner
- ◯ Other

5. Nationality *

6. How often do you visit the supermarket?

- ◯ Daily
- ◯ Weekly
- ◯ Monthly
- ◯ Seasonal
- ◯ Never

7. Do you buy microgreen in supermarket?

- ◯ Yes
- ◯ No
- ◯ Maybe

8. Which of the microgreens will you prefer to buy in the supermarket?

- ◯ Imported from abroad
- ◯ Grown inside supermarket
- ◯ Homebased product transported to supermarket
- ◯ Other

9. What aspect of growing microgreens inside the supermarkets greenhouse system will you cherish the most?

- ◯ Freshness
- ◯ Agricultural tourism
- ◯ Trust gain through growth observation
- ◯ Carbon footprint
- ◯ Other

10. How likely will you encourage growing microgreen inside the supermarket knowing fully well that the following might result from it?

	Very likely	Somewhat likely	Neither likely nor unlikely	Somewhat unlikely	Very unlikely
Smell	◯	◯	◯	◯	◯
Pest	◯	◯	◯	◯	◯
Less market space	◯	◯	◯	◯	◯
Less water use	◯	◯	◯	◯	◯
Less energy use	◯	◯	◯	◯	◯
Less waste	◯	◯	◯	◯	◯

11. What do you think about setting up this system inside a supermarket, Is it in accordance with the laws of the area?

◯ Yes

◯ No

◯ Maybe

12. Do you feel that the cost of setting up this trolleybased technological system of microgreen production have a significant influence on the prices of microgreen?

◯ Yes

◯ No

◯ Maybe

13. If the trolley based growing system is made completely automated (from sowing to harvest), how likely would you be willing to pay for it?

- ◯ Very likely
- ◯ Somewhat likely
- ◯ Neither likely nor unlikely
- ◯ Somewhat unlikely
- ◯ Very unlikely

14. Overall, how will you rate this idea of growing microgreen inside trolleys within the supermarket premises?

1	2	3	4	5

15. Comments