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**WATER AS A POLEMICOLOGICAL FACTOR**



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## **WATER AS A POLEMICOLOGICAL FACTOR**

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### **ABSTRACT**

Throughout the 20th century, Mankind was witness of transformation of water from an abundant and cheap resource to a strategic resource, comparable with oil, due to its importance for human survival and due to the impossibility of increasing its supply to face the demographic explosion and the vertiginous industrial and agricultural development. Furthermore, the small amount of water available for human consumption (0.025% of the total existing on the planet) and the irregular distribution of this vital resource has been a cause of tension between different peoples throughout history. The situation tends to become even more complex due to the increase in demand generated by an increasing population that cannot be followed by an increase in supply, since water reserves are finite. In addition, the existence of hundreds of basins shared by two or more countries, the influence of climate change and contamination of the springs can be factors for the beginning of the 21st century to go down in history due to the water crisis. This fact, added by the lack of policies and necessary actions that guarantee the coherent use of this resource, is generating an unprecedented pressure on the water sources, being able to become "casus belli" in diverse regions of the planet. This work, based on the historical study of the conflicts caused by the control of water and in the analysis of the evolution of international treaties on the subject, seeks to predict consequent scenarios of the struggle for this resource in the future. In this context, this work takes into account the technological development that will optimize the exploitation of existing reserves and, thus, can turn water management into a point of approach for the people, instead of a reason for the outbreak of wars; analyzing, in particular, the diplomatic effort to find peaceful solutions for the exploitation of the shared basins and the technological development that allows the increasingly efficient use of this finite resource. Finally, this work concludes predicting scenarios of possible conflicts in the future, as well as verifying which tools can be efficient to become the existence of water reserves a reason for union between peoples and not the reason of future armed confrontations.

**Keywords:** War Resources; Water Conflict; Water Diplomacy. Transboundary Waters. Water Security.

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## INTRODUCTION

"Water is the new oil."  
T. Boone Pickens, American businessman (2008)<sup>2</sup>

When looking at the planet from space, it is a fact that its name should be 'Water' instead of 'Earth', because the gigantic oceans that dominate the image of the third celestial body orbiting the Sun make the continents seem like mere islands and an inadvertent observer could conclude that there are no problems in terms of water resources since the 'blue planet' would have an abundance of water to supply its inhabitants.

However, Human being has been fighting for water for millennia<sup>3</sup> because 97.45% of the total existing on the planet is salt water, while of the 2.55% of fresh water, almost 74% is in the form of ice , 25% is found in aquifers that are difficult to access (underground) and only 1% is superficial fresh water, that is, only 0.025% of the planet's water is available for easy consumption (figure 1).

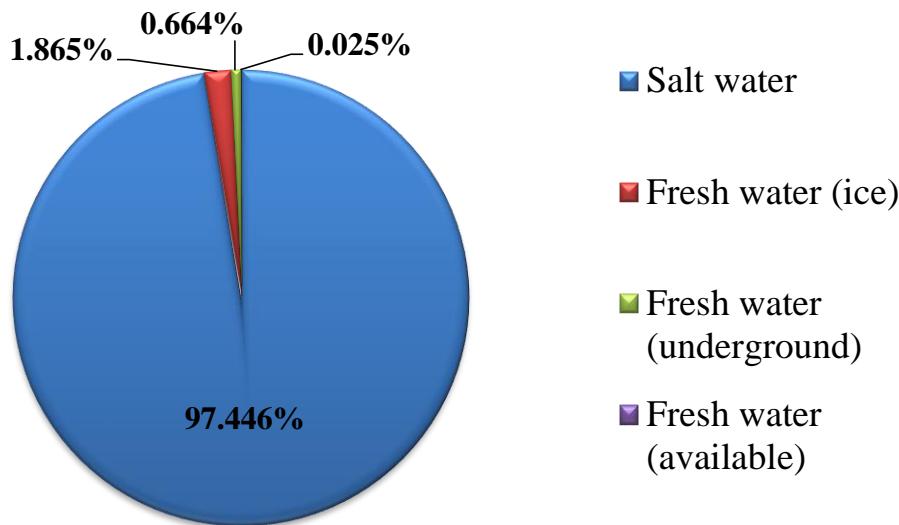


Figure 1: Distribution of water on Earth

Source: the author

The situation is even more complex because this small amount of water suitable for human consumption is irregularly distributed, causing water scarcity to affect all continents and, as can be seen in the list of conflicts due to water (available in <http://www.worldwater.org/conflict/list/>), has been the cause of various crises throughout history.

The graph below (figure 2), based on data obtained from the Water portal of the United Nations Educational, Scientific and Cultural Organization (UNESCO), compares the current availability of water resources with respect to the population globally and allows to clearly observe the irregularity of its distribution, since Asia with 60% of the population owns 36% of the water resource; Europe has 12% of the population and only 8% of the water resource; in Africa, 13% of humanity lives and has 10% of the water; On the other hand, 8% of the population resides in North and Central America and enjoys 15% of the water resource; and, finally, South America, which has only 6% of the world's population, but owns 26% of the total water resources.

<sup>2</sup> Available in <http://www.waterpolitics.com/2008/06/13/t-boone-pickens-water-is-the-new-oil/>

<sup>3</sup> Experts believe that the first war caused by competition for water occurred on the banks of the Euphrates River, in Sumeria, now Iraq. Urlama, king of the city-state of Lagash, diverted the river and prevented the supply to another city-state, Umma, giving rise to the conflict in 2500 BC.

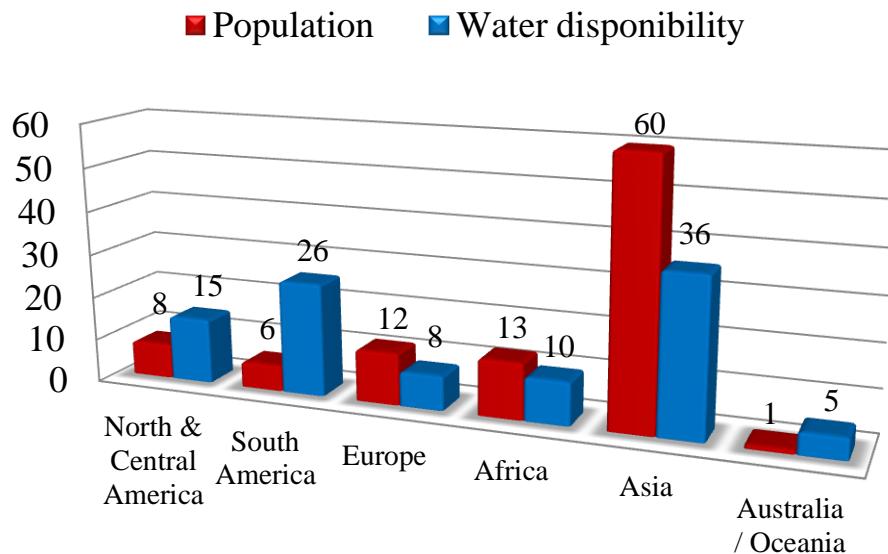


Figure 2: Comparison between population and water availability

Source: the author

In addition, there are at least 273 multinational river basins in the world, with 214 shared between two countries, 36 between three countries and 23 between four or more countries. Nearly 50 countries have 75% or more of their territory as part of international river basins and it is estimated that between 35% and 40% of the world population lives in these basins, since many of these water systems are being used until its exhaustion, as for example the Yellow rivers in China, Ganges in India and Nilo in Africa, which are below their historical marks.

According to the United Nations (UN), currently about 1.3 billion people do not have sufficient access to water suitable for consumption, since, although the exploitation of water is perhaps one of the activities in which Mankind has tried to use all their ingenuity and capacity, has not always imposed the rationality on its use, being easily detectable problems of access to drinking water sources that have numerous communities and populations throughout the planet.

As the amount of water on the planet remains relatively constant, the population explosion, urbanization, the disruption of public order, the mismanagement of an irreplaceable resource and the vertiginous industrial and agricultural development of the last half century are generating unprecedented pressure on the finite sources and resources of water, which has not been accompanied by policies and necessary actions that guarantee the coherent use and preservation of said sources, causing hundreds of conflicts.

To all this, the influence of climate change and the contamination of springs due to the action of Mankind is added, which will generate an increasingly intense imbalance between demand and supply, converting, according to several economists, scientists and geopolitical strategists, water in the new oil.

For these experts, it is a fact that humanity will not be able to count on water forever and, just as at the end of the 20th century there was an oil crisis, the beginning of the 21<sup>st</sup> century can go down in history due to the water crisis, because scarcity would produce an increase in the prices of a resource that in developed countries has always been abundant and cheap.

According to a 2007 report by the consulting firm Sustainable Asset Management in Zurich, in 1900 the total water consumption worldwide was about 770 cubic kilometers. Currently, the figure is 3,840 km<sup>3</sup> and it is estimated that it will exceed 5,000 km<sup>3</sup> by 2025<sup>4</sup>.

Of course, economic interest will generate tension and, if today all military analysts are unanimous in pointing to oil as the cause of various conflicts, nothing more logical than perceiving that the same can happen with water as its importance as a resource grows

<sup>4</sup> Available in <http://www.knowledgeatwharton.com.es/article/el-agua-el-nuevo-oro-de-la-economia-global/>

exponentially. There will be rivalries between countries for access to water sources and international mediations will be necessary to avoid possible conflicts.

The average citizen has not yet realized the importance of the issue, because he has always thought of water as "a free good", due to the ease of access through the pipes, allowing them to take long baths and not manage their consumption. This happens because most of them do not know (or are not affected) the problems that already exist in regions of Africa and Asia, in which women need to walk, on average, 6 kilometers to collect water.

In addition, the average use of water is 200-300 liters per person per day in most countries in Europe and less than 10 liters in countries such as Mozambique. In Tajikistan, almost one third of the population takes water from irrigation canals and ditches, with risks of contamination and people living in the suburbs of Jakarta, Manila and Nairobi pay between 5 and 10 times more for water than those who live in luxury areas in those same cities or in London and New York.

The importance of the above for this work is in the fact that a study published in the journal Nature by the Earth Institute of the American University of Columbia shows the relationship between water scarcity and war.

Analyzing the "El Niño" phenomenon, which in cycles of three to seven years leads to an increase in temperature and decrease in rainfall, the researchers found that, in the 90 countries affected by the climatic phenomenon between 1950 and 2004, the risk of civil war has doubled, from 3% to 6%.

According to Mark Cane, climate scientist from Columbia University, "only lack of water does not cause wars. There are social, political and economic factors that must be taken into consideration, but where there are latent tensions, that can be the necessary spark." (HSIANG et al., 2011).

Thus, rich countries such as Australia suffer with the phenomenon, but the possibility of a civil war is almost zero, while the civil war that killed more than two million people in Sudan in 1963, 1976 and 1983 is clearly related to the severe droughts caused by "El Niño".

This paper aims to analyze this problem, based on past events to try to predict possible conflict scenarios, as well as to verify the extent to which society's awareness of the issue and technological advances can turn water management into a point of approximation for the peoples, instead of a reason for the outbreak of wars.

In resume, in the last 70 years the world population has tripled and the use of water has multiplied by six, as a result of industrial and agricultural development. However, the amount of fresh water has not changed.

The lack of water and its contamination are already considered by many experts as a global threat. The situation is already so dramatic that, in developing countries, 80% of diseases and one third of deaths are related to contaminated water and lack of hygiene.

## WATER CONFLICT

### In The Past

The aforementioned list of conflicts due to water presents 551 incidents related to disputes over water throughout history, of which 136 were conflicts involving the use of weapons.

From his analysis it can be verified that, although all the regions of the world are represented, since the 1980s there has been a clear concentration in areas with water scarcity, since, as can be seen in the following graph (figure 3), 50% and 24% of the incidents occurred in Asia and Africa, respectively.

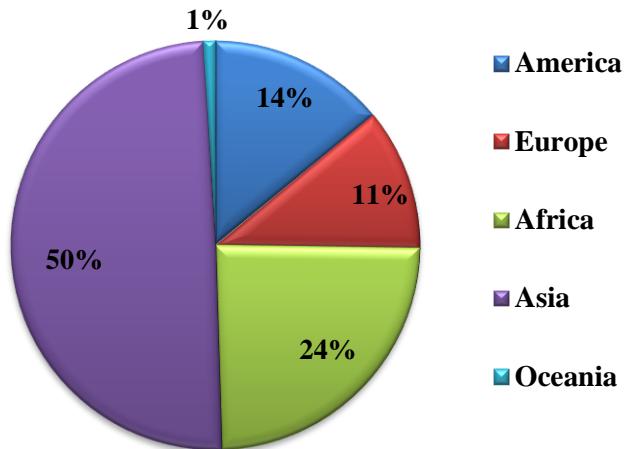


Figure 3: Distribution of incidents by water since 1980  
Source: the author

This relationship is even clearer when this data is compared with the global availability of water (Figure 4) and its evolution since 1980, which shows the degradation of water reserves in Africa and Asia (initially more serious in the Middle East, but since 2000 the situation is also worrying in India-Pakistan), based on data retired from ‘Global Trends 2015: A Dialogue About the Future With Nongovernment Experts’, published in 2000 and available in <http://www.dni.gov>.

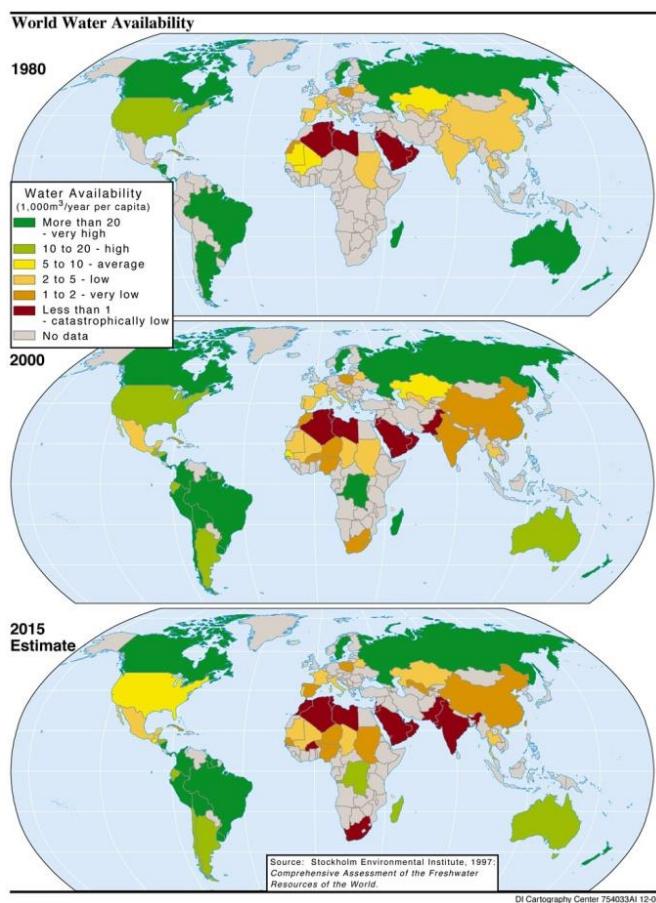


Figure 4: World Water Availability 1980-2015  
Source: Global Trends 2015 (p. 29), US National Intelligence Council, 2000

In the last version of the same document – Global Trends: Paradox of Progress – published in January 2017, the US National Intelligence Council defends that “*half of the world’s population will face water shortages by 2035, according to the UN. Rising demands from population growth,*

*greater consumption, and agricultural production will outstrip water supplies, which will become less reliable in some regions from groundwater depletion and changing precipitation patterns. More than 30 countries—nearly half of them in the Middle East—will experience extremely high water stress by 2035, increasing economic, social and political tensions.”* (p. 24)

The lack of data on Egypt is also a relevant factor, because its dependence on the waters of the Nile (cause of the war with Sudan in 1958) is known to all and already in 1979, Muhammad Anwar Al Sadat, then President of the country, declared that “water was the only aspect that could lead Egypt to enter the war again.” (LA RAZÓN, 2006)

Thus, Mahmoud Yacoub, an officer of the Egyptian Army that concluded the General Staff Course of the Armed Forces in Spain, reviews some conflicts in Africa that had water as the main cause (MAHMOUD YACOUB, 2010):

- 1958: between EGYPT and SUDAN for the use of the Nile. It was resolved with a treaty between the countries.
- 1964: ETHIOPIA and SOMALIA discussed for the underground water resources in the Ogaden Desert.
- 1975: tension between ANGOLA and SOUTH AFRICA in order to protect the water resources obtained with the Gove Dam built on the Kunene River in ANGOLA.
- 1978: between EGYPT and ETHIOPIA, because the latter wants to build dams at the head of the Blue Nile. The discussion persists until today.
- 1986: SOUTH AFRICA supported a coup d'état in LESOTHO after having passed a water law that harmed the South African Republic.
- 1988: CUBA supported ANGOLA against SOUTH AFRICA by attacking the Caluenque dam.
- 1999: NAMIBIA, BOTSWANA and ZAMBIA, for access to water in the Zambezi river basin. The discussion was taken to the International Court of Justice.
- 1999: terrorist attacks in ANGOLA caused 100 deaths around four wells in the central region of the country.

Furthermore, the reasons for the conflict between India and Pakistan, which dispute the Kashmir Region (1947-1960), are confirmed, taking into account that the formation of the two States left the basin of the Indostán River divided between them. At the same time (decades of the 50s and 60s), Israel, Jordan and Syria, for their part, disputed the control of the Yarmuk and Jordan rivers. Years later, still in the Persian Gulf, Iraq had conflicts with Iran in the 1980s and, in 1991, during the Gulf War, the supply and sanitation systems of Baghdad were damaged by the clashes between the Allied and Iraqi forces.

It should be noted that terrorist acts with water resources are a constant and occurred on 57 occasions: since 1748, when the East River ferry station in Brooklyn (USA) was set on fire and neighbors in New York accused those in Brooklyn having provoked it as a protest for an unjust distribution of rights over river water; until 2010, when a remote-controlled bomb hidden in a water truck killed three people in the Afghan province of Khost, near the border with Pakistan.

## In The Present

At this moment, incidents of global importance are not occurring, but regions such as Somalia, which has experienced the worst drought in decades since 2011, tend to be the focus of conflicts caused by the exploitation of refugees, which makes the situation even worse, by itself, is already exasperating.

However, in almost all continents there are latent conflicts related to water. In Asia, the main conflict continues to be the one concerning the border between India and Pakistan and the control of the basin of the Indostán River. In addition, part of the reason why the Chinese do not accept the independence of Tibet is due to the importance of its water resources for China - the Tibetan plateau has large reserves of water in glaciers and the sources of ten of the largest rivers in Asia, including Yellow, Yangtze, Mekong, Brahmaputra and Salween.

Likewise, in the Middle East the problems of the use of the waters of the Jordan, Tigris and Euphrates persist, added to the ethnic resentments and to the dispute between different clans and religions. In short, it is a region that concentrates diverse polemological factors: religion (Arabs vs. Jews), the imbalance of oil reserves, which are gigantic in some countries, and the lack of water.

In Africa, in addition to the eternal problem of the Nile, there are constant local conflicts as a result of the scarcity or maldistribution of water. For its part, in America, the recent border conflicts between Peru and Ecuador were not fully resolved and both countries are still faced with the growing difficulty of accessing water.

Finally, Europe, although it does not have conflicts over water at present, is affected because its allied forces fighting in Lebanon, in a certain way are involved with this problem (dispute over the control of the Golan Heights and the Jordan and Hasbani rivers).

### **In The Future**

To predict scenarios, obviously we must bear in mind that water is essential for human life and for social development; the availability of accessible fresh water is, as already mentioned, only 0.025% of the total existing on the planet; and many countries share water resources, either because their borders were established based on rivers, or because the vast majority of them start in one country and pass through other states before emptying into the ocean.

As the world population is expected to increase from 6,900 million in 2010 to 8,300 million in 2030 and reach 9,100 million by 2050, it is estimated that by 2025, 1,800 million people will live in countries or regions with absolute water shortages and two thirds parts of the world population could do so under conditions of water stress.<sup>5</sup>

Only this population increase is already enough factor to aggravate the problem in the most conflictive areas, being able to become the racket to trigger a conflict over water.

The problem is not only the lack of fresh drinking water, but also the poor management and distribution of water resources and their methods of exploitation. Thus, at the beginning of the year 2000 Fortune magazine announced: "Water promises to be in the 21<sup>st</sup> century what oil was in the 20<sup>th</sup> century. A precious commodity that determines the wealth of nations" and, a year before, the World Bank's vice president, Ismail Serageldin, had warned that "the wars of the next century will be for water". (NOTTEBOHM, 2005)

Thus, the possibility of this resource becoming more and more the subject of disputes is as clear as its transformation into a very lucrative business: dams, irrigation channels, potabilization and desalination technologies, sewage systems and wastewater treatment, in addition to the bottling of water, which exceeds in profits the pharmaceutical industry. Pollution of water courses or their variation for their energy use can also be a source of conflict.

Vera Bolaños (2010), in a prospective analysis, argued that the following regions may be scenarios of conflicts in the future, particularly because they have latent problems for decades or centuries:

- Valley of the Nile: three countries maintain rivalry for the control of their waters: Egypt, Sudan and Ethiopia. The country with the greatest difficulty is Egypt, whose agricultural production depends on 95% of irrigated land and has a population that reaches 64 million inhabitants. 85% of the flow of the Blue Nile that arrives in Egypt originates in Ethiopia, a country that will have an estimated population of 130 million inhabitants by the year 2025. Something similar happens with the waters of the White Nile, which have their origin in Sudan, with a population of 29 million inhabitants and a population growth rate of around 3% per year. Egypt does not admit any relevant change in the flows of the Nile, being able to consider it "casus belli" with Sudan (where the water passes) and Ethiopia

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<sup>5</sup> Defined by the UN through the water/population relationship. An area will experience water stress when its annual water supply falls below 1,700 m<sup>3</sup> per person. When that same annual supply falls below 1,000 m<sup>3</sup> per person, then there is talk of water scarcity. And absolute shortage of water when the rate is less than 500 m<sup>3</sup>.

(origin of more than 80% of the springs of the river). The accelerated increase of the population in the area is an aggravating factor, in addition to the fact that Sudan (recently dismembered in two) presents a constant instability in the last twenty years.

- Hindustan Basin: India and Pakistan, although they have always respected the essence of the Treaty signed in 1960 for the distribution of the flows, remain under stress mainly due to the colossal population increase in the region.
- Jordan Valley: the basins of the Jordan and Yarmuk rivers are disputed by the societies of Jordan, Syria, Israel and Lebanon. These countries use between 95% and 100% of the annual water supply. The case of Jordan is the most serious, since only 5% of their lands receive enough rainfall to be used in agriculture and only 10% of their agricultural lands are under irrigation. Syria, on the other hand, has the disadvantage that 90% of its waters originate from international sources coming from its neighbors Turkey, Iraq, Israel, Lebanon and Jordan. In 1967, one of the causes of the Arab-Israeli war was precisely the dispute over the water of the aquifers of the Golan Heights. Because it is a historically warlike region, water is just one more reason to light the wick of the true powder keg that constitutes the region, although it is considered that the ambitious desalination program undertaken by Israel will alleviate the pressure on resources.

To these regions, Guisández Gómez (2010) added:

- Gambia Valley: The Gambia depends on the water policies of Guinea and Senegal (the strongest in the area) regarding the river that gives it its name.
- Mekong Valley: Vietnam's dependence on the Mekong River that starts in China and passes through Myanmar, Thailand, Laos and Cambodia can be a cause of future frictions, particularly with the last two countries mentioned.
- Okavango Valley: the Okavango River was born in Angola and passes through Namibia before entering the territory of Botswana. In 1996, when Namibia suffered a severe drought and tried to divert the river, a conflict almost broke out.

Mateo y Álvarez de Toledo (2008) considers, in addition, the following regions:

- The Guarani Aquifer: 132 million years old, is the third largest known in the world, after the Nubian Sandstones and the Northern Sahara, both in North Africa. Located under the territory of four countries (Brazil, Argentina, Uruguay and Paraguay), it has an area close to 1,200,000 km<sup>2</sup>, a larger area than Spain, France and Portugal combined. Its exploitable volume (from 40,000 to 50,000 km<sup>3</sup>, equivalent to four times the total annual demand of Argentina) is so high that there are suspicions that it may have been considered a strategic world water reserve by the United States.
- Tigris and Euphrates Valley: Turkey started a project (Güneydogu Anadolu Projesi - GAP) which consists of a series of 22 dams chained for electricity production and irrigation of large areas and involves a decrease in the flow of the Tigris and Euphrates rivers (which are born in Turkey), with the consequent protests of Syria and Iraq. It is one of the largest hydraulic projects in the world and will cause a significant decrease in the volume of water reaching Syria and Iraq (between 30% - 50% in the next 50 years), as well as the water quality that already presents high salinity index. This will particularly affect Syria, as this river is responsible for more than half of its water supply. The situation will tend to be complicated when it is analyzed that the growth rate of the country's population is 3.8%, so it must double in 20 years. Something similar happens with Iraq, located downstream to Syria, with a population that will amount to 52 million by the year 2025.
- Antarctica: is one of the largest reserves of hydrocarbons, minerals and fresh water worldwide. Its sovereignty is claimed by seven countries (New Zealand, Australia, France, Norway, United Kingdom, Chile and Argentina) and is subject to the Antarctic Treaty, signed in 1959, prevented the economic or military exploitation of the area for 50 years. Still, there is a dispute between the main powers for the sovereignty of the area and, therefore, its resources.

- China: the problem with Tibet remains and, in addition, a country that owns 22% of the world population and only 6% of the water reserves has to consider water a strategic resource. Its main rivers (Amarillo and Yangtze) are already contaminated and the problem can be aggravated if the forecasts that the Himalayan glaciers can disappear by the global increase in temperature by the year 2035.

The paper of Mahmoud Yacoub, an officer of the Egyptian Army that concluded the General Staff Course of the Armed Forces in Spain, reinforces that the “Nile represents the greatest risk of conflict linked to water in Mediterranean Africa” because it’s “located in an area arid or semi-arid in which agriculture is impossible without the presence of the river. The Nile is the only source of life for the 82 million Egyptians.” (MAHMOUD YACOUB, 2010)

Mahmoud Yacoub also states that “in 1959, Egypt and Sudan agreed that Egypt would use annually 55 billion cubic liters of water from the Nile. Half a century ago this quota was more than enough, but since then the population has almost doubled and today to 70 million people.” Consequently, since 1929 Egypt (and the then colonial power, Great Britain) has been negotiating with the other countries touched by the Nile to prevent the execution of works that limit the passage of water to Egypt and “until today Cairo holds this position, including the armed threat in case of transgression.”

In addition, this officer argues that the danger of water becoming an outbreak for an armed conflict in Africa is great because as it appears in the Human Development Report published for the United Nations Development Program (UNDP) in 2005: “There are greater probabilities of obtaining violent results in societies marked by deep polarization, weak institutions and chronic poverty”.

Beyond that, it's necessary to add that in 2011, was discovered the aquifer "Alter do Chão", in the Amazon Region, which became the largest aquifer in the world - the volume is 3.5 times larger than that found in the Guarani Aquifer (FAPESP, 2014). This reserve has a volume of 86,000 km<sup>3</sup> of fresh water, which would be enough to supply the world population, around 100 times. This new aquifer can increase external interest for the Amazon Region, add one more reason to environment speech talking about the importance of this region for the Earth and increasing the number of NGOs “worry” about its protection.

A despite of these predictions, it must be set the catastrophism outside, as stated by Lena Salamé, Coordinator of the Resolution of Water Conflicts of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and responsible for the Day World Water Summit 2009, “there are very few water conflicts between states, contrary to what may seem.” (LA RAZÓN, 2009)

In this sense, the next topic will address the tools that will allow the dispute over water to be resolved by building “bridges” between peoples and not with the use of force of arms.

## TOOLS TO MANAGE WATER CRISES

### Current Situation

The shortage of water is a phenomenon not only natural but also caused by the action of the human being. There is enough potable water on the planet to supply 6,000 million people, but the resource is distributed irregularly (six countries receive almost half of the continental water, led by Brazil with more than 12% and Russia with 10%), Much of it is contaminated and managed unsustainably. (SHIKLOMANOV, 2000)

According to the UN, close to 1.2 billion people, almost one fifth of the world's population, live in areas of physical water scarcity, while another 1.6 billion face situations of economic water scarcity, that is, they live in countries that lack the necessary infrastructure to transport water from rivers and aquifers.

This shortage constitutes one of the main challenges of the 21st century. Over the last century, the use and consumption of water grew at a rate twice that of the population growth rate and, although we cannot speak of global water scarcity, the number of regions with chronic levels of lack of water increases every year.

Add to that the climate change, with its alterations in the seasonality and in the periodicity of the episodes of rain, snowfall, thaw and evapotranspiration. As a consequence, the world suffers more and more with floods and long-term droughts, becoming a gigantic challenge for water managers when it comes to foreseeing the conditions to specify the distribution of water resources.

According to the Intergovernmental Panel for Climate Change (IPPC), another influential factor is the warming of the Earth. The Report of Expert Meeting on Climate Change, Land Use and Food Security, occurred in Rome between 23-25 January 2017, defends that "climate-induced changes in precipitation directly affect the amount of water entering water basins. Variations in temperature, radiation, humidity and wind speed affect evapotranspiration, resulting in dryer river basins." Furthermore, the report argues that "most regional studies project a decrease in water availability as a result of climate change well into the future. Projected food demand increases imply increased demand for irrigation, but global projections based on water supply offer divergent outcomes and irrigation acreage may decrease because of reduced supply. In hotspot regions with acute water scarcity, reduced freshwater in areas that are currently irrigated may indicate that irrigation has to be abandoned altogether." (ELBEHRI, 2017, p. 4)

Due to the above, various entities are dealing with this issue, among which are:

- The World Water Council (WEC): a discussion platform established in 1996 at the initiative of recognized specialists in water matters and various international organizations. It organizes the most important event in the field: the World Water Forums, which are already in their eighth edition: Marrakech (Morocco, 1997), The Hague (Netherlands, 2000), Kyoto (Japan, 2003), Mexico City (Mexico, 2006), Istanbul (Turkey, 2009), Marseille (France, 2012), Gyeongju and Daegu (South Korea, 2015) and Brasília (Brazil, 2018). Its mission is "to promote awareness, build political commitment and trigger action on critical water issues at all levels, to facilitate the efficient conservation, protection, development, planning, management and use of water in all its dimensions on an environmentally sustainable basis for the benefit of all life on Earth".<sup>6</sup>
- UNESCO also has an intergovernmental program of scientific cooperation in hydrological research, management, education and capacity building related to water resources called the International Hydrological Program (IHP).
- The research program of the Oregon State University called Program in Water Conflict Management and Transformation (whose website<sup>7</sup> allows access to various articles that were used in this article).

In addition, the UN celebrates World Water Day on March 22, with the intent to disseminate, educate and raise public awareness about the care that must be taken with the water used to live and avoid devastating consequences on the environment.

Almost half of the water in drinking water supply systems in developing countries is lost through leaks, illicit connections and vandalism. In China, the aquifer water tables in the north have dropped thirty-seven meters in thirty years and, since 1990, it has dropped by one and a half meters each year. The internal Aral Sea, in Central Asia, has already lost half of its extension.

In the world water industry, whose estimated volume is 400 to 500 billion dollars, there are people, such as businessman T. Boone Pickens<sup>8</sup>, who defend that "water is the new oil". They are opposed by activists and governments who think that water is a basic right and, therefore, should not be treated as property.

## Diplomacy

The Food and Agriculture Organization of the United Nations (FAO) has identified that, since 805 AD, more than 3,600 treaties related to water resources were signed, revealing that water

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<sup>6</sup> Available in <http://www.worldwaterforum8.org/en/>

<sup>7</sup> Available in <https://transboundarywaters.science.oregonstate.edu/>

<sup>8</sup> He owns more water than any other individual in the US and plans to build a pipe network to sell water to the city of Dallas

disputes can be handled diplomatically. In fact, in the last 50 years only 37 serious disputes have been computed that included violence, in comparison with the 150 treaties that were agreed upon (GOROSITO ZULUAGA, 2006, p.36), proving that many of the crises do not go beyond verbal threats and postures adopted by Heads of State, looking for a lot more influence on your own electorate than to resolve the situation.

While the disputes are usually caused by the volume of water or the unilateral construction of infrastructures, the agreements cover a greater variety of issues such as hydroelectric power, the quantity and quality of water, economic development or joint management.

Due to its importance, negotiating for water is a long and complex process. Each water basin has a multitude of specific characteristics, both physical (geography, ecosystem, climate, etc.) and social (demography, history, culture, etc.), so that it is difficult to reach common parameters for these negotiations.

In the last decades, several legal agreements on the subject of water sharing were negotiated, even among the most implacable enemies. It should be noted that these agreements were maintained even when the negotiation was interrupted and conflicts were triggered.

There are several examples of diplomacy action to prevent wars, such as the position of Israel and Jordan, which, since 1955, with the help of the United States, have held frequent talks about the distribution of the Jordan River, despite being until recently in a legal situation of war.

Two years later, Cambodia, Laos, Thailand and Vietnam (with the support of the United Nations) have been able to cooperate since 1957 within the framework of the work of the Mekong River Commission and have held technical exchanges during the Vietnam War.

The same happened in the negotiation between India and Pakistan that survived two wars, in order to fight against poverty and promote economic development in the region, promoting equitable use and the use of water resources in common.

The discussion process usually takes time. The Hindustan agreement took ten years; the Ganges, thirty and the Jordan, forty years! But, off course, it's nothing if we think about the gain obtained when to build trust between the countries involved.

On October 26, 1994, a Peace Treaty was signed between Jordan and Israel (the second peace agreement signed since independence), in which one of the main issues addressed was the river basin of the Jordan and Yarmuk rivers and the groundwater of the Arava. Israel agreed to transfer 50 million cubic meters of water annually to Jordan and, instead, has reached a series of bilateral agreements on the multilateral basin.

In 1997, the United Nations approved the Convention on the Law of the Non-Navigational Uses of International Watercourses. This Convention<sup>9</sup> is the only treaty governing shared freshwater resources that is of universal applicability and establishes the following:

#### *“Article 4*

##### *Parties to watercourse agreements*

*1. Every watercourse State is entitled to participate in the negotiation of and to become a party to any watercourse agreement that applies to the entire international watercourse, as well as to participate in any relevant consultations.*

*2. A watercourse State whose use of an international watercourse may be affected to a significant extent by the implementation of a proposed watercourse agreement that applies only to a part of the watercourse or to a particular project, programme or use is entitled to participate in consultations on such an agreement and, where appropriate, in the negotiation thereof in good faith with a view to becoming a party thereto, to the extent that its use is thereby affected.*

#### *Article 5*

##### *Equitable and reasonable utilization and participation*

*1. Watercourse States shall in their respective territories utilize an international watercourse in an equitable and reasonable manner. In particular, an international watercourse shall be used*

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<sup>9</sup> Available in [http://legal.un.org/ilc/texts/instruments/english/conventions/8\\_3\\_1997.pdf](http://legal.un.org/ilc/texts/instruments/english/conventions/8_3_1997.pdf)

*and developed by watercourse States with a view to attaining optimal and sustainable utilization thereof and benefits therefrom, taking into account the interests of the watercourse States concerned, consistent with adequate protection of the watercourse.*

*2. Watercourse States shall participate in the use, development and protection of an international watercourse in an equitable and reasonable manner. Such participation includes both the right to utilize the watercourse and the duty to cooperate in the protection and development thereof, as provided in the present Convention.*

(...)

#### Article 8

##### *General obligation to cooperate*

*1. Watercourse States shall cooperate on the basis of sovereign equality, territorial integrity, mutual benefit and good faith in order international watercourse.*

*2. In determining the manner of such cooperation, watercourse States may consider the establishment of joint mechanisms or commissions, as deemed necessary by them, to facilitate cooperation on relevant measures and procedures in the light of experience gained through cooperation in existing joint mechanisms and commissions in various regions.”*

It's important to highlight two key principles to guide nations in relation to shared watercourses: “equitable and reasonable use” and “optimal and sustainable use”, in addition to promoting cooperation among neighbors.

In 2001, Palestinians and Israelis agreed to reduce attacks on water-related infrastructure. Since then, Israel has provided the agreed water with the Palestinian Authority, managing it through a coordination committee.

In November 2002, the Committee on Economic, Social and Cultural Rights approved General Comment No. 15 on the right to water, stating that "the human right to water is indispensable to lead a life in human dignity" and on July 28 of 2010, through Resolution 64/292, the General Assembly of the United Nations explicitly recognized this right.

All these treaties seem to show that the possibility of conflicts arising from the water dispute is unlikely; but as Aaron Wolf, professor in the Department of Geosciences at Oregon State University and director of the Transboundary Freshwater Dispute Database, says: “there are no guarantees that the future will look like the past; water and conflict are undergoing slow but steady changes. An unprecedented number of people lack access to a safe, stable supply of water. Two to five million people die each year from water-related illness. Water use is shifting to less traditional sources such as deep fossil aquifers and wastewater reclamation.” (WOLF, 2006, p.5)

However, two probable scenarios for water disputes that will be key elements in future negotiations can be proposed:

- Territorial appropriation - through the purchase of land with natural resources (water, biodiversity), or through military conflict.
- The privatization of water - since large corporations have come to control water in much of the planet and it is speculated that, in the coming years, a few private companies will have a monopoly of almost 75% control of this vital resource for life on the planet.

This last scenario is verified analyzing the sales of pure bottled water: between 1970 and 2000, the sale of water grew more than eighty times - in 1970 it was a billion liters and in 2000 it reached 84 billion, with gains of 2.2 one billion dollars.

#### Technology

Unless a global effort is made to improve our understanding and knowledge of the planet's water resources, its management in the future will face even greater uncertainty and risk.

More than 60% of the global population growth between 2008 and 2100 will occur in Sub-Saharan Africa (32%) and South Asia (30%). Together, these regions are expected to account for roughly half of the world's population by the year 2100.

First, we must abandon the idea of the majority who only seem to care about the amount of water available, when it would be reasonable to place the quality at the same level.

With respect to the uses and exploitation of sources, direct human consumption is still small compared to other uses. Only 10% - 12% of the drinking water of the globe is used directly by human beings. The industry uses twice as much, while the agricultural sector is responsible for 70% of total consumption.

In addition, a huge amount of drinking water is lost through distribution systems; According to the World Bank, 32,000 million cubic meters of water are lost annually due to leaks and damage to aqueduct systems.

Because the increase in wealth in emerging economies, in particular China, will mean a gradual and constant increase in the consumption of food, especially meat<sup>10</sup>, it will be essential to develop new technologies that are capable of maximizing efficiency in the use of this resource and respond to the growing demand for food and other agricultural products.

Some countries are already treating the water used to make it drinkable again. There are also initiatives to improve agriculture dependent on rainwater, develop plants that are more resistant and able to withstand longer periods of drought; replace "abundant" irrigation systems, in which much water is wasted, by more efficient systems such as "trickle down"; modernize the old infrastructure, which wastes immense volumes of water every year; and stimulate individual savings.

On the supply side, there are plans to exploit new water sources through investments in desalination processes, whose technology has improved a lot in the last three decades thanks to the use of reverse osmosis, in which sea water flows through a membrane that extracts its salt.

Meanwhile, high fuel consumption has prevented desalination plants worldwide from achieving the same success as in the Middle East. But, the improvements introduced in membrane technology and energy saving could change the scenario.

By way of comparison, a new \$ 300 million plant north of San Diego will have an energy expense to produce 1,000 gallons of drinking water equivalent to \$ 1.10. In one of the old plants, the cost of production was \$ 2.10.

It should be noted that Spain was the first European country to build a desalination plant in the Canary Islands almost 40 years ago and is one of the largest users of desalination technology in the western world. Spanish companies are leaders in the design, engineering, construction and operation market of new desalination plants around the world and operate in regions such as India, the Middle East and North America.

According to some economists, a factor that would accelerate the development of a more efficient water system is precisely the object of the wrath of the environmental movements: privatization.

The need to develop more sustainable practices for the management and efficient use of water resources has substantially changed the sensitivity and public attention in this regard in the last decade. However, economic criteria and policy-based approaches still govern decisions on the development of water resources in most local, national and international spheres. The response of management strategies to the potential threats of climate change is an opportunity to implement more sustainable policies and practices regarding resources.

## **WORLD HYDROLOGICAL SCENARIOS IN THE FUTURE**

Water is fundamental for socioeconomic development and, if we properly analyze the possible future of water (availability of resources, reliability and the evolution of demand in response to external pressures, etc.), we will obtain a valuable tool for those responsible for the decision

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<sup>10</sup> Beckett and Oltjen of the Department of Animal Sciences at the University of California estimate that 3,700 lt of water is needed to produce 1 kg of beef.

making in sectors that are traditionally not considered part of the water sector: food security, health, energy, land development planning, etc.

It is estimated that to cover the water demand of the 6.250 million inhabitants, to which we have arrived, 20% more water would be necessary (FRERS, 2005). The conflict occurs between those who believe that water should be considered a commodity or tradable (such as wheat and coffee) and those who express that it is a social good related to the right to life.

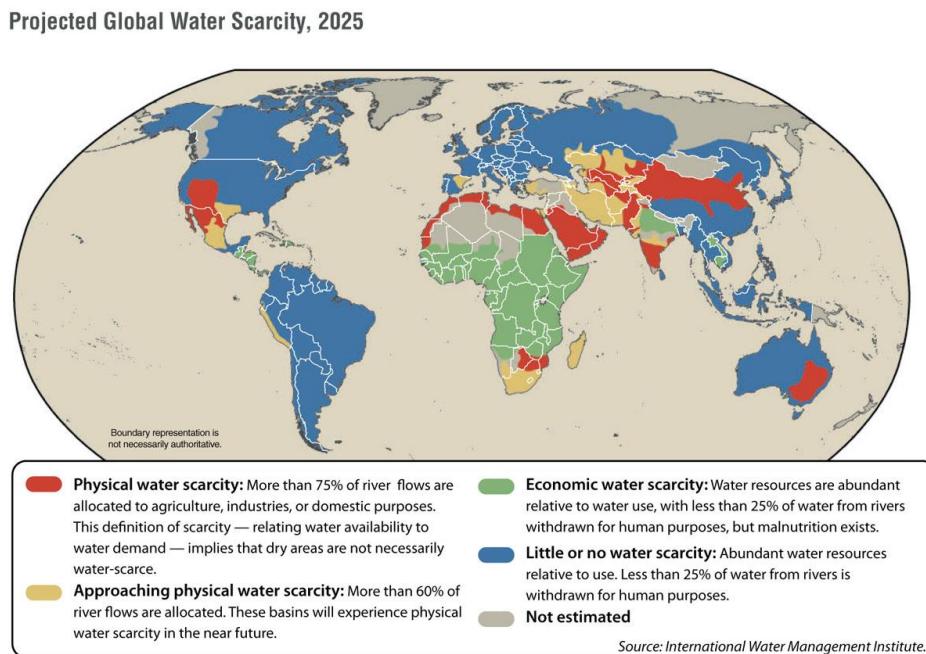


Figure 5: Global Water Scarcity in 2025  
Source: Global Trends 2025 (p. 55), US National Intelligence Council, 2008

The figure 5 shows the water shortage in 2025, estimating the areas in that is most probably to present problems due to lack of water resources. These are: the US border - Mexico, North Africa (particularly the Vale of the Nile), the India - Pakistan border, the China - Tibet dispute and the Middle East.

In addition, Patrick Johnson suggests, in an article<sup>11</sup> published in a Canadian Intelligence Publication to pay attention in this three situations:

- The Brahmaputra River (China-India): The Brahmaputra River is a 2,900 km river that originates in Tibet and flows through India's Arunachal Pradesh state before merging with the Ganges and draining into the Bay of Bengal in Bangladesh. It is considered an important resource in all three countries that it flows through: for energy-hungry China, it provides hydroelectricity; and for India and Bangladesh, a key agricultural lifeline in otherwise overpopulated and arid region. The tension is caused by the possibility, second some experts, that the Chinese projects of power plants in Tibet will reduce the flow of the Brahmaputra in India, compounding an already tenuous water situation in the affected areas.
- Grand Ethiopian Renaissance Dam and the Nile River (Ethiopia-Egypt): In 2011, the Ethiopian government announced plans to build the 'Grand Ethiopian Renaissance Dam' – a \$4.1 bn, 6,000MW-capacity hydroelectric dam on the Blue Nile near the border with Sudan. The dam is meant to capitalize on Ethiopia's considerable hydroelectric potential and provide electricity for not just Ethiopians but regional populations as well. The potential impact on water supplies, particularly downriver, is a grave concern in Egypt; which, unlike neighboring Sudan, has consistently opposed the construction of the Grand

<sup>11</sup> Available in <https://www.geopoliticalmonitor.com/three-international-water-conflicts-watch/>

Ethiopian Renaissance Dam from the start. In August 2017<sup>12</sup>, the Ethiopian government disclosed that the construction of its Grand Ethiopian Renaissance Dam had reached 60 percent completion rate.

- Ilisu Dam and the Tigris River (Turkey-Iraq): Turkey's Erdogan government has been keen to push through the final part of its long-running Southeastern Anatolian Project: the Ilisu Dam on the Tigris River near the border of Syria. The Southeastern Anatolian Project entailed the construction of some 22 dams and 19 hydroelectric plants in the Tigris-Euphrates basin, so this is an international water conflict that has existed for quite some time. Iraq has historically enjoyed the lion's share of these rivers' waters, which have historically supplied the seasonal marshlands needed to grow food. But these waters have been receding over the past decade, even well before the Ilisu Dam's completion. In fact, northern Iraq and Syria are currently experiencing droughts so protracted that some analysts are questioning whether or not they have contributed to the rise of ISIS in the region. Some of the more extreme projections hold that, owing to a combination of climate change and upstream dam activity, the Tigris and Euphrates rivers won't have sufficient flow to reach the sea by as early as 2040.

Furthermore, under the current climate change context, by 2030, almost half of the world's population will live in areas of water stress, including between 75 and 250 million people in Africa. In addition, the scarcity of water in arid or semi-arid areas will cause a displacement of refugees of between 24 and 700 million people.

The change in the diet has had the greatest impact on water consumption in the last 30 years. For its part, agriculture contributes to climate change with its share of greenhouse gas emissions, which also affects the planet's water cycle, adding another element of uncertainty and risk to food production. Predictions indicate that by 2030, the regions most affected by food shortages due to climate change will be South Asia and Africa.

Thus, in order to achieve global food security, the following will be necessary:

- To produce more nutritious food with less water, through innovative technologies that guarantee a more sustainable food production. These technologies are necessary to improve crop yields; to implement efficient irrigation strategies; to allow the reuse of wastewater; to find smarter ways to use fertilizers and water; to improve crop protection; to reduce losses after harvest; and to develop a more sustainable livestock and marine production.
- Strengthen human capacities and the institutional framework, with the purpose of holding those responsible for poor water management accountable.
- To improve the value chain, carrying out efficient water reuse strategies in all phases of the process, from production, harvest handling, processing, retailing and consumption, to distribution and trade. This could help to guarantee the environmental requirements associated with water in those cases where the reuse of treated water is not culturally accepted for other uses.

Of course, we must take into account the discovery of new technologies that, by increasing the efficiency of water exploitation, in addition to allowing greater savings in the consumption of water resources, will reduce the catastrophic consequences of these predictions.

To this we must add, the increasingly strong awareness of the population that adheres to the campaigns for an adequate use of water, changing customs and avoiding the waste of this vital resource for Man.

In this context, several scholars are producing works to bring this issue to the agenda of the world society and we must highlight two important concepts: Virtual Water and Water Footprint. Virtual Water<sup>13</sup> - John Anthony Allan, a researcher at King's College London and the School of Oriental and African Studies, created the concept of "Virtual Water" in 1993 when he studied the

<sup>12</sup> Available in [http://www.xinhuanet.com/english/2017-08/08/c\\_136506781.htm](http://www.xinhuanet.com/english/2017-08/08/c_136506781.htm)

<sup>13</sup> Data obtained on the site of the Stockholm International Water Institute - <http://www.siwi.org>

importation of water as a solution to the resource shortage in the Middle East. The concept can be simplified as being the water contained in the products, that is, the water used to produce them and, in addition to developing the theory, the British scientist also created a method to calculate it accurately. Thus, for example, to obtain a piece of cheese of 500 grams would require about 2,500 liters of water. Allan remembers that citizens not only consume water when they drink or shower, but also when they eat or dress and, from the sum of the products consumed and their equivalence in virtual water, it can be said that each person spends between 2,000 and 5,000 liters of water per day. The customs of the country in which they live also affect the consumption of virtual water, so it is estimated that an American spends about 2,500,000 liters of virtual water annually (7,000 liters / day), more than three times as much as a Chinese who It consumes 700,000 liters per year (1,920 liters per day). In virtue of the practical applications for the concept, such as the so-called "virtual water trade", the Stockholm International Water Institute, awarded the English scientist for having valued that the theory of virtual water "enhances the use of trade to alleviate the water shortages in some regions and more efficient use of water resources".

Water Footprint<sup>14</sup> - In 2002, Arjen Hoekstra, whilst working at the UNESCO-IHE Institute for Water Education, created the water footprint as a metric to measure the amount of water consumed and polluted to produce goods and services along their full supply chain. Water footprints can be calculated for an individual person, a process, a product's entire value chain or for a business, a river basin or a nation. They provide powerful insights for businesses to understand their water-related business risk, for governments to understand the role of water in their economy and water dependency, and for consumers to know how much water is hidden in the products they use. Most importantly, they help drive strategic action toward sustainable, efficient and equitable water use. Some examples:

- The production of one kilo of beef requires 15,000 liters of water.
- To produce a cup of coffee you need 140 liters of water.
- China's water footprint is around 1070 cubic meters per year per capita.
- Japan has a total water footprint of 1380 cubic meters per year per capita.
- The US water footprint is 2,840 cubic meters per year per capita.

## CONCLUSIONS

The current tension generated by water unavailability can be synthesized as a classic economic problem since the resource is finite while the needs do not stop growing. The direct consequence of this is the substantial increase in the price of water, which will generate repercussions in the geopolitical, economic, social, military and environmental fields.

The human activity that has consumed the most water has always been agriculture and its productive intensification, based on the use of machinery, chemical fertilization, the use of phytosanitary products, the sowing of selected seeds and the spread of irrigation, caused an excessive increase of water inputs in agricultural production.

The 273 existing transboundary basins prove that water can be considered as the most natural representation of globalization, since it crosses administrative boundaries without a passport or documentation. The problem is a consequence of the historical use of water courses for the establishment of borders, in addition to the fact that rivers often cross different countries on their way to the sea.

Thus, shared waters can serve as a link between the parties, serving as a common point that stimulates cooperation and equitable distribution or, conversely, as a source of tension, becoming a reason for competition and rivalry.

There are several examples of the two situations, but as the worsening of the situation in the future is estimated, the possibility of a resurgence of these tensions and even the increase in the armed confrontation is great. This can be aggravated by the increasing contamination of the

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<sup>14</sup> Data obtained on the Water Footprint Network site - <http://www.waterfootprint.org>

springs that spoil part of the already small fraction of the water available for human consumption.

It should also be noted that the economic valuation of water resources plays a preponderant role in the management of demand and in a better distribution among its various uses. Thus, the value of water resources depends not only on their quantity, but on at least four other factors: quality, location, access reliability and availability time.

Regarding conflicts, 'Annex A' shows the incidence of various terrorist attacks that, throughout history, used water as a vector of contamination or attraction for tricks or attacked its supply, as well as verifying that conflicts over the resource is usually regional and the scarcity of water can often serve as a fuse for the deflagration of a struggle that, in fact, has several other polemological factors.

The analysis of the possible scenarios, apart from the comparison between the availability of the resource with the projection of the population in the short term, allows us to affirm that the regions most prone to future water conflicts are: Egypt - Sudan, India - Pakistan and China - Tibet.

On the other hand, it is also perceived that the international community is increasingly aware of the problems arising from the mismanagement of water resources and there is an effort to optimize the diplomatic capacity in crisis resolution, as well as in the development of technologies able to avoid the current waste.

Regarding the first mentioned effort, there is a series of international law studies on the subject and the United Nations Organization, as the great world forum, established March 22 as International Water Day with the aim of promoting debate, disseminating good practices and encourage the development of new technologies, both for the most efficient exploitation of the resource, and for its use more efficiently.

This technological development is what will allow the survival of the Man, in spite of the growth of the population and the growth of the demand, because as the Secretary General of the UN said, on April 22, 2012, "in the next twenty years, the world will need at least 50% more food ... 45% more energy ... 30% more water ... and many millions of new jobs. Our challenge at Rio + 20 and beyond is to adopt a holistic and integrated approach to these interlinked difficulties - an approach that focuses on interrelations so that solutions to a problem translate into progress in all of them."

This collective effort will allow water to continue to be the main resource of Humanity, as, in addition to having been the environment that allowed the emergence of life and have served as a means for the great navigators to expand knowledge to beyond their At the same time, there are hopes that it will serve more as a motivator for cooperation among peoples than as an obstacle that impedes mutual understanding.

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