SPECIAL DOUBLE ISSUE

WINTER 2019 / ISSUE NO.13

$ 15.00 | € 10.00 | 1500 RSD

HORIZONS

JOURNAL OF INTERNATIONAL RELATIONS AND SUSTAINABLE DEVELOPMENT

ISSN 2406-0402

THE NEW GREAT GAME

DEBATING MIGRATION

RUSSIAN QUANDARIES

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THE WATER CHALLENGE

Brice Lalonde

MOVING further into the twenty-first century, humanity will have to cope with challenges posed by resource scarcity—first and foremost by the water challenge.

There is a limited amount of water on the planet, only 3 percent of which is fresh water. Half of this 3 percent is frozen, and what remains is mostly found underground or in the air. A small part runs on the surface and through living creatures. As the world's population and water demand increase, the amount of water available per person decreases—it is that simple.

Water is unequally distributed on Earth. Some regions have a lot of it, some do not. Nine countries possess 60 percent of the world's freshwater resources: Brazil, Canada, China, Colombia, India, Indonesia, Peru, Russia, and the United States. Yet even in these countries the situation at local levels varies from the national average. Besides, human settlements and their needs do not match water resources. Around 60 percent of all human beings live in Asia, where only 30 percent of the world's water resources can be found, while 0.3 percent live in the Amazon rainforest, which contains 15 percent of all available water. From North Africa to Pakistan, in more than 20 countries, inhabitants enjoy less than 1,000 cubic meters of water per year, not to mention some islands where water must be imported. They live in a state of chronic shortage.

No less than 20 liters per capita per day should be assured to take care of basic hygiene needs and basic food hygiene. If you add the water needed in the food life cycle, it amounts to 2,000 liters (730 cubic meters per year). The annual global average of water use per person, directly or indirectly, is around 1,300 cubic meters. According to certain estimates, water stress starts right under 1,700 cubic meters per year. The average amount of water used per person in the

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Photo: Pexels.com

Water: 71% of the Earth is covered in it, yet it too can soon become a scarce resource

United States is 2,500 cubic meters, while in Egypt and Libya it is less than 500 cubic meters. Hence water scarcity affects nearly half of the global population.

WATER FOOTPRINT

The United Nations has always considered access to drinking water to be a top priority, and actually, the proportion of the population using what is called "an improved source of water" (safely-managed access within a 30-minute round trip) has increased in recent years.

Unfortunately, the same cannot be said for either sanitation or wastewater treatment. If only three in 10 people lack access to safe drinking water today, that ratio grows to six in 10 of those who do not have access to sanitation facilities, which creates dangerous health risks. More than 80 percent of wastewater that results from human activities is discharged into rivers or seas without any pollution control. Therefore good and fair management of water is one of the 17 Sustainable Development Goals (SDGs) that form the core of the UN 2030 Agenda, which was adopted by world leaders in 2015. The World Bank estimates the cost of reaching the UN water goals at more than $100 billion a year up to 2030.

But the world is not on track to achieving this SDG.

Only 8 percent of the total water intake goes to domestic household use (or 12 percent for cities). In Cape Town, during a 2018 shortage, people were allowed to use only 50 liters per day in their home, three times less than the average European citizen (equivalent to less than 20 cubic meters for the year). Another 19 percent of global usage goes to industry, and a huge 69 percent goes to agriculture. Therefore, reducing the share of poor irrigation practices is an important goal.

> *Agriculture thus uses nearly 70 percent of the water withdrawn by humans, but represents 90 percent of the water that is actually "consumed" (and lost for further use) in the world.*

Many innovations are improving irrigation or water-saving crop varieties. "More crop per drop" is the motto. That is especially so because most of the water used for irrigation is lost for further use downstream as it evaporates, while most other uses, be they domestic or industrial, return the withdrawn water to the water cycle, but often at a degraded quality. Agriculture thus uses nearly 70 percent of the water withdrawn by humans, but represents 90 percent of the water that is actually "consumed" (and lost for further use) in the world.

Countries that lack water resources can buy water either directly—water trade is at an early stage—or use the water hidden in the products they import, i.e. the water that was necessary to make these products. This is called the "virtual water." There is now a large compendium of data concerning the amount of water needed for food and different consumer products.

A cotton T-shirt is worth 2,700 liters of virtual water. To make a kilogram of cheese, you need five liters of milk, and for those five liters of milk you need 4,800 liters of water. The changing diet, implying exotic products or more meat, is water-voracious. Eating a kilogram of steak means consuming 16,000 liters of water. Adding up the real and virtual water uses of a community reveals its "water footprint," an indicator that can apply to countries, cities, or businesses, and one that sheds light on the global and geopolitical implications of water usage.

Water management has usually been organized at the national or watershed level. Typically, water statistics account only for the water supply and demand within a country. But water demand patterns have reached a global dimension. Countries which trade water-intensive products are externalizing their water footprint without consideration for the impact it can have on water resources elsewhere. A 2011 Dutch study demonstrated that 20 percent of the water consumed between 1996 and 2005 was virtual water from international trade, underlining the dependence of those nations that lack water resources. The water footprint concept is therefore gaining ground and introducing a new understanding of water management.

Photo: Guliver Image/Getty Images

One of the world's largest desalination plants in Tel Aviv, Israel

While water statistics are still quite uncertain, the water footprint metric differs from traditional withdrawal measures by concentrating on the effectively consumed water, adding the indirect water incorporated in products to the direct use of rain (green water) plus water lost by pollution (gray water).

This, however, does not account for the part of water withdrawn from surface or underground water (blue water) that returns to source. For instance, thermal plants use large amounts of cooling water, but send it back into the river. The "green water" is a newcomer in water management. It underlines a dimension of the water cycle that was neglected, namely rainwater that infiltrates and moisturizes the soil and is absorbed by the vegetation. An average of 65 percent of rainfall evaporates, 24 percent streams away (to become blue water) and 11 percent infiltrates. This 11 percent is green water available for plants and crops.

Considering that 74 percent of the water consumed on Earth comes from rain, this makes a lot of water to consider.

WATER ECOSYSTEMS

Water ecosystems do not follow political borders. More than 260 hydrographic basins are shared by neighboring countries, sometimes by as many as 19 countries—like in the case of the Danube basin. Sharing trans-boundary waters is becoming an increasingly important task for hydro-diplomats, especially in areas were the resource is scarce.

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Disputes can see neighbors opposed, like Jordan and Israel over the river Jordan, or upstream and downstream countries, like Egypt and Ethiopia over the Nile, or Iraq and Turkey over the river Tigris. More than 3,000 legal agreements on water sharing have been negotiated around the world, and two UN conventions have now entered into force, allowing for the setting up of a stronger framework.

To date, no water war has erupted, but water facilities have often been targeted during conflicts, and challenges remain high in the Middle East and Southeast Asia.

Underground water is probably the most pressing issue. In the Middle East, for instance, there are no agreements to share underground resources. Water is instead distributed on a first-come-first-served basis. What is alarming is that most of the aquifers in Middle Eastern and North African countries are, for all practical purposes, not replenishable at current projections.

Over one billion people currently live in river basins where the use of water exceeds minimum recharge levels, leading to the drying out of rivers and the depletion of groundwater. Some rivers no longer make it to the sea. In most countries, even the well-endowed ones, the water table of aquifers is lowering due to over-pumping.

America's breadbasket, where a sixth of the world's grain is produced, depends on the large Ogallala aquifer of the High Plains. But that aquifer replenishes far slower than the pace at which the water is withdrawn. Depletion of aquifers brings about land subsidence, as is the case in large areas of the United States, in Mexico City, Djakarta, or Shanghai. When too much water is withdrawn from coastal aquifers, it allows the seawater to penetrate, making the water too salty to be used.

Obviously, saving water is the first step towards achieving a good management solution, which brings us naturally to the issue of good governance. Most specialists call for an integrated water resources management scheme, one that encompasses the whole drainage basin and arbitrates between the different uses: agriculture, fisheries, energy, industry, transportation, recreation, cities, and nature.

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The term "nexus" has been coined to underline the connection between water, food, and energy. Pumping and cleaning water requires energy. Some cities find their water miles away, like Mexico City, New York, or Paris. In the United States, 15 percent of primary energy resources go to water. On the other side, you often need water to produce energy, whether it is a dam, cooling system, or steam turbine. it is therefore important that people in charge of energy, water, food, and land use speak up on such issues together.

Most governments have concentrated their efforts on the supply side, but not nearly enough on the demand side. There are something like 50,000 large dams worldwide, some empty or filled with sediment. Many people have been evicted from their lands and homes to make way for reservoirs.

And the downstream effects of dams also upset thousands of others from the loss of fisheries, decreased amounts of water, and the loss of natural fertilizers in seasonal floods. Diesel fuel or electricity subsidies have led to the over-pumping of underground water, desiccating old irrigation infrastructures, like the qanats in Iran.

It is only recently that governments have begun working on the demand side, with a whole range of measures involving the generalization of meters.

One of the toughest questions is pricing. Water is given by nature, but who pays for collecting, transporting, distributing, pipe-building and plant treatment, waste water collection and cleaning, as well as maintaining all of the aforementioned without interruption or heavy leaks?

Strong opposition to cost accounting and public-private partnerships have delayed the building of modern water systems in cities. Putting a price on water is said to promote efficient use, combat pollution, and generate investment. On the other hand, not only must water be affordable, but access to water must be acknowledged as a human right that the authorities and the international community must agree to finance with social or solidarity transfers. The balance between the three Ts of the OECD (taxes, tariffs, and transfers) is a difficult one.

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Saving and Reusing

Obviously, after being used upstream, water flows downstream. It is the same water, and it should stay clean. But adequate wastewater treatment is still lacking, and pollution remains a considerable issue, whether it is organic or chemical, and irrespective of whether it flows from farming, industries, or cities.

Heavily polluted rivers create dead zones at their estuaries, and deposit large amounts of waste into the oceans. New chemicals continuously replace those that are banned, but no one really knows what cocktail remains in the environment and what its impact will be. Pesticides or endocrine disruptors have become a major concern. A growing number of scientists believe an international chemical pollution watchdog should be set up, something that would serve as an equivalent of the IPCC.

Whenever one drills for fossil fuel or mines for minerals, one encounters underground water or disturbs the local water system. Actually, an oil well yields more water than oil (the technical term is "produced water"), but this type of water is dirty.

The deeper one goes, the more the water carries salt, metals, or radioactivity. What happens to this water? In the best case, it can be re-injected into the well with chemicals to enhance the recovery of oil. It can also be simply dumped in the environment. Shale gas fracking also uses large quantities of water it sends underground loaded with additives.

Mining is probably the dirtiest business of all, as it needs lots of water for its processes and can impact the water ecosystems with metal and chemical contamination, or with the mine plague called "acid mine drainage," i.e. sulfuric acid produced when sulfides are present in the tailings, or removed rocks and interact with air and rain. Water is already the limiting factor for mining in some countries. The new rush for minerals triggered by the energy transition is likely to further threaten water resources.

Water scarcity will encourage cities and nations to consider wastewater as a source of supply, and to treat it accordingly. Reuse is the new frontier of water policy, implementing the circular economy model. The wastewater challenge becomes the reuse opportunity. Not only will wastewater treatment safeguard health and protect the environment, but it will extract additional value from materials, heat, and water carried by wastewater streams. This new paradigm, of which Singapore and Israel are pioneers, is applied around the world.

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The ultimate technology for reusing wastewater is the membrane. Membranes emerged as a viable means of water purification in the 1960s and have been continuously improved upon since. They allow some particles to pass through while blocking others. Depending on the size of the membrane's pores, the technology can go from microfiltration to ultrafiltration, and even nanofiltration, restraining bacteria, viruses, and even most molecules. But it is still expensive and requires energy to push the water through the membrane.

Membranes are today the preferred way to desalinize seawater, a business experiencing strong development around the world. The Mediterranean and Gulf regions were the first to build large-scale facilities. They have now been followed by a number of other countries, with 20,000 desalination plants today producing 1 percent of global drinking water.

Desalination has its drawbacks, however: the raw water must be clean; anti-fouling uses biocides, and you have to find the best disposal solution for brine, which usually means sending it back to the sea, which could have a local negative impact. The future of desalination is open and new technologies are appearing every day—notably the use of renewable energy instead of fossil fuels. Undoubtedly seawater is now becoming a source of freshwater supply for coastal populations.

Crisis Exacerbated

Climate change is exacerbating the water challenge. The hydrological cycle is being accelerated, more water evaporates from the warmer oceans, and more water vapor is held by warming air; all this is leading to more rainfall.

Atmospheric rivers carry huge amounts of water vapor from tropical regions to temperate zones, then suddenly release in one place as much water as the lower Mississippi, provoking monster flash floods in areas unprepared to deal with them. This is especially of concern in towns where the runoff can be very damaging. The Chinese have invented the concept of sponge cities to address this new threat. Adaptation to climate change also means that coastal cities will have to cope with rising sea levels and the new intensity of hurricanes.

> *Water is becoming a global asset, if not yet a global common. Let us not forget that if humans need water, nature does too.*

Inevitably, as floods become more frequent, droughts will be the other consequence of higher temperatures and accelerated evaporation. They will pose a serious problem to agriculture and wildlife, as well as to unprepared settlements.

Multilevel drought governance will require the involvement of all stakeholders. Innovative small-scale tools have been successful for harvesting fog or moisture from the air, but if they do not have the resource of reusing waste water or desalinating seawater, landlocked rural regions will be at risk.

Recent tragedies remind us of the necessity of water availability to combat forest fires that are bound to expand in semi-arid climates. Authorities facing limits for investing in water will have the choice of setting priorities between providing water in downtown areas, where people can pay, in the suburbs, where social unrest can bring political instability, or in rural areas, in order to keep farmers on the land.

Water, or a lack thereof, has fueled many crises. Between 2006 and 2011, Syria experienced a severe drought that sent more than a million farmers to the outskirts of cities, where already a million Iraqis were refugees. Obviously the water crisis contributed to the civil war.

Today, three million people move each week to live in cities around the world. They need water. From 1950 to 2015, the OECD calculated that the land area required to supply water to cities with over 750,000 inhabitants had grown 28 percent. Most mega-cities of more than 10 million inhabitants will face water scarcity issues.

In the developed world, the challenge is on maintaining infrastructure (a pump has a lifespan of 25 years, a pipe lasts 80 years) and preventing leaks. People are actually reducing their tap water consumption (or buying more bottled water), reducing the revenues of urban water services companies.

In the developing world, the challenge pertains more to infrastructure building. A quarter of urban dwellers in developing countries do not have access to piped water at home. Eight hundred million people live in slums often built in flood-prone areas that lack basic services and are exposed to health hazards. It is probable that a centralized model of urban services will not apply to fast-changing conditions in developing world cities.

The river basin dimension is still the appropriate level at which to manage water safely and equitably. But water trade, virtual or real, is changing the picture. Climate change is forcing the manager to look beyond the limits of the basin to see if El Niño is back or if a hurricane is heading his way. Pollution flows along rivers and into aquifers without stopping at any border. Satellites measuring gravity see a global water cycle, alongside the 200 largest river basins.

Water is becoming a global asset, if not yet a global common. Let us not forget that if humans need water, nature does too. Animals and trees drink. About 50 percent of the world's water fauna and half of the wetlands disappeared between 1970 and 2000. Healthy aquatic ecosystems provide invaluable services. To manage water, it is better to understand the role of wetlands and lakes in buffering floods and droughts, and to have a clue about the hydrological cycle. The time has come to improve water governance, to better collect water data, and to stop considering protection of the environment as the fifth wheel of the cart.