How do we make complex water use calculations accessible and understandable to the public? We sat down with the man who thought up the "Water footprint" term. ► INTERVIEW PAGE 7

"This handbook gives an entry pass to understanding the importance of cross-disciplinary collaboration when taking on the SDG targets and indicators" writes SIWI's Dr Jenny Grönwall. ► BOOK REVIEW PAGE 16

STOCKHOLM
WATERFRONT
THE FORUM FOR GLOBAL WATER ISSUES | # 3-4 | DECEMBER 2016

OPINION

PUT THE RAIN TO WORK

Large scale rainwater harvesting is the only way to alleviate hunger in sub-Saharan Africa

LAST WORD

"I want to talk about toilets"

ANALYSIS

Environmental security in the Anthropocene

HAS TIME COME TO RE-EVALUATE A SACRED DOCTRINE?

PUBLISHED BY STOCKHOLM INTERNATIONAL WATER INSTITUTE

water for crop production, following examples from India and China.

At World Water Week in 2016, the hunger alleviation challenge of dryland Africa was analyzed, concluding that science clearly shows the necessity of a sustainable, resilience-based agricultural revolution with special focus on how to achieve water resilience in the vast water-scarce regions in Africa. An Expert Call was issued, declaring that it will not be possible to reach the SDG's in Africa without an African Water Revolution, based on green water.

Thus, rain is a core resource for securing reliable food production to alleviate hunger in the semi-arid and dry sub-humid African drylands. The considerable water losses in current rain-fed agriculture will have to be met by agricultural upgrading, turning non-productive evaporation into productive transpiration (vapour shift), and from water harvesting systems providing supplementary irrigation based on rain water flows, harvested from slopes and valley bottoms and stored in ponds or dams for use during dry spells and drought periods. This potential is vast, with e.g., *hopespots* where such simple technology can be applied on the millions of smallholder farms already identified.

"The considerable water losses in current rain-fed agriculture will have to be met by agricultural upgrading, turning non-productive evaporation into productive transpiration"

What's needed

- A long-term, and continental-scale innovation plan for a sustainable transformation of the agricultural systems across sub-Saharan Africa. What is suggested is a **Green Water Initiative for Africa** to lead the path towards achieving the food security and hunger alleviation goal, which in turn is a precondition for reaching all the other SDGs in the region.
- A **Water Harvesting Innovation Coordinating Mechanism for Africa** under pan-African ownership. This should take the form of a strategic African Green Water Plan, supported by a minimum of USD 100 billion investments in the green water innovations n eeded to build water resilience for food security and human wellbeing, and to incentivize the business community to invest in small-scale farming innovations and catalyze a Triple Green Revolution in Africa.
- A need for Africa to spark a **Triple Green Revolution** (green for green water, green for productivity, green for sustainability), where rain is the core resource for securing reliable food production in the huge semi-arid and dry sub-humid African drylands.

Malin Falkenmark is a globally renowned water expert and currently serves as Senior Scientific Advisor at SIWI, and Professor of applied and international hydrology at SRC (Stockholm Resilence Centre).

Note: Malin Falkenmark has, together with several renowned international water, climate and development experts, issued a Call for an African Water Revolution. **Read it here.**

WATER FOOTPRINT NAME CAME TO ARJEN HOEKSTRA, OF COURSE, WHILE SHOWERING

TEXT & PHOTO | RANDALL HACKLEY

HOW DO WE MAKE COMPLEX WATER USE CALCULATIONS ACCESSIBLE AND UNDERSTANDABLE TO THE WIDER PUBLIC? WATERFRONT SAT DOWN WITH THE MAN WHO THOUGHT UP THE "WATER FOOTPRINT" TERM.

Some people sing in the shower, some people dream and some people think.

As streams of hot water cascaded over his head while showering at home 15 years ago, Dutch engineer Arjen Hoekstra thought about what water means to a thirsty world -- and came up with the name for the concept he'd developed that changed the way humans look at Earth's most valuable resource.

Water footprint. The words encapsulize a sophisticated scientific concept that measures the amount of water it takes to produce an almond, T-shirt or hamburger. Water to grow the grain that feeds the cow, to build the truck that brings the meat to market, for the energy that refrigerates the food and grills the beef that arrives sizzling in a bun on your plate.

With one phrase symbolizing how much water is used to produce goods and services, Hoekstra created a new paradigm that has become essential to scientists, policy planners and businesses worldwide. The best term to describe and quantify water consumed by a country, in a river basin, from an aquifer.

The Delft native also found, ironically, that shorter showers aren't going to solve the world's water problems because household use makes up such a small fraction of overall usage. The elephant in the room sucking up the planet's water resources with its massive trunk is agriculture: Food production accounts for 70 per cent of global water withdrawals. In one swoop, Hoekstra gave us a vital measurement tool. In years of developing a famous concept similar to a carbon footprint that endures to this day, he has mapped out a sustainable road that requires an overhaul of what we grow and eat.

A longtime colleague and collaborator who admires the University of Twente water management professor describes Hoekstra's `aha' moment:

`What I remember most is that some of Arjen's creativity comes under the shower including coining the word `water footprint,'" said Mesfin Mekonnen, who worked with Hoekstra for nine years and is now at Nebraska University in the US involved in Ogallala aquifer research.

The thinking was that people use lots of water not only directly at home for showers and bathing, drinking and cooking, but also indirectly to produce energy and make things like a computer chip and car. Even more is used growing food, especially meat, said Hoekstra, who lives in a rural home near the German border studded with masks from his and his wife's African travels.

Hoekstra felt he was being hypocritical to eat meat in an increasingly thirsty world with rising food and energy demands. His research showed it takes 10 litres of water on average to make 1 kcal of beef, much of that to grow the crops fed to cattle, versus 0.5 kcal per litre for cereals and 1.0 litre per kcal for vegetables or pulses, an important protein replacement for meat.

Showering faster won't solve the impending water crisis though it makes sense because it uses less energy, Hoekstra says, advocating a world where eating less meat is seen as a logical way to help reduce pressure on the environment.

Farming is the biggest user of water and animal products alone account for about one-third of humanity's water footprint. Populations are increasing and meat consumption per capita keeps climbing as incomes grow, Hoekstra says.

Escalating water consumption is a serious concern, even more so with climate change fueling the incidence of drought.

As water usage at home generally comprises between one and three per cent of a person's water footprint, a briefer shower isn't necessarily where savings can occur. Take a closer look at the diet because 25 per cent of the water footprint of many people comes from meat consumption, up to 40 per cent in some countries, his research shows. Of increasing concern are biofuels due to their large impact on land and water use. Solar and wind energy are our only options, Hoekstra said, to reduce both our carbon and water footprint.

`It's about getting diet, trade policies and energy politics right, it's about getting agricultural policies right," he said in an interview at his university office where a bookshelf was crammed with water-related literature, the top stacked with water bottles from around the world.

"If the water system isn't healthy, the economy isn't healthy," said Hoekstra, 49. "Water has always been seen to be exploited but now we see that water is talking back, putting constraints on economic growth."

Hoekstra advocates better pricing of water scarcity: ``If water remains for free, it aggravates the water problem." He favors regulated and enforced water footprint caps so every river basin has a maximum extraction limit to help curb overuse. He further advocates water footprint benchmarks for products so companies can formulate targets to reduce the water use in their operations and supply chain and consumers and governments have a means to measure the water sustainability of brands.

Strictly speaking, a water footprint measures the amount of water used to produce goods we consume and as such helps people understand for what purposes limited freshwater resources are being used or polluted. The impact depends on where the water is taken from and when. If it comes from where water is scarce, like cotton from the Indus basin in Pakistan or asparagus from the desert in Peru, long-term consequences can be significant.

About a half-billion people on a planet of 7.4 billion now live in places with severe water scarcity year-round, with ancient aquifers being depleted, rivers running dry. Lakes and river basins are under increasing pressure; the Aral Sea that's almost dried up from farming and water diversion in 20 years is the latest red flag.

California's Central Valley, the most agriculturally productive land in the US, is overusing underground supplies that are depleting as its historic drought continues. Research by Hoekstra and Mekonnen shows the US with the highest per capita water footprint – twice the global annual average per capita. Meat consumption accounts for 30 per cent of that figure.

Asked who his "water heroes" are, Hoekstra said Peter Gleick of the Pacific Institute was "a great influence, a great source of data." Also mentioned: Malin Falkenmark, senior scientific advisor at the Stockholm International Water Institute renown for her water scarcity indicator and blue and green water distinction, and Hubert Savenije, a professor of hydrology at Delft University of Technology who like Hoekstra is a civil engineer with an expertise in water-resource management.

The origin of the concept

Professor John Anthony Allan was awarded the 2008 Stockholm Water Prize Laureate for pioneering the development of key concepts in the understanding and communication of water issues and how they are linked to agriculture, climate change, economics and politics.

In 1993, Allan demonstrated this by introducing the "virtual water" concept, which measures how water is embedded in the production and trade of food and consumer products. Behind that morning cup of coffee are 140 litres of water used to grow, produce, package and ship the beans. That is roughly the same amount of water used by an average person daily in England for drinking and household needs. The ubiquitous hamburger needs an estimated 2,400 litres of water. Per capita, Americans consume around 6,800 litres of virtual water every day, over triple that of a Chinese person.

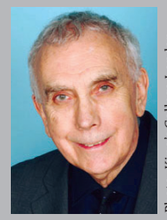

Photo: King's College London

Prof John Anthony Allan

140 LITRES The amount of water used to grow, produce, package and ship the coffee beans.

1,700 LITRES The amount of water needed to produce 100-gram chocolate bar

Water footprints for an almond grown in California and asparagus in southern Peru are all part of the water-resource management concept introduced by Hoekstra as an alternative indicator of water use. It's related to the idea of virtual water trade from John Allan, the 2008 Stockholm Water Prize laureate. Many countries have substantially externalized their water footprint of consumption by importing water in virtual form. The EU's water footprint for instance is 40 per cent outside Europe.

A nation like India has long-established water, sanitation and pollution problems, exporting too much water in the form of virtual water with its cotton, sugar and cereal production. In Hoekstra's opinion, it's not just improving water efficiency that could reduce India's water consumption, "it's growing and producing things in the right place."

Many of India's water-rich crops such as cotton are grown in dry states like Punjab and Haryana that have high evaporation rates. India could grow cotton in less arid states such as Bihar with more efficient irrigation and fewer pesticides to reduce the crop's impact on water resources, he says.

Thirsty crops aren't just almonds, cotton, rice or sugarcane. The water involved in a cup of coffee isn't just what's in the cup: 140 liters of water are – 140 being the amount of water used to grow, produce, package and ship the coffee beans. A 100-gram chocolate bar requires 1,700 liters of water. A hamburger is a veritable water cow, needing an estimated 2,400 liters of water.

Hoekstra, with a master's in civil engineering and a doctorate in policy analysis from Delft University of Technology, says simply of his work: ``Water attracted me most." A childhood memory of summer at the family's favorite holiday spot in the eastern Netherlands involved his creating a landscape of creeks on a mound outside with a water hose.

After his studies and research, he became the first to quantify the water volumes virtually embedded in trade while at UNESCO-IHE. Showing how a global perspective plays in water use and scarcity, Hoekstra helped introduce supply-chain thinking into water management.

With the development of the Water Footprint Assessment, Hoekstra's expertise led to a new interdisciplinary research field that addresses the ties between water management, consumption and trade. Besides his university work and writings, Hoekstra, founder of the Water Footprint Network, now chairs The Hague-based organization's supervisory board.

The colours of the water footprint

The water footprint is described in three components:

- the green water footprint, the consumption of rainwater;
- the blue water footprint, the consumption of groundwater and surface water; and
- the grey water footprint, the volume of moderately polluted domestic wastewater.

Together, these show a more comprehensive picture of water use by delineating the source of water consumed and volume of fresh water required to assimilate contaminants.

Arjen Hoekstra

"The EU's water footprint for instance is 40 per cent outside Europe"