



Fig1. Google Image: Future Green Paris.

Research for applying Vertical Farming in Paris with customers point of views

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14 January 2019, Almere, Netherlands

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Class: Bachelor's degree, 4IRA, Management of the living environment - Rural Innovation

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Preface & acknowledgment

This report has been written by Sébastien Ambroise, a student at AERES University in 4th year. Following a bachelor's degree named 'Management of the living environment' and the option 'Rural Innovation', a thesis has to be written to complete the degree. The thesis should have a link with the module and complete all the criteria the module-book mentioned.

My motivation for writing this paper is that I would like to show the capability of indoor agriculture in a big city for consumers. This could be the agriculture future, and the study of customer behavior on this would be very helpful.

I would like to thank my mentor, Istvan Boros, for his time and his advice. He answered my questions with great diligence and enlighten me when I was lost. Every time I went to him during the class planned, I improved more and more my main research question and what I wanted to do.

I would like to thank my other teachers who help me with their courses and advice regarding this paper.

I would also thank my family and friends during this period of time for their patience and helps. The peer sessions, the help on the thesis subject and the support they gave me, were useful.

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Summary

Many agriculture problems remain nowadays concerning the future of humanity. The world population will increase more and more, and the fertile lands will decrease with the city's expansions. Rural depopulation already began, and the carbon food print of the food is no longer an issue. Pollution is one of the main threats for the future and every sector has to participate in fighting against it. Therefore, the intensive utilization of chemicals through the past decades have polluted our soil, our air, and our water. Those problems are outdoor, which mean that indoor production could be a solution for solving those issues.

Cities begin for the past few years to encourage urban agriculture inside the city. Many of them have initiatives producing food on rooftops, gardens, and greenhouses. It exists several kinds of urban agriculture, and one of them is vertical farming using the hydroponic system. It is a production in a vertical way, off-ground cultivation, producing all over the year the same quantity and in a controlled environment. Everything is controlled which make the plant produces a high yield. Using also recycling water, and energy coming from a sustainable way, the concept has an important issue.

In Europe, the richer city is Paris and it is a city with a green wish. The paper dealing with this city and the concept of vertical farming, related to the customer's thinking. The aim is to make a clear list of benefits about the concept and comparing into the other systems. Then, the customer will be interrogated in order to know the choosing process he does. The main research question is: How vertical farming can be applied in a big city as Paris for improving customers life?

The findings are that vertical farming has many benefits for the inhabitants in the surroundings. The comparison with other models shows that the concept can adjust many problems. The customers do not have the knowledge about the difference between organic and vertical farming. The concept of indoor and outdoor are the only arguments they have. Furthermore, people think that the concept could be the future of agriculture whereas they would choose the cheaper price between two products, from organic and vertical production. The quality is evidence after explaining the concept for them, however, the price is still an important argument for buying. In the meantime, the appearance, the price and the haptic are the most characteristics people look for choosing a food product. Then, the concept has to be competitive to the other systems in order to have its place. Moreover, the vertical farming concept needs to be promoted and explained in order to reach more people and extend people's awareness.

1. Introduction

The world population increases more and more every day, and the expectation for 2050 would be 9 billion inhabitants (Al-Chalabi, 2015). It is about 1,5 billion people more than today, 2018. Consequently, the demand for food would increase by 50% in 2050 (Pinstrup-Andersen, 2018). Moreover, it is predicted that 5 billion people will live in an urban area by 2030. It includes the urban expansion at the expense of fertile soil about 185% increased (Seto, 2012). Nevertheless, the urban expansion would be mostly in Asia with more than half of the total amount.

Furthermore, with the expansion of the urban area, the world will face agriculture challenges beginning by land uses.

Fertile soil would become rarer and rarer converted to other uses making land uses conflicts. Furthermore, when it is changed into an urban area, the land is rarely irreversible (Wästfelt, 2018). Farmers are always fighting for keeping their lands against cities and municipalities. Every year, it is thousands of hectares lost and many farms disappear because of that. Indeed, some farms have only a few hectares and by losing a part of their lands, they will not be able to continue their activities. The fertile lands are precious and need protection.

But fertile lands are also facing the use of fertilizers, phytosanitary products in order to protect the crops. Nowadays, many regulations are raised by the European Union for preserving soils. The way of production is not the best one for environmental issues. Indeed, agriculture is one of the biggest polluters in the world (Li, 2017).

The agricultural sector is one of the responsible stakeholders for pollution and climate change. Climate change currently happens which mean there will be more extreme temperature and extreme weather such as drought or flooding. It would have a significant effect on the agriculture area. The extreme heat during the growing period can affect the grain yield of the plant (Wang, 2017) and it is difficult to prevent such problems. Furthermore, we know that extreme climate will be more and more present because of global warming (Agoston, 2018).

Consequently, the quantity of production will be difficult to foresee and would have a crucial impact on farmers. Seasons are also changing according to the temperatures, and the Flores are adapting themselves. The greenhouse effect increases because of many facts, and one of the causes is the CO₂ emissions by motors. It is mostly by transportations from the production site to the consumer's mouth, but also by tractors for producing the food.

To reduce this CO₂ emission in the agricultural area, shorten the supply food chain (SFC) would allow reducing the distances between producers and consumers. Less transportation would have an impact on the carbon footprint of the companies and eventually on the environment. Suppressing stakeholders in the SFC would prevent food waste and create food security by reducing food losses (Garcia-Herrero, 2018). During each step of the food chain, many wastes are done even at the end of the chain by the consumers. More than 30% of global food production is wasted (Vidal, 2005). Furthermore, selling locally to the producing point would also decrease the waste due to the transportation as well as the carbon footprint. A product which suffered damage would be throw away because it has no longer the characteristic for selling. Then, a way to produce closer to the consumers in safe environment would be the solution.

Nevertheless, all those problems are outdoor and outside cities which mean an indoor production in the city could be an interesting solution to provide sustainable food to inhabitants.

Urban farming would be a solution for food safety and a sustainable way to produce the same place the food is eaten. It can be indoor or outdoor farming in the city. This would help the inhabitants to know exactly how the food comes from: a seed, a tuber. Furthermore, people do not know any more the vegetables, and it begins in early age (Oliver, 2010). People in cities see only the food as the last form of the food chain, and they usually cannot recognize the plants of it.

Most of the customers do not know how the food they bought is produced. Urban agriculture (UA) makes the relation between the producer and the customer sharing and speaking with a professional person to improve knowledge and awareness. Therefore, they would take more care about what they eat, and it begins with educational farms for example. Besides, the main aim of UA is to reduce the number of entities between the

producer and the consumer as a short food supply chain (SFSCs). Several types of urban farming are already existing, but one has many beneficial points for an environmental issue, the vertical farming.

Vertical farming is a way of producing food vertically with stacked layers. Often integrated into a structure as a skyscraper or containers, this is an indoor production. Everything can be controlled, including environments, light, temperature and the precise quantity of nutrients. Many benefits are provided as no pesticides, no soil, no land used (except for the building), and 95% reduction of water used compared to conventional crop (Pinstrup-Andersen, 2018). Vertical farming technique gathers all the parameter to make the plant as comfortable as possible to optimize the energy of the plant, the energy that is used to get the nutrition. A gathering of techniques and agricultural knowledge make the plant use in its best capacity for producing good nutrient and better yield.

Moreover, the yield from vertical farming is more significant than conventional agriculture because vertical farming's production time is shorter (Pinstrup-Andersen, 2018). Some research shows that increasing the CO₂ in the air will amplify the yield (Nguyen, 2017). The light offers constant progress to the plant all the time which give the plant a quicker development and shorter cycle. One of the methods used by vertical farming is "Hydroponic system".

The hydroponic system is a method to grow plants in water-nutrient solution. It is a more sustainable and efficient way to produce. The water provides the right quantity of nutrient to the plant in a gutter. After the water is filled with nutrient, it will make another tour. Besides, more characteristics of the water are controlled as electrical conductivity, pH, dissolved oxygen and temperature of the water (Son, 2016). All those parameters accentuate the facility of access for the plant to the nutrient it needs. Furthermore, the ion concentration in the water can change over time, and then it requires constant analysis. This production can allow producing all over the year, not depending on the season which means the vegetables will be available every time for the customers with the same vitamins and quality whatever the season is. Indeed, it is essential to know that the production will be constant with the same quantity of products. There will be no surprise as difficult winter or others because the 100% controlled climate. Then, this method, the hydroponic system is a part of the vertical farm concept, and answer to many problems.

Some prototypes of vertical farming are already built, but the difficulties reside in the cost of the techniques for producing. It is about two hundred millions of dollars for a production building (Banerjee, 2014). An important investment is needed, and specifics requires (water and energy), with a particular way to think about making the project successful. Only a few vertical farms exist around the world. Such a plan needs to be explained, and every aspect of it need to be performed. But vertical farming could be different as in containers, for example, some companies develop small projects because it is cheaper, and takes less space. It is an example among many others, but this one is well known in Paris, developed by the company Agricoool. Based in Paris, the company use the proximity of the consumers as well as the original project by showing the production technique.

Such companies show the origin of their products, then, it is essential to be aware of different food origins: conventional, organic, from the hydroponic system and the locality of the production. Indeed, food coming from a local business has a strong impact on customers choices. Food is the primary sources of human life, which make the provenance much more important.

Talking about local food, Paris would like to turn into green in 2050 and use the latest technologies. Vertical farming might be a possibility for Paris to begin the green architecture of it, as well as improving the footprint of the food. France is known for its good artisanal products as well as its food. By producing no polluted food in the center of the city in the most sustainable way, Paris will share a great image and motivate other cities. The French capital is the most likely city to ensure this kind of project in Europe because of its population. Furthermore, in the view of some architects, seeing Paris with few green towers would be the future. Then, the vertical farm project is part of the future of Paris with local and sustainable production. Many initiatives of urban farming already exist, and a vertical farm might be a complicated business which can pass through with a complete customers study.

How the customer behaves in front of a product, is an important way of study in order to know the thinking of the customer toward the vertical product. It gathers the perception in the first place, then comes to the exposure through the environment, the attitude and the most important the interpretation (Solomon, 2018). But other external factors are applied to the customer choices as the lifestyle, the cultures, and the family. There are influences in every step of the perceptual process said by Solomon. Furthermore, it is mainly about our five

senses, beginning with the vision. A product without any marks on it would be more attractive than the contrary. Considering a vertical farming indoor product and an organic outdoor product, the indoor one would theoretically attract more than the other one.

How customers percept the products should be studied, especially in Paris. This is unknown and making an analysis would help to applied vertical farming in a city like Paris. The country is the first one in the agriculture area in Europe, making the vertical farm evident to begin in France, in the capital. The benefits of it have to be found in comparison to the urban outdoor farming and conventional one. Indeed, no comparison has been done yet. This would describe better the gap between the different systems. Furthermore, it would help to promote the VF to the customers. By asking directly, the consumers through a questionnaire about indoor farming products and their preferences would allow making advice for potential vertical farming.

Then, the main research question is: **How vertical farming can be applied in a big city as Paris for improving customers life?**

Following by its sub-questions, helping to answer the main research question:

- What benefits can vertical farming offer to consumers in comparison with outdoor productions?
- What are the customers looking for regarding the type of food in Paris?
- How could Paris inhabitants be encouraged to consume indoor products instead of outdoor ones?

Those questions will be described further in the Material & Methods part, telling how the answers will be found.

2. Material & Methods

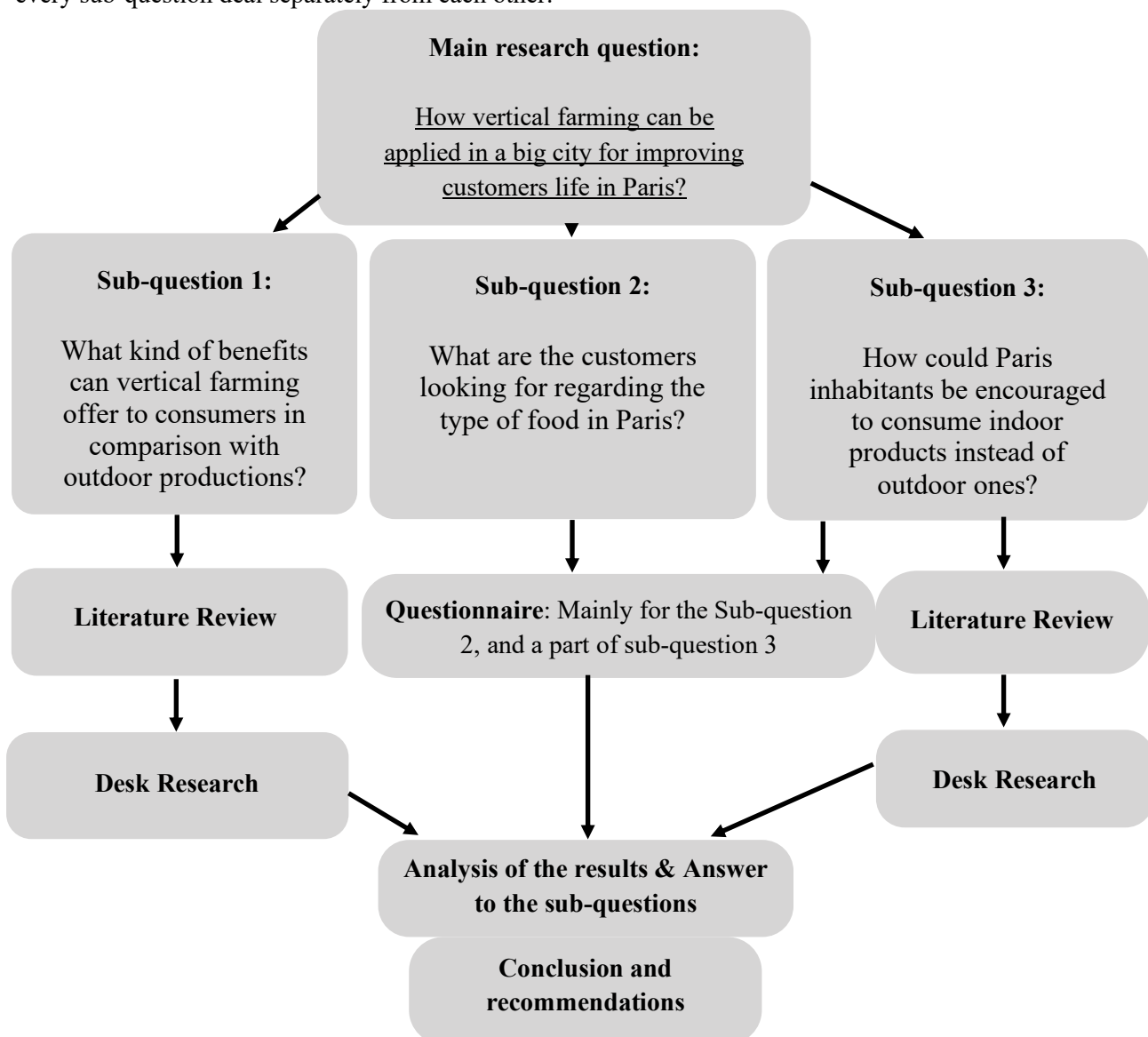
The research of the scientific articles has been done mainly on [ScienceDirect.com](https://www.sciencedirect.com) with special keywords. Beginning with “Vertical farm”, because it is the main topic of this thesis. Sharpen the research with other keywords as “urban farming”, “customers”, “benefits of vertical farming” and also “environmental impacts”. Those keywords allowed to get the main articles for this thesis.

However, a term very important need to be enlightened. It is vertical farming, which is one type of urban farming. The vertical farming uses the hydroponic system and sometimes in combination with aquaponic one. Because of the concept, it aims to produce more and faster than other kinds of farming using controlled climate indoor.

By using these keywords as well, the articles were found for answering to unknown elements. Then, after reading the articles, the research question came up as:

How vertical farming can be applied in a big city for improving customers life in Paris?

This main research question will be answered by answering the sub-questions. Then, in this chapter, the methods of research will be showed and described for each sub-question. Depending on the sub-question, different methods of research will be carried out. The question of why, what, when, where and how the sub-question will be answered, will be explained in detail for further research based on this written. Therefore, every sub-question deal separately from each other.



2.1. What kind of benefits can vertical farming offer to consumers in comparison with outdoor productions?

In order to answer this question, desk research will be done in a qualitative way. By comparing two models and three different methods of production, it would allow raising a list of benefits. The two models are respectively the indoor and outdoor production knowing that the indoor involve only the hydronic system as vertical farming and the outdoor production carry the organic and conventional production, in urban agriculture.

First of all, each term will be defined. The comparison of those will be allowed desk research mainly on sciencedirect.com by sharpening the keywords used. The aim is to create a list of benefits and disadvantages for vertical farming. By comparing the quality of the production for each, as well as the market possibilities and the environment welfare, will make a tour of the main subjects of study for this sub-question.

This list will help to ensure the next questions and make more precisely the survey for the interviewees.

2.2. What are the customers looking for regarding the type of food in Paris?

For knowing the customers' preferences about food purchase, a survey will be done in both quantitative and qualitative way (Cf. Appendix 1). The perception of the interviewee is needed as well as liker scale for some question. This survey will entail several questions related to the choice people do in shops between two same products with different origins. It would help to understand better the customers' behavior and will help for answering the main research question.

The survey will be done during the Christmas period in shops having mainly organic products in Paris. The organic store has been chosen because it is the healthiest outdoor products. None shops sold indoor production in Paris, then the organic shops are the closest way to reach the potential customers. These people want to buy healthy food in this kind of shops and are ready to spend more money. Then, the similarity as vertical farming will make more natural for them to answer the survey. In the street or usual shops, it would be too difficult to find people ready to buy quality, therefore they had not been chosen as the target. However, the target should be defined more precisely and also for the survey place.

The shops chosen will be in the center of Paris, in one of the wealthiest districts and the other one is a correct district. The location chosen would be the primary target for the survey. Near the first and second districts of Paris, would be the central area of the survey in different food shops. Those two districts are very popular which mean that people are more inclined to spend money conferring the price of the housing. Asking at different hours in a day will help to target different types of people related to the primary target.

Furthermore, the questionnaire will be complete in between the 20 and 29 of December. It has importance because people will answer easier during this period. Plus, it will be the holiday period, which means that the inhabitants are more likely at their home for cooking. Then, in the shops, the primary target will be present.

The affluent family coming usually in the organic stores would be the target, and people who want to try new things would also be. This will be the inhabitants who have a healthy lifestyle always regarding the quality of the food in the first place. Then, an organic shop for the first location would be the best place to find the people according to the target. The first questions of the questionnaire would be asking the size of their household as well as what they do in life in general term. This would help to know exactly which customer will be interesting to consumer vertical farm products.

Then, an organic shop called “Bio c’bon” meaning “Organic is good”, would be the first location, because it is organic and the place is in the richest districts in Paris, the 16th district. Furthermore, the grade of this shop is higher than the others on Tripadvisor. An application allows giving feedbacks for the customers with a grade from 1 to 5. Furthermore, they can give comments on it. Then, by looking at the comments, people are saying the price is high because the quality is there.

The other shop has a dietetic specialization. Situated in the 5th districts, near the 6th and 4th, it has a very good grade on Google. The products would be of high quality, and then the main target will be there. This shop called “La nature à Paris” meaning “Nature in Paris” has a very nice image from the comments.

The population for both districts is surrounding 40 thousand people. With a web calculator (SurveyMonkey), calculating the size of the sample for the survey, with an 80% level of confidence and 10% error margin, it gives a number like 41 people to interview. Indeed, the error margin can be explained by the different kind of people surveyed. Furthermore, the level of confidence can be related in the context of consumers behavior with the price of the food. People who have money issues, will probably not telling the truth. Asking random people in food shops, anonymously will make the answers more usable.

Then, the analysis would be the frequencies of answers of yes or no for the qualitative research. However, for the more open questions, it would be by interpreting and gathering the information the interviewees gave. After analyzing this, a concrete conclusion of it will be done, making the synopsis of what the customers know and would like. Then the sub-question will be answered at the end of this part.

2.3. How could Paris inhabitants be encouraged to consume indoor products instead of outdoor ones?

This question will be answered by using the previous data collected in the first sub-question and making others desk research in a qualitative way. Furthermore, few questions on the questionnaire will serve to this sub-question. Indeed, the open-ended questions are aimed to answer mainly to this sub-question, because the interviewees will give their opinions about the vertical farm and why they are buying organic products. They would also answer what are the differences between the two type of farming for them. Following their answers, it will make some conclusions as explained more the concept of vertical farming. This is only if people say that they are not aware of this kind of production.

The customers are looking for good products, but also the contact with the producer. They want to know who has produced the food they eat. Two questions on the questionnaire are about this, then it would be using desk research and qualitative questionnaire.

Vertical farming has many interests for consumers about the quality of the food. The research of it would be more in-depth and in relation to the previous sub-questions on customer behavior. Then the accumulation of data from scientific articles and the previous sub-question will make a part of the answer to this sub-question.

However, the citizens who are not customers can also have benefits of it. By holding a great building design, it would play a part in making Paris a greener city as its wish. Many architects are making plans for the future of Paris, and it would be by searching on those studies.

By those researches, and analysis of the survey, the sub-question will be answered.

3. Results

The results will answer to the 3 sub-questions raised at the end of the introduction. Before, a presentation of the site of study will be done for better understanding of the area chosen. Furthermore, this would allow helping to answer to the sub-questions.

The methods of answering have been explained in the previous chapter called “Materials & Methods”. The data collections are mainly qualitative with 3 scientific articles for the sub-question which deals with the comparison of the different agriculture systems. The second one is an analysis of the questionnaire done in two shops on the site explained below. This is qualitative and quantitative analyses of the consumer. The third sub-question will be answered by desk research as well as questionnaire analysis. The consumer opinion has a part for this question, especially in a large city as Paris.

3.1. Presentation of the city of Paris

Paris, the French capital, located in the middle of France, in the “Ile de France” region, count nowadays 2.2 million inhabitants. The City gathers 20 districts and its surrounded by other cities having Paris influence. This is the first urban area in the European Union. Its location, in the middle of the territory with the Seine River passing through the city, makes the city special. By its highway, transports as airplanes or trains, it makes Paris an international and national convergence point.

This is the richest city in Europe by its PIB per inhabitants. It is the perfect city to sell high-quality products. Indeed, it is the ideal city in Europe for selling vertical farm products even if urban agriculture is very existent, Paris still has the highest population.

The urban agriculture in Paris is truly present. Many initiatives exist like rooftop gardens, educational farms, apiaries, grapevines, and many others. Vertical farming began few years ago, and inhabitants become more aware of this concept. However, it is only a small part of Paris’s population.

The City encourages every kind of urban agriculture project in order to educate people. Paris municipality often launches agriculture projects in the capitol in order to promote the increased of small companies dealing with the products concerned. For example, the 18 of October was the launch of a project about hops for promoting the breweries in the city (Paris, City Hall, 2018).

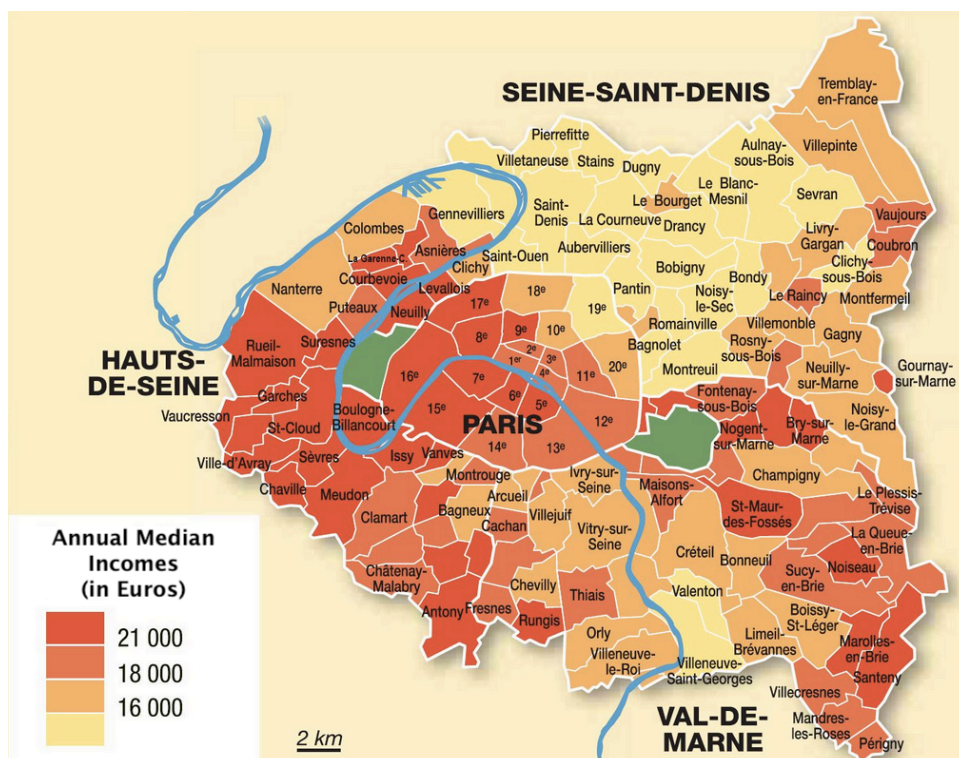


Fig 2. Annual Median Incomes in Paris according to the districts.

The picture above shows the annual median incomes according to the districts of Paris. As expected, the districts around the Seine River are wealthier. The 7, 6, 8 and 16 are ranked as the township the highest for the annual median incomes. In order to have two different opinions from two social conditions, the questionnaire will be done in the 1st and 6th districts into two shops well ranked on Tripadvisor. This is an application allowed to give feedback to the companies by giving stars from 1 to 5 (5 the highest grade) as well as making comments.

Therefore, Paris is surrounded by large fertile lands. But by its expansion, Paris has taken the best fertile soil for building houses. Many buildings are abandoned, and the city has raised a project for reconditioning those kinds of building into green space. Indeed, Paris has a mission to make itself a green city in 2022. Then, the importance of making researches about the consumer point of view and the vertical farm in an urban agriculture movement would help the further entrepreneur.

3.2. Comparison of different types of agriculture

Indoor and outdoor production is the main topic of research. Indoor one carries out vertical farming with the hydroponic system. Besides, the other one involves the conventional, organic and urban production. The comparison will begin with the description of the two models, conventional and organic production. Then, the comparison will be with the vertical farm concept. A list of advantages and disadvantages will be raised for vertical farming and will be compared to urban outdoor agriculture. It would make a clear and precise description table.

First of all, the two-first models need to be defined in a proper way.

As the United States of Agriculture says on the paper, “Conventional farming is the use of seeds that have been genetically altered using a variety of traditional breeding methods, excluding biotechnology, and are not certified as organic. Conventional crops may be grown simply as commodities and enter the commodity stream where they are mixed with other crops, including GE, or they may be grown to meet a requirement set forth by an end market, such as a specific chemical or nutritional requirement. “(United States Department of Agriculture, 2015).

As the definition of an Encyclopaedia Britannica, organic agriculture is: “Organic farming, an agricultural system that uses ecologically based pest controls and biological fertilizers derived largely from animal and plant wastes and nitrogen-fixing cover crops. Modern organic farming was developed as a response to the environmental harm caused by the use of chemical pesticides and synthetic fertilizers in conventional agriculture, and it has numerous ecological benefits.” (Encyclopaedia Britannica, n.d)

Firstly, the comparison between conventional and organic products will be explained, using the paper of Morgan (Morgan, 2010). It is written in the paper that the conventional model has been established in the UK by the 1940s. The main objectives of it were an economic and strategic rationale; then political commitment and administrative authority to give farmers sustained assistance; and technological innovation in order to increase productivity. Farmers had to produce more and more, the efficiency of their work was imperative. The improvement of new agricultural technologies came up as well as subsidies for allowing farmers to invest in new technologies. After the 1950s, it was the beginning of agro-chemicals products researches and used by farmers. These, completely change the agricultural practices, using more the chemicals products than crop rotations as before despite a good weed control. The paper mentioned the rotation in the 1960s became “Old fashion”.

Before the apparition of the chemical's products, farmers knew their lands by their composition, fertility, rhythm and were very intimate with the local ecosystem. By plowing and doing long rotations, they were able to control the weed and the pest. However, farmers began to use chemicals products and the knowledge they gained during generations, were lost progressively. Then, farmers were more and more incorporated into the industrial food chain. Local activities of crafting were replaced. Furthermore, only a few companies control the most part of the chemicals products market, as in Britain where it is 4 companies.

Conventional agriculture model has moved into crisis on three main topics. The increasing cost of agricultural support (hire more and more employees), the quality of the food and the effects of the environment, were the worries. There were many new agriculture policies concerning those points. Some farmers turned into it by converging to organic production for better quality.

Organic production is a model aiming to co-exist with natural systems by building soil fertility and minimizing the pollution and damage the environment can face; as well as making a good social and ecological impact of agricultural systems. Certification of organic produce was created gathering the ideas organic production has. The organic market becomes grower those last few years, stimulated by the health scares and industrial food chain. Began to grow rapidly at the end of the twenty century, organic farmers become more and more numerous. But it is sometimes complicated to set up because the land has to be cleaned of diseases, pests, and weeds. This system does not allow to use any chemicals which mean the mechanic way is the only way to fight those problems. It is a way of production close to nature using products from nature for fighting diseases and pests.

The two models have some similarity, they came from the same agriculture but took two different ways in the 19th century. Nowadays, the conventional system tries to turn back and reduce the chemicals used. It is a complicated process and the organic system is harder to set up because of the required conditions.

Second of all, the urban agriculture system needs to be explained because agriculture comes into cities, making the relation between the countryside and city, between conventional, organic and vertical agriculture systems.

As the definition on Cambridge dictionary, urban farming is: “any growing of plants or raising of animals within the city limits”. (Cambridge University Press, n.d)

Urban farming is well-known in many cities around the world. This part will use the paper of Pölling (Pölling, 2018). The concept can improve the economic, social, environmental sustainability and resilience in cities. Many studies show that urban farming is strongly accepted to the citizens in cities. Those studies were taken place in the capital of European countries as Berlin, Copenhagen, Paris, and others but also in North America as Toronto. Produce, and sell in the same place is the aim. Indeed, most of the farmers involved in such project had to make choices in the ‘80s. Spending money to develop their farms with high technologies or finding ways to improve their business. Then, it was the beginning of urban farming. Nowadays, the concept is very known and has many benefits for the inhabitants and consumers.

Third of all, the last definition is about vertical farming, a part of the urban agriculture system.

As the definition on Cambridge dictionary, Vertical farming is: “Vertical farming promises to increase food supplies without using more land. Vertical farming is an industry with the enormous potential to change the way we eat.” (Cambridge University Press, n.d)

Table 1. Comparison of the different kinds of farming.

Different kinds of farming	Advantages	Disadvantages	Summeraze
Conventional	<ul style="list-style-type: none"> -Large scale production for feeding the world -Using technologies, create a huge economy -For Industries 	<ul style="list-style-type: none"> -Chemical products used -Land use -Far from customer -Many Stakeholders 	Need a part in conventional for producing enough food in order to feed the world. It uses many technologies making a whole economy behind.
Organic	<ul style="list-style-type: none"> -Organic label -Health product close to nature -Higher biodiversity -Sometimes complicated to set up 	<ul style="list-style-type: none"> -Land use -Far from customer 	Farmer closer to nature, using the biodiversity to fight diseases and pest.
Urban	<ul style="list-style-type: none"> -Closer to the consumer -Initiatives with volunteers -Bring the green into city 	<ul style="list-style-type: none"> -Pollute 	Many initiatives exist for producing food in urban area. Volunteers and Childs can get knowledge. However it is still in a polluted area.
Vertical	<ul style="list-style-type: none"> -Closer to the consumer -Climate controlled -No chemicals -No pollution -Gain of space -Only use a small plot of land -Higher yield -Not depending to the season -Fast growing 	<ul style="list-style-type: none"> -No organic label -Seems like ‘Artificial production’ 	The only problem can be that there is not any specific label for it because it grows plant using only nutrient and water and none soil.

The table above shows the advantages and disadvantages of the different farming concepts explained before. Each of them has a principle and a logical story. The table would allow to compare the best technique for the producer but also for the consumer.

The urban farming can be organic or using chemicals depending on the farmer philosophy. However, most of the initiatives are organic, it is more valuable to produce organic food in cities. It means that the cell 'urban' has also the benefits of the organic one. Urban farming has many beneficial points regarding the table and only one disadvantage. This is the pollution within the city which cannot be avoided unless it is indoor production.

The conventional and organic system is needed for feeding the world and fulfill to the health desire. However, the recent global warming causes many agriculture troubles. Diseases, pests, extreme temperature and weather put the crops unstable. Yields are changing every year depending on the climate, as well as the market availability and prices. Outside production is needed but it has to imply more local activities and close to the consumers. Furthermore, as seen before, 70% of the world population will live in cities by 2030. Producing into the city seems the best solution. Saving land used by cultivating on the rooftops is a nice solution. It is the same for producing in buildings were the production per square meter would be higher in order to feed the population.

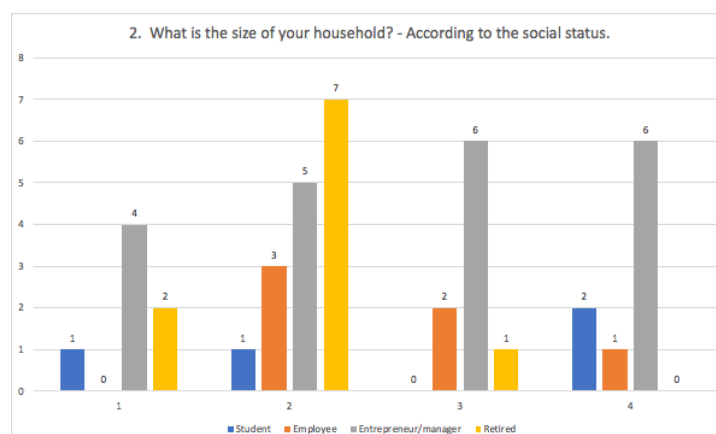
Therefore, vertical farming seems a great concept with many advantages. However, the customer point of view regarding this concept is needed in order to know if this technique will be accepted or not. The bad points of this concept come from a different way of thinking. The customers made choices for what they eat, then promoting the vertical farm concepts is needed in order for them to understand better where the concept comes from.

3.3. Survey analysis

By analyzing the survey made by 41 persons in two different places in Paris, the second sub-question will be answered. It took place in two different organic shops in Paris, and it has been done in two days interviewees.

The answers are analyzed per percentage and with different diagrams, in the first place in order to have a clear overview of what the people think, and why they think like this according to their social situation. A description and explanation of each diagram will be done.

First of all, the social status of the people interviewed is divided into 4 sections. Student, employee, entrepreneur (or executive position, manager) and retired, are the 4 poles. A question with the size of the household is also in the questionnaire in order to know if there is a link between the answers and the social background. It is also linked to the number of times, people bought organic product per week.

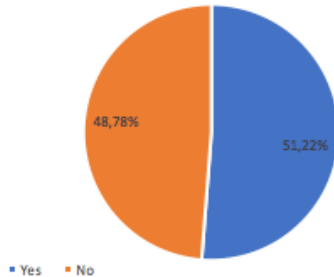


Graph 1. Number of people according to their social statue and their household size.

The survey has been done on the 27 and 28 of December in Paris as wanted. It happened on two days because it has been very difficult to interview the people there. Otherwise, the 41 interviews are done, with more than a half from people working has entrepreneur or managers. Then, retired and employees with 22 and 17% followed by the students with 9%. As planned, it is the target wanted due to the localization of the shops and the districts. Most of the person questioned have a household between 2 and 3 people. It seems that big families

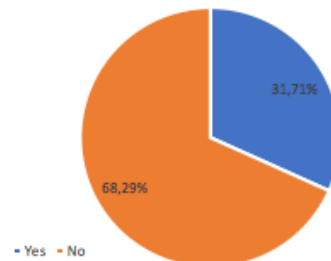
have more difficulties to buy an expensive and qualitative product than others even if special helpers are available in France for big families. It shows equally that even students take care of what they eat. It is a way of thinking, coming from the experiences, the background, and social status.

3. Do you know the concept of vertical farming?



Graph 2. Percentage of people who know or not the concept of vertical farming.

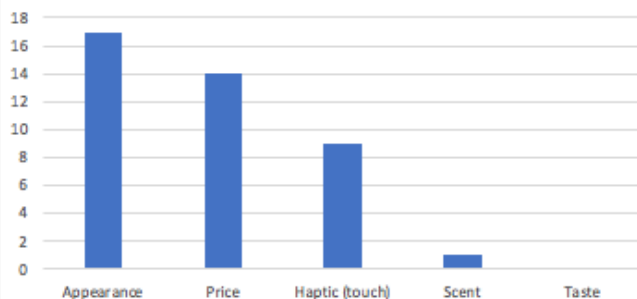
5. Do you know the difference between organic and vertical farming?



Graph 3. Percentage of people who know the difference between organic and vertical farming.

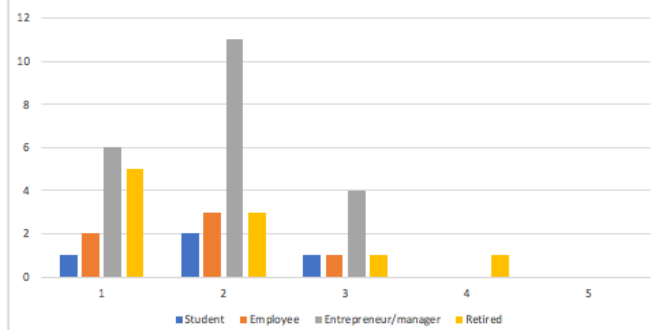
The question about the concept of vertical farming is known or not, has half positive and half negative answers. Then, the importance of promoting vertical farming is really important. This question is related to the question concerning the difference between organic and vertical products. Indeed, people who will know the concept has more chance to know the difference between the two products. Therefore, the two questions appeared to link anyhow, however, the result of this question is that even people know the concept they do not know the differences. It is a problem for selling the product because it counts on the beneficial points. But if they are not known, people will not buy those kinds of products.

6. What is the first thing you look for buying a vegetable?



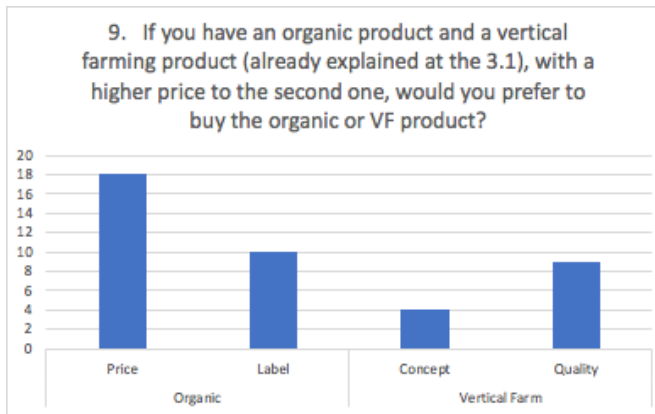
Graph 4. Number of people regarding to the characteristic of a product before buying it.

8. Do you take care of product origin? (Strongly agree=1 / Strongly disagree=5)

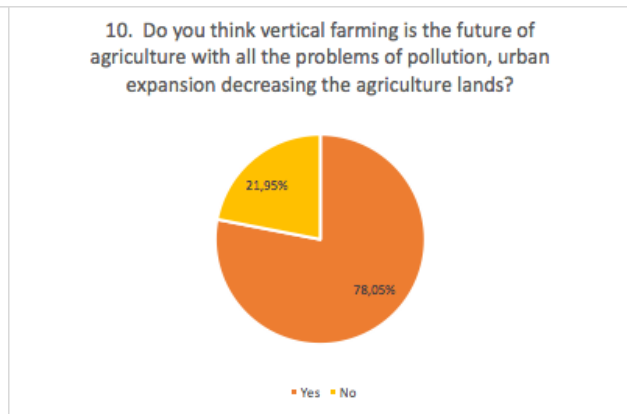


Graph 5. Number of people who take care of the food origin.

Specific questions about what people are looking for when they buy a product has also been asked in the questionnaire. The appearance and the price are the highest answers on the left diagram above (Cf. Graph 4). Following by the touch, but many people said that it is really different according to the product. They will not behave the same way for two different vegetables. The appearance is important, 17 people over 41 vote this, it is 41%. But the price has 14 votes (34%) as well as the touch with 9 (22%). The three of these are close from each other. The origin of the product is needed in order to make choice of buying after the first look. Mostly, people take care about where the food comes from, as it is in bar diagram (Cf. Graph 5). People agree that they take care of the food origin. Most customers agree but the diagram is following the different social status.



Graph 6. Number of people who choose organic or vertical farm product regarding to 4 characteristics.



Graph 7. Percentage of people who think that vertical farming is the future of agriculture.

The diagrams above deal with the concept of the vertical farm. 18 people vote that they will choose an organic product if the price is lower than vertical farm product. The organic label and the vertical farm concept have approximately the same average (9 and 10 people). It means that the quality is important but the label of organic food show that it is traditional and not kind of “Artificial”. The question after, people said yes at 78% if vertical farming could be the future of agriculture. Paris is a big city and people mostly think that the urban production of food is a relevant solution. Saying all the arguments in the question, people agree with vertical farming, the future of agriculture.

However, these are close-ended questions with the simplest answers. This is not completely reflecting people’s mind. Then, for better understanding and answering the main research question, the open-ended questions are needed.

3.4. Encourage people to consume vertical farm product

The survey is linked to this part by interpreting the open-ended questions. Most people did not answer to the open-ended question because they did not what to say and it takes time to answer to those type of questions. 14 people give a response to this part, which means that it might not reflect the general opinion of the people. However, the answers are quite the same thinking, then, they can be used for this part.

First of all, as saw on the previous sub-question result with the questionnaire, most of the people do not know the difference between organic and vertical farm product. Indeed, it is 68% of the interviewees who could not answer the next question, an open-ended one. However, the general answer to it is that people think it is an indoor production. Some of them have mentioned, it is a system off-ground in a vertical way. The crops are above each other. Therefore, people are not aware of the agriculture challenges as well as the most part of the system.

Second of all, the origin of the product seems to be very important for everyone. The average of the answer says that people are between strongly agree and agree with 1.8 and 1 is strongly agree, 5 strongly disagree. People take care of the food origin, firstly by the country. Indeed, they are more inclined to buy French products than others if they have the choice. But if the options are tinier, then they will prefer the closest products to the country they live. However, it is rarely written where exactly the product come from in the country. Having a selling point especially with products from the local surroundings would consolidate the choice people make.

Third of all, the last open-ended question is about the future of agriculture. The target group mostly said that they prefer to buy food coming from nature, from the soil and not from “artificial production”. However, they also mention that it has many benefits like the reduction of the production space. But the price is still an issue, and the interviewees would prefer a lower price for vertical farm product than an organic one. Some of them claim that urban agriculture would be the future of agriculture and not only vertical farming. Then, they mostly agree of the benefits of this concept ‘Vertical farming,’ besides, they do not completely agree because of the price and the artificial way of production. Furthermore, only a few had the knowledge of vertical farm and these people affirm that it costs too much energy to produce. It is a debate between price and concept. But the price has a big part of the people’s thinking, then it becomes a strategic point.

Many examples of bringing the production closer to the consumers exist in Almere, in the Netherlands. Indeed, by visiting the location of the initiatives and discussing with the professional responsibility of the company as Onze or Care farm. They have a vision of sharing and giving agricultural knowledge. Making gardens, greenhouses, and aquaponics in the city, and making events, these people know that it is the future. This movement started in 2010 and has been growing in many cities around the world.

The vertical farming advantages will be described by using the paper of Benke dealing with vertical farming concept indoor (Benke, 2017). Every crop can be growth thank to the vertical farming. The economic viability is the most important for the entrepreneur and if the food will be sold.

Several areas are covered in term of vertical farming benefits. The social one is that vertical farming will provide new jobs. For the maintenances, retail staff, biochemistry, and many others sector, this would create demand. It would be an industry, with lots of labor, and lots of technologies.

Then, the environmental area where the food is grown in a controlled climate without any pollution. The climate is built for giving the best of the plant needs. Therefore, the water nutrient is controlled as well in every small detail for making the plant as comfortable as possible and produce the best yield. This is recycled water and nutrient in a closed circle.

The genetics has done many signs of progress, but outdoor the diseases, the pollution, and the chemicals reduce the capacity of the plant because it has to spend energy to fight against those. In indoor production, hydroponic system or vertical farming make sure that no energies are used for such things. Then, the plant can focus on giving every nutrient, and all the quality to the fruits or vegetables.

Furthermore, there will be no emissions of carbon dioxide because of the absence of transportations. It would be sold locally in short range which diminishes the pollution as well as the carbon food print of the food. The food coming from indoor production is tastier, richer and better in every aspect than an outdoor product. However, the energy spent on making these products is a part of the price. Using photovoltaic panels and wind-turbine would help to decrease this price. The price is the most problem for the customer, but most of the interviewees did not have the opportunity to taste indoor production.

By making a great design of the building, the people will be attracted. Then, the other benefits of vertical farming can be the design of the building. It can provide a better quality of the environment in terms of social, aesthetic, environmental and economic benefits (Taufani, 2017). Add green facade to the building or even the container could improve the landscape and the quality of life in the surroundings. The shops, the apartment will be in a better position for selling at a higher price.

Vertical farming could be an impressing evolution, a better quality of food but many issues are still remaining such as the energy used, the prices, the cost and especially what the people think. By promoting the concept of vertical farming, the people will start to see further, in the future.

4. Discussions

After having explained the results, this part will describe the further learnings improvement as well as the reflection of the results. Indeed, by comparing the findings and making the analysis of the results in order to be able answering the sub-questions and the main research question.

4.1. Reflection on the applied methodology, learnings improvements

Another questionnaire for the customers of actual vertical farming in Paris will help to answer in a more efficient way to the sub-questions. Indeed, why these people buy some of their food from vertical farm production instead of organic. The reasons people would give are a precious helper in order to promote better the concept. Furthermore, the companies already launched have begun the promoting of their product, of the special way of production. However, in order to do that, it needs more time and also it needs to be in France more often for arranging an interview. Two of them would be great, the time was the issue as well as making an appointment.

Doing the survey in a special Facebook group like “Organic lifestyle” or others would also be a good idea. It could have helped and saved time than going to shops in Paris. By making interviews in different places and with different methods, it would be more efficient and would touch a bigger range of people. People who buy organic products could be very closeminded. It is a completely random interviews which can provide not the general thinking of people.

The third sub-question is too large and being more precise would help to have a clearer answer. But it works this way, it needs more work even if the time goes.

Another question would be the difference people taste in 3 different products as organic, conventional and vertical. Strawberries seem to be the easiest way to do this kind of tasting. Then, doing a liker of scale in order to give a grade and helping for answering the sub-question would be perfect. This way, a clear a precise difference will be sharpened. However, it asks funding and lots of time.

Therefore, the time was the most issue of this paper. But without making those things, the sub-questions and the main research question will be answered.

4.2. Reflection on the results

The results presented before will be explained with details in this part. Each part answers to one sub-question.

4.2.1. Benefits of vertical farming

Vertical farming is a part of urban agriculture, a way of production closer to the consumer. However, the concept has many differences, controlling the climate without any chemicals added. The plant grows without any contact with the pollution.

Using a small land for the building, vertical farming is a gain of space. In comparison with the other system, it is the better one for a human. In terms of the environment, organic spread biological product on their crops which is sometimes bad for the soil. Furthermore, the world requires always more and more of land for building cities, then it decreases the fertile land. Therefore, the concept has a higher yield than other products because of its 100% controlled climate. There is no disease and no pollution, which means that genetics is the only limit. Controlling the temperature and the light, there is no dependence to the season and the growth is faster.

Even if vertical farming seems a great concept with many advantages, it has some limits. There are, firstly the cost for the owner and secondly the people’s thinking. It is a concept producing food off-ground which means that there is no contact with any soil. The label of organic production cannot be used for this, because it cannot

be considered as. Furthermore, in many studies about vertical farming, there is a paragraph within the social problems of it. Indeed, people think as an 'artificial production'.

The customer point of view regarding this concept is important and needed in order to know if this technique could be accepted.

4.2.2. Inhabitants in Paris search in terms of food

The questionnaire has served to know what the inhabitants in Paris already in healthy products are looking for. It shows that most of them search healthy product at a low price, but with quality and when they know the food comes from. Half of the personal interviews were an entrepreneur or executive position. The level of their life is very correct, and they can afford to buy a quality product. However, some students and employees buy also quality products. It is a way of thinking to buy organic, in order to be more in health. Most of the people are between 2 and 3 people on their household. It has an impact because they can afford to pay more money to food.

As seen on the result part, the concept of vertical farming needs to be explained to people. The way of production needs also to be described in order to understand better the challenges the concept faced. The promotion of it will have an importance in the coming years. And yet, already few companies promote this concept in Paris sensitizer every day more and more inhabitants.

Most of the people prefer to look after the appearance and the price, even the haptic before buying a product. Regarding those 3 senses, the quality of the product is really important. The vertical farm proposes qualitative products and those are without damaging at all of diseases or transportation. Furthermore, as the product sells directly in proximity, the maturity is perfect. Then, the vertical farm production has the best chance of keeping the best of the 3 different actions of choosing before actually buying the products.

Otherwise, people would preferably choose organic production because of the price in the first place but also because there is a label. They explained that they wanted a product coming from the soil. However, a part of the person would say vertical farm product because of the quality and the concept. The explanation of the concept is the most difficult part because people have to see how it is produced. Then, they will be able to compare the products.

Therefore, people are looking for quality of the product at a cheap price. Indeed, most people think that organic and vertical farm is the same, the only difference is that is not grown on soil. But the price has importance if the vertical farming wants to larger it customers. With the same or lower price than organic, people will think differently.

4.2.3. Encouraged inhabitants to consume vertical farm products

By promoting vertical farming, people will be encouraged to consume those kinds of product. Giving a good image of the concept with all the challenges it faced, and all the benefits people will get from it. Social, environmental and economical, those are the benefits of vertical farming. Hiring people for working on the vertical farm, produce food without any pollution, using sustainable energy and selling in the local community, allow inhabitants and owners surrounding the farm to benefit from it.

This would change people thinking. Most of the person questioned think vertical farming as an artificial production. It is also why the concept does not have yet any labels. It is off-ground cultivation, in water nutrient which seems artificial. However, it is a concept addressing many problems all around the world. The production is done in cities close to the consumers and there is no damaging or waste. The benefits are much more numerous than other systems presented in the result of the first sub-question.

Furthermore, the image is more than putting an image on the concept, it is in the street by the design of the building. It has many benefits for the surrounding area.

The results were discussed, and the answers of the sub-questions and the main research question will be given in the following part in order to conclude this research.

5. Conclusions

The purpose of this paper was to answer the main research question: **How vertical farming can be applied in a big city for improving customers life in Paris?**

The thesis deals with vertical farming and the customer's point of view regarding this concept. The aim is to know if the concept is accepted and to promote it. A methodology has been done, answering the 3 sub-questions by desk researches, and a questionnaire. It took place at the end of December in Paris, France, asking the customers of different organic shops questions about vertical farming. Desk researches about the different types of agriculture have been done as well as the beneficial points the vertical farm can bring to the inhabitants in the surroundings. Most of the person questioned does not know the concept of it, which mean that the promotion of the system is an important matter.

The conclusion of the three sub-questions is that the concept has many beneficial points and only two disadvantages. Those two are mostly because of the thought pattern regarding the questionnaire and other studies. But most people are not aware of vertical farming production and cannot really say the difference between another product. The promotion of the concept is an important matter in order to be ready for the future. People have to be educated to the concept in order to give a chance to this futurist system. It is a promoting system, having more qualities than the other systems but the most difficult part reside in the image which has to be changed.

Therefore, vertical farming brings many benefits for the customers, even for the inhabitants were not customers. By the quality of the products, the whole visions behind the concept, the challenges the world faced, the social, environmental and economic issue but also with the design of the building, the vertical farm show great potential and a great image. However, people have answered that vertical farming could be the future of agriculture without really say that they will be part of the concept. Going to the customers and having their feedback, is to be the best option for improving the marketing plan and reaching people in order to share the concept philosophy.

To conclude, the concept of 'vertical farming' has many advantages and few disadvantages which can be changed. The customers have the power to change but they need a little push. Vertical farming could bring a very nice picture to the agricultural world answering to nowadays issues. The concept has to be competitive to the other systems in order to have its place

6. Recommendations

6.1 For other researchers

This subject 'vertical farming' needs to be performed by doing a further questionnaire to the customers as well as the companies already settle. More precise questionnaire would describe more in depth what the people could think about the concept with different products from different systems of production. It will help to know better people's mind and draw an overview of what has to be changed.

6.2 To the municipality

Vertical farming is a futurist concept having already a place to the views of people in 2050. The city of Paris would like to turn into green in the next coming decades, but reasonable choice needs to be done in order to make the better choice. The city has many green rooftops, having vegetables on it. Moreover, many sites have natural products as the beehives in some hostels. The vertical farming can bring another image to the city and bring a better quality of life for its inhabitants. By using its characteristics and benefits, the vertical farm could make the city more inclined to futurist concepts.

6.3 To companies

Customers have the power by choosing their own food, their own products, and their own shops. Creating a need from vertical farming, by describing in detail how it works, and why this concept came up, will certainly help to reach the customers.

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Appendix 1, Questionnaire in Paris

Explanation about what is the aim of the questionnaire will be given in the first place. Then, the thematic of the research will be also explained to the interviewees in order for them to have the context of the study.

1. What is your status?

Student Employee Entrepreneur/Executive position Retired Other:....

2. What is the size of your household?

1 2 3 4 and more

3. Do you know the concept of vertical farming?

Yes No

4. How often do you buy organic products per week?

1 2 3 4 5 and more

5. Do you know the difference between organic and vertical farming?

Yes No

5.1. If yes, can you give me one example? And if no, explanation will be given.

.....

The vertical farming concept will be explained after the question above in order for people to know what it is about. Using existing examples and making the differentiation between the other kind of farming, would help for the person questioned to have some basic knowledge at this point in order to answer better to the further questions.

6. What is the first thing you look for buying a vegetable?

Appearance Scent Haptic (Touch) Taste Price

7. Do you take care of the price when buying a vegetable production or quality? (Strongly agree=1 / Strongly disagree=5)

1 2 3 4 5

8. Do you take care of product origin? (Strongly agree=1 / Strongly disagree=5)

1 2 3 4 5

8.1. If (strongly) agree, can you give me one example? And if no, why?

.....

9. If you have an organic product and a vertical farming product (already explained at the 3.1), with a higher price to the second one, would you prefer to buy the organic or VF product?

Organic

Vertical

9.1. Why did you choose this one?

Price

Same products

No label/organic

Others:.....

10. Do you think vertical farming is the future of agriculture with all the problems of pollution, urban expansion decreasing the agriculture lands?

Yes

No

10.1. If yes, can you give me one example? And if no, why?

.....

11. Do you think that having direct contact with the producer and the production site would be better?

Yes

No

11.1. If yes, can you give me one example? And if no, why?

.....