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Mexico, Factor 9: Water & Sanitation

Rainy but Thirsty: A view from Chiapas

For many decades Planet Earth has been considered unique in our Solar System, the reason is simple yet amazing and almost incredible for it has the exact amount of elements and conditions to make it an excellent place for us, for life. These conditions didn't appear from one day to another, it was the result of millions of years of evolution that little by little brought Earth, as we know it today. Since humans stepped on it, things have changed, this specie has been positioned above all the others, this because of our capacity for developing as we have been doing it. Of course, the evolution of human beings has been a path full of mistakes and investigation but thanks to it now we have electricity. We´ve been to space many times, technology is focusing on robots and items to make life easier, and medicine is trying to find ways to make patients last longer. In conclusion, it looks like the human specie is trying to achieve life´s perfection, where there´s less work and a total control about our world. But, how realistic is this? Are science and technology really helping to make a better world? I may say they are, but not totally. Many products are thought to be consumed by certain people, humans are progressing but only if it´s seen from big cities. People can´t talk about progress when there are many other who still don´t have basic supplies for a dignified life.

According to the Universal Declaration of Humans Rights' article 25, "*Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services[…]"(***UN, 1948).** However, the fact that it´s a right does not open the possibility for everyone to access to this right. Many people live nowadays without this right. The reasons are subjected to economic, political, geographical and even social issues. Amongst all the deficiencies that humanity is now facing, there´s one which I want to emphasize and that it´s supposed to be equally administrated all over the world but has become a necessity in many countries and has caused more deaths than tuberculosis: the shortage of clean water which is not only an actual reality but a problem for the next generations that may get worse because of the lack of water expected by 2025. **(WHO, 2017)**

It turns out to be that water must be "sufficient, safe, acceptable, physically accessible, and affordable for personal and domestic uses" because it is a fundamental element for humans. **(UN, 2012)**As it is known, water is basic for life, but it has become limited and even though today there have been many inventions and propaganda to prevent water waste, humans need clean water in order to consume it. But this is far from reality in many communities. According to World Health Organization (WHO), 884 million people don´t have access to basic water supply service, which includes 184 million people consuming water from lakes or other water bodies, which of course, don´t supply people with water acceptable for human activities. The reasons why this water is contaminated vary from bacteria, to chemicals thrown by industries nearby. It is estimated that around 842,000 deaths are caused annually by diarrhea after consuming unsanitary water. 361,000 of these deaths are children under 5. **(WHO, 2017)**

Consuming contaminated water can transmit diseases such as diarrhea, typhoid and cholera and even though this problem is worldwide, it is affecting countries mainly with low and medium incomes. This is the case of Ixtapa, Chiapas in Mexico.

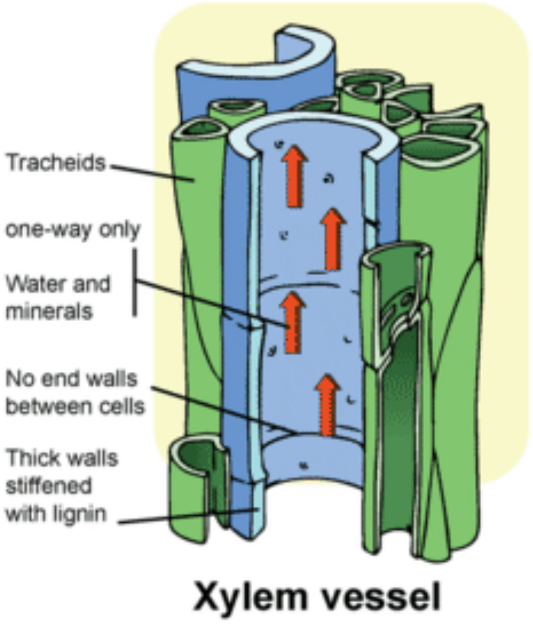
Chiapas is known for its biodiversity and beauty, besides that it was part of the Mayan world; it's a place rich in flora and fauna. This Mexican identity has seven different ecosystems, including jungles and forests, meaning that about 49.9% of the water comes from rain from which a considerable quantity is poured into one of the 46 rivers, 5 lagoons or dams. But even if Chiapas is a rainy place, this makes no difference if water can´t be cleaned because of the lack of economic resources, which in fact, brings the absence of basic services in rural areas and in some cases even in residences. Actually, according to a study made by the National Institute of Statistics and Geography (INEGI) in 2010, only 57.2% of Chiapas's homes have piped water, which means that the other 42.8% does not have access to water appropriate for human activities. **(INEGI, 2010)**

Even though many areas in Chiapas are affected because of water shortage, Ixtapa is an interesting zone to point out because of its geography and its culture. Ixtapa is home for over 600 indigenous people that besides being a municipality with water issues, Ixtapa is a place full of unemployment, malnutrition and poverty. It is considered as one of the most marginalized places in Mexico as it lacks from basic services but it also lacks from attention from authorities. Due to political aspects, Tzotziles, who are the indigenous people who inhabit this area, can´t have clean water neither a water system. This makes Tzotzil people use the muddy water, to which they have easier access, for daily activities including cooking and drinking. As a "fast solution" these people have the opportunity to walk over 3 hours in order to get water from the nearest community, which is Aztlán but it is only permitted to get 20 liters per person which is not enough for a family besides that, many people decides to stay in Ixtapa consuming the water they have easier access due to sickness or age. There´s another case, were women have to walk over 40km in order to get water from rivers nearby, but it is not clean. This puts these people in disadvantage, because they risk themselves by doing large and dangerous trips to get the water, the waste of time between getting the liquid and using it is incremented and that prevents Tzotziles from doing activities like attending school in the case of children. In terms of familiar economy, these people are susceptible to get sick and waste money that for them is very difficult to earn, in medicaments and medical assistance, which, is not available in the municipality. Biologically speaking, a human body needs water in order to work properly, if a human does not drink clean water regularly, the chances of having a breakdown increase. For example, it may cause digestive, skin and cholesterol problems and contractions in the brain so it also affects in terms of learning and development. In places were water is not abundant, people tend to let hand washing behind, which increases even more the chances of getting sick. Children and pregnant women are main target of sicknesses if unhealthy water is drunk. In fact, men need to drink around 2,5 to 3,7 liters per day and women from 2 to 2,7 but drinking contaminated water may bring deathly consequences. **(Revolución TRESPUNTOCERO, 2017)**

The shortage of clean water is a problem, but it may have a solution, in Ixtapa´s case a very efficient and reliable one and it is simple: a filter. Today, there are many methods in order to clean water and it goes from chlorination to something more elaborated and complicated like water´s treatment by means of ozone. All of them have certain level of trustworthiness depending on its complexity and use of technology, in the same case, each one of them have certain level of accessibility and of course of contamination. In consequence it is the level of accessibility that makes filters imposible for all people to have them, besides contaminating the ecosystems, which by the way, are already damaged by other human activities. But here is where social responsibility takes place. In 2013 scientists interested on this global problematic had the task of searching an alternative to all the filtering methods, a more economic one but with a great level of filtration. This led to a project made by a group of scientists from MIT, who decided to look into the woods. This project was based on the xylem and its structure, which allows the flow of sap but filters the bubbles, something similar to water, where the objective is the filtering of germs.

It sounds amazing except for the fact that not many people know what xylem is. Well, xylem is the set of plants´ woody vessels. It is used as conductor, which is constantly transporting raw material from

the roots to the leaves; little ducts placed in parallel compose this structure. These vessels have porosities where the bubbles are kept but not the sap. In the filter´s case, the water passes but not the other particles. But to make the filter effective as it is planned it is needed a type of xylem which vessels are very narrow in order to establish water resistance and automatically force the liquid to pass slower through the holes but more effectively. **(S.H., MICHAEL, LEE, J. *Et al., 2014)***



(ck12.org)

The process can be made with gymnosperms, which are plants with ramifications that flower but do not have fruits and their leaves are simple, such as pines, cedars, firs, among others species. Ixtapa is located on the edge of the Altiplano Central and Montañas del Norte, Mexico, two mountainous areas, making the zone the home of flora such as pines, cedars, cypress, mahogany and other gymnosperms that makes xylem filter perfect to eradicate clean water problems in this area not only by this factor but also because Ixtapa´s hydrographic network that is formed by 4 rivers and 2 streams besides being a place where rains a lot during summer time. **(AYUNTAMIENTO DE CHIAPAS, Not Defined)**

The effectiveness of xylem filter is high since gymnosperm xylem can filtrate particles of 150 nanometers in reason of 0.05 mm/s and it is needed less than a centimeter of diameter to start cleaning water. When water passes through this structure, it works as a little sieve in which all the particles that cannot pass through the holes from the tracheas get trapped. These "particles" involve protozoa, bacteria, and other pathogens and objects. Before trying with official experiments, MIT scientists made a previous test where particles from red paint from around 70 and 500 nanometers were dissolved in water and it was proved that most of the paint had been trapped in the filtering process. In fact, all the particles apart from the water were trapped in the first millimeters of the branch. This type of xylem traps particles larger than 100 nanometers demonstrating a high level of efficiency, eliminating 99% of the particles of 150 nanometers or bigger. Following this, the filters were now tested with *Escherichia coli* and in all cases it was demonstrated that at least the filters caught 99% of the bacteria. This allowed scientists verify the

product´s reliability in terms of bacteria eradication. Even though these filters cannot filter virus, which are 1 nanometer large. It is believed that there are gymnosperms with smaller porosities that could do it. What is certain is the fact that a single piece of branch can filter up to 4 liters of water per day. **(S.H., MICHAEL, LEE, J. *Et al., 2014)***This makes another point for the filter because with a large branch, used wisely, a person could have the 20 liters needed for human use recommended by the WHO without causing major deforestation if the usage is done with responsibility. **(NATIONAL WATER COMMISSION, 2015)**

As it can be seen, despite being a filter made by natural elements, it is pretty effective and it is easy to elaborate one, it only needs one fresh branch around 1 inch long and 1 cm diameter, one plastic tube from the same diameter, a clasper and two containers, one for the water to be cleaned and the other where the cleaned water falls. The measures can be adjusted according to the quantity of water that needs to be cleaned. **(S.H., MICHAEL, LEE, J. *Et al., 2014)***

Photograph by Victoria Lozano

Comparing the cost of the xylem filter with other filters, one can realize that is pretty economic because as the material is simple, it can be made out of recycled items. The approximate cost of production ranges between $30 to $35 pesos for a filter, that is less than 2USD. In a community like Ixtapa, this xylem filter

in a very good solution because even though people there live in poverty, this project can be accesible because of its simplicity and resistance because it only needs a constant spare, the branches. Because of its simplicity, this method can be taught to the Ixtapa´s inhabitants, leading into an independent and healthier way of survival.

In conclusion, the xylem filter is a great and adaptable alternative to counteract the unsanitary water problem. Even though the filter was presented but is still not used neither known by many people, it could improve considerably Tzotziles´ lifestyle by helping decrease health problems related to unhealthy water usage because Ixtapa is a place surrounded by water bodies. If there´s any complication for a family to get there, we are talking about a rainy area, where people can catch water from rain besides that, its flora contains different types of gymnosperms, which are the best type of plants for this filter. As it was mentioned before, the cost of its elaboration is low. Further than these reasons, this invention fulfills the sustainability´s definition because it brings a benefit to present generations without endangering future generations. Despite using a natural resource for this benefit, if its used with responsibility, the payment for this usage can be a reforestation program, plus, this solution can be extended worldwide. This can be the solution to other places with similar climatic characteristics such as Tanzania, some areas in Afghanistan, Togo or Peru.

I´ve been told that every problem has a solution, I still don't know how truthful this saying could be, but if I know one thing is that we are a globalized world, with significant progress in terms of technology and science but still with many necessities in terms of humanity. A balance between what it is needed and what it is used must be a reality, but this cannot be achieved if us, as a globalized world, become blind against problems such as the one Ixtapa and many places in the world are living. It is our obligation as prepared people to become socially responsible by helping others who are in disadvantage. A little science, heart and dedication can make the difference in a simple glass of water. Decisions nations make, affect the rest of human population depending on what is being discussed. Death from drinking unhealthy water can be prevented and it is a challenge that us, as part of globalization must accomplish.

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