Rachel Carson Center
Perspectives

How to cite:

Mauser, Wolfram. "Sustainable Water." In: "On Water: Perceptions, Politics, Perils," edited by Agnes Kneitz and Marc Landry, *RCC Perspectives* 2012, no. 2, 77–81.

All issues of *RCC Perspectives* are available online. To view past issues, and to learn more about the Rachel Carson Center for Environment and Society, please visit www.rachelcarsoncenter.de.

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Leopoldstrasse 11a, 80802 Munich, GERMANY

ISSN 2190-8087

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Federal Ministry of Education and Research

Deutsches Museum

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

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Sustainable Water

Most articles about water start with a statement that outlines the tremendous meaning of water for life on this planet; they start with sentences like "there would be no life on Earth without water." Can we think of anything more rudimentary? Very few people, and especially nobody from water-scarce regions of the globe, challenge these statements. An interested reader, reading further, is impressed by the manifold ideas on water, which develop with more or less pain and vigor from such a mighty but almost trivial introduction. Some tell us about religion and myths, trying to explain our own feelings of dependence and vulnerability towards water and the fact that we can only live without it for a few days. Some tell fanatic or fantastic stories about tamed rivers, artificial lakes, pipelines, and hydraulic heads and flows. They try to convince us that culture depends on the right kind of water at the right time. And, of course, some are stories about those who can magically conjure water to be there right when it's needed most. Some tell us that cultures vanished because they ran out of water. They analyze how it was and is wasted and contaminated, how it was and is the origin of most diseases and the source of many conflicts, and how it was and is badly governed. They tell us stories of greening deserts, of endless food instead of the usual starvation, of fertile fields and open landscapes instead of muggy and impenetrably dense forests. Why don't we find a similarly manifold palette of stories on crude oil, on the sun, or on nature itself? What do all these stories and myths tell us about water, and what do they tell us about ourselves?

Some facts: No doubt, water is systemic for Earth. Systemic in a much more basic sense than any bank is to the global financial system; it makes Earth different from all known planets and is responsible for its comfortable and hospitable living conditions. Together with its close relative, carbon dioxide, it established a greenhouse thermostat that captures solar heat, raises Earth's temperature by 35 degrees Celsius, and keeps it there. Without this thermostat, Earth would basically be a frozen snowball in the universe. This temperature increase made liquid water, lakes, rivers, and oceans possible, and in the course of evolution formed carbon-based life. It took generations of scientists to understand that water on Earth is not produced or destroyed, but rather follows a cycle of evaporation, moisture transport, rainfall, and runoff. It is this constant global distillation and distribution process that simultaneously purifies water while cycling;

water evaporates, leaving all substances behind in the oceans—their salt content has increased to 3.7 percent during the last 3 billion years—and starts the next round with fresh water in the form of rain. It is not hard to imagine what water on Earth would look like after 3 billion years of cycling without this natural purification: Billions of years worth of waste would have accumulated and water would be saturated with all the soluble materials on Earth. Therefore, everything could be found in water in large quantities, because everything can be dissolved in water.

The perception of distillation and transport as a permanent reset of the quality of rainfall was the blueprint for our understanding of renewable natural resources. A renewable natural resource not only follows a cycle that sends the resource around the globe until it returns to the origin of its travel. A renewable natural resource follows a cycle that also systemically returns the resource to its original state. This is not trivial, and we have very few other cycles on Earth that can also serve as an example for such a robust yet simple loop, which could, at least in principle, go on forever. This idea of a cycle has formed the foundation for a deeper understanding of ecosystems and their functioning. Similar cycles were discovered—such as the carbon cycle, in which plants constantly build extremely complicated, even self-reproducing, carbon-based molecules essentially from carbon dioxide and water in order to finally convert them back into carbon dioxide and water with the help of powerful micro-organisms. At first glance this may sound like a zero-sum game. Nevertheless, over the ages these two cycles have managed to totally change the shape of the planet; they have eroded and removed tall mountains, accumulated huge flood plains, put oxygen in, and removed most carbon dioxide from the atmosphere, storing it in mountains of limestone. The co-evolution of life and its inanimate environment over the past 3 billion years has eventually managed to create an increasingly hospitable environment for life on Earth and, by constantly renewing itself, maintains a balanced state that is far from the original inanimate equilibrium, which existed at the beginning of this process.

Even though the basic principles of distillation, transportation, composition, and destruction within the fundamental cycles on Earth seem simple at first, up close they reveal an intricacy that allows for the complex and unique interaction of all living and non-living elements of the Earth's ecosystem independent of their location on the globe. Equipped with a lifespan of approximately 70 years, we wonder whether the fact that these cycles have uninterruptedly been in place now for at least 3 billion years expresses

their fundamental robustness: Are they, and the life they produced, a basic property of Earth such as gravity? Almost everybody would agree that gravity cannot be switched off, because it is a fundamental property of matter. In this case, if the water cycle can also be considered a basic property of Earth, nothing could switch it off either. Or does the water cycle express the resilience of a uniquely coupled bio-physical system, which, through evolutionary adaptation and within boundaries, buffers changes in the natural environment and thereby keeps it suitable to carry life? These are undoubtedly fundamental and important scientific questions at the center of today's debate on sustainable development! Can the water cycle, and thereby life, be stopped through human interference or will the Earth system buffer it away as it has buffered all external disturbances in the history of the planet and kept life alive on Earth? The academic answer may most likely be, "Yes, it can be buffered but at the expense of humankind." Since this answer is irrelevant from a human perspective, the relevant question is: "can human interference with the global water and carbon cycle be buffered without humankind disappearing?" This is the systemic question that goes beyond the myths and stories told about water.

At this point, a closer look at how humans use water is worthwhile. More than 60 percent of the rainfall that falls on the global land surface, is already used by humankind mainly to produce food and biofuel. Water is transpired into the atmosphere in large quantities by growing vegetation. One may argue: "how can water be used when it is only entering the plants through the roots and leaving them through the leaves?" Using the term "water use" in this context expresses a decision in favor of one pathway along the water cycle instead of another. Without vegetation most of the water would have most likely ended up in rivers, with vegetation it ends up in the atmosphere. But how do we, by growing food, influence the water cycle differently than the natural vegetation that has grown since before humankind? We substitute natural vegetation with our favorite breed of plant species with the intention to use as much rainfall or irrigation water as possible to produce as much food as possible with the help of fertilizers and pesticides. We thereby change the rules of nature, following our own interests and altering the environment in favor of our preferred plants. Agriculture is not a tiny backyard experiment; it is the largest human undertaking on Earth, actively involving 3.5 billion people, or half the global population, from different cultures, interests, technologies, and with different goals.

Natural ecosystems are familiar with starvation. They have throughout the course of evolution been short of nutrients and, therefore, rely on efficient recycling strategies that

minimize erosion and land degradation. With the invention and application of fertilizers, man-made agricultural ecosystems forgot how to starve and now produce and release waste, which erodes and degrades land. Stimulated by fertilizer, they drive agricultural water use to its limit and beyond at the expense of river water. This can be observed in the case of the Colorado River, the Yellow River, and many other rivers, which at times have almost completely evaporated and not been able to reach the sea. Does it make a difference whether river water is used for the benefit of food production and evaporates on land instead of in the ocean, where it was originally headed? Yes it does! Eventually the water that evaporates leaves all constituents behind. It makes a difference whether this happens in the ocean or on farmland. The ocean will dissolve all salts, fertilizers, pesticides, and human waste. The soils on the farmland will keep these constituents and, if badly managed, will lose fertility. The land will eventually be unsuitable for food production or, in the worst case, maybe even for sustaining vegetation. Today, the amount of irrigated land on the globe that is lost each year through soil salinization and degradation is almost as large as the irrigated land that is newly established. Clearly, this process is not sustainable.

Without land resources, water resources cannot materialize, because only land can turn rainfall into food or biofuel. The current land rush in all parts of the world is a clear signal that the geopolitical and financial keyplayers, in their urge to turn as much rainfall as possible into tradable commodities, see the access to water utilization, rather than the access to water, as the critical strategic resource of the future. Will this trend eventually destroy the water cycle? No clear answer can be given yet, but at least it cannot be precluded. What seems to be clear is that the land rush increasingly affects the global water cycle either by agricultural expansion and the removal of protected areas, or by agricultural intensification and pollution and erosion of existing arable land. Some accompanying effects are quite clear: Land rush surely will intensify water and land use. It will boost agricultural production, which is necessary to expand western style consumption patterns, feed the increasing global population and satisfy the investors. It will make millions if not billions of people landless. There is a good chance that it will wash away any suitable and productive protected areas on the globe, and leave the wilderness reserved to places not suitable to turn rainfall into commodities. However, productive protected areas are vital for the long term stability of Earth's life-support system to preserve biodiversity as a pool of opportunities to adapt to currently unforeseen future developments. We are currently witnessing the onset of the second global wave of "land

grabbing" after the expansion of the colonial powers in the nineteenth century. As in the past, this wave seems to be largely uncoordinated and will most likely not follow any ethical and environmental standards.

Unlike in the past, this current wave takes place within the framework of a globalizing food and bio-fuel market. Deteriorating land resources is the price for cheap food, animal feed, and biofuel, which are produced in developing regions below minimum environmental and social standards and then injected into a growing globalized trade system to maximize profits in regions of high income. Without trade regulations, which take into account minimum environmental and social production standards, this is the inevitable logic of the globalized trade.

Unlike in the past, this also takes place on a transparent globe. Today we have at our disposal detailed up-to-date information on each corner of the globe and even the smallest and most remote piece of land. An active internet and a growing fleet of satellites, transmitting a continuous stream of images on the state of the land surface and the water resources, irrespective of national boundaries or political restrictions, mirror how we transform the globe. Knowledge creates responsibility.

On a transparent globe, ignorance is no excuse anymore.

Further Reading

Mauser, Wolfram. *Water Resources: Efficient, Sustainable and Equitable Use*, translated by Karen Schneider. The Sustainability Project Series. London: Haus Publishing, 2008.