

# Journal of Agricultural Sciences Research

Acceptance date: 22/11/2024

## THE PORTABLE URBAN GARDEN AS AN INTEGRATIVE SOLUTION TO THE LACK OF SPACE FOR CULTIVATION IN LARGE METROPOLISES

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**Abstract:** To speak of urban gardens is to speak of the welfare of society in terms of health, and although this initially refers to the body, in reality it is sought to benefit the whole being in its integrity. The natural healthy coexistence of participation in the work of urban community gardens will foster the promotion of love for others, which will be manifested in all dimensions of being, but also, and above all, in the spiritual, in every moment of interaction with neighbors, family members, and students of a community, for example. We know, unfortunately, of the great impact of disinterest in healthy eating, which companies have caused in society, through the conceptualization of advertising, which promotes the consumption of industrialized products in large percentage. It is therefore of great importance to promote new strategies that encourage the consumption of food of organic origin, and grown by urban and peri-urban consumers themselves [1]. In large cities, such as the CDMX, there are extensive urban areas where there is no land or space for the cultivation of urban gardens (CHU), including: schools, houses, housing units, etc., i.e., they are spaces that were not designed for urban or peri-urban agriculture. An innovative solution proposed here to the problem of the lack of cultivable space in the megacities is the portable urban garden (HUP), since the HUP can be placed in strategic points, both for lack of space and for being a site of great human activity, to provoke and expedite citizen participation, both theoretically and practically in its implementation, care, maintenance, monitoring, and during the whole process of cultivation that they want and need to do. Since this HUP can be placed in all spaces, and according to the specific needs of the users of the space, they will determine the type of crops appropriate for each social group, where the HUP is implemented. Here are presented the calculations for the

construction of a HUP, with a certain type of materials, and a budget of the materials, and their approximate costs, on the date this research was carried out in the CDMX, as well as several schemes of its assembly step by step, until obtaining its final finish.

## INTRODUCTION

Therefore, it is essential that in every school (Figure 1)[2], in every street of every neighborhood without CHU space, in every housing unit without CHU space (Figure 2) [3], in every workplace, hospital, etc., at least one HUP be implemented.



Figure 1: Schoolyard without portable vegetable garden



Figure 2. Condominium without portable vegetable garden

It has been proven that natural food of organic origin is essential for healthy human life, as currently multiple diseases have developed, such as obesity (Figure 3) [4], heart disease,

diabetes, tumors, liver and cerebrovascular diseases (Figure 4) [5]. Therefore, reducing the consumption of processed and industrialized foods will directly and noticeably improve people's health.



Figure 5. Consumer warning labels.

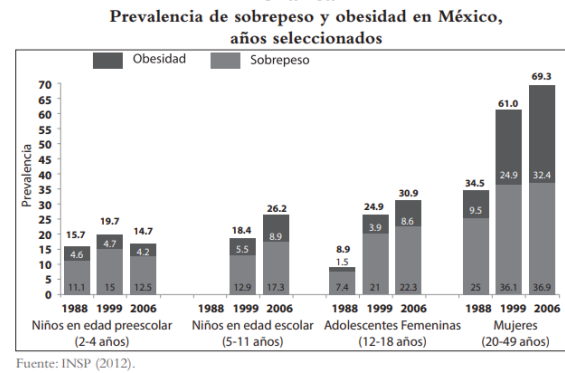


Figure 3: Prevalence of overweight and obesity in Mexico, selected years.

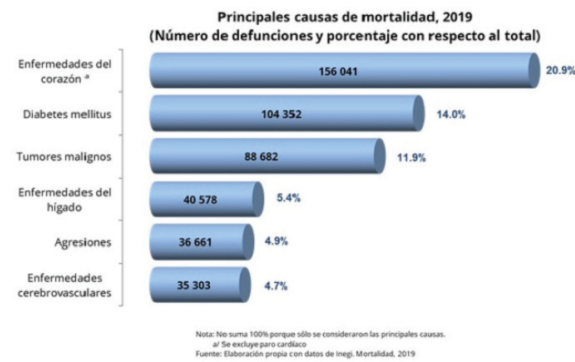


Figure 4: Main causes of mortality, 2019. GOB MX

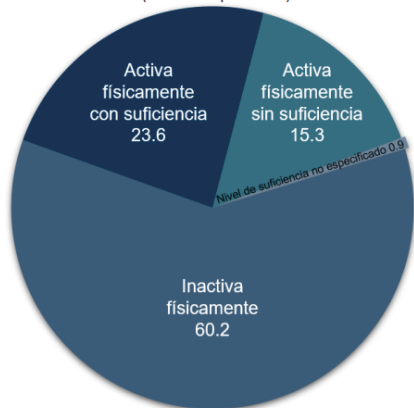
The lack of consumption of organic food not only speaks of the problems caused in the physical body, but also affects the mental health of consumers [6], so it must be taken into account that the dose is very important in all consumption [7]. A reference for the care of citizens is the Federal Consumer Protection Agency (Profeco) [8], which established, to place black hexagon-shaped seals on the packaging of products offered to the consumer, according to the basis of a critical nutritional profile. These hexagons indicate alerts, to know that it is a harmful product, so, the more seals a product contains, the more is the alert for the consumer (Figure 5)[9].

Sedentary lifestyle is another key element that should be taken up as a challenge for the development of community participation strategies in the HUP, in order to combat it with appropriate actions that significantly reduce it, since it is very harmful to health. It is known to be promoted by several elements. One of them is the lack of interest in exercising, which is caused, in a certain percentage, by the same technological conceptualization, by the ideology spread by highly industrialized food companies (Figure 6) and also by the basic needs with reference to work. Figure 7 shows a study by INEGI, [10] which shows that physical inactivity is higher among the population aged 18 years and older.



Figure 6: Diffusion of industrialized food, photo: Chacón Zavala Ángel L.

**POBLACIÓN DE 18 AÑOS Y MÁS SEGÚN PRÁCTICA FÍSICO-DEPORTIVA EN TIEMPO LIBRE Y NIVEL DE SUFICIENCIA (distribución porcentual)**



Fuente: INEGI. MOPRADEF, 2023.

Figure 7: Population aged 18 years and older according to physical sports practice.

Therefore, and with the results of multiple health studies, it has been shown that having a constant physical activity, as well as [11] a good diet, based on organic products, benefits the health of the population. However, other social factors should also be considered, whose frequency is not very high, such as what happened, worldwide at the end of 2019, with the spread of the SARS Co-V 2 pandemic [12], and which has been a clear demonstration of sedentary lifestyle (Figure 8) and poor diet, due to the total cessation of all human activity.

**Aumento de peso en pandemia**

Desde que comenzó la pandemia, ¿Cuál de las siguientes acciones ha hecho personalmente?

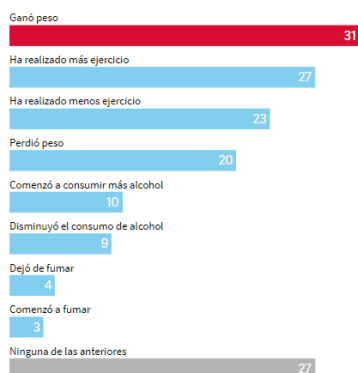


Figure 8: Weight gain in pandemic.

## THE IMPORTANCE OF HAVING A HUP

We know that if the above is positively satisfied, it will become a gain for any nation-state, so designing and implementing urban gardens in general, and in particular the HUPs, will create a new reference for the reduction of patients within hospitals, and not only regarding physical health problems, but also those referring to mental problems, since socialization helps to eradicate some emotional and behavioral problems, such as depression, which could be a symptom that marks the beginning of addictions, since many of these are caused by lack of sources of happiness [13] (Figure 9).



Figure 9: Rat Park experiment.

The importance of community urban gardens and of the best known types, plus the novel HUP proposed here, whose design, assembly, and costs are shown below, will make a city have a higher degree of socialization and a greater social connection among its individuals, causing an awakening to the vocation of love for others (Figure 10) through concrete actions, such as the healthy coexistence of collaborative work in the garden, starting with the closest family members, expanding later to neighbors, and all people of any age, etc.

We know that the above will bring a reduction in various problems, derived, for example, from prejudice (which usually causes marches of inequality and nonconformity), and will cause a decrease in violence (homicides, femicides, assaults, suicides, etc.), all of

which is desirable for the government of any country on the planet, which seeks these benefits for its people.

This will provide greater food security, high nutritional quality food, and greater economic and social stability to the groups in the communities that implement the HUPs. Those who participate in these HUPs will know exactly what food they have, what their nutritional level is, what other food they need, what their surpluses are, and how much they can exchange for organic products with other HUPs. They will also know how much they can offer for sale, thus generating monetary gains (which could be reinvested to implement other HUPs), which will raise the socio-economic level of the Mexican communities and families that implement a HUP.



Figure 10. Children in a street with Portable Urban Gardens in the State of Mexico. Render: Chacón Zavala Ángel L.

## SOME TYPES OF URBAN GARDENS

Taking as a reference the various forms of cultivation, by different methods, and speaking specifically of the interrelation of the cultivation of food with a healthy diet, and to optimize its operation through organic farming, the most common is the **garden based on natural soil** (Figure 11)[14], which has some disadvantages due to the difficulty of its maintenance, pest control at that level, its irrigation (which is usually through watering by hand), and have only solar lighting, depending on where they are located.



Figure 11. Vegetable garden based on natural soil

Another classification of orchards, which are found at the same time, are the **vertical orchards**, which can have automatic irrigation by gravity. One of their advantages is that they have easy soil maintenance, which avoids a large number of pests, due to the reduced space in which they are placed (Figure 12),[15].



Figure 12. Vertical vegetable garden with PET bottles

## THE PORTABLE URBAN GARDEN

The following pilot project is presented, which consists of the realization of the suggestive experiment, based on the novel ideas of: 1) being portable, 2) being automatable, 3) having low implementation cost, 4) easy to assemble, 5) initial planning with PVC materials, 6) provides a new way to grow food, 7) suitable for everywhere, 8) with free displacement, 9) advantage of vertical irrigation, 10) use of runoff by plants at lower levels at the time of irrigation, 11) blackboard with calendar and irrigation schedule, 12) treated water tank for irrigation. 13) the whole community committed to the HUP will take care that everything works according to specifications. See (Figure 13).

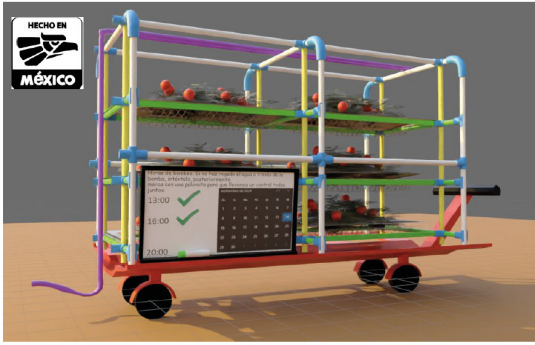


Figure 13: The Portable Urban Garden.  
Render: Chacón Zavala Ángel L.

### INITIAL COMPOSITION OF THE HUP: MATERIALS

The material is 1 ½ " diameter PVC pipe (quotation marks indicate inches), spaced 60 cm apart on each side, in both vertical and horizontal sections, as shown in Figure 14, using the following materials from Table 1:

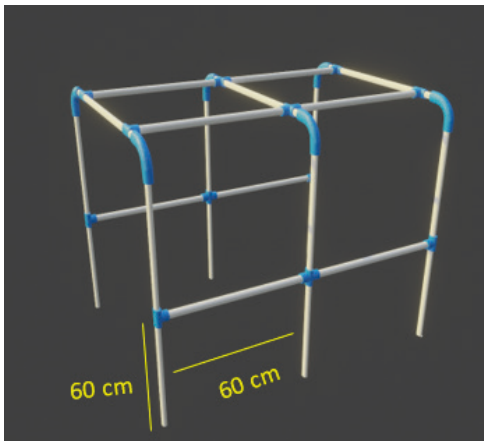


Figure 14: Assembling the 1st part of the HUP.  
Rendering: Chacón Zavala Ángel L.

Material	Measures (" = inches)	Quantities (pieces or m)
PVC pipe	1 1/2	14 m
Tee	1 1/2	8 p
Elbows	1 1/2	6 p
Crosses	1 1/2	4 p

Table 1

A panel is the next assembled structure, as shown in figure 15; it will be multiplied 3 times. The materials are shown in Table 2, as, for example, the following are needed 3 shelves:

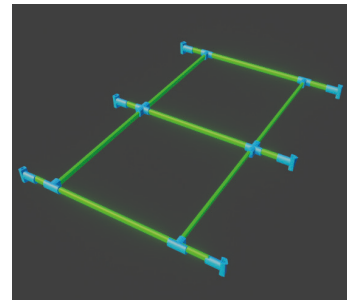
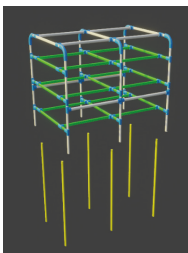


Figure 15 HUP panel assembly.  
Rendering: Chacón Zavala Ángel L.

	Measures ("=inches)	Quantities (pieces or m)	For all 3 shelves
PVC pipe	1 1/2	5 m	15
Tee	1 1/2	10 p	30
Crosses	1 1/2	2 p	6

Table 2

The structure with the three shelves would be as shown in Figure 16, which requires 7 meters of 1 ½ inch PVC pipe for supports (yellow color), see table 3, between the nodes, and to resist the weight of the soil and water, and would be as shown in Figure 17:



Material	PVC pipe
Measures (inches)	1 1/2
Quantity (meters)	7

Table 3

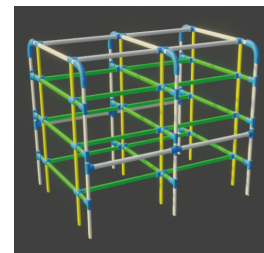


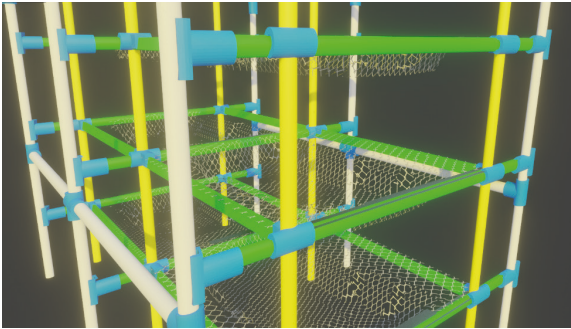
Figure 16: Diagram of supports.  
Render: Chacón Zavala Ángel L.



Figure 17: Diagram with supports.  
Rendering: Chacón Zavala Ángel L.

## COSTS

Approximate costs in Mexican pesos, as of the date of the pilot project.



For this prototype, it is proposed to place a plastic mesh as a container for the harvest and biomass, see Figure 18 and Table 4.

Table 4

Mesh	quantity	Cost
2.1x10m	1 roll	100

Figure 18: Mesh placement detail. Render: Chacón Zavala Ángel L.

For the support, base and transportation of the PVC structure, as shown in Figure 19, the following materials are required and their costs are shown in Table 5:

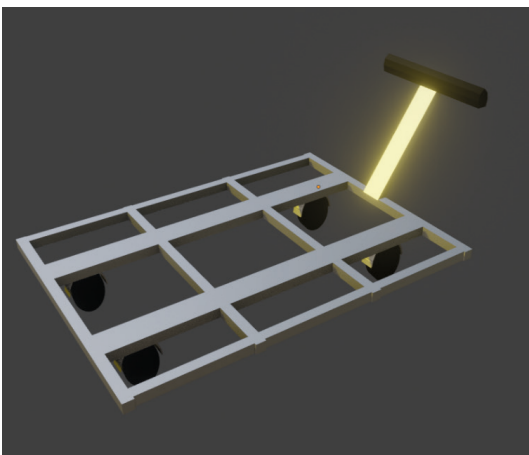


Figure 19: Iron support for HUP. Render: Chacón Zavala Ángel L.

Material	Measure (" = inches)	Quantity (pieces or m)	Cost (Pesos Mexican)
PTR pipe	1 1/4	9.4 m	640
Wheels Rotating PVC	2	8 p	256

Table 5



8 Pcs Kit De Ruedas Giratorias De Pvc Negro C/freno De Zinch

4.9 ★★★★★ (200)

\$ 256

## TOTAL COST OF PORTABLE URBAN GARDEN

The prototype of the portable urban garden would look as shown in Figure 20 and its total cost can be seen in Table 6.

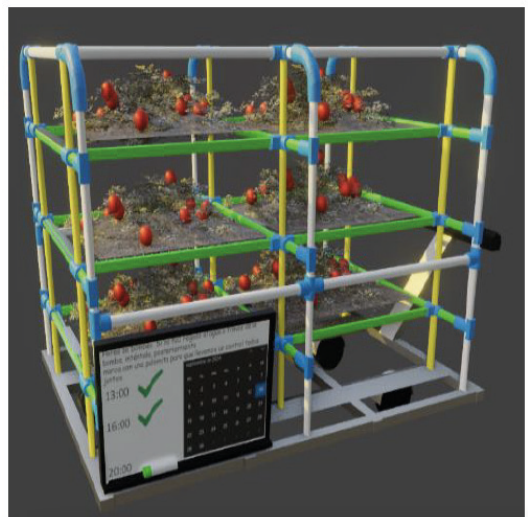


Figure 20: Portable Urban Garden. Render: Chacón Zavala Ángel L.

Material	Measure (" = inches)	Quantity (pieces or m)	Cost (Pesos Mexican)
PTR pipe	1 1/4	9.4 m	640
Wheels Rotating PVC	2	8 p	256
Tee	1 1/2	38 p	1216
Elbows	1 1/2	6 p	20
Crosses	1 1/2	10 p	60.82
PVC pipe	1 1/2	36m	1080
Slate	30 cm	1	189
Total includes glue and solder			3,861.82

Table 6

## DISADVANTAGES TO ATTEND

To extend the life of the materials that make up this prototype, care must be taken in the correct union of all the pieces, so it is proposed to join all the PVC pieces, filling them with concrete, since the overlapping of one material inside another, will give greater cohesion to its molecules, and will provide greater support in the strength of the structure of the HUP, unlike maintaining a hollow PVC. It is also recommended to paint over this material to avoid wear due to humidity or irrigation water filtration, see Figure 21.

## INNOVATIVE MODIFICATIONS

To optimize and facilitate irrigation at the top of the HUP, this structure allows us to add another PVC pipe, as can be seen in the purple pipe added for irrigation in Figure 21, and/or hoses with holes can be installed for more automatic pumping, and various devices can be added for more autonomous operation.

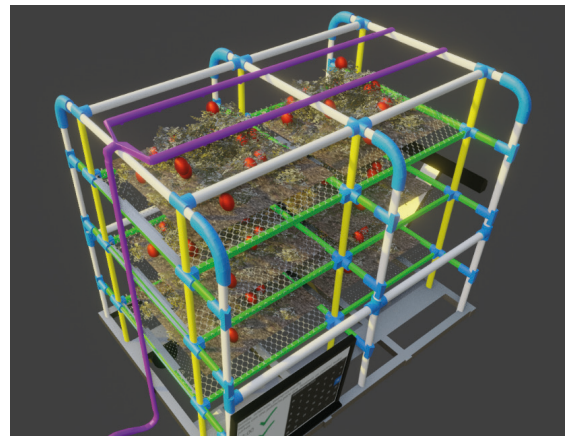


Figure 21: Upper irrigation by purple pipes.  
Render: Chacón Zavala Ángel L.

## CONCLUSIONS

This pilot project presents the following innovations that are of utmost importance: 1) being portable, 2) being automatable, 3) low implementation cost, 4) easy to assemble, 5) initial planning with PVC materials, 6) provides a new way to grow food, 7) suitable for any place, 8) with free movement, 9) advantage of vertical irrigation, 10) use of runoff by plants at lower levels at the time of irrigation, 11) blackboard with calendar and irrigation schedule, 12) treated water tank for irrigation. The whole community committed to HUP will take care that everything works according to the specifications of this garden, and because of its mobility for any terrain, it can be implemented, for example, inside school yards (Figures: 22, 23 and 24), or even inside housing units (Figures 25, 26 and 27), in the streets outside houses, to be attended by the community (Figures 28 and 29), which will promote, generate and apply more opportunities for society, thus achieving a more stable welfare, and awakening to a more genuine socialization.





Figure 22: Portable urban garden with irrigation schedules and water tank, to facilitate students' attention and save water in the schoolyard. Render: Chacón Zavala Ángel L.



Figure 23: Portable urban garden in school fields. Rendering by Chacón Zavala Ángel L.



Figure 24: Learning from the Portable Urban Garden in school classrooms. Render: Chacón Zavala Ángel L.



Figure 25: Portable Urban Garden in Unidad Habitacional del Estado de México. Rendering: Chacón Zavala Ángel L



Figure 26: Community of Unidad Habitacional del Estado de México attending the HUP. Rendering: Chacón Zavala Ángel L.



Figure 27: Implementing the HUP in the community of Unidad Habitacional de Alcaldía Iztapalapa. Render: Chacón Zavala Ángel L.



Figure 28: Implementing HUP in community streets in the State of Mexico. Render: Chacón Zavala Ángel L.



Figure 29: Participating in the HUP in community streets in Estado de México. Render: Chacón Zavala Ángel L.

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