**INSTITUTO TECNOLÓGICO DE ESTUDIOS SUPERIORES DE MONTERREY
CAMPUS ESTADO DE MÉXICO**

**Leadership for Sustainable Development
Masters in Nanotechnology**

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Final Project Report

GardenGem

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Background

The Problem

Plentiful, healthy, economic and safe food for the entire planet is a topic to be held in our minds for the following years. Food safety and security are the main challenges to be discussed along with the confrontations against climatic change. Food policies require training citizens about new lifestyles. The training purpose is to incentivize awareness to address sustainable food safety and security. (Sandrini, 2014)

The lifestyle of human kind shall be amended, particularly in regards of our food supply chain, from the farming, distribution to the end consumer. Through food education, the system players (consumers and producers) are trained. A new lifestyle will also have an environmental impact related to transportation and distribution. (Sandrini, 2014)

It is important to conserve farming land, especially in areas already subject to strong urbanization. GardenGem's purpose is to be a tool for urban gardeners, researchers and citizens for food education and urban agriculture.

Economic Perspective

Urban gardening has been part of the human economic activities since the emergence of cites as the urban phenomena developed. (Calvet-Mir, L., & March, H., 2019) A study carried out by Calvet-Mir, L. & March, H. established the importance of urban gardening as a response to financial crisis and their strong correlation to community resilience against war and other adversities. Populations of growing poverty rates in cities are also impacted by the development of urban gardens. Self-production or self-sufficiency of food are directly related to food security during economic crisis and shortages. Helping build self-sufficient cities improves the health and quality of food and rises awareness around local produce food sovereignty.

GardenGem takes this perspective into account, trying to aim towards an economically sustainable activity that can provide better food prices and optimal operational costs to any user of the application.

Social Perspective

Urban gardening comes as a response to changing social and political circumstances. There have been numerous initiatives to promote their practice during conflicts and economic crisis to tackle food distribution problems during specific historical moments. These factors have an important effect shaping the form, function and culture of urban

gardens and their members. (Calvet-Mir, L., & March, H., 2019) Since the last century, we have witnessed a growing institutional recognition of urban gardening, through national and local legislation in many countries, including Mexico.

Urban gardening portrays emancipatory and alternative views about the urban development and social relations. There is evidence of urban gardens being used to protest against political corruption, empowering the people and appealing to citizen responsibility to overcome any crisis. (Certomà, C., 2015) Social entrepreneurship and social innovation are strongly related to urban gardening since it is subject of continuous improvement mainly due to the huge positive impact it has in people's lives. It has been demonstrated that urban gardens have the effect of strengthening community ties, enabling intercultural exchanges, facilitating community building as and enhancing social cohesion where the garden is located. (Calvet-Mir, L., & March, H., 2019)

The GardenGem team is making research on these aspects to develop the right campaign for the encouragement of urban agriculture. We are working to find the correct approach towards people and government for incentivization and support.

Environmental Perspective

Human beings have been altering their environment since the beginning of their existence; in fact, this specific trait is the most concluding evidence of human presence in any place or time. Urban planning is the practice of spatial arrangement of urban areas. (Certomà, C., 2015) These arrangements unequivocally have an impact on the environment, thus the planification of cities must always consider alternatives for the best land distribution to allow human development without strangling itself by damaging its resources. Urban agriculture enhances the diversity and distribution of food and non-food products through processes that reuse human and material resources. This has a positive impact in and around the urban area supplying products and services to the same area in return. (Broadway, M., 2009)

We want to prepare people with tools that empower them to take their environmental impact on their hands and start acting positively in the right direction. GardenGem is meant to improve the caring of the environment in a sustainable and practical way.

Objective

Garden Gem's goal is to help urban gardeners find compatible food plants with similar care and know the number of plants that can be placed within a given land area, in order to assist them in the correct development and maintenance of their urban gardens.

Methodology

The methodology to follow in order to get the best contribution to urban agriculture is first to develop some surveys that can help having a better and more realistic view of the current situation of the way agriculture is done in cities.

Once the data has been gathered, the next step is the development of a mobile application that considers all the issues and situations regarding growing plants. The application must be provided by this information so it can give more accurate information related with growing plants.

The next step is for the user to enter the information about the plants that wants to grow. The application must be able to provide the user with a detailed description of the necessary growing conditions in order to make plants grow better despite all conditions that may affect their growing, depending on the issues found for the given plant.

Finally, the application must be tested by real users in order to get the necessary feedback to verify the correct operation of the application. Thus, the development of the application could be validated and considered for furthermore applications.

Results

Development of the mobile application

The app can record data about growing plants in order to monitor the growing conditions and make the plants grow better by identify potential issues during the growing process. The application is also concentrating in the three pillars of sustainability focusing on its impact in the improvement of life standards for any user of our application according to the economic, environmental and social perspectives that were previously described in this project.

Figures 1 to 3 show the final application running on an android device. In Figure 1 the actions that have been already done to the plant are recorded and showed. Figure 2 shows the proper characteristics needed for feeding Amnesia X OG. Finally, figure 3 shows all the current plants that are intended to growth in the best possible way.
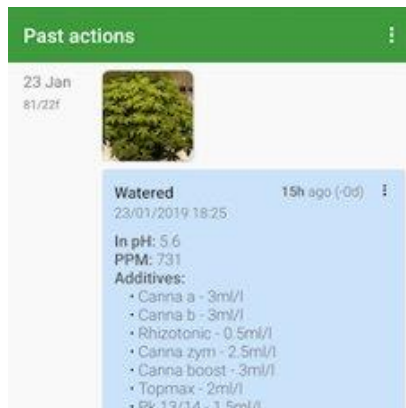

Figure 1 Record of the actions done to a given plant.

Figure 2 Feeding Amnesia X OG, characteristics.

Figure 3 All plants.

Discussion and Conclusions

Next Steps…

GardenGem will be a functional "plant data base" to allow the users to search over 30,000+ plants of the world over multiple criteria and get up-to-date information about their specific requirements for successful culture. GardenGem aims to become the most reliable resource for food education and urban agriculture development.

After having provided the information and know-how to the users, we will be adding hardware on sale for the physical improvement of their urban gardens. For this step, we will be contacting external providers to announce their products on our application

and make them compatible with our technology. One of the main projects we are to be involved in is OpenAg Initiative from the MIT. The Personal Food Computer (PFC) they have developed has all the hardware and software design necessary for the automation of crops. ("pfc_edu_3.0 [OpenAg]", 2019) Together with GardenGem, this computer may be more easily operated by any user. Talking with authorities to provide legal advice and permits in the development of this gardens in public areas is another important task to be done for a larger positive impact in local communities.

Resources

Barthel, S., Parker, J., & Ernstson, H. (2015). Food and Green Space in Cities: A Resilience Lens on Gardens and Urban Environmental Movements. Urban Studies, 52(7), 1321–1338. https://doi.org/10.1177/0042098012472744

Broadway, M. (2009). American Cities : The Example of Milwaukee by. New York.

Calvet-Mir, L., & March, H. (2019). Crisis and post-crisis urban gardening initiatives from a Southern European perspective: The case of Barcelona. European Urban and Regional Studies, 26(1), 97–112. https://doi.org/10.1177/0969776417736098

Certomà, C. (2015). Expanding the 'dark side of planning': Governmentality and biopolitics in urban garden planning. Planning Theory, 14(1), 23–43. https://doi.org/10.1177/1473095213506202

pfc_edu_3.0 [OpenAg]. (2019). Retrieved from https://wiki.openag.media.mit.edu/pfc_edu_3.0

Sandrini, S., & Cabini, E. (2014). Multi-subject training for a sustainable farming and food system. Education Sciences & Society, 5(1), 83–92. Retrieved from https://bit.ly/2SXzLcQ

Trefle, the plants API. (2019). Retrieved from https://trefle.io/reference
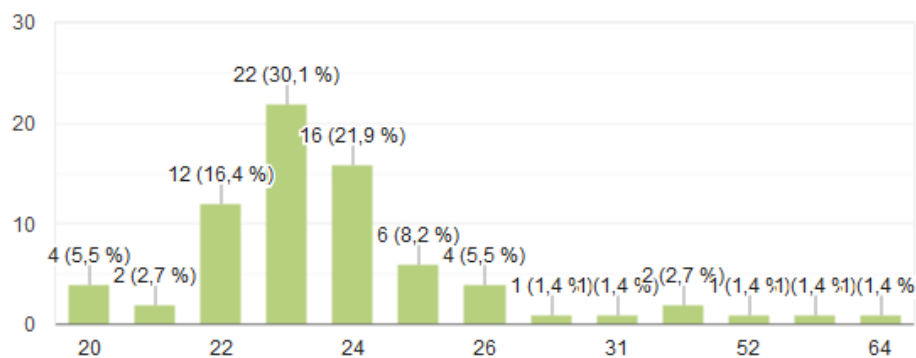
Annex

A survey was applied to validate the direction of our project and the interest of the general population on our proposed solution. Here we show the results:
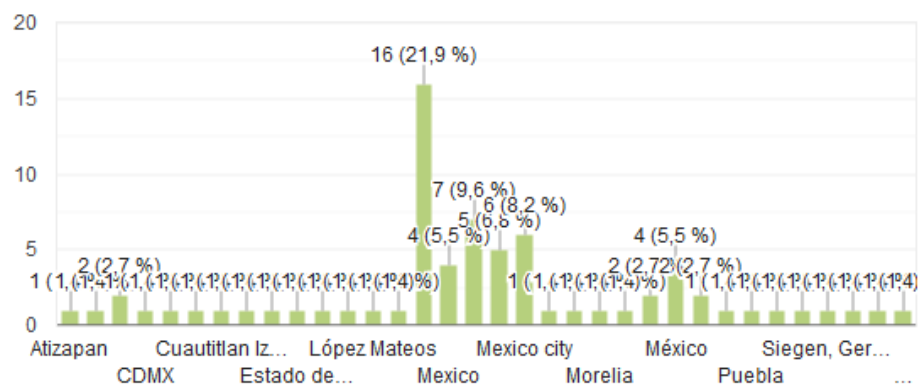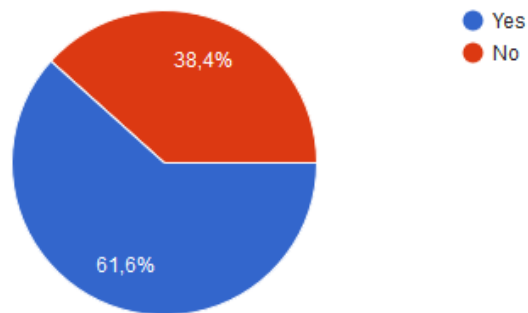
Meet GardenGem!
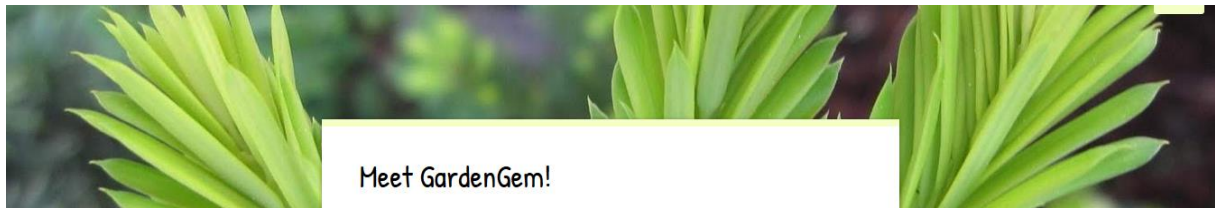
How old are you?

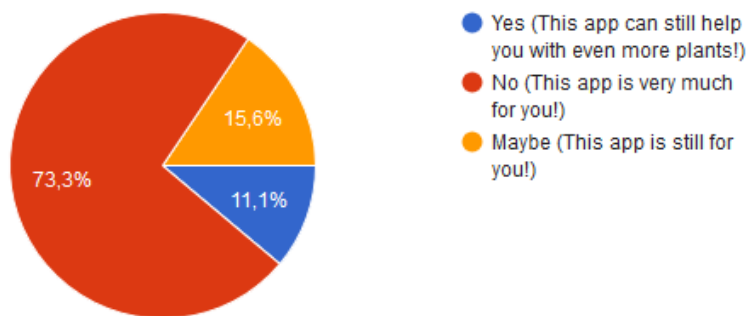73 respuestas

In which city do you live?

73 respuestas

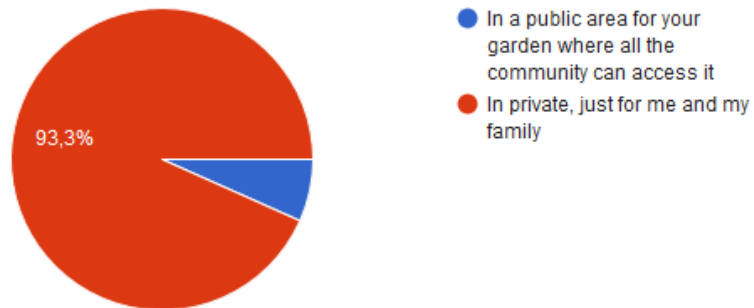# Have you ever considered practicing urban gardening to produce your own food?

73 respuestas

- Yes
- No

38,4%

61,6%

Do you know all the conditions requiered to plant the plants you are interested in?

45 respuestas

- Yes (This app can still help you with even more plants!)
- No (This app is very much for you!)
- Maybe (This app is still for you!)

15,6%

73,3%

11,1%

Where would you build your garden?

45 respuestas

- In a public area for your garden where all the community can access it
- In private, just for me and my family

93,3%

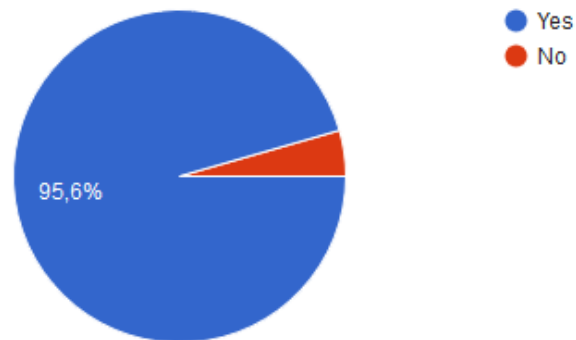# Would you harvest forpersonal consumption or would you sell your crops to neghbors and others?

45 respuestas
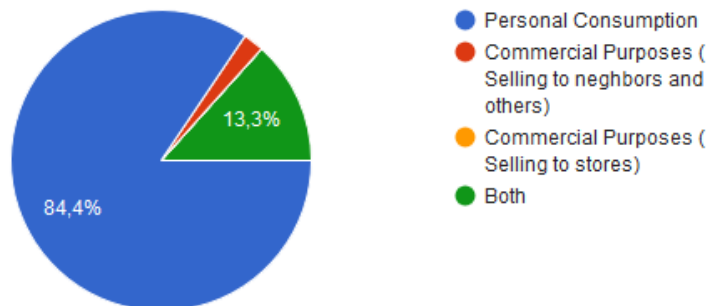
- Personal Consumption
- Commercial Purposes (Selling to neghbors and others)
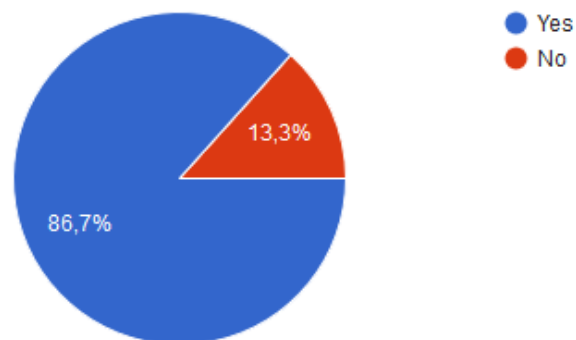- Commercial Purposes (Selling to stores)
- Both

84,4%

13,3%

Would you like to have an application where you can consult all the requirements you need for your plants and schedule its lighting and watering, for example?
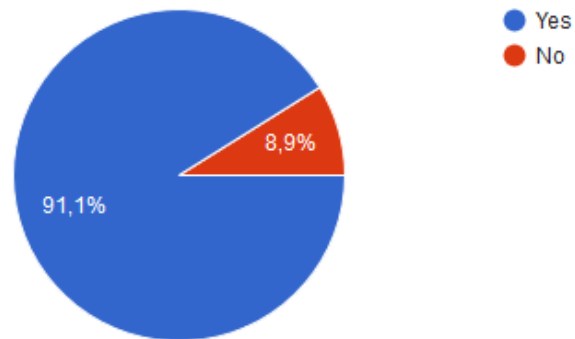
45 respuestas

- ● Yes
- ● No

95,6%

Would you find it useful to access a store on this app to compare prices and buy anything you need receiving it in your home or desired address?

45 respuestas

- ● Yes
- ● No

13,3%

86,7%

Would you support this application being compatible with a Food Computer that counts with the sensors and actuators to automate your crops?
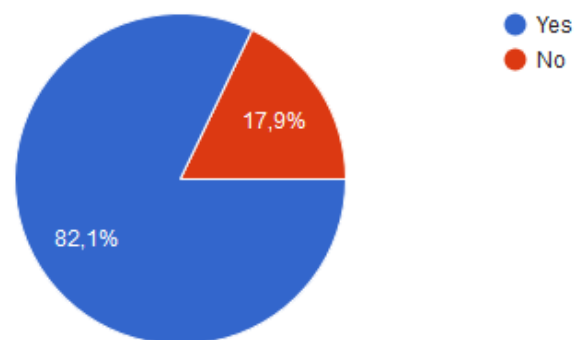
45 respuestas

- Yes
- No

8,9%
91,1%

Let us try to convince you that it is a good idea!

Do you consider there is an oportunity to protect your economy by having your own crops?
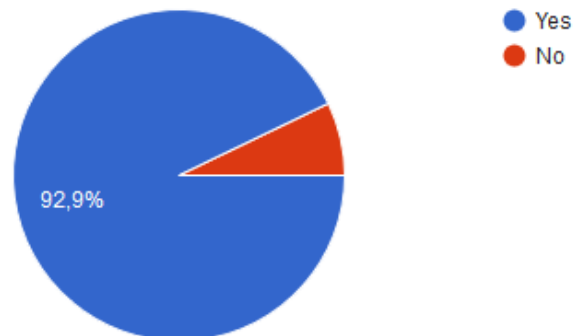
28 respuestas

- Yes
- No

17,9%
82,1%

If you decided to have an urban garden would you use it for personal consumption or would you sell your crops to neghbors and others?

28 respuestas
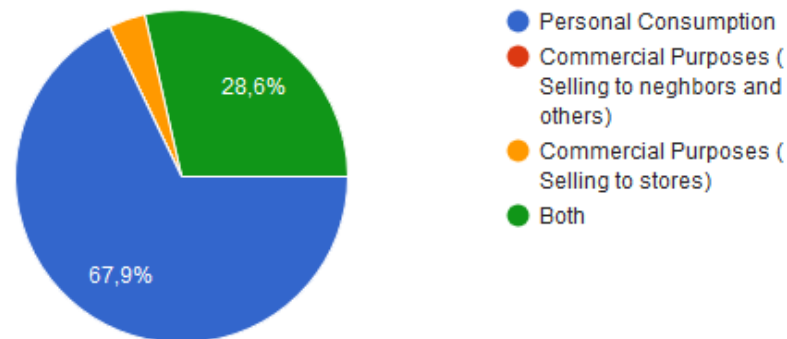
- Personal Consumption
- Commercial Purposes (Selling to neghbors and others)
- Commercial Purposes (Selling to stores)
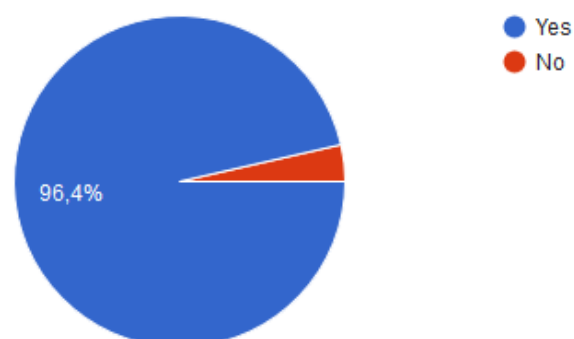- Both

28,6%

67,9%

Would you like to have an application where you can consult all the requirements you need for your plants and schedule its lighting and watering, for example?

28 respuestas

- Yes
- No

92,9%

Would you find it useful to access a store on this app to compare prices and buy anything you need receiving it in your home or desired address?

28 respuestas

- Yes
- No

96,4%

Would you support this application being compatible with a Food Computer that counts with the sensors and actuators to automate your crops?

28 respuestas

- Yes
- No

96,4%