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What technologies are being applied in La Guajira (Colombia) for the collection and distribution of water?

¿Qué tecnologías están siendo aplicadas en La Guajira (Colombia) para la recolección y distribución de agua?

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Within this article we take a brief look at the water situation in Guajira (Colombia). We talk about the available water resource and its rationing for the support of the community. We also present a small historical review to know the origin of the inconveniences related to water in the territory. The technologies used to obtain drinking water are then discussed. First, we describe the drinking water wells that are not an applied technology, but they are one of the main sources of supply, and are still being installed throughout the region. Secondly we will see the water desalination system, its application in this territory and its different methods and techniques developed, and as the latest technology is the Warka wáter, an ambitious project but little applied due to the climatic and geographical conditions of the territory.

Keywords: Desalination, drinking water, Guajira, Warka wáter, water wells

Dentro de este artículo damos un breve vistazo a la situación del agua en la Guajira (Colombia). Se habla del recurso hídrico disponible y su racionamiento para el sostenimiento de la comunidad. También se presenta una pequeña reseña histórica para conocer el origen de los inconvenientes relacionados con el agua en el territorio. Luego se habla de las tecnologías usadas para la obtención de agua potable. Primero se describen los pozos de agua potable que no son una tecnología aplicada, pero son una de las principales fuentes de abastecimiento, y aun en la actualidad están siendo instalados por toda la región. En segundo lugar veremos el sistema de desalinización de agua, su aplicación en este territorio y sus diferentes métodos y técnicas desarrolladas, y como última tecnología está el Warka wáter un proyecto ambicioso pero poco aplicado por las condiciones climáticas y geográficas del territorio.

Palabras clave: Agua potable, desalinización, Guajira, pozos de agua, Warka wáter

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Introduction

The Department of La Guajira is in northwest Colombia (Fabregas, Valencia, & Vanegas, 2017). It is made up of 15 municipalities and has a population of approximately 846,000 inhabitants, of which 54.6% live in urban areas and 45.4% live in rural areas (Ferrero, 2015). Of the 20,848 square kilometers, it covers, 41% is classified as a subtropical desert (Moreno et al., 2015).

The area has characteristics that do not allow it to be served traditionally with a network of aqueducts (Banks, 2017; Ospina, Domínguez, Vega, Darghan, & Rodríguez, 2017). The extension of the territory, the dispersed population, or the nomadic life of many communities forces us to think of alternatives to the problem (Beier, Bernal, Ruiz, & Barton, 2017; Calle et al., 2017; Osorio, Montoya, Ortiz, & Peláez, 2016).

This article describes the current situation of water shortage in La Guajira, the new technologies for obtaining drinking water that is supported and applied in other countries, which are being studied on a large scale and may be possible solutions to the current problems of La Guajira.

Currently, there is the possibility of exchanging information with Israel, which is a country that has managed to position itself as one of the most advanced and innovative countries in the field of water technologies through diplomatic efforts.

The main objective of this article is to inform and raise awareness about the situation that has existed in La Guajira for years, highlighting mainly the neglect of the state that has made it impossible for this territory to obtain drinking water.

Theoretical framework

Water in La Guajira

The issue of water in the territory of La Guajira is developed in a framework of scarcity and drought, especially the Wayuu indigenous community living in rural areas of the department. Factors such as the abandonment of the state, corruption, and misuse of the resource have been causing the population for decades to be at risk from the lack of water, because it should not be forgotten that this is indispensable for human life, for food and health. It also affects the economy because without water it becomes complicated for the inhabitants of the area, the water obtained is often not suitable for crops or livestock.

Historical overview

From the ancient Guajira civilizations that maintained water as the guarantee of life for their communities; a resource that in the first instance was altered by the mining extraction activity that saw its beginning in December 1984 and that was privileged because its promoters claimed that it would be an engine for the economic growth of the region getting to generate during its first 20 years of gas, coal and salt production some royalties of the department that exceed 5 billion pesos. La Guajira assumed progress, one that in many economic and industrial aspects arrived, but was never reflected in the quality of life of the community. Added to the previous one, another of the main aggravating factors for the region are the corrupt behaviors of the state and the authorities responsible for the distribution of resources in the region because, in the last decades, scandals about education, health, child care, and civil works programs have become a habit in the department. A department that, to top it all, is plagued by droughts that have not stopped for years.

The current situation

The current situation is worrisome, very often there are human victims due to the lack of water in the Wayuu communities and the figures of infant mortality are alarming and heartbreaking. The liquid is scarce about the high temperatures that plague the department and is a problem that to date has not been solved by either the public or the private sector and has also become more important for the national and international agenda due to the climate changes felt in recent years.

The water problem currently contributes to the deterioration of the health of the population, with the spread of disease and malnutrition, which in turn generates stagnation in the agricultural, economic and social development of the department; the community is not in optimal conditions to work, which in turn also generates poverty and social imbalance.

According to the same leaders of the Cerrejón mining area, the Ranchería River supplies 16%. Of the water used, mainly for human consumption by employees, contractors, and inhabitants, and for delivery to neighboring communities, they also state that of the total water we consume each day, 90% is of low quality, i.e. not suitable for human or animal consumption or for irrigating crops. This water comes mainly from coal seams and rainwater and is used for environmental dust control measures, as established in the Environmental Management Plan.

The problem and the new technologies

Drinking water wells

A resident of the Wayuu community can take hours to get a ration of water, this is a routine that is part of their customs but the situation of mobilization of the complicated year after year for this reason since August 2016 the Ministry of Housing installed water sources for communities with supply problems in the form of wells with quality groundwater, these wells but are not considered as a new technology if they are a long-term solution to the problem.

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Water desalination

97.5% of the water present on earth is salty, so only less than 1% is available for human use. The situation in recent years, coupled with conflicts on the border and underlying reasons such as extreme poverty in the region and corruption, has aggravated the water crisis in La Guajira. This is why the company Col Energía in alliance with the company MFT created a supply system based on water desalination with the use of solar energy, wind power, and automated plants (Adak & Tewari, 2014; Cardona, Vela, & Martínez, 2015).

Col Energy S.A.S is a Colombian company focused on proposing, designing, and implementing innovative projects, sustainable over time, and with high social and environmental impact within the framework of energy management and water treatment.

How does a desalination plant work?

The first stop in a plant is the collection and cleaning of water. Collection pipes located at the bottom of the sea capture the saltwater and transport it to the pre-treatment area to eliminate the solids in the water and sodium hypochlorite is added to eliminate bacteria and other microorganisms present in the water. After this, it passes through a section where it is filtered by the sand and different coagulants that soften the smallest particles that are in the water (Le Roux, Nada, Khan, & Croué, 2015). Then they are separated by a microfiltration stage where the smallest particles are removed, the filters used contain activated carbon and other products, capable of retaining micro impurities. The most important stage is the passage of the water through the reverse osmosis frames (Abdeljawad, Zaqoot, & Aish, 2016; Sankar, Deepa, Rajagopal, & Karthik, 2015). These are responsible for converting salt water into freshwater by applying mechanical pressure on the container of the most concentrated solution, the water moves in the opposite direction, separating from the salt during the process (Carravetta et al., 2016). A pressure pump makes the saltwater pass through a tube with seven semi-permeable membranes inside, which only allow the water molecules to exit, retaining the salts in porous support. Finally, the water passes to the post-treatment stage where it is remineralized by adding lime and carbon dioxide so that it is suitable for human consumption. The treated water is stored in special tanks, ready for distribution.

Currently, less than 1 percent of the world's population depends on seawater desalination for its daily drinking water supply. There are about 21,000 operating desalination plants, most of which are located in the Middle East.

Alternatives to desalination

Wind desalination. A wind-powered desalination plant was built. The plant consists of the Wind Energy Transformer tower whose rotational energy directly initiates the operation of a compressor through a gear system. Subsequently, the temperature levels are raised and the pressure reaches the appropriate level for the water to evaporate. The evaporation causes the freshwater to condense, leaving the salt behind (Rezaei, Naserbeagi, Alahyarizadeh, & Aghaei, 2017).

In La Guajira, the system promises to be a system where the area is swept almost all year round by the trade winds that blow from the Caribbean Sea in a north-east and south-west direction. The Guajira is home to the only wind farm in Colombia that registers winds equal to or higher than 5 m/s, even reaching 11 m/s these figures sound attractive to implement the model.

Solar desalination. It consists of the evaporation of water to separate salts and other impurities from the water. Thermal desalination imitates the natural process of the water cycle, evaporation from the ocean, accumulation in the atmosphere, condensation in the form of rain or snow, and harvesting. As heat is vital in thermal desalination, the process is often linked to refinery power stations, to use the waste heat (Fig. 1).

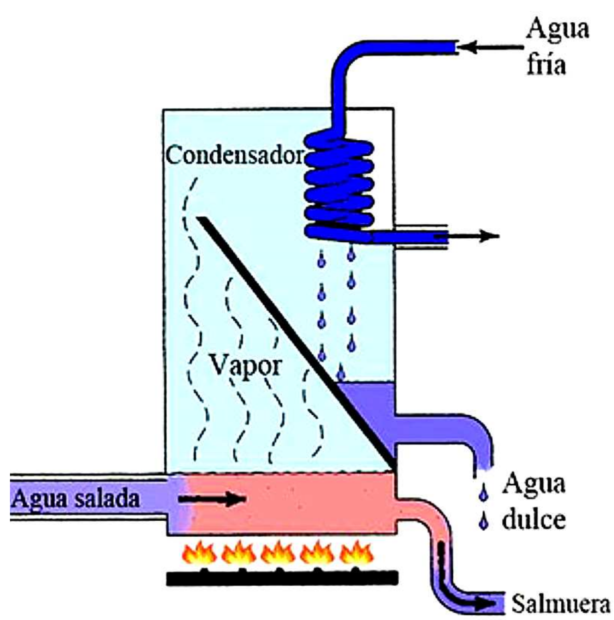

Figure 1. Thermal or solar desalination and its operation (Opex Energy, 2017).

The initiative will benefit 2,975 natives directly and up to 2,275 indirectly. The cost of this proposal exceeds 785 million pesos, of which the Cerrejón Foundation finances 53 percent. This percentage, in figures, is equivalent to more than 415 million Colombian pesos.

Warka Water

Warka Water is a tower made of bamboo and biodegradable plastic that can collect water from rain, fog, and dew. It was developed by the architectural firm Architecture and Vision; the architect Arturo Vittori designed it in 2012 in his laboratory in Italy and a year ago he took a prototype to a villa in Ethiopia where the pilot project is being made. This structure stores rainwater, decanting fog and converting wind humidity into gothic, which then becomes water threads to supply the neediest communities. It is a vertical structure with a perforated fabric inside that hangs to collect water from the air through condensation. The triangular mesh structure is made of natural materials such as reeds and can be built by the villagers. The structure, which weighs only 60 kg, consists of 5 modules that are installed from the bottom to the top and can be lifted and assembled by 4 people, without the need for scaffolding. The tower can obtain up to 100 liters of drinking water per day.

The tower is about 10 meters long, according to the prototype, and can generate up to 100 liters of water per day. It holds about 3,000 liters. Its construction is manual and takes a maximum of 10 days and 10 people.

Warka Water Tower in La Guajira. In February 2016 Arturo arrives in Colombia intending to provide a clean solution for the indigenous people suffering from a delicate water situation, first arriving in La Guajira to make an excursion in which the architect accompanied by a group of engineers and specialists to evaluate the conditions of the land and determine if it is suitable for the installation of the system.

Supporting studies

The average salinity of seawater is 35000 ppm (parts per million), although in warm seas it can reach 42000 ppm. In inland seas, it varies between 5000 and 7500 ppm. There are aquifers with a salinity of 2000 ppm (parts per million) (Arreguín & Martín, 2000).

Desalination systems

Desalinated water is used for human consumption, in industrial processes, and in a very limited way (Fig. 2).

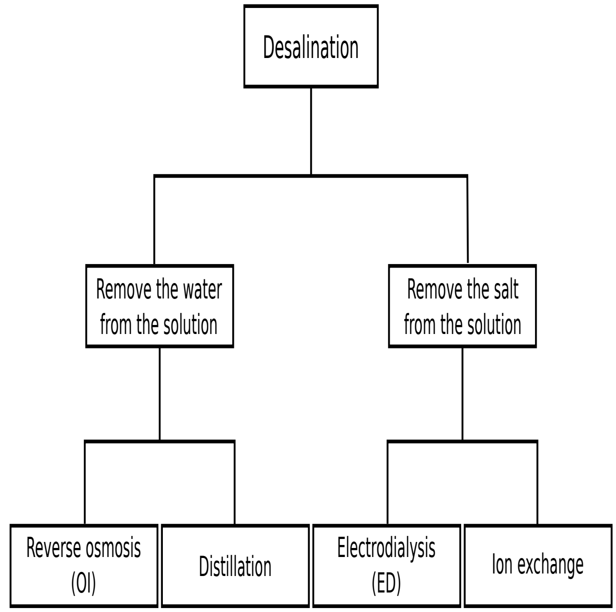

Figure 2. Desalination systems (Arreguín & Martín, 2000).

Costs of desalination

The cost of desalination is very variable. This is due to several factors, including the following:

- Source water quality.
- Plant capacity.
- The conditions of the installation site.
- Energy costs.

Environmental impact of desalination plants

The construction of a desalination plant implies the need to prepare the corresponding environmental impact studies, and to propose the mitigation measures following the regulations.

The benefits of water desalination in terms of the uses that can be made of it already in that condition are infinite, as well as its availability. One of the most striking benefits is to achieve the development of cities or towns where there is no drinking water, such as in the Caribbean islands, Spanish islands, Japan, Singapore, and the Arab countries, or in areas of low availability such as Florida and California, in the United States, or Baja California, Baja California Sur and Sonora, in Mexico, and northern Chile and Venezuela (Fuentes, 2007).

Negative aspects

- The initial investment costs are high.
- Operating and maintenance costs are not competitive with good drilling and surface water treatment.
- Desalination is recommended only when there is no cheaper alternative for obtaining drinking water. Besides, specialized personnel is required to operate the equipment, and spare parts are expensive.

Potential solution

Due to the lack of water availability in the world and the desire of most nations to improve their use of existing water sources, find alternative water sources and promote new technologies, Israel is becoming the country

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that proposes to the world to collaborate in the transfer of information on existing technologies, the development of new technologies and the preparation of future national and possibly international standardization in this field.

Israel has managed to position itself as one of the most advanced and innovative countries in the field of water technologies and has almost half of the territory is desert. Much of the water used in Israel for drinking, bathing, and daily use comes from the sea.

One solution to the problem La Guajira faces in terms of water shortages could be the implementation of Israeli technologies. Israeli experts and scientists were in several regions of Colombia and learned about the situation of La Guajira, the problems they face in terms of water and food, it is possible that the technologies used in Israel reach the national territory.

For five decades, Israel has facilitated the exchange of knowledge, especially in agricultural matters, to Colombia. There have even been successful examples and in desert areas, they are growing potatoes. An experience recognized in the Middle East.

From now on, it is the diplomatic efforts that will allow progress in the use of Israeli technologies in areas such as La Guajira. A future in which the Caribbean Sea is the main source of drinking water for several regions of Colombia is not so far off. International cooperation could facilitate the resolution of food problems in the poorest areas of the country.

Conclusions

As a first conclusion, it is important to highlight the conditions that the Wayuu community is living, but above all the real possibility that there is a solution to the problem, being an issue that became an international priority because the abandonment of the Colombian state has meant decades of decline for the region, with inhumane living and health conditions. This article, in addition to its academic purposes, has a social sense that invites awareness of the adverse situations of the inhabitants.

The desalination of water is postulated not only as a potential solution for La Guajira and its situation but also for the threat of shortages that will occur in several decades considering the technological advances projected for several years in the future desalination techniques can improve.

The Warka Water Tower model emerges as one of the most attractive alternatives, especially because of its success in Ethiopia where the problems of a small community were solved with the installation of the tower. As it is an economical system, easy to maintain and sustain, it is only necessary that the soil conditions and the climate of the area are optimal.

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