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Use of Rainwater in a Hydroponic Greenhouse

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ABSTRACT

The increase in population in the world is currently generating needs for basic resources such as food and even liquids, resulting in a shortage of food that affects families, likewise, hydroponics as an alternative way to produce food with greater profitability and a lower use of land, water and energy, since the rainy seasons have constantly undergone changes, which have affected the natural growth of crops giving a smaller amount of this which generates losses, for this reason a greenhouse is being implemented (hydroponic) since they are more profitable and easier to control, which makes it an alternative to combat food shortages. To contextualize in the following paragraphs, an alternative method will be shown that allows the collection of rainwater that is used to harvest plants without the need for land through a closed system of 100% use. The system has a recollection of water by galvanized sheet roof capturing rainwater and storing it in 3 tanks with a capacity of 20L. They are connected in series which will replenish a 150L capacity tub containing tilapia fish. The tilapia´s waste will allow the vegetables to be nourished by means of a pump. It is proposed to use a hydroponic greenhouse, to grow vegetables and use the waste of the wall as fertilizer since the physical and chemical factors of the water du0072ing the activities of hydroponics and recirculation aquaculture, mainly in relation to the amounts of macronutrients, is undoubtedly the accumulation of nutrients dissolved in the water and helps in the cultivation of tomatoes, lettuce, slices, and cilantro, thus reducing water consumption and contamination of the land.

Keywords: hydroponics; aquaculture; greenhouses

INTRODUCTION

The increase in population in the world is currently generating needs for basic resources such as food and even liquids, resulting in a shortage of food that affects families, likewise, hydroponics as an alternative way to produce food with greater profitability and less use of land, water, and energy, allows for more profitable and easier to control hydroponic crops, which makes it an alternative to combat food shortages.

To contextualize in the following paragraphs, an alternative method will be shown that allows the collection of rainwater that is used to harvest plants without the need for land through a closed system of 100% use, the system has a collection by galvanized sheet roof capturing rainwater and storing it in 3 tanks with a capacity of 20LTRS of water connected in series which will replenish a 150LTRS capacity tub containing tilapia which, with its waste, will allow the vegetables to be nourished by means of a pump: a system of channels in which Vegetables such as lettuce, radishes, cilantro are planted, as well as a drip system for pots which have tomato seeds planted.

To obtain a structure capable of withstanding the effects of weathering such as corrosion and oxidation, resulting in an economical and easily accessible structure for growing vegetables, incorporating a medium-capacity vertical Aquaponic system and thus being able to search for a type of fish that provide the necessary nutrients for the development of vegetables.

METHODOLOGY

In many of the communities that are dedicated to agriculture and there is a constant need for an irrigation system since the rainy seasons have constantly undergone changes, which have affected the natural growth of crops, giving a lesser amount of this, which generates losses.

Added to the constant contamination of rivers and lakes, the ability to use the liquid decreases, since this affects the pH, acidity, and heavy metals that they contain, adding to this the contamination of the soil, deforestation (mostly caused by conversion of land to agricultural uses) and greenhouse gas emissions from the farms themselves cast doubt on the sustainability of the current model.

Resulting in the use of hydroponic systems as an alternative to reduce planting space since they are easily accessible for growing vegetables, incorporating a medium-capacity vertical aquaponic system and thus being able to search for

a species of fish that provides the necessary nutrients for the development of vegetables through a closed system with a profitability of 100%.

FIGURE 1: Metal frame.
Source: Own, year 2022.

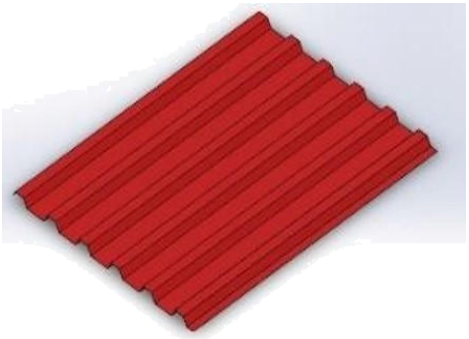

FIGURE 2: Galvanized sheet.
Source: Own, year 2022.

This project has a metal structure made of ½-inch PTR, which is made up of a 32-gauge galvanized sheet roof.

FIGURE 3: 1 Plastic tank of 20 liter.
Source: Own, year2022.

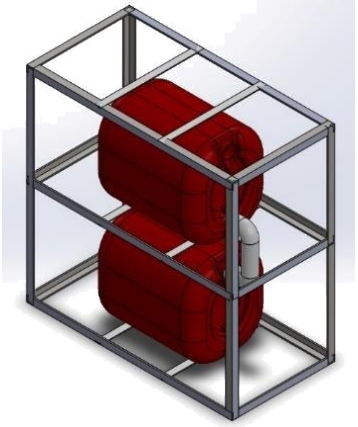

FIGURE 4: 4-inch pipe.
Source: Own, year 2022.

A 4- pipe collection system that collects 3 20-liter plastic tanks where rainwater is stored.

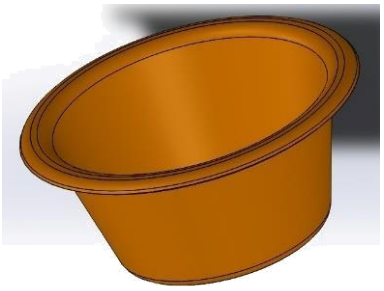

FIGURE 5: Plastic tub.
Source: Own, year 2022.

FIGURE 6: Tub inside the structure.
Source: Own, year 2022.

In the interior part we can find a 150 LTR plastic tub with fish of the tilapia species that will provide the necessary nutrients for the seeds and thus they can germinate.

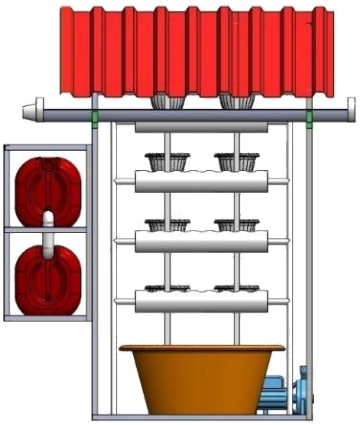

FIGURE 7: Submergible water pump.
Source: Own, year 2022.

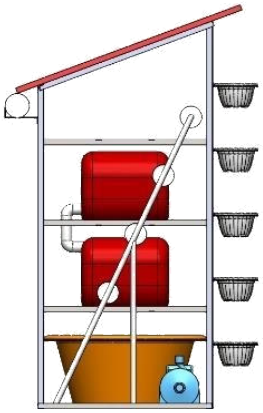

FIGURE 8: Series connected piping system.
Source: Own,year 2022.

Using a submersible water pump, the water with the nutrientsis transported to a 1/2-inch pipe system that is connected in series to 3-inch pipes where baskets with radish, cilantro, and lettuce seeds are placed.

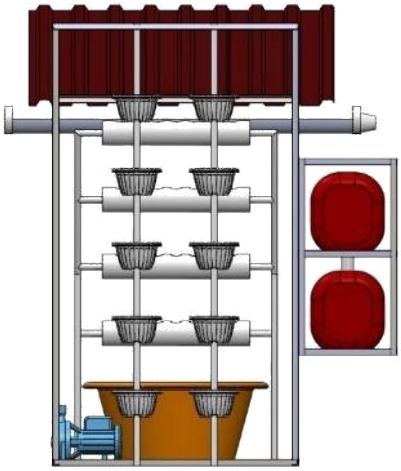

FIGURE 9: Tomato pots.
Source: Own, year 2022.

FIGURE 10: Complete prototype.
Source: Own, year 2022.

In the back, pots containing tomato seeds are placed, which are irrigated by a drip method to control growth, all this water is recirculated back to the 150LTR tub, controlling the level of the 3-inch pipes by means of stopcocks sphere type pitch.

FIGURE 11: Assembly of the structure.
Source: Own, year2022.

FIGURE 12: Hydroponic system paint coating.
Source: Own, year 2022.

FIGURE 13: Complete greenhouse assembly.
Source: Own,year 2022.

The development of this project entailed the construction of the greenhouse structure, the application of paint on it and on the galvanized sheet that served as a roof, as well as the assembly of the serial piping system where the baskets with the seeds are located its interior, the placement of the submersible pump, the pots that are in the back of the greenhouse and the assembly of the drip system, it was decided to place tilapia-type fish so that it provides us with the necessary nutrients for an optimal development of the vegetables.

FIGURE 14: Coriander sprouts.
Source: Own, year 2022.

FIGURE 15: Radish sprouts.
Source: Own, year 2022.

At the end of the assembly of the prototype, a gram of seeds was placed inside the baskets and in a period of 3 days the coriander seeds germinated and on the 4th day the radish seeds germinated, we observed that the process started correctly.

FIGURE 16: Serial system.
Source: Own, year 2022.

FIGURE 17: Baskets and regulation valves.
Source: Own,year 2022.

However, it was observed that regulating valves had to be placed in the structure of the germination tubes to control the level of water circulation.

With this project it was possible to observe the importance of the hydroponic technique, which is very effective and also provides us with a constant saving of drinking water, because it tries to capture as much rainwater as possible and makes the process more efficient to be more sustainable than it is the most important stage of germination since it requires greater absorption of water in the seed.

TABLE 1: Parameters and general environmental conditions required for the proper development of vegetables commonly grown in aquaponics.

Crop species	Germination time	Growth time	Temperature (°C)	Sun exposure
Lettuce	3-6 days	4-5 weeks	15-22	Moderate /High
Radish	3-4 days	3-4 months	13-20	Moderate /High
Cilantro	3-5 days	2-4 weeks	15-20	Moderate /High
Tomato	4-7 days	2-3 months	15-25	High

Source: Own, year 2022.

CONCLUSIONS

In the development of this research, it was observed that vertical hydroponic systems are a good method to consider as an alternative system for the harvest of vegetables, since by having a recirculation of the liquid by gravity, it allows the capture of the nutrients that the tilapia provides us. of natural form. By developing this type of cultivation system, we are generating organic products that do not have any contaminants that could alter their growth. In addition, as it is a closed system, we can take advantage of all the resources that the system generates without generating waste. It is possible to harvest different types of vegetables that at no time are they worn out in general on the seeding surface since it is in continuous circulation. Since being a miniaturized system, it allows its placement in small spaces and captures a large amount of water with the use of rainwater systems. Like any system, there are some shortcomings in the project. One of them, we have detected is that this type of hydroponic system cannot be placed in areas with high pollution since this type of environment sometimes generates acid rain or pests that directly affect the vegetables, also if the place where it is placed has a low rate of rain, it is not possible to keep the system functional at all times, so we consider that this type of system is viable for areas of high humidity.

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