BIOMIMICRY FOR BIO-WATER

Sustainable Accessibility

Sustainable Water Management Model: Innovative nature-inspired solutions to address freshwater scarcity and improve access to basic sanitation. Our project aims to promote responsible and efficient water use practices through the implementation of biomimetic technologies. Proposal for the installation and development of collection and filtration systems for water from natural sources, followed by a process of sedimentation, UV treatment, and reverse osmosis filtration to obtain potable water.

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“Water is the driving force of all nature."

Leonardo da Vinci.

INTRODUCTION

This project focuses on the importance of water as an essential resource for life and sustainable development, and the need to ensure access to clean water and adequate sanitation.

Despite its importance, millions of people worldwide still lack access to clean and safe water. Climate change and the growing demand for water in human activities such as agriculture and industry are increasing the pressure on freshwater resources.

The accessibility to clean water varies depending on geographical location, level of economic development, and the quality of water resource management. The lack of access to clean water and proper sanitation not only affects human health and well-being but also the environment, economy, and society as a whole. It is necessary to address these challenges and promote efficient water use to ensure the survival and sustainable development of all species on our planet. Freshwater scarcity is one of the major challenges humanity faces. Let's look at some data to frame our reality:

- In the coming decades, two-thirds of the world's population may lack access to clean water.
- Global water demand is constantly increasing and estimated to reach 5,200 km3 by the year 2025.
- According to FAO, the world's population has increased by 4 billion people in the last 50 years, which calls for sustainable water management and conservation of this resource.
- According to United Nations data, around 2.2 billion people worldwide lack access to safe and properly managed drinking water.
- Nearly 4.2 billion people worldwide lack access to adequate sanitation facilities.
- 263 million people worldwide travel more than 30 minutes to collect water that meets their basic needs.
- United Nations data indicate that 1 in 3 people worldwide lack access to clean water and must rely on unsafe or unreliable water sources, such as contaminated rivers or untreated water wells, which can lead to serious illnesses.

Ensuring access to clean water and adequate sanitation is crucial due to its social, human health, environmental, and political implications. Climate change is exacerbating the situation by affecting water availability for human consumption and increasing water stress. Water-related disasters are on the rise, and lack of access to clean water results in premature deaths.

Access to clean water is a fundamental human right, but contaminated water resources can have significant impacts on human health, flora and fauna, and the economy. Exposure to contaminated water can cause a range of diseases and problems, as well as long-term effects on human health. Flora and fauna can also be negatively affected, and water pollution can reduce crop quality and yields.

Proper water resource management and effective measures to prevent its contamination are necessary to protect its quality and ensure access for all users. This may include strict laws and regulations, sustainable agricultural practices, and investment in infrastructure for drinking water treatment and distribution.

To ensure the sustainability of the vital water resource and ensure access to clean and safe water for all, challenges must be addressed through concrete and coordinated measures on a global level. Additionally, it is essential to explore natural alternatives for water collection and filtration, and to act responsibly and proactively to ensure equitable and sustainable access to water.

OBJECTIVE AND PURPOSE OF THE PRESENT PROJECT

The project aims to address freshwater scarcity and the issues of access and basic sanitation faced by millions of people worldwide. Our focus is to promote a sustainable water management model that enables the saving and regeneration of this vital resource through the implementation of nature-inspired technologies. The main objective is to improve the quality of life and reduce poverty in populations experiencing water access challenges, through responsible and efficient water use practices and the promotion of a culture of awareness and care for water resources.

We present a model that includes the collection of water from natural sources: rainwater, dew, and humidity condensation, which is then filtered through sedimentation, activated carbon, ultraviolet filtration systems with ionization, and reverse osmosis, according to specific requirements and demands.

We rely on biomimicry for the creation of our proposal. Biomimicry is a science that studies nature as a source of inspiration to create sustainable technological and design solutions. It involves emulating the patterns and strategies that nature has developed to solve problems and adapt to the environment.

Our objective is to offer sustainable solutions for access to clean and safe water in disadvantaged areas through the installation and development of collection and filtration systems inspired by biomimicry. This will not only aid in human consumption but also benefit agriculture and sanitation, contributing to the conservation of water resources and the protection of the environment. We aspire to work in collaboration with local communities, organizations, and governments to achieve a more sustainable and equitable future in terms of water access.

DEVELOPMENT

Have you ever wondered:

How do animals and plants survive in the most arid environments in the world?

How is it that camels can store water for long periods of time in their bodies?

And how do some plants collect and retain water from rainfall?

Nature offers us innovative solutions to complex problems such as access to clean water, and biomimicry is the key to harnessing these solutions.

By studying efficient natural systems of water collection and filtration, we can design more effective and cost-efficient solutions to tackle one of the greatest challenges humanity faces today. Join us on this journey to discover how nature can be our best ally in the quest for a sustainable solution to the problem of access to clean water.

Rainwater and dew harvesting is a sustainable technique that has been used for centuries by many cultures around the world. Filtration of the collected water is an important step to ensure that the water is safe for use. Filtration systems can range from natural activated carbon and sand systems to more advanced reverse osmosis and ultraviolet systems.

These collection systems are related to biomimicry by imitating the natural strategies of organisms to collect and store water in environments where the resource is scarce.

Natural filtration using gravel, sand, and activated carbon is a process in which impurities are removed from water as it passes through different layers of filtering materials. In nature, many organisms use similar filtration processes to purify water. For example, rivers and streams are naturally filtered by rocks and sediments, and some plants have roots that act as natural filters for water. Therefore, this natural filtration using gravel, sand, and activated carbon is a form of biomimicry as it mimics natural processes for water purification. Furthermore, current filtration technology is also being enhanced by using biomimicry techniques to mimic the filtration processes of organisms in nature and achieve greater efficiency in water purification.

Reverse osmosis and UV filtration are influenced by biomimicry by studying natural processes and finding more efficient and sustainable ways to purify water.

In conclusion, biomimicry presents itself as an innovative solution to address the challenges we face in accessing clean water. By studying and learning from nature, we can design more efficient and sustainable solutions for water collection and filtration, thus ensuring a supply of clean water for all inhabitants of the planet.

PROTOTYPE AND DEVELOPED MODELS

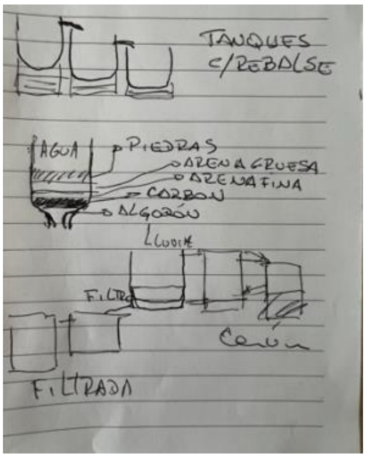
Our idea aims to be affordable for populations in Argentina who do not have access to clean water due to economic limitations. We seek to help meet this basic need to improve their livelihood.

Our models are accessible, cost-effective, easy to implement, and can be funded by governmental or private institutions. Simple materials were used, and we aim to disseminate the knowledge gained in educational institutions for replication in local communities.

We have created a biomimetic system for water capture and filtration inspired by nature, designed to meet the basic needs of populations lacking water resources. This biomimetic system consists of individual models that can be used independently or combined, adapting to the needs and material availability of different urban, suburban, and rural areas.

Lightweight and waterproof materials were used to design a prototype for rainwater collection with natural filtration and hydroponic cultivation for contaminated soil. We also designed models for air-to-water collection and advanced filtration techniques, such as UV filtration, ionization, and reverse osmosis, which can be applied to collect contaminated water.

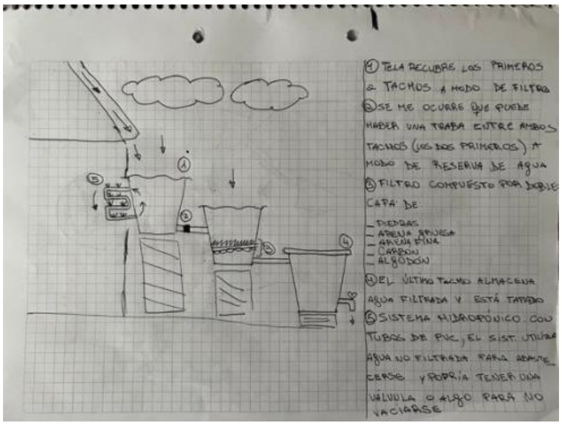
Hydrobuddy: Prototype of rainwater harvesting with sedimentation filtration with activated carbon and hydroponic plant cultivation.



The Hydrobuddy Project, a prototype designed to address global challenges related to access to clean drinking water, was presented and certified as part of the "AFS Global You Changemaker" program at the University of Pennsylvania. This program focuses on identifying innovative, sustainable, and cost-effective solutions to address issues affecting diverse communities worldwide. Additionally, the project includes a section for hydroponic plant cultivation, which accelerates plant growth and allows for vegetable cultivation in areas where it was previously impossible due to soil contamination caused by polluted water sources. With its community-focused approach, Hydrobuddy has the potential to positively transform the lives of many people around the world.

Hydrobuddy utilizes rainwater as its water supply source, which undergoes a filtration process where large particles are first filtered out, followed by natural filtration. This prototype not only filters the water but also allows for its storage for later use. In this process, after all sediment has been filtered, the water is stored in a container, which is considered as “sanitation water”, as it can be used for cleaning, irrigation (in our case, for supplying the hydroponic crops), or even toilet flushing. It then goes through a natural filtration process before being stored in a second tank. The obtained water is potable and suitable for human consumption. To enable storage in large quantities, both the sanitation water and potable water containers have tubes on the sides designed to connect additional containers, preventing overflow and ensuring conservation.

The hydroponic cultivation system consists of a wooden structure that houses PVC pipes for storing the filtered water. The necessary nutrients for plant growth are provided through the application of liquid worm humus, a natural fertilizer. To ensure proper oxygenation of the water, an air recirculation pump is used, which allows for the circulation of water so that plants can absorb the necessary nutrients and oxygen for their optimal development.



Why did we opt for hydroponic cultivation?

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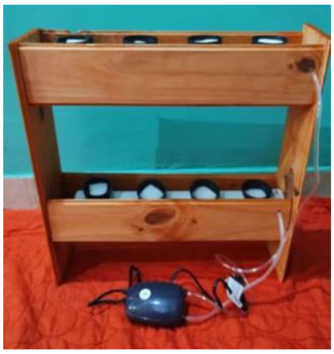
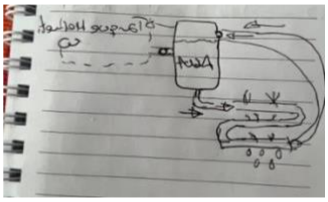
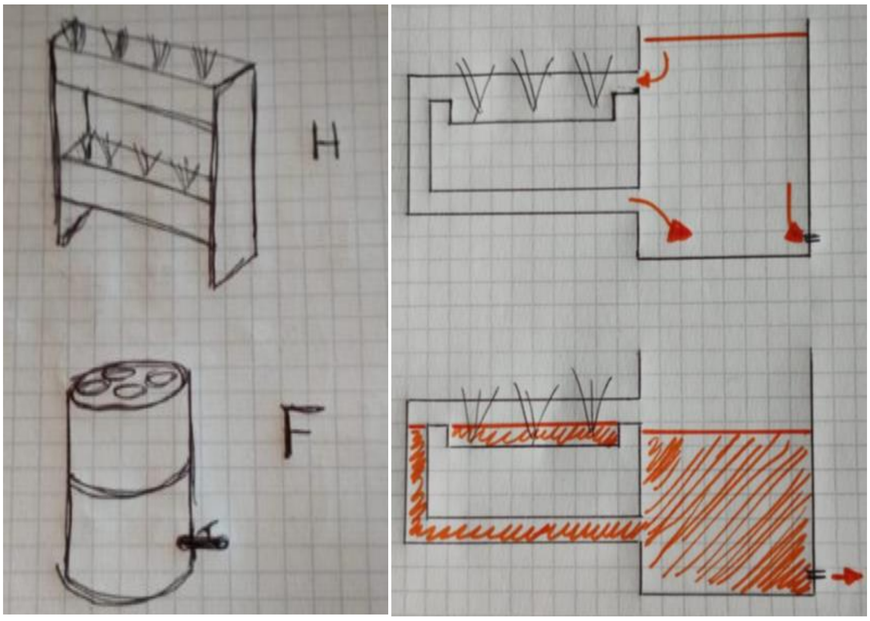


In addition to the initial purpose of addressing soil contamination, there are multiple arguments that support the convenience of employing this technique. Firstly, plants grown hydroponically are in constant contact with water and the added nutrients, which contributes to rapid growth, often several times faster than in traditional cultivation. Secondly, the amount of water used is lower because the water is constantly circulating, allowing for efficient consumption, and minimizing water usage. Additionally, the use of pesticides is not necessary. Unlike soil-based cultivation, where plants are in contact with various microorganisms and insects, this method allows for the control of the environment in which the plants are grown, preventing pest infestations without the need for expensive chemical repellents. Another advantage of hydroponics in Hydrobuddy is that it reduces the space required for cultivation.



Firstly, the space required for installing the crops is reduced as the plants are placed in PVC tubes that store the filtered water and necessary nutrients for their development. The close proximity of the plants to each other, due to the constant presence of water, promotes higher vegetable production. Additionally, hydroponic cultivation can prevent soil degradation caused by excessive farming and the use of chemical products since the Hydrobuddy system only requires water, nutrients, and a container for storing water and growing plants. Therefore, it can be a viable solution for cultivation in areas where soils are degraded or unsuitable for traditional agriculture.



Natural Filtration. Utility and Development:

The natural filtration system consists of sand, gravel, activated carbon, and cotton, forming a technique used to purify water in a natural and effective way. It involves a series of layers made of different materials that trap particles, remove impurities, sediments, and chemical substances, thereby purifying the water.

We employ this system in the prototype because it is useful in purifying natural sources such as rivers, lakes, and streams, as well as in the collection of rainwater and dew.

The process is carried out in four stages:

Pre-filtration: A mesh is used to remove large particles such as branches, insects, leaves, and any debris from entering.

Filtration with gravel and sand: The water flows through a layer of gravel and sand. These materials act as mechanical filters and remove smaller particles and sediments.

Filtration with activated carbon: The water continues its path through a layer of activated carbon, which eliminates chemicals and organic compounds. Activated carbon is a porous and highly absorbent material that traps impurities such as pesticides, herbicides, chlorine, heavy metals, and other contaminants.

Filtration with cotton: Finally, the water passes through a layer of cotton, which acts as the final filter to remove any remaining residue or particles.

This natural filtration system with sand, gravel, activated carbon, and cotton is a more sustainable and cost-effective option compared to conventional water purification systems. Conventional systems often rely on chemicals and energy to purify water, which can be costly and potentially harmful to the environment. In contrast, the natural filtration system utilizes natural materials and does not require the use of additional energy or expensive chemicals. Therefore, this alternative can be more environmentally friendly and economically viable for populations with limited resources.

Requirements for Hydrobuddy:

Two 20-liter polyvinyl chloride (PVC) containers were used for water collection and storage. A natural filtration system was installed between the two containers. The first container was protected by a one-meter diameter metal mesh. Four PVC valves were used in the system. One of the valves is connected to a hydroponic cultivation system constructed from wood, which can accommodate eight plants distributed across two levels.

Costs (in Argentinean pesos):

Considering a 20-liter water collection and storage system with eight hydroponic crops.

- 2 PVC containers of 20 liters: $1,500 per container. Total $3,000.
- 1 metal mesh with a diameter of 1m: $1,500.
- 4 PVC valves: $270 each. Total $1,080.
- Wooden structure used for the hydroponic cultivation: $500.

The humus used is vermicompost produced at home through the digestion of organic waste by specifically California red worms. This compost is ideal for plants due to its nutrient-rich composition of nitrogen, phosphorus, and potassium, making it a natural and sustainable fertilizer for plant growth at no cost.

Requirements:

The amount of natural filtering material required to filter 20 liters of water will depend on the type and size of the container used for filtration and the number of layers of natural filtering material used.

It is recommended to use the following quantities of material per layer:

- Gravel: at least 2 cm thick. Equivalent to 1 kilogram.
- Sand: at least 2 cm thick. Equivalent to 1 kilogram.
- Activated carbon: at least 1 cm thick. Equivalent to 500 grams.
- Cotton: at least 2-3 layers of cotton, equivalent to around 200 grams.

Costs of the filtration system (in Argentinean pesos):

- Sand 25 kg: $320 Total per 1 kg: $12.80
- Gravel 25 kg: $2,500 pesos. Total per 1 kg: $100
- Activated carbon 1 kg: $1,500. Total per 500 grams: $750
- Cotton 1 kg: $1,600. Total used: $300

Total cost of Hydrobuddy: $7,242.80

Advantages of Hydrobuddy:

The water obtained through this prototype can be of sufficient quality to provide drinking water to a community of several hundred inhabitants in areas where the water resource is inadequate or can only be obtained through costly water tankers. The system is easy to install and maintain, and it does not require energy to operate, which means that the operating cost is virtually zero.

Disadvantages of Hydrobuddy:

This system can only work under specific conditions. If there is a drought, the system will not be able to collect water, and therefore, there will be no water production. However, it can be complemented with another water collection system to always ensure water availability. To prevent this, the system allows for water storage with attached storage tanks.

DEVELOPED MODELS

In addition to our scaled prototype, we have developed two models for collecting air moisture through dew and humidity condensation, which are detailed below.

Air Moisture Collection Models: Future Bioaqua Prototypes

The inspiration for this collection method is stimulated by biomimicry in the dew-collecting properties of plant leaves. Some plants have leaves that are designed to collect water from mist and dew. Some of their leaves feature a rough or hairy surface that generates a larger contact area with dew and a waxy layer that helps retain water on the leaf surface. Scientists have used this knowledge to create artificial materials that can be used in mist and dew water collection technologies, which is an example of biomimicry to develop innovative solutions.

Obtaining dew and obtaining water through humidity condensation are similar processes in the sense that both involve capturing water present in the atmosphere. However, there is a difference in how the condensation of water occurs.

Obtaining dew involves collecting the water that condenses on cold surfaces during the night or early morning hours. This process relies on the temperature difference between the collection surface and the surrounding air. As the surface temperature cools below the dew point, water from the air condenses onto it and accumulates on the surface.

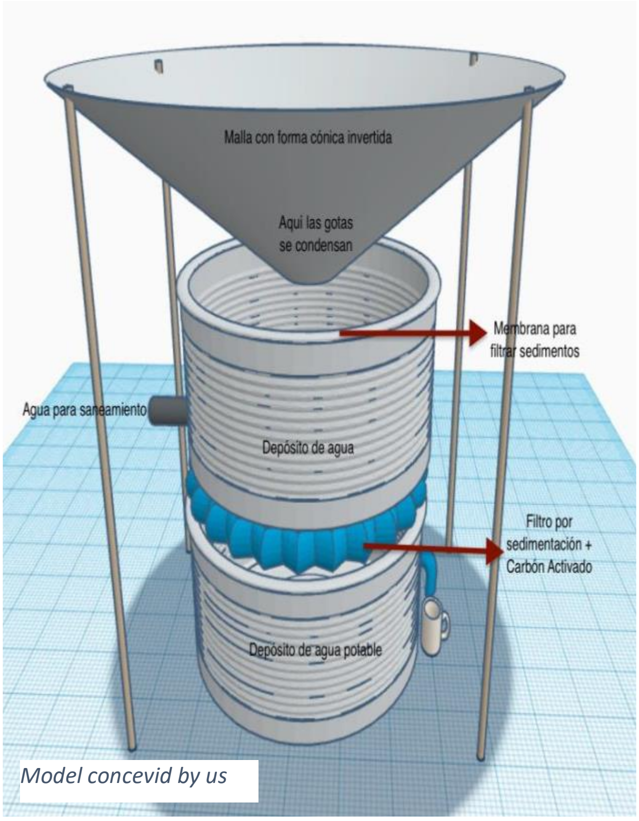
On the other hand, obtaining water through humidity condensation involves using a device specifically designed to condense water from the air. These devices use coolers to cool the air and cause water vapor to condense on a collection surface. The condensed water is then collected in a container.

The main difference between obtaining dew and obtaining water through humidity condensation is that the former relies on the temperature difference between the collection surface and the surrounding air, while the latter involves cooling the air to make water vapor condense.

These models enable the acquisition of water for developing regions that lack water sources or where the available sources are not safe.

The dew water collection model:

The conception and design of this device have been considered for its application in both urban and rural environments, utilizing its compact platform for additional purposes underneath the collectors. If not needed, the structure can be easily disassembled and stored for future use.



Model concevid by us

The dew collection technique can be employed in regions where water supply is scarce or limited to obtain water. This technique involves the placement of collection surfaces, such as meshes or sheets, in areas where dew is frequent, to collect the water droplets. We acknowledge that the amount of water collected can be limited and is conditioned by climatic factors such as relative humidity, ambient temperature, wind speed, and the surface area used for collection. Therefore, a detailed analysis of these variables is necessary to determine the effectiveness and viability of the technique in each region.

This system is ideal for implementation in areas experiencing population growth with the purpose of providing water to residents. Each collection unit, with an approximate size of 30 square meters, has the capacity to extract at least 150 liters of water per day from the environment. The volume of water obtained will be determined by the number of collectors employed and can be increased accordingly. For example, a network of approximately 4 square meters can capture around 20 liters of water daily, which amounts to 600 liters monthly and 7,200 liters annually.

Requirements:

Different types of meshes can be used for collection:

1. Stainless steel meshes: Fine woven structure for desert areas. They resist corrosion and have an extensive lifespan. They are suitable for extreme climates.
2. Shade meshes: Made of high-density polyethylene, these meshes are widely used in the agricultural industry to protect plants from extreme

weather conditions. They are ideal for dew collection as the small water droplets adhere to the surface of the meshes for subsequent collection.

3. Polyester meshes: They have high strength and can collect water due to their great retention capacity. They are also weather-resistant, making them suitable for extreme climates.

The selection of the appropriate mesh will depend on the application context and the environmental conditions in which it will be used.

The cost of acquiring a mesh for dew collection can vary based on the material, quality, and size of the mesh. In general, shade cloths made of polyethylene are a cost-effective option for dew collection.

The price of a polyethylene shade cloth can range from $450 to $1350 (in Argentinean pesos) per square meter, depending on the quality and size of the mesh.

Elements to be used for the dew collection model:

1. Collection surface: Shade cloth that can capture and collect dew water.
2. Pipes: Channels to direct the collected water to the storage location.
3. Storage tank: Container where the collected water is stored. It can be made of plastic with sufficient capacity to store the expected amount of water.
4. Metal mesh: Protects the tank from impurities entering.
5. Filtration system: To remove any impurities or contaminants from the collected water before use.
6. Pump and distribution system: To transport water from the storage tank to points of use, such as faucets or irrigation systems.

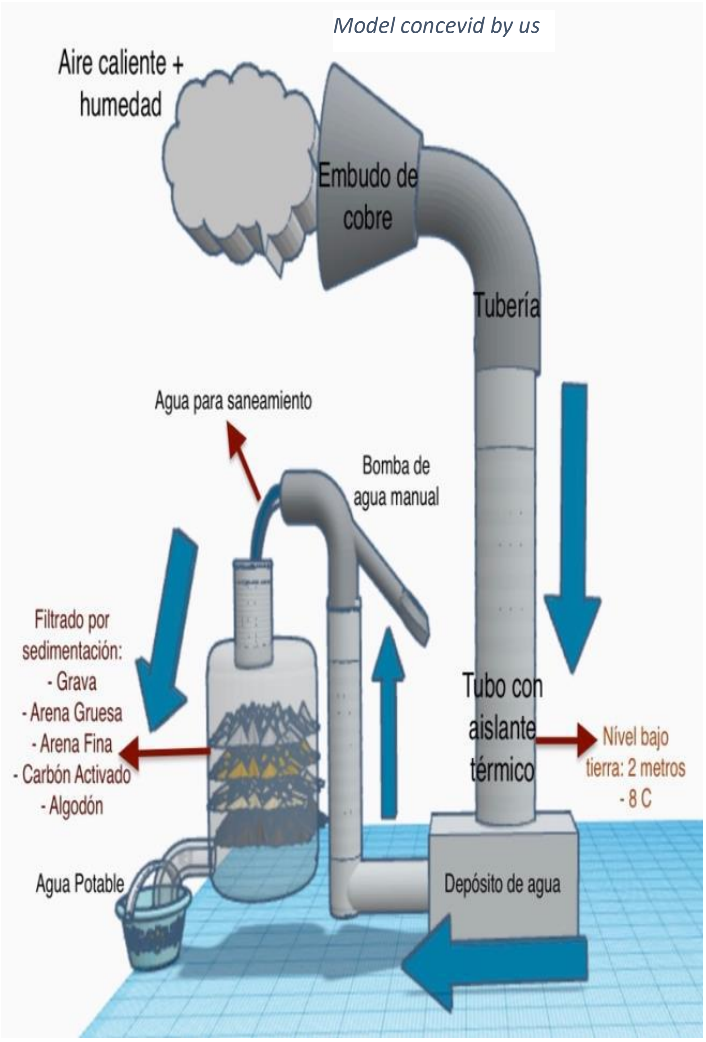
Costs and materials (in Argentinean pesos):

- Polyethylene shade cloth for 30 square meters: $13,500
- Pipelines and pipes: In general, PVC pipes (polyvinyl chloride) are an economical and popular option for directing the collected water to the storage location. The cost of a 20mm diameter and 4m length PVC pipe can range from $450 to $900. Total for 3 pipes: $2,700
- Storage tank: The cost can vary depending on the brand, quality, and material. Approximately, a PVC collection drum with a capacity of 150 liters has a value of $4,500.
- Metal mesh with a diameter of 1m: $1,500.
- Plastic manual siphon water collection pump: $14,900
- Distribution system with faucets and irrigation: Estimated with four faucet valves and their corresponding pipes: 4 faucets $270 each, total $1,080, 4 pipes $450 each, total: $1,800.

Total value of the dew collection model: $39,980.

Water collection by condensation of humidity:

It mainly consists of taking advantage of the condensation of environmental humidity.



The process is based on capturing water present in the air through the condensation of ambient moisture. To achieve this, it is necessary to understand the processes of condensation, dew, and precipitation. Condensation occurs when water particles in the air become too heavy to remain suspended and fall to the surface, which is referred to as precipitation. The dew point is reached when the atmospheric relative humidity reaches 100% and the temperature decreases, causing water to condense. This process can be harnessed to collect water, and it is important to consider environmental conditions such as temperature and relative humidity to maximize the efficiency of the method.

The following factors will be considered: climate type (sunny, partly sunny, cloudy, very cloudy, and cold), maximum and minimum temperature, atmospheric pressure, calculation of the dew point in degrees Celsius, relative humidity, wind speed, and measurement of the amount of water collected in milliliters. Quality materials at an accessible cost will be used to address water scarcity in areas lacking this natural resource and the inability to economically acquire reliable water sources.

The model is based on physical processes that allow its functioning as follows:

- Warm air containing moisture enters through the collection medium.
- Through a thermally insulated PVC pipe, the air is cooled, and condensation occurs. By burying the pipe to a depth of approximately 2 meters, a temperature decreases of around 8 degrees Celsius is achieved, which promotes water condensation.
- Subsequently, the water is stored in a tank and can be extracted using a pump.

This model utilizes copper or aluminum in its construction. Copper has a low specific heat. In this system, copper is located inside two plastic pipes, and thermal insulation is used between them to prevent heat loss. A copper or aluminum funnel is used, which, when in contact with the warm and humid air, causes water to condense on its cool surface. The warm and humid air contains more moisture than the air found in a desert, and when this air encounters a cool surface, condensation occurs. The funnel should be positioned in the direction of the wind, or air injection is necessary to enhance the water collection process.

Requirements:

- Copper funnel: with a diameter not exceeding 30 cm, for effective water collection. The funnel diameter should not be too large as it could decrease air velocity and reduce condensation rate.
- PVC pipes: for the humid air to start condensing.
- Copper sheets to cover the pipes.
- Additional thermal insulation: to regulate temperatures and increase the efficiency of the condensation water collection system.
- Water storage tank: to store the collected water and ensure its availability during times of scarcity. The amount of water that can be collected per day using a condensation water collection system depends on various factors such as relative humidity, ambient temperature, and the size of the copper funnel. Under ideal conditions, approximately 20 liters of water can be collected per day with a single collector. However, the actual amount of collected water may vary depending on the climatic conditions and the specific design and size of the dew water collection system.
- Water pump: if the collected water needs to be pumped to a distribution or treatment system.
- Water filter: to remove impurities and ensure the quality of the collected water.
- Shut-off valve: to stop the water flow in case of emergencies or maintenance.

The selection of materials and elements will depend on the needs and available resources, as well as the climatic and environmental conditions of the installation area.

Costs (in Argentinean pesos):

- 30 cm diameter copper-covered funnel: Total $3,057.
- Copper sheet 50mm x 1000mm: $1,257.
- Funnel: $1,800.
- 2 meters of thermal insulation: $995.
- 6 meters of 400mm diameter PVC pipes: $2,337.
- Copper sheets to cover the pipe surface 50mm x 1000mm: $1,257.
- 90-degree PVC elbow: $541
- 20-liter water storage tank: $1,200
- Small plastic manual siphon water pump based on collected liters: $3,000.
- Filter: specified in previous models.

Total cost: $12,387.

This method is cost-effective and can be used by low-income families to obtain water.

In conclusion, both the dew water and humidity condensation water systems provide water that can be used directly for hygiene and domestic purposes: washing, bathing, toilets, laundry, cooking, and, of course, irrigation. Although the water obtained may not be initially suitable for human consumption, it can be made potable using the purification method of Hydrobuddy.

TECHNOLOGIES FOR WATER PURIFICATION

Throughout our work, we have presented various technologies for water collection and their potential integration with systems that can convert non-potable water into potable water. In this regard, we have developed both the Hydrobuddy prototype and the Bioaqua models.

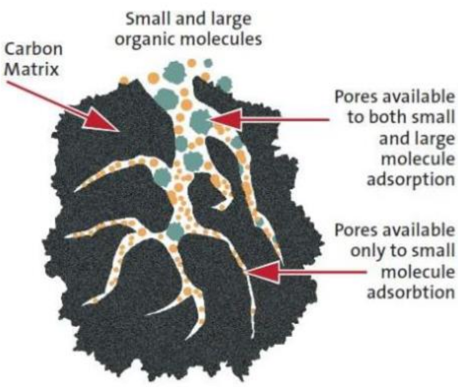
One approach focuses on rainwater collection, which allows for the simple and cost-effective acquisition of water. Additionally, we have designed a sedimentation filter with activated carbon, a material that works effectively in combination with other filtration and purification techniques.

Another technology considered in our work is UV filtration, which utilizes ultraviolet light to eliminate bacteria, viruses, and other microorganisms. We have also evaluated the use of reverse osmosis, a process that employs a semi-permeable membrane to remove impurities and contaminants from water.

In summary, we have analyzed and designed models that incorporate different technologies for transforming non-potable water into potable water. These technologies can be integrated with water collection systems to achieve a sustainable and accessible solution to the scarcity of potable water in various regions of the world.

Activated Carbon

Activated carbon is a material that has small pores on its surface, which are very tiny and capable of trapping organic substances present in water. Additionally, this material has the ability to break down free chlorine present in water and can also slowly decompose chloramines. In summary, activated carbon is a material that can effectively remove organic substances and chlorine from water, thus purifying it.



Functioning:

Activated carbon is a material with a large surface area that allows for the absorption of organic compounds in water through different forces. It is commonly used in conjunction with other technologies in the water purification process and should be considered in the design of water collection products. One of the main advantages of activated carbon is its ability to remove chlorine and chloramine during the pre-treatment process. Additionally, it is effective in filtering heavy materials from water. During the filtration process, contaminants are absorbed onto its surface, aiding in water purification and the removal of impurities. However, its effectiveness in removing heavy materials depends on various factors such as the concentration and type of contaminant, the amount of activated carbon used, the contact time with water, and the flow rate of water through the filtering medium.

The large surface area of activated carbon enables the adsorption of organic compounds onto its surface through ionic, polar, and Van der Waals forces.

- Cost of activated carbon (in Argentinean pesos): $1500 per kilogram.

Water Decontamination

It is important to ensure the availability of potable water worldwide and prevent health problems and contamination of natural resources. Strategies include both the prevention of water contamination and the decontamination through physical, chemical, and biological processes.

Contamination leads to the lack of accessibility to this resource and the inability to have fertile lands for cultivation, which would be harmful without appropriate decontamination processes. The focus is on purifying contaminated water to make it usable in different applications. Various techniques have been developed, such as decontamination with aquatic plants and bacteria, to achieve this goal.

There are several options for water filtration to make it potable that can be economically viable for a population with a water source contaminated with industrial waste. Some options include:

1. **Activated carbon filtration system**: An economical method. Already explained in this study.
2. **Gravel and sand filtration system:** An economical method. Already explained in this study.
3. **Reverse osmosis membrane filtration system:** Uses a semipermeable membrane to filter water and remove contaminants. This system can be costly to install but can be cost-effective in the long run due to low maintenance costs.
4. **Ultraviolet light filtration system:** Inactivates microorganisms by altering their DNA, preventing their reproduction. Low-pressure mercury lamps are used in laboratory water purification systems for this purpose.

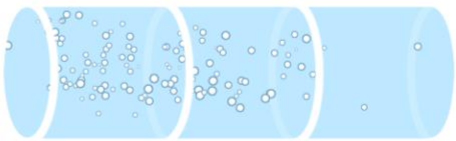
Determining the impurities in the water will allow us to establish the most suitable method for its filtration and ensure its potability.

Water impurities:

1. **Inorganic compounds** (can be treated by reverse osmosis): The main impurities in water are inorganic compounds, such as salts, carbon dioxide, silicates, chlorides, among others. Inorganic compounds are those that do not contain carbon atoms, although some may contain them. These compounds are often simple, such as sodium chloride (table salt).
2. **Organic compounds** (can be treated by reverse osmosis): Organic impurities in water usually come from the decomposition of plant materials,

which produces humic and fulvic acids, tannins, and lignin. Additionally, contaminants from human activity can increase the amount of organic compounds in the water, which can promote the growth of microorganisms and disrupt various biological applications.

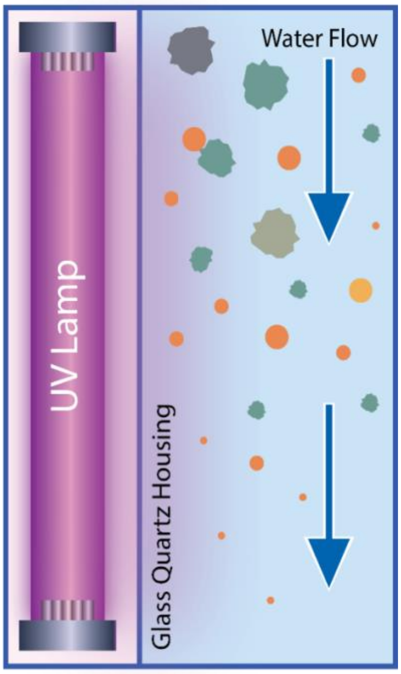
3. **Microorganisms and bacteria** (can be treated by reverse osmosis and UV system): Bacteria are the predominant microorganism in natural water contamination. Although chlorination is effective in removing harmful bacteria, drinking water still contains live microorganisms. Bacteria control in drinking water is achieved by using disinfectants such as chlorine, but once they are removed during water purification, bacteria can regrow.



Ultraviolet Light Filtration System

Ultraviolet (UV) radiation is used to purify water. It can alter DNA and enzymes responsible for producing RNA at low doses, and it can also break down large organic molecules into smaller components that are removed from the water. To do this effectively, organic ions are first removed through ion exchange resins. Additionally, ultraviolet light is also used to remove chlorine and chloramine from water through a process called photolysis.

Water treatment with ultraviolet light is used to remove organic contaminants and microorganisms. UV light disrupts organic impurities and converts them into charged molecules that can be removed through ion exchange. The UV lamp is used in conjunction with an ion exchange process to maintain water quality. This method can produce water with very low levels of organic carbon and bacteria.



A UV light-based filtration system can be a cost-effective option because it does not require the use of chemicals and has a long lifespan with low maintenance. However, the initial installation cost can be high, and it is not the best option for treating certain contaminants such as excessive sediment.

It effectively eliminates bacteria, viruses, and coliforms (but does not degrade heavy metals), while activated carbon can degrade heavy metals or an ionization chamber can be used.

The price of a UV water filtration system in Argentina can vary depending on the model, brand,

and capacity of the system. Generally, UV filtration systems can be found ranging from around $10,000 to $100,000 (in Argentinean pesos) or more. However, it is important to consider that price should not be the sole factor when selecting a filtration system, but also the quality and effectiveness of the system in removing water contaminants.

Ionization Chamber:

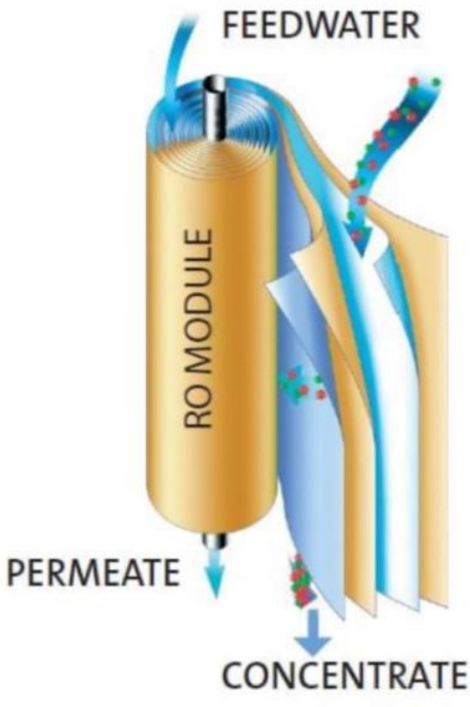
Removes heavy metals and carcinogenic chemicals such as lead, mercury, chlorine, iron, cyanide, magnesium, chromium, and calcium. Along with UV filtration, it provides water free from viruses, bacteria, algae, etc.

Functioning:

It utilizes electrolysis technology to separate minerals and impurities from water. A device with a titanium plate and a copper or silver anode is electrically charged to attract negative and positive ions and form pure water molecules while separating impurities in a sedimentation chamber. The resulting water is known as ionized water, with high mineral content and a pleasant taste. However, this system can be expensive and require regular maintenance, and it may not remove certain chemical contaminants from the water.

The cost in Argentina can vary. A filtration system for 100,000 liters requires a kit priced at 80,000 Argentinean pesos.

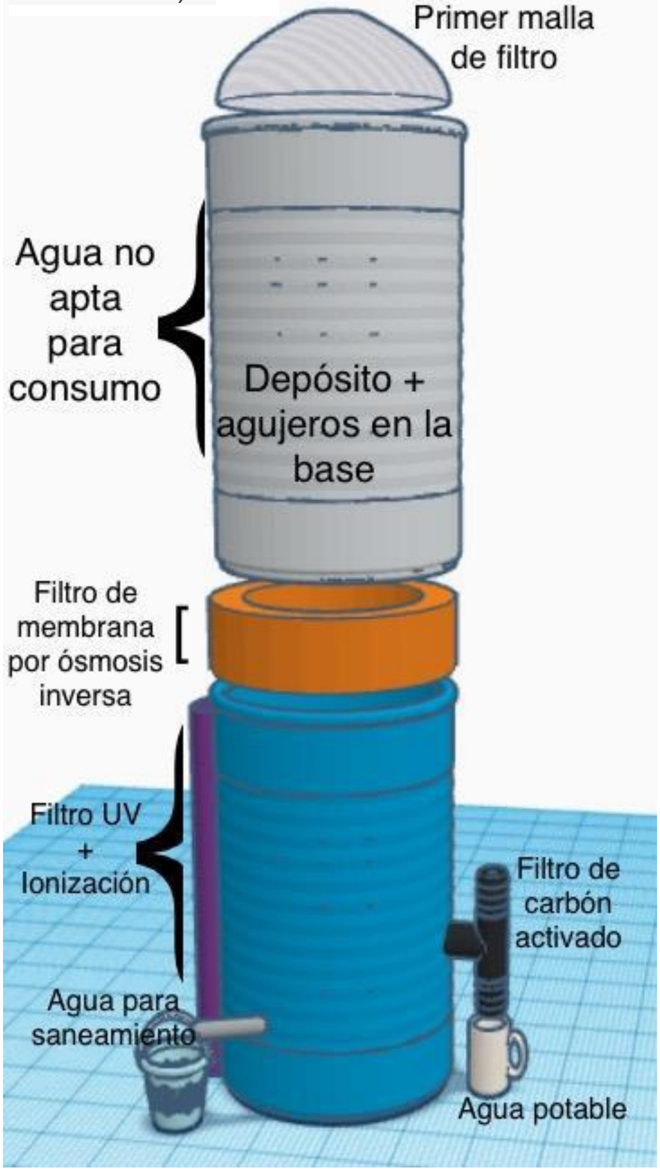
Reverse Osmosis Filtration System:



A reverse osmosis system is a highly effective method for water purification. The process involves the circulation of water through a membrane under pressure in a cross-flow manner, removing up to 99% of impurities.

Functioning:

During reverse osmosis, water is forced through a membrane under pressure, separating contaminants and dissolved solids from the water. Most of the water passes through the membrane as permeate, while the remaining water becomes a concentrate that contains the contaminants. The membranes used are thin and typically made of polyamide. They are pH-resistant and are designed to remove contaminants and retain substances smaller than 1 nm in size.



Model concevid by us

The model we have devised consists of several components that work together to eliminate a wide range of water contaminants. Pre-filters are the first components in the reverse osmosis process and are used to remove large particles and organic matter before the water enters the purification process.

The pressure pump is necessary to force the water through the semipermeable membrane in the next step of the process. The semipermeable membrane is the most important part of the reverse osmosis system as it separates pure water from contaminants. During this process, water moves through the membrane from the side with higher solute concentration to the side with lower solute concentration, creating a flow of pure water or permeate that is separated from contaminants in the concentrate.

Finally, post-filters are used to improve the quality of water and eliminate any residual taste or odor that may remain after the reverse osmosis process. This system is highly effective in removing a wide variety of water contaminants, including salts, heavy metals, organic and inorganic chemicals, and some types of bacteria and viruses.

It should pass through a chlorine filtration system such as activated carbon.

The system requires regular maintenance, including the replacement of filters and semipermeable membranes. Additionally, the reverse osmosis process can be slow, meaning it may not be the best option for water systems that require large volumes of filtered water in a short time.

The model we have designed and presented consists of a contaminated water collection system that is stored in a container previously filtered through a metal mesh to remove large impurities. The water then flows through a reverse osmosis membrane filter to reach a second tank where UV filtration and ionization take place. In this tank, there is a tap for extracting water for sanitation or attaching a tank for storage and subsequent use. Additionally, the tank has an outlet to an activated carbon filter to ensure complete purification and safe consumption. It is important to note that while this system is effective in ensuring the supply of potable water, its implementation may be costly for low-resource communities. However, it is financially viable for industries, educational institutions, and governmental organizations that can collaborate in subsidizing and assisting these underprivileged communities in need of this vital resource.

Therefore, to ensure that our work and purpose do not remain a utopia, we propose basic ideas and alternatives for community awareness and participation as a whole, to proactively address this issue that affects millions of people.

Water Awareness Proposals for Life

Measures are proposed to raise awareness about the importance of clean water, promote responsible water usage, and prevent water pollution in educational institutions, private sectors, and businesses.

Measures for the population:

1. Implementation of mandatory education on water resources and their natural acquisition methods in the school curriculum.
2. Conducting workshops and educational talks in communities to teach them about the importance of water, scarcity issues, and the need to implement water collection systems.
3. Creation of educational manuals and instructional materials that explain in a simple and visual manner how to build and maintain rainwater and dew collection systems, as well as the process of water filtration and purification.
4. Encouraging active participation of communities in the construction of water collection systems by fostering collaboration among neighbors and organizing brigades for filtration system construction.
5. Carrying out awareness campaigns on social media, media outlets, and public spaces to sensitize the population about the importance of rational water use and the utilization of natural resources such as rainwater and atmospheric water.
6. Encouraging local governments and organizations to create public policies that promote the implementation of rainwater and dew collection systems in homes, schools, and other community spaces.
7. Conducting hands-on activities in schools, such as the construction of water collection systems and hydroponic school gardens, to enable children to learn about the value of water and how it can be used sustainably.
8. Organizing fairs and exhibitions showcasing water collection technologies and systems, where the population can explore and learn about different options for water collection and filtration.

Promoting industries to assist their neighboring population in obtaining natural water and its filtration:

1. Conduct an assessment of water availability in nearby communities and determine if assistance is needed for access to clean and potable water.
2. Establish partnerships with local organizations dedicated to water management, sustainability, and community development to ensure the viability and success of the project.
3. Engage industry employees in volunteer initiatives to install water collection systems in nearby communities and train residents in their maintenance and care.
4. Consider implementing rainwater or dew harvesting systems in industry buildings and green areas to reduce dependence on municipal water supply.
5. It is essential for governments to promote public policies that foster corporate social responsibility and collaboration with communities to ensure access to clean drinking water. This can be achieved through tax incentives, corporate social responsibility programs, and stricter environmental regulations.

In conclusion, the industry can significantly contribute to access to clean and potable water in neighboring communities by implementing sustainable initiatives committed to conservation and community development.

Conclusion

Water is a vital and indispensable resource for life and sustenance on our planet, and its sustainable use and responsible care are essential to ensure the survival of all forms of life on Earth. Furthermore, it is our duty and collective responsibility to ensure that all people have access to clean drinking water, regardless of their geographic location. Lack of clean water, climate change, and pollution are critical and urgent problems that require our immediate attention and action. Together, we can take concrete measures to protect and preserve this vital resource for present and future generations. Let's care for water, let's care for life!

Contribution to the United Nations Sustainable Development Goals (SDGs)

Our project aligns with multiple SDGs set forth by the United Nations in 2015 to be achieved globally by 2030.

These include:

- **Goal 2 Zero Hunger**: Hydrobuddy provides access to fresh vegetables to communities without access to green foods.
- **Goal 6 Clean Water and Sanitation**: We offer safe drinking water suitable for human consumption and cleaning purposes.
- **Goal 9 Industry, Innovation, and Infrastructure**: We foster an inclusive structure to assist individuals lacking vital resources without harming the environment.

- **<u>Goal 11 Sustainable Cities and Communities</u>**: We utilize sustainable and inclusive approaches to address a problem affecting communities, promoting sustainable practices.
- **<u>Goal 12 Responsible Consumption and Production</u>**: We promote awareness of the water access problem and its responsible use, such as minimizing consumption through hydroponics.
- **<u>Goal 13 Climate Action</u>**: We drive immediate action to assist communities without access to water due to pollution or other factors.
- **<u>Goal 14 Life Below Water</u>**: We promote the protection of seas, oceans, and marine life by using environmentally friendly alternatives.
- **<u>Goal 15 Life on Land</u>**: Hydrobuddy prevents the exploitation of land resources by implementing a hydroponic system.

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