



The toilet revolution is coming. Durban is one of the pioneers in off-grid sanitation.



Climate change will lead to increased spread of waterborne diseases, warns Rita Colwell.

STOCKHOLM

# WATERFRONT

#3-4 | DECEMBER | 2018

## NEWS BRIEFS

*Asparagus as a water risk, toilet tech from space, and more.*

*New procurement rules to save antibiotics*

# WATER & HEALTH



## A hot topic in a hot climate

Water and health will be an increasingly important topic in coming years, for several reasons. Climate change is expected to trigger the spread of many waterborne diseases around the world. Population growth will make the issue of access to clean water and sanitation even more pressing. On top of that comes a health crisis that could emerge as the result of growing antimicrobial resistance.

All these challenges are addressed in this issue of WaterFront, focused on water, health and climate change. On page 14 we meet Professor Rita Colwell, who pioneered the study of waterborne diseases and climate but feels there's an urgent need for intensified research.

There are also some encouraging signs, with philanthropist Bill Gates predicting a sanitation revolution. WaterFront visits Durban in South Africa where 85,000 waterless toilets are installed. Read more on page 10.

The role of pharmaceutical production in the spread of antimicrobial resistance was long overlooked but has now moved to become a top issue on the international agenda. To learn more, turn to page 4, and for an op-ed on the topic, see what Nicolai Schaaf has to say on page 23.

In addition, we analyze two topics related to climate change. On page 18, John Joyce sheds light on the debate around this year's recipients of the economics Nobel, while on page 20, Maggie White describes the fascinating but poorly understood interlinkages between water and climate change.

Enjoy the read!



**Torgny Holmgren**  
Executive Director,  
SIWI

**SIWI**  
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# Asparagus linked to water crisis



A global surge in demand for trendy food items like asparagus and avocado has boosted economic growth and created jobs in Peru's Ica valley. But according to a new report from independent Swedish research organization, Swedwatch, it has also led to an acute water crisis. Since 90 per cent of the available freshwater is used to grow export crops, residents may now only have access to water for a few hours a week. The researchers call on food importers to follow up on their suppliers' compliance with human rights requirements, including the right to water.

## Space tech for sanitation

The European Space Agency and The Toilet Board Coalition, a business-led partnership addressing the global sanitation crisis, are looking to space for inspiration. Solutions developed for space travel may be useful also when developing off-grid, circular sanitation services for expanding cities with insufficient sewage systems.

# 5,000

Google searches for "composting toilet" grew by 5,000% in January 2018 as Cape Town looked set to become the first metropolis to run out of water.



Photo: Andreas Karlsson

## New light on India's water crisis

India is suffering "the worst water crisis in its history", according to a June report by government policy think tank NITI Aayog. The report warns that the situation is likely to get worse, with water shortages threatening the lives and incomes of hundreds of millions of Indians.



## UN Security Council on water and conflict

At the Arria-formula meeting in October, the UN Security Council addressed the relationship between water risks and conflict. The aim was to assess how the UN system can work systematically to address water scarcity and develop systems for early warning.



## Engineered rice resilient to drought

Rice cultivation is known to be a particularly water intensive activity but scientists from the University of Sheffield believe they have found a way around that. They are experimenting with rice plants engineered to have fewer stomata – tiny openings used for gas exchange – which makes them more tolerant to drought and resilient to future climate change.



# NEW HOPE TO RESCUE THE

Text | Maria Sköld

**Antimicrobial resistance is one of the greatest known threats to human health. Recent research shows that insufficient treatment of wastewater from pharmaceutical plants is an important contributor, but so far, the problem has been difficult to tackle. Now there is new optimism, with talk of tougher regulation and new incentives. Will 2019 mark a turning point?**

**The World Health** Organization warns that antimicrobial resistance, AMR, could quickly wipe out many of past decades' health gains. It is expected that by 2050, more people could die from AMR than from cancer and diabetes combined.

Over-subscription of antibiotics to humans and overuse in intensive animal farming are two main culprits behind the worrying trend, but in recent years it has been discovered that wastewater emissions from pharmaceutical production play a larger role than previously assumed. Back in 2007, researchers from University of Gothenburg, Sweden, became the first to discover shockingly high levels of antibiotics in rivers downstream from a wastewater treatment plant in India's pharmaceutical hub, Hyderabad. The concentration of antibiotics in the water was not only the highest ever recorded in the environment, it exceeded what can be found in the blood of patients taking the drug.

**Ten years later**, the team continues to study the polluted environments, not least how the discharges contribute to the spread of AMR. "There's no doubt that having such high concentrations of



Carl-Fredrik Flach

antibiotics released into the environment drives antimicrobial resistance and selects for resistant bacteria," says researcher Carl-Fredrik Flach, associate professor at the Centre for Anti-

biotic Resistance Research (CARE) at the University of Gothenburg.

**He is particularly** worried about discoveries implying that antibiotic resistance genes found in pathogens may originally stem from harmless environmental bacteria, and that such movements of genes and in turn emergence of resistant bacteria may be favored in these environments.

With today's travel patterns, it doesn't take long for resistant bacteria to spread throughout the world. Carl-Fredrik Flach believes that antimicrobial resistance must be tackled as a high-priority global risk rather than solely as a local problem for the manufacturing countries.

**In the wake of** the World Trade Organisation's 1994 agreement on trade-related aspects of intellectual property rights (TRIPs), India and China have emerged as the international pharmaceutical giants, producing the vast majority of the world's medicines. As a result, the cost of medicine has come down, but the price has often been paid by the production countries' watersheds and the people living close to them.

India's severe water pollution crisis has many sources, but the country's manufacturing industry is certainly one of them. According to a 2015 report from the Indian government, half the country's rivers are now polluted, and the number of contaminated waterways doubled between the years 2010 and 2015. ●●●

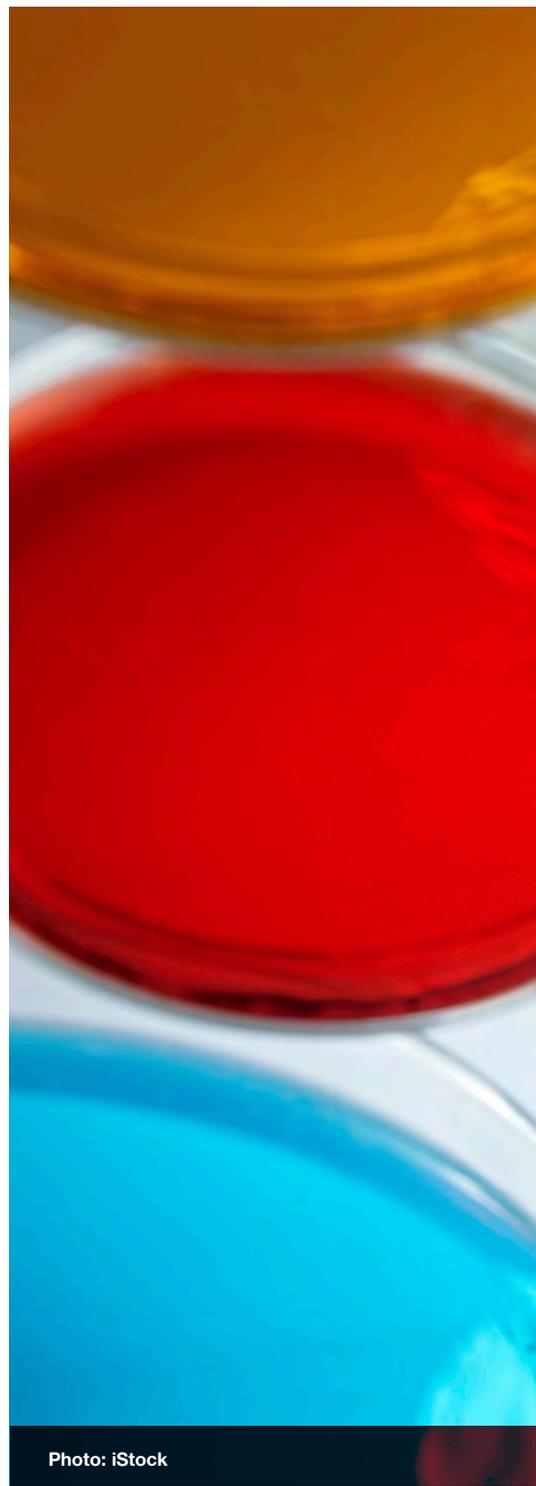


Photo: iStock

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# LIFESAVING ANTIBIOTICS



●●● **In Hyderabad**, some effects are visible even to the eye. The area was once famous for its abundance of pure lakes but today many of them are foaming with toxic waste. In a report commissioned by the Nordic bank Nordea, it is described how villagers living close to the Dharani Nagar lake have been forced to evacuate their homes after 50 houses became covered with toxic foam. Researchers working on the report also collected testimonials from locals about thousands of dead fish washed ashore and about school children developing rashes and eye conditions.

**Still, the most serious** long-term consequences may not yet be fully understood. There is concern that chemicals

are seeping into the groundwater and the Gothenburg team has found antibiotics in ground wells close to manufacturing sites.

Local groups, quoted in two Nordea-funded studies, complain that the growing body of academic and NGO reports about the dangers of water pollution in Hyderabad are not taken seriously enough. Companies continue to discharge insufficiently treated wastewater into the area's waterways without the authorities being able to handle the situation. Activists fear that the situation could get even worse as India is seeking to further expand the national pharmaceutical industry, which is already one of the fastest growing segments of the Indian economy, employing 2.5 million people.



Resistant bacteria inside a biofilm. Photo: iStock

## ANTIBIOTICS

Antibiotics are medicines used to prevent and treat bacterial infections. After 1945, they have spread rapidly around the world, revolutionizing modern medicine.

**Antimicrobial resistance:** Antimicrobial resistance occurs when a microorganism evolves to resist the effects of an antimicrobial agent. Globally about 700,000 people die of resistant infections every year because available antimicrobial drugs have become less effective at killing the resistant pathogens.

**Source:** UNEP

### Read more

- Access to Medicine Foundation: Antimicrobial Resistance Benchmark 2018
- The Review of Antimicrobial Resistance, available at <https://amr-review.org>
- Nordea Asset Management: Hyderabad's Pharmaceutical Pollution and Impacts of Pharmaceutical Pollution on Communities and Environment in India, available at <https://sustainablefinance.nordea.com>
- UNEP: Frontiers 2017, Emerging Issues of Environmental Concern
- WHO: Global Action Plan on Microbial Resistance

According to Make in India, a government-sponsored initiative to attract investment, the cost of producing pharmaceuticals in India is almost 50 per cent lower than in western Europe.

**At the same time**, there is another, competing, trend.

The national Indian government is starting to speak up about the dangers of antimicrobial resistance, with the Environment Ministry classifying the pharmaceutical industry as a "red category", over concerns about hazardous waste from production. Among international organizations, the government's ambitious National Action Plan on Anti-Microbial Resistance from 2017 is often cited as a benchmark example.

"The situation is complex," says Dulce Calçada, researcher at Access to Medicine Foundation, a non-profit that guides and incentivizes pharmaceutical companies to do more for people without access to medicine.

"Traditionally, regulation on industrial wastewaters focuses on water quality parameters that should safeguard environmental integrity. There are currently no antibiotic discharge limits aimed at preventing development of antibiotic resistance in the environment. Not anywhere in the world, to the best of our knowledge."



Dulce Calçada

**Within India**, there are calls for the country to become the first to introduce limits also to pharmaceutical effluents. The Central Pollution Control Board, which is monitoring the implementation of the National Action Plan, is now working on draft standards for the industry which could come into effect in 2019.

The Access to Medicine Foundation started to work on antimicrobial resistance in 2016 and published the world's first independent benchmark of pharmaceutical action on the topic in January 2018. According to the organization's Director of Strategy, Damiano de Felice, there is definitely a shift in attitudes. "Antimicrobial resistance has now become a global issue and that has created new expectations. Pharmaceutical companies



**Streptococcus pneumoniae, potentially deadly pathogens.** Photo: iStock

begin to feel the pressure and see the advantages of developing and implementing stronger risk management strategies to prevent antibiotic discharge in the environment” he says.

**It was in 2016** that antimicrobial resistance really came into the international limelight. That year, more than 100 pharmaceutical companies and industry associations signed the Industry Declaration on AMR at the World Economic Forum in Davos in January. A few months later, 13 companies committed to the more detailed Industry Roadmap for Progress on Combatting AMR. In May, economist Jim O’Neill published a Review on AMR with a chilling description of an international health crisis many had so far managed to ignore. Soon after, in a political declaration from the UN General Assembly, governments promised to take action. Various countries, international organizations and UN agencies have produced their own strategies, as have the G7 and G20 groups.

**All these activities** are important, argues Damiano de Felice, since they build momentum and clarify expectations. Still, most activities remain based on voluntary contributions and that may not be sufficient to trigger a real shift in the industry:

“Many companies point to the high cost of implementing better waste treatment technologies and a lack of incentives, such as procurement agencies rewarding responsible manufacturing practices,” he says.

**In the debate** over whether the voluntary approach will be enough, a common argument against regulation is a lack of scientific agreement on which emission levels that could be considered safe. But Carl-Fredrik Flach argues that ongoing research shows that it is indeed possible to establish acceptable emission levels. His research team from Gothenburg University has also published a list of predicted “no-effect concentrations” regarding resistance selection for 111 antibiotics, an approach that was highlighted in the AMR Review from 2016 as a good

starting point for defining discharge limits.

**An important step** was taken last September, when the AMR Industry Alliance – the coalition coordinating implementation of the commitments made by companies in 2016 – published a list of recommended antibiotic discharge targets. The Alliance now encourages its member companies to work towards ensuring that these limits are enforced in their manufacturing operations.

“We need regulations on emission levels and the producers must become transparent about what they do. Some companies claim to have emission restrictions in place but since they never disclose any details, there is no way for us to know,” Carl-Fredrik Flach says, adding:

“Without increased transparency, companies don’t need to reveal where they get their substances, so it’s impossible to know where a product is really produced. But I’m optimistic that this is beginning to change – hopefully we will soon have regulations in place.”●

# The pharma company leading the campaign

Text | Maria Sköld

For pharmaceutical company Centrient Pharmaceuticals, the fight against antimicrobial resistance is a necessity. As a maker of generic antibiotics, their products would be ineffective if bacteria became resistant to their healing effect. But so far there is no consensus in the industry on how to tackle the threat from antimicrobial resistance.

As global head of Centrient Pharmaceuticals Sustainable Antibiotics Program, Alba Tiley has become a well-known



Alba Tiley

campaigner for strict pharmaceutical effluent criteria and transparency within the pharmaceutical sector.

“When the issue of antimicrobial resistance came on our radar a few years

## CENTRIENT PHARMACEUTICALS

Until 10 December 2018, the company was known as DSM Sinochem Pharmaceuticals. The new name was adopted after a change of ownership to Bain Capital Private Equity.



ago, we were shocked to realize the potential cost to human health and the global economy. Soon we also saw how this could negatively affect the products that we've had for decades," she recalls.

**Centrient Pharmaceuticals** then began a programme of advocacy, raising awareness about antimicrobial resistance (AMR) and the consequences if the industry does not adequately treat its wastewater following the production process. They called for stricter pharmaceutical wastewater standards, with the aim of creating a more level playing field that would encourage and benefit companies with responsible environmental practices.

**Suman Sharma**, Director for Centrient Pharmaceuticals' Sustainable Antibiotics Program at the South Asia and Asia Pacific business unit, plays a key role in this strategy. She is based in Gurgaon, India, and it is part of her job to reach



**Suman Sharma**

out to decision-makers and represent Centrient Pharmaceuticals at stakeholder meetings with the government's Central Pollution Control Board, CPCB. "The CPCB handles regulations and they have begun working on draft standards on antibiotic effluents which are now being reviewed by the government. Though it remains to be seen exactly what they will include in full, I generally feel our message of responsible production of antibiotics has been very well received," she says.

**Centrient Pharmaceuticals** also aims to reduce its own environmental impact, particularly its wastewater emissions. Together with other companies in the AMR Industry Alliance, they have developed an Antibiotic Manufacturing Framework to establish a benchmark for good manufacturing practices, including targets for pharmaceutical effluents.

**Another important** aspect is working with suppliers to make sure they too reduce their environmental impact. Centrient Pharmaceuticals is doing this through the Pharmaceutical Supply Chain Initiative, which requires participating companies to carry out five supplier audits every year. The audited data is then aggregated into a single database where other companies can access it.

"In this way, not every company has to conduct its own audit and at the same time we have access to a lot of data. More importantly, the data will now include wastewater treatment of antibiotics," explains Tiley.

***"When the issue of antimicrobial resistance came on our radar a few years ago, we were shocked to realize the potential cost to human health and the global economy."***

**Standards within** the pharmaceutical industry still vary greatly, according to the Antimicrobial Resistance Benchmark report, a first of its kind, which was released by the non-profit Access to Medicine Foundation in early 2018. The study reviewed AMR-related risk management strategies of 18 large

R&D-based and generic pharmaceutical companies. It turned out that only eight set limits on the concentration of antibiotics in their wastewater.

"We will now raise awareness about why this is important, in particular among generic medicines manufacturers from emerging economies like China and India, and among big procurers of antibiotics who can trigger industry



**Damiano de Felice**

change by rewarding responsible manufacturers with larger contracts," says Damiano de Felice, Director of Strategy at the Access to Medicine Foundation. He and his colleagues are currently working on updating the methodology for the next benchmark study, to be published in 2020. Through his conversations with companies, he notes a growing recognition of the importance of the issue and hopes to see improvements in the next report.

**Both Tiley and Sharma** at Centrient Pharmaceuticals, also believe the industry is changing – though maybe not fast enough. In their view, supply chains should become more sustainable, with regulators setting standards and health-care buyers including environmental criteria in public procurement policy.

This is also increasingly discussed, not least in Europe where the it has been raised in the European Parliament.

In the Netherlands, CSR Netherlands, a network of companies striving for corporate social responsibility, has seized on public momentum and is convening meetings within the private sector to

improve sustainability of the pharmaceutical supply chain.

"We don't need to reinvent the wheel, but should look at other industries, such as fashion," Sharma says, "they managed to raise consumer awareness on the sustainability of the supply chain – what can we learn from that?" ●



# Tougher demands ahead

Text | Maria Sköld

**Swedish county councils were early in setting up sustainability criteria when buying medicine, an idea that is now gaining global traction. For the pharmaceutical industry, it is of particular importance that the United Nations has started to apply environmental criteria in its own procurement of medicine.**



Pauline Göthberg

The Swedish county councils and regions have since 2010 cooperated on a national level to use environmental and social criteria in their procurement of pharmaceuticals. According to Pauline Göthberg, national coordinator for sustainable public procurement at the county councils, the result has been satisfactory so far.

“We do see an increased interest from suppliers, the industry is beginning to take more responsibility. There are now much more discussions about what should be regarded as sustainable supply chains,” she says.

In recent years, public procurement has become a popular way to address different societal challenges and is now encouraged in both EU regulations and in frameworks like the 2030 Agenda for Sustainable Development and the UN Guiding Principles of Business and Human Rights. “I do believe that we can use our combined purchasing power to make a difference, public procurement can definitely be a tool to drive change,” Pauline Göthberg says.

However, applying sustainability criteria to the pharmaceutical industry is widely considered to be more difficult than what is the case with many other types of goods and services. For one, companies tend to be very secretive, protecting patented research that they have spent years and fortunes to develop. In addition, supply chains are often long and complex,

with production taking place in low- or middle-income countries. Of the giants in the field, China stands out as an especially opaque country where it is much more difficult to obtain information than in India.

Still, Pauline Göthberg believes that it is possible to apply sustainability criteria to pharmaceuticals, encouraging the industry to become more transparent. If more and more countries and organizations make such requirements, companies will adjust.

*“Green health procurement is a major contributor to the 2030 Agenda for Sustainable Development and the attainment of the Sustainable Development Goals”*



Rosemary Kumwenda

A major step in that direction was recently taken as the UN begins to use sustainability criteria in its own procurement. “Green health procurement is a major contributor to the 2030 Agenda for Sustainable Development and the attainment of the Sustainable Development Goals,” says Dr. Rosemary Kumwenda, SPHS Coordinator and UNDP Regional Team Leader HIV/Health and Development, Eastern Europe and Central Asia.

She heads the Sustainable Procurement in the Health Sector Initiative (SPHS), which was launched in 2012 as an informal initiative to bring together UN agencies and global health financing institutions

to ensure that health procurements done by the member agencies are sustainable.

More recently, UNDP also launched the Sustainable Health in Procurement Project, SHiPP, which aims to reduce the harm to people and the environment caused by the manufacture, use and disposal of medical products and the implementation of health programmes. The project targets ten lower middle-income countries and emerging economies to develop and pilot a set of sustainable health procurement practices and policies.

“By hosting and supporting the implementation of the SPHS and SHiPP, the UN acknowledges that saving lives and environmental sustainability are two sides of the same coin. This supports the reduction of toxic chemicals and materials in health products, greenhouse gas emissions in the healthcare supply chain and the conservation of resources,” Rosemary Kumwenda says.

Pauline Göthberg follows the UN initiative with great interest.

“If all UN organizations would come together and set demands, that would really boost the sustainable part of the industry.”

**The Sustainable Procurement in the Health Sector Initiative (SPHS)** was launched in 2012, bringing together UNDP, UNEP, UNFPA, UNHCR, UNICEF, UNOPS, WHO, Gavi, The Global Fund and UNITAID, to ensure that their procurement is sustainable.

**The Sustainable Health in Procurement Project (SHiPP)** is an initiative from UNDP and Health Care Without Harm to promote procurement practices that consider environmental and social impacts, as well as cost-efficiency and affordability.



RITA COLWELL:  
**“Expect unpleasant surprises”**

Text | Maria Sköld Photo | Thomas Henrikson

Humanity may be in for some unpleasant health surprises in coming years, warns **Rita Colwell**, world-leading expert on waterborne diseases. Increasing waste from a growing population at a time of rising temperatures is great news for many bacteria, but less so for humans. In this interview, Dr. Colwell talks about the risk for massive outbreaks of, for example, water borne diseases and what she sees as the best solution – clean water and sanitation.

When **Rita Colwell** became the Stockholm Water Prize laureate in 2010, it was in recognition of her contributions to the understanding of waterborne infectious diseases.

As a microbiologist, she was the first

to discover that cholera can lie dormant in waterbodies. She then moved on to propose groundbreaking and low-cost solutions that have saved numerous lives, which was emphasized in the Prize citation.

**The Distinguished** Professor from the University of Maryland and Johns Hopkins University Bloomberg School of Public Health in the United States was also the first scientist to research impacts of climate change on the spread of infectious diseases.

She continues to work on bridging advanced technical solutions with inexpensive applications and has helped create the study of bioinformatics, combining biology, computer science, and information technology. Recently this approach has led to a new way of detecting increased cholera risks at such an early stage that outbreaks can be mitigated or maybe even avoided. ●●●



**RITA COLWELL**

**Title:** Distinguished Professor from the University of Maryland and Johns Hopkins University Bloomberg School of Public Health, USA.

**Known for:** Groundbreaking research on waterborne infectious diseases and the impact of climate change.

**Awards and recognition:** Stockholm Water Prize 2010, the Lee Kwan Yew Water Prize in 2018 and 61 honorary degrees. In 2005 she was inducted into the National Women’s Hall of Fame.

●●● **Dr. Colwell, could you please describe your main findings related to cholera?**

“We have learned that the *Vibrio cholerae* bacteria are closely associated with zooplankton, mainly copepods that have a similar cell structure as shrimps. It turned out that some components of the human gut are similar in composition to structures in internal parts of the copepod.

England and Europe in an almost direct relationship with the warming of the seawater in the North Atlantic. We have published this finding in the *Proceedings of the National Academy of Sciences* a few years ago. It’s an interesting study because it illustrates how infectious disease can be attributed to changes in temperature of the ocean and likely due to climate change.”

*“Interestingly, infections caused by these *Vibrio* bacteria have increased in England and Europe in an almost direct relationship with the warming of the seawater in the North Atlantic.”*

Up to 80 per cent of genes found in *Vibrio cholerae*, the causative agent of cholera, can be transferred from one cell to another, not all at once but individual genes or clusters of genes, back and forth. That makes the bacterium very versatile and adaptable. It was a new idea that such a potentially dangerous human pathogen can be found everywhere in the natural aquatic environment.”

**How is this linked to climate change?**

“Temperature is a very important factor, in addition to salinity. As the water warms, the bacteria become active and can multiply rapidly.

**You have also studied the situation in countries like Bangladesh?**

“Yes, already in the 1980s we had measured chlorophyll and sea temperature by satellite. Chlorophyll is a measure of phytoplankton and the phytoplankton can serve as a surrogate for the zooplankton which become abundant a few weeks after the phytoplankton populations increase. The zooplankton carry *Vibrio* bacteria as part of their natural flora. We figured that if we could measure chlorophyll and sea temperature by satellite, we could develop a model to predict when cholera would occur in countries like Bangladesh where the population obtains drinking water directly from rivers and ponds without treatment.”

“**In a study with** wonderful colleagues from Italy, Germany, and England, we also found that the warming of water in the north Atlantic over the past 40 years is correlated with an increase in infectious disease in humans caused by *Vibrio* bacteria. We were able to detect an increase in the *Vibrio* bacteria in plankton samples, collected over the past 40 years, stored in a marine laboratory in England. DNA methods were used to detect the *Vibrio* bacteria in the stored plankton samples. Northern Europe and England, of course, don’t have cholera epidemics today, but there are other species related to *Vibrio cholerae* that cause human infections, for example *Vibrio parahaemolyticus* and *Vibrio vulnificus*. And they can be serious pathogens.”

“**And sure enough,** from the satellite data and our calculations, we successfully linked outbreaks of cholera in the villages near the Bay of Bengal with chlorophyll and water temperature. This first study was successful with results that were very crude but highly correlated with cholera incidence. We published a paper on these findings in 2000. The model has since been significantly improved and we are now working with the British aid agency and UNICEF to predict cholera in Yemen with the help of the British meteorological agency and their data. This has significantly contributed to reduction of cholera cases in Yemen since supplies and medical personnel can be positioned to those areas that our model calculates to be of highest risk for cholera.”

“**Interestingly,** infections caused by these *Vibrio* bacteria have increased in

**“Over time, our work** has become very practical, but it always starts with fundamental curiosity. Another example is how we hypothesized that it may be possible to reduce cholera by filtering plankton that carry bacteria from the pond water used for drinking in Bangladesh villages. This was tested in Bangladesh where we trained women to filter water through sari cloth.

**It seems important to you that your research also contributes to solving practical problems?**

“Well, it is very gratifying that the scientific knowledge that I and my students have gathered can be used to help people. The message is that we can do fundamental, curiosity driven research and provide powerful human applications. It may take a long time, I started my work in 1965, but now the discoveries can be used to reduce cholera in, for example, Yemen and countries of Asia and Africa. The basic principles of our work in Bangladesh have been nicely extrapolatable to the west coast of Africa. Now we’re planning to do studies in the central and east coast of Africa as well. We’ve also done work in Peru. Our work is funded by NASA, the National Science Foundation, and the National Institutes of Health.”

**“This is perhaps** also an argument for diversity of ideas since the research I have described has, in the early days, been perceived as... a very different perspective, not always taken very seriously.”



**You talked about how your career started in 1965. What are the most important differences between then and now?**

“When I started out, I was almost always the only woman in most of my science classes and women were not particularly welcome in laboratories. I ended up working in microbial systematics, in those days it was pretty much classical

taxonomy, which at the time was considered to be boring, just people fighting about accurate names to give to new species. But I found it interesting since it was an opportunity to do science and it was a way for me to earn my PhD. I developed the first computer programme for taxonomy, something that at the time was considered to be way out of the “hot” areas of research work and much of an outlier.”

**“It’s rather ironic** how things have changed. Today, genomics, systematics, and the evolution of microorganisms are among the hottest topics of research... So, I’m riding a crest of a scientific wave and find it quite amusing and satisfying.”

**And looking ahead, what shall we expect from the future?**

“We will become technologically more capable of dealing with problems, of which a major one is climate change. Climate change will certainly lead to migration of disease agents, including viruses and parasites into new geographical areas. We already see examples, with warming waters in Alaska harbouring an increase in Vibrio bacteria that cause food poisoning and that was not the case 30 years ago. Similarly, we now have serious algae blooms along the coast of Florida as our waters become unusually eutrophic.”

**“We also see** a migration northward of malaria in some countries and expansion

*“It’s tragic that the importance of investment in safe water is not properly understood.”*

of the West Nile virus in new areas of the United States and, in Sub-saharan Africa, incidence of a bacterial species that causes meningitis associated with dust storms. So far, these new occurrences of infectious disease are subtle but persistent and increasingly pervasive, so we will have some more surprises ahead. If we don’t take caution, we will have to deal with the combination of

larger amounts of waste going into river systems and the oceans from increasing populations – along with rising temperatures – microbiologically, that’s a bad combination.”

**How concerned should we be?**

“We should be doing much more environmental research and investment in public health. The fact that we now have declining investment in this kind of research really goes against the need to increase our understanding of environmental factors in disease and public health. At the same time, there are also many things we already know that we need to implement. I strongly believe that safe water and sanitation are key to the health of human populations.”

**“Millions of people** still don’t have access to clean water because we haven’t invested in safe water and sanitation. Policy makers don’t seem to understand that this would make it possible for people to work, pay taxes that could support needed infrastructure, and successfully take care of their families. It’s tragic that the importance of investment in safe water is not properly understood.”

**What do you wish everybody would know about the link between water and disease?**

“The most important message is that we, as human beings, are highly integrated with our natural environment. We need to understand biological diversity and climate change, not as some distant, unrelated phenomenon that has nothing to do with human beings, but that we ourselves, as human beings are an integral part of our environment. Our environment is us and we need to understand that biological diversity is fundamental to human health.” ●





In eThekweni, sanitation is seen as both a public health issue and key to successful water conservation. eThekweni Water & Sanitation won the 2014 Stockholm Industry Water Award for its transformative and inclusive approach to providing water and sanitation services. Photo: iStock

# eThekweni chose waterless toilets

Text | Görrel Espelund

**Sanitation is not just about providing toilets. It is a public health issue. To address it, and to live up to the constitution, eThekweni in South Africa has installed over 85,000 waterless toilets in the community.**

When South Africa adopted its new constitution in 1996, water became a right and local governments were mandated to provide basic services, including sanitation.

This meant a fundamental change for municipalities around the country as services to non-white communities had been inadequate, unsafe or nonexistent during the apartheid regime.

In 1994, when South Africa became a democracy, it was estimated that 30 per cent of the population lacked access to adequate water supply services and that 50 per cent were without adequate sanitation.



Teddy Gounden

*“The national government had to correct the injustices of the past.”*

“The national government had to correct the injustices of the past. The cities were well managed but the rural communities and the townships had been largely neglected,” says Teddy Gounden, Strategic Executive, eThekweni Water and Sanitation (EWS) unit.

With the new political dispensation, administrative boundaries were also shifted, and in 2000, the city of Durban was amalgamated with former black townships and rural areas to form the new metropolitan municipality of eThekweni. The population grew instantly (today it stands at 3.5 million) and roughly 60 per cent of the new municipality was now made up of rural areas with no, or very few, services in place. The same year, there was a cholera outbreak in the province. It became a grim reminder of the urgent changes that were needed.

“People collected drinking water from the rivers and defecated in the open or used poorly constructed pit toilets. Our idea was to provide free basic drinking water, dry onsite sanitation and appropriate education programmes to the households as a package. Not as separate services,” Gounden says.

As the city is extremely water constrained, flush toilets were not an option.

In 2001, a pilot programme that provided 1,000 households with urine diversion toilets was launched.

“We received feedback on social and technical issues and we could alter the pilot accordingly. After roughly six to seven months, the politicians and the communities were mostly happy with the toilets and we decided to scale up.”

One technical issue that came up during the pilot was the size of the toilet. “The pedestals were designed for adults, meaning that when children used the toilets they contaminated the urine compartment with faecal waste. This was solved by adapting the seats, adding a second smaller lid to the pedestal that suited children,” explains Gounden.

The project also faced other challenges. The toilets had two chambers for faeces: when one was full the pedestal was moved to the empty chamber allowing for the content of the first chamber to decompose and for pathogens to die off. But, for the elderly, it became a burden to empty the dry content of the chamber after the decomposition process. Some community members also complained about the process being un-hygienic and that the chambers filled up too quickly.

“We had to review our policies and started to provide an emptying service. This shows that the programme was not a straight-forward process, it was all about responding and adapting to different scenarios as we went along.”

The installation of the toilets was subsidized by the national government as part of the development programme for previously disadvantaged communities and up to date, eThekweni has delivered over 85,000 toilets. In conjunction with the roll- ●●●



*“We built approximately 1,000 toilets a month and each household was visited about five times during the project cycle: from the installation to the first emptying.”*

●●● out, each household was provided with a ground tank that would give the family 200 litres of free basic water daily.

An important part of the roll-out was to educate the beneficiaries in health and hygiene, behavioural change and technical issues on how to maintain a urine diversion toilet.

“**Education is always** the key to success. We have our own division of educators but for this programme we had to employ local people and train them as facilitators. We built approximately 1,000 toilets a month and each household was visited about five times during the project cycle: from the installation to the first emptying. It was a lot of information to get out there.”

A large majority, Gounden estimates some 80 per cent of the community, is satisfied with the project. The toilets are new and previously the only option was open defecation or unsafe pit latrines.

“The ones who have had objections had different aspirations and had in some cases been promised flush toilets. They didn’t understand the reason why they couldn’t get flush toilets and didn’t like the fact that they had to maintain the toilets themselves.”

**Throughout a process** like this, you have to make sure to maintain the dignity of the people, Gounden points out, and if people see it as an inferior service it is a challenge that has to be addressed.

“It is a legitimate issue. Some of the poor communities think they are being treated in an unjust way but the need to deliver potable water was far more urgent than to provide a flushing toilet.”

**There is a lot of interest**, both locally and internationally, in the project, but Gounden knows of no municipality or city that has made urine diversion toilets part of its guidelines for basic services.

“I get visitors from all over the world and everyone thinks what we are doing is great. There have been a few attempts to roll it out elsewhere, but it all boils down to the political will and the need for continuous improvement that many municipalities do not address.

“You cannot just deliver and then walk away. This is not a static process. However, in most places, they don’t have a plan for what to do if something goes wrong, and you need that if you are going to scale. You also need to commit yourself in terms of resources, the budget that is going into it and the policy to support it. If you don’t have these things in place you will fail.”

**Gounden believes** that the municipality has lived up to the human rights as spelt out in the constitution. The success in eThekweni, he says, boils down to Durban being a progressive city on many levels. Gounden explains, “And it’s not only in the water and sanitation sector, it is equally true for human settlement and gender mainstreaming. We have an integrated development plan where everything is linked to performance management. At the end of the day, it comes back to the commitment on a political level, functioning on an institutional level and how we partner with the community.” ●

## THE RIGHT TO WATER

**South Africa was early** in recognizing water as a human right back in 1996.

**On the global level**, the human right to water and sanitation (HRWS) was acknowledged by the United Nations General Assembly on 28 July 2010: “The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses.”

*“I have to say, a decade ago I never imagined that I’d know so much about poop. And I definitely never thought that Melinda would have to tell me to stop talking about toilets and fecal sludge at the dinner table.”*

Bill Gates

Photo: ©Gates Archive



## NEXT: THE TOILET REVOLUTION

**Is it time for a toilet revolution? Currently there are many novel ideas about what tomorrow’s toilets could look like, with a growing number of water free solutions. If we are to reach Sustainable Development Goal 6:2 about safe sanitation for all by 2030, it will most likely require a new generation of off-grid toilets.**

**As expected,** it caused quite a few raised eyebrows when Bill Gates recently appeared at a conference with a jar of poop in his hand. The philanthropist wanted to talk about toilets, not just because the Bill & Melinda Gates Foundation has invested heavily in public health and sanitation initiatives, but because he feels a radical technological breakthrough is about to happen.

“We are on the cusp of a sanitation revolution. It’s no longer a question of if we can do it. It’s a question of how quickly this new category of off-grid solutions will scale,” he said in a speech during the Reinvented Toilet Expo in Beijing.

In his address, Gates turned specifically to the business representatives in the audience: “Those of you in the private sector are here because – with new advances in technology – you see a market opportunity to meet the needs of 4.5 billion people worldwide. Opportunities of that scale don’t come along very often.”

**The Reinvented Toilet Expo** was initiated by the Gates Foundation to showcase cutting edge toilet technology that Bill Gates believes will appeal to rapidly growing cities that are not able to expand their sewage systems to keep up with the influx of new residents. So far, fewer than 40 per cent of the global population has access to safe sanitation, which is detrimental both to

human dignity and to public health. But to make it possible for everyone to use a safely managed toilet already 12 years from now is a huge undertaking, at least if all the new toilets are to be linked to sewage systems. Therefore, much research is now focused on developing water free toilets that are both safe and convenient.

China, host to the Reinvented Toilet Expo, has proclaimed its own toilet revolution to accelerate progress on safe sanitation. Whichever will be the technology of choice on this giant market will likely impact what tomorrow’s toilets will look like around the globe.

- 6 out of 10 people, 4.5 billion, lack access safe sanitation.
- Safe sanitation – a toilet that prevents contact with human waste and a system that disposes of that waste.
- 1.8 billion people are forced to drink water that could be contaminated by faeces.
- Lack of clean water and sanitation kills more people every year than HIV/aids and malaria combined.
- Around the world, 443 million school days are lost to water-related illnesses every year.

# WATER SOLUTIONS PROM

Text | Maggie White

**Most people will experience climate change in the form of water – with a surge in floods and droughts, an increase in waterborne diseases, and with exacerbated pollution when sewage systems are unable to cope with new demands and regurgitate the waste into nature and cities. At the same time, water offers some of the best solutions for reducing emissions and tackling effects of climate change. Yet, the role of water is often forgotten in the international climate debate, writes Maggie White, Senior Manager International Policy at SIWI.**

**The UNFCCC's 2015** Paris Agreement sets ambitious goals for reducing carbon emissions and assisting countries in adapting to the adverse effects of global climate change. But water is largely absent from the Agreement. At least there is little specific mentioning of the essential role that water plays in reducing emissions and adapting to climate change. At the same time, many of the parties who ratified the Paris Agreement made water a central component of their Nationally Determined Contributions (NDCs). This discrepancy between the wording of the Paris

*“According to a recent report, avoiding the draining and conversion of peatlands alone, [...] could store upwards of 678 million tonnes of carbon emissions equivalent per year – equal to removing 145 million cars from the streets.”*

Agreement and the facts on the ground has become increasingly noticeable during the COP 24 meeting in Katowice, Poland, in December 2018.

**In the process of finalizing** the Rule Book for the Paris Agreement, the water community, fears a missed opportunity to leverage water's full potential to mitigate the negative impacts of climate change. With recent estimates saying that emissions must come down dramatically in the next few years, this is a risk the world cannot afford. Similarly, the most powerful manifestations of climate change are water-

related and if that is not acknowledged, it will be difficult for countries to respond adequately. Climate change will also exacerbate water quality and variability, through changed precipitation patterns and changes to evapotranspiration and ultimately the water balance.

**So, what is really** at stake here? When it comes to mitigating climate change, some of our biggest hopes are tied to forests, landscapes and agriculture. Forests and wetlands act as sinks and reservoirs of greenhouse gases and play a central role in the hydrologic cycle, filtering, storing and regulating surface and ground-water flows. Water flows and storage form a complex system, intrinsically linked with the larger landscape.

**Unfortunately,** this important function is at serious risk when the landscape is altered through development and alternative land uses. In coming years, we will see intensified competition over land, resulting from a growing population, urbanization, increased consumption, and the global middle-class' seemingly insatiable appetite for beef and cheese. Without a general understanding of the role landscapes play to protect us from escalating global warming, we risk a dangerous erosion of land, reducing the effectiveness of crucial restoration activities.

**The importance** of wetlands is often even less well understood than the role of forests. In many countries, wetlands are threatened from changes to flow regimes that are linked to poor governance. There is also little awareness that the waterlogged soils of peatlands are able to hold more carbon per acre than any other terrestrial sink and can contain twice as much carbon as the world's forests. According to a recent report, avoiding the draining and conversion of peatlands alone, which are lost at a rate of approximately 780,000 hectares globally each year, could store upwards of 678 million tonnes of carbon

# NOTED AT COP 24

emissions equivalent per year – equal to removing 145 million cars from the streets.

Managing peatlands for both carbon sequestration and water conservation produces important co-benefits and can make a significant contribution to reducing global emissions. Water scientists and policymakers are working to better understand, protect and restore these important water regulation systems and their work could be of great use to countries looking to meet their national carbon reduction commitments and improve their resilience to climate change.

**Obviously, the same kind** of reasoning applies when it comes to adapting to the adverse effects we are destined to see even at relatively modest increases in temperature. Here, too, forests, wetlands and landscapes are key. They can act as buffers and provide nature-based solutions to many infrastructure problems that increasingly need to be addressed by decision-makers, not least to make human settlements more resilient to floods and droughts.

**Increasing severity** and frequency of floods, drought, tropical cyclones, and receding coastlines are just a few of the threats we face. Resilient and secure communities and ecosystems are only possible if water is taken into account from the outset. To systematically integrate water issues into national adaptation plans is essential.

Stronger, more frequent storms already impact coastal communities worldwide and much work is being done to improve the adaptive capacity of these regions: mangrove planting, seawall reinforcement, coastal floodplain re-connection, early warning system creation, integrated coastal planning etc.

**Intensified water scarcity** can also lead to decreasing agricultural production and increasing fire risk for communities. To tackle this, both agriculture and the forestry sector must change their practices to ensure that their watersheds are more resilient and able to withstand longer dry periods.

In the coming years, water expertise will be needed at all levels of decision-making around climate change. There is therefore an urgent need for a greater understanding of how water and climate are interlinked.

**This is why** FAO, IUCN, IUFRO and SIWI have joined forces, advocating for greater recognition of the importance of the waterforest nexus, not least in



Maggie White

relation to climate change. SIWI also highlighted its Source-to-Sea (S2S) platform, a multi-stakeholder initiative to support joint action for improved management of land, water, coastal and marine linkages.

With 80 per cent of wastewater being thrown back into nature without any treatment, our rivers and seas have become the litter homes of on-land consumption and production patterns. The Oceans provide 50 per cent of our oxygen but also absorb 30 per cent of CO<sub>2</sub> emissions. An imbalance in the water quality and temperature of the seas will have dramatic effects on sea level rise and salt water intrusion but also destroy the marine ecosystem that performs a balancing role between oxygen production and CO<sub>2</sub> absorption.

Agriculture, energy, fisheries, cities, infrastructure development, and water abstraction and treatment must all be collectively engaged in planning, operations, and management from source to sea.

**Resilient water management** plays a key role in tackling climate change and is crucial to achieving the objectives of the Paris Climate Agreement. As the demand for water is steadily growing with increased needs for production of energy, food and manufacturing, climate change intensifies the challenges and trade-offs by dramatically and rapidly changing the availability, reliability and quality of water resources.

To ensure sustainable development, food security and economic stability, it is essential that water is acknowledged and integrated into efforts to mitigate climate change and adapt to its adverse effects.

Countries, cities, private sector, international organizations, bi- and multilateral organizations, academics and civil society organizations need to work collectively and systematically to integrate and enforce resilient water management strategies when it comes to climate change measures, policies and programmes.

**Because many aspects** of climate impacts are uncertain, integrated freshwater-marine solutions should be robust (spanning a wide range of potential futures) and flexible (capable to responding to unexpected or alternative futures). They should also adopt a circular economy paradigm where one's waste can be another's resource.

The Earth has formidable resources and a resilient capacity to bounce back but we need to stop over exploiting her and reuse the resources that have already been extracted before we reach a tipping point of no return. ●

# TWO ECONOMICS NOBELS AND

When the prominent economists William Nordhaus and Paul Romer recently were awarded the “economics Nobel”, the decision divided the environmental community. SIWI’s Chief Economist John Joyce explains what has made them so controversial.

Text | John Joyce ILLUSTRATIONS | Niklas Elmehed © Nobel Media



John Joyce

In October it was announced that William Nordhaus and Paul Romer would receive Sveriges Riksbank Prize in Economic Sciences Memory of Alfred Nobel, popularly

known as the economics Nobel.

Romer is best known for his contribution on the dynamics of ideas and economic growth and how countries can improve performance through research and development as well as innovation and skills (termed supply-side measures), if supported by progressive government policy such as patents for innovation or tax credits for research and development. He is a pioneer in the topic of endogenous growth theory.

Nordhaus, a policy-oriented economist, is best known for his integrated assessment models and work on the cost of climate change and the use of carbon taxes. He is a pioneer of the field of environmental economics and he is influential in the efforts of the Intergovernmental Panel on Climate Change, IPCC.

Both are firmly anchored in the field of sustainable economic growth, albeit from different orientations.

The Royal Swedish Academy of Sciences said the two men had won the prize for designing “methods for addressing some of our time’s most basic and pressing questions about how we create long-term sustained and sustainable economic growth.” Furthermore, an underlying message in the award, is that “countries [need] to cooperate globally to solve some

of these big questions,” according to Göran K. Hansson, the Secretary General of the Royal Swedish Academy of Sciences.

However, the decision was also soon questioned by leading environmentalists as well as other economists.

Anne and Paul Ehrlich, in a recent article in *The Millennium Alliance for Humanity and the Biosphere*, question the award to Nordhaus and Romer. They critically focus on the role of an economy rooted in the notion of perpetual growth that is not based in the biophysical realities. (Paul is notable for this book, *The Population Bomb*, and Anne for co-authorship of subsequent key texts in this domain.) It could however be argued that there is a hint in the name of Nordhaus’s integrated model, DICE, suggesting that we are gambling with the planet’s future.

William Nordhaus has also come under fire for his approach to calculating the economic impact of climate change, by underestimating the costs of climate change, implicitly curtailing the call for action. He was also critical of the use of the low discount rate used in calculating public infrastructure investments.

The choice of the appropriate discount rate remains one of the most controversial issues in economic literature, particularly when dealing on the economics of climate change, as highlighted by Nordhaus in 2007 based on a Review of the 2006 Stern Report. One argument for a high discount factor (e.g. 10 per cent) is that future generations will be better off: this could be questioned with



“Many factors are at play here, not least the issue of the discount rate.”

# AN IPCC REPORT



William Nordhaus



Paul Romer



global risks and the equity issue of who will bear the costs. However, in environmental cost benefit analysis, the trend is towards lower discount rates to give weight to long-term (negative) impacts (e.g. climate change, pollution). For example, the Dutch treasury argues for 4 per cent discount rate. The 2013 Quinet report for public infrastructure in France advocates for a rate of 2.5 per cent and 1.5 per cent from 2070 on.

**The Nobel announcement** came shortly after the United Nations' IPCC issued a new report comparing the consequences of a 2-degree Celsius temperature increase, above preindustrial levels, to the impact from warming by 1.5 degrees. In the report, IPCC demonstrates how the effects of a 2-degree temperature rise are dramatically worse than if the temperature rise can be kept at 1.5 degrees, and that we may only have 12 years to get on track – a short timeframe, given the magnitude of the challenge.

**The report connected** heavily to water related issues such as droughts, floods, precipitation and sea level rise. With various degrees of confidence, it indicates that “risks from droughts and precipitation deficits are projected to be higher at 2°C compared to 1.5°C of global warming in some regions. Risks from heavy precipitation events are projected to be higher at 2°C compared to 1.5°C of global warming in several northern hemisphere high-latitude and/or high-elevation regions, eastern Asia and eastern North America. Heavy precipitation associated with tropical cyclones is projected to be higher at 2°C compared to 1.5°C global warming. Heavy precipitation when aggregated at global scale is projected to be higher at 2°C than at 1.5°C of global warming (medium confidence). As a consequence of heavy precipitation, the fraction of the global land area affected by flood hazards is projected to be larger at 2°C compared to 1.5°C of global warming.”

**The report also** caveats these types of challenges by indicating that “future climate-related risks would be reduced by the upscaling and acceleration of far-reaching, multilevel and cross-sectoral climate mitigation and by both incremental and transformational adaptation.”

**What is the connection** between these two coincidental announcements – the IPCC report and the Nobel laureates? While Nordhaus has been an active player in the IPCC world, modelling impacts of climate change and advocating for stronger government policy, such as carbon tax, Romer's contribution to this challenge lays in highlighting the role of human ingenuity to solve critical challenges, through innovation, both technological and behavioural, if supported by proactive government policy. His play is towards the market economy and the nature of ideas and innovation to spur solutions and growth.

**The IPCC report** implies that the market for mitigation and adaptation is growing fast and that the scope for ramping up government policy to support innovation and market economy is significant. Many factors are at play here, not least the issue of the discount rate.

**Combining the thinking** from these two announcements would lead to a fairly straight forward conclusion: to meet the ambitious timeframe set by the IPCC, far more ambitious government policy (new policy mechanisms, research and development, and investments) combined with accelerated market support is needed to sieve through innovations to harness the positive ones that display limited side effects.

**Tax-based budgets** alone cannot meet this challenge and the private sector, including private finance has pivotal role here. The role of water, in adaptation and disasters remains a critical and costly investment and policy challenge. ●

# It takes two to tango

Text | Nicolai Schaaf

**How can we promote** sustainably produced antibiotics? This is a complex question. On the one hand, the pharmaceutical industry wants to see clear business benefits, for example in the form of procurement decisions, before improving their supply chains and sharing information. On the other hand, procurers need better information and transparency to be able to impose effective and verifiable sustainability criteria. To solve this Catch 22, there is only one approach: dialogue that enables transparency and accountability in both directions. There are, however, also other steps that can be taken to fight antimicrobial resistance, a global health threat projected to kill 10 million people per year by 2050:

**First, prohibit what** is dangerous. There must be no such emissions to the environment. It is as simple as that.

**Second, promote and** incentivize the pioneers. This is where regulation and procurement should support each other. Of course, this is not to say that implementing these regulations and incentives will be easy. There needs to be a mutual understanding between the supply and demand sides, with a dialogue about what are reasonable criteria in procurement and realistic regulations on emissions. SIWI facilitates this process by providing a safe environment for players to meet. The development of criteria for regulations and procurements must be matched with the practical engineering perspective. To avoid a costly end-of-the pipe approach, we encourage a holistic view on the process design. Where can water, solvents, chemicals and energy be saved or recycled between the different steps of reactions and production? And how can the resources be recovered after the last step?

**When asking** this kind of questions, it soon becomes apparent that business priorities can actually be well in line with environmental needs.

**Just as we see** in other sectors, optimizing resource flows instead of fine-tuning the end of the pipe, can be a profitable approach, with a high return on investments. Also the pharmaceutical industry has a huge resource saving potential that would prevent scarce resources and products from being flushed down the drain or being broken down with advanced but costly wastewater treatment. Getting both parties to engage in a constructive dialogue about practical solutions, instead of hiding behind formalities, is the only way forward.

**At the same time**, it is important to recognize that finding the right processes is not always easy. For example, Zero Liquid Discharge is rapidly becoming a standard requirement in India. But what looks like a straightforward approach is often abused



to suggest a trade-off between different sustainability objectives when too much energy and greenhouse gas emissions are required. If Zero Liquid Discharge means that you evaporate all water, or irrigate the company garden, the production actually remains a flow-through system and it is misleading to speak of zero liquid discharge.

**The cost of** implementation must also be kept at a level the demand side is willing to pay, bearing in mind that in large parts of the world access to antibiotics remains a problem, while other countries are already entering the post-antibiotic era. At the same time, the actual relationship between production costs and market prices is often hard to establish, with many factors to consider. But the fact that there exists a business model for buying medicine in one part of Europe to resell them in another could indicate that there are some margins.

**In sum, there are no** shortcuts when tackling the problems of emissions from pharmaceutical production and their contribution to antimicrobial resistance. But there are solutions. Among actors on both the demand and the supply side, there also seems to be a determination to succeed. At SIWI we encourage pioneers on both sides to join forces and bypass the laggards. Only living the example will make a difference. ●



#### ABOUT THE AUTHOR

Nicolai Schaaf is Programme Manager responsible for SIWI's work on water and pharmaceuticals

14 JANUARY

New MOOC on water

Launch of **Water: addressing the global crisis**, a free on-line water course developed by SIWI and the UN Sustainable Development Solutions Network. (See also last page.)

[www.siw.org/watercourse](http://www.siw.org/watercourse)



14-18 JANUARY

Global Pact for the Environment

The working group of the Global Pact for the Environment meets in Nairobi, Kenya, for its first session. The Pact is a UN initiative to create an overarching framework for environmental law.

<https://www.unenvironment.org/events/conference/towards-global-pact-environment>



Stockholm

18-21 MARCH

The geoscience & society summit 2019

The summit takes place in Stockholm Sweden, with topics including water resources and agriculture, energy and health.

<https://connect.agu.org/gss/home>

22 MARCH

World Water Day 2019

The theme for 2019 is World Water Day – Leaving No One Behind (Human Rights and Refugees)

[www.unwater.org](http://www.unwater.org)



All publications can be found online at [www.siw.org/publications](http://www.siw.org/publications)

**POLICY BRIEF**

### The blue trinity: freshwater, oceans and climate change

Science to sea management addresses a vital development and environmental challenge of our time. Coastal communities and Small Island Developing States (SIDS) face increasing risks as a result of climate change. These risks are amplified when upstream activities impact coastal areas. Science to sea management will increase resilience of these vulnerable communities.

**Freshwater and oceans – working together to face climate change**

The increase of almost 100% in water use efficiency and the reduction of water loss and leakage, combined with the expansion of water infrastructure, have led to a significant increase in water availability for use in agriculture, industry and domestic consumption. This has led to a significant increase in water availability for use in agriculture, industry and domestic consumption. This has led to a significant increase in water availability for use in agriculture, industry and domestic consumption.

**Marine protection – pollution**

The ocean is the largest repository of marine biodiversity in the world. It is also the largest source of marine biodiversity. It is also the largest source of marine biodiversity. It is also the largest source of marine biodiversity.

**Sea level rise**

Sea level rise is a global threat to coastal communities and ecosystems. It is a global threat to coastal communities and ecosystems. It is a global threat to coastal communities and ecosystems.

**SIWI**

Read our latest publications!

Ahead of the UN Climate change conference COP 24, SIWI released several papers to influence policy-makers.

- The Blue Trinity: freshwater, oceans and climate change
- Water Management key to tackling climate change

**POLICY BRIEF**

### Water Management key to tackling climate change

Resilient water management is crucial to achieving the objectives of the UNFCCC's Paris Climate Agreement. It is essential for the delivery of the Sustainable Development Goals (SDGs) and the achievement of the Paris Climate Agreement.

**Putting water on the climate agenda**

Water is a key element of the global climate system. It is a key element of the global climate system. It is a key element of the global climate system.

**Water and the Paris Agreement**

The Paris Agreement is a landmark agreement in the history of international climate change negotiations. It is a landmark agreement in the history of international climate change negotiations.

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STOCKHOLM **WATERFRONT**

**THE NEXT ISSUE** will focus on youth and water. Story ideas? E-mail us at [waterfront@siwi.org](mailto:waterfront@siwi.org).

SDGacademy



## Get water?

Water is the defining issue of our age. The United Nations SDG Academy and SIWI have joined forces to create the open course *Water: addressing global crisis*, covering the latest water trends.

The course brings together some of the world's leading experts and practitioners. It is aimed at development professionals, private sector actors, water activists and advanced students. You will learn about the challenges of achieving SDG 6 about safe water for all; the links between climate change and water; food security; energy; water governance; transboundary cooperation and tools for taking action.

**Water: addressing global crisis** is free and online so that you can connect with a global community of practice.



THE COURSE STARTS 14 JANUARY – SIGN UP TODAY! [WWW.SIWI.ORG/WATERCOURSE](http://WWW.SIWI.ORG/WATERCOURSE)

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