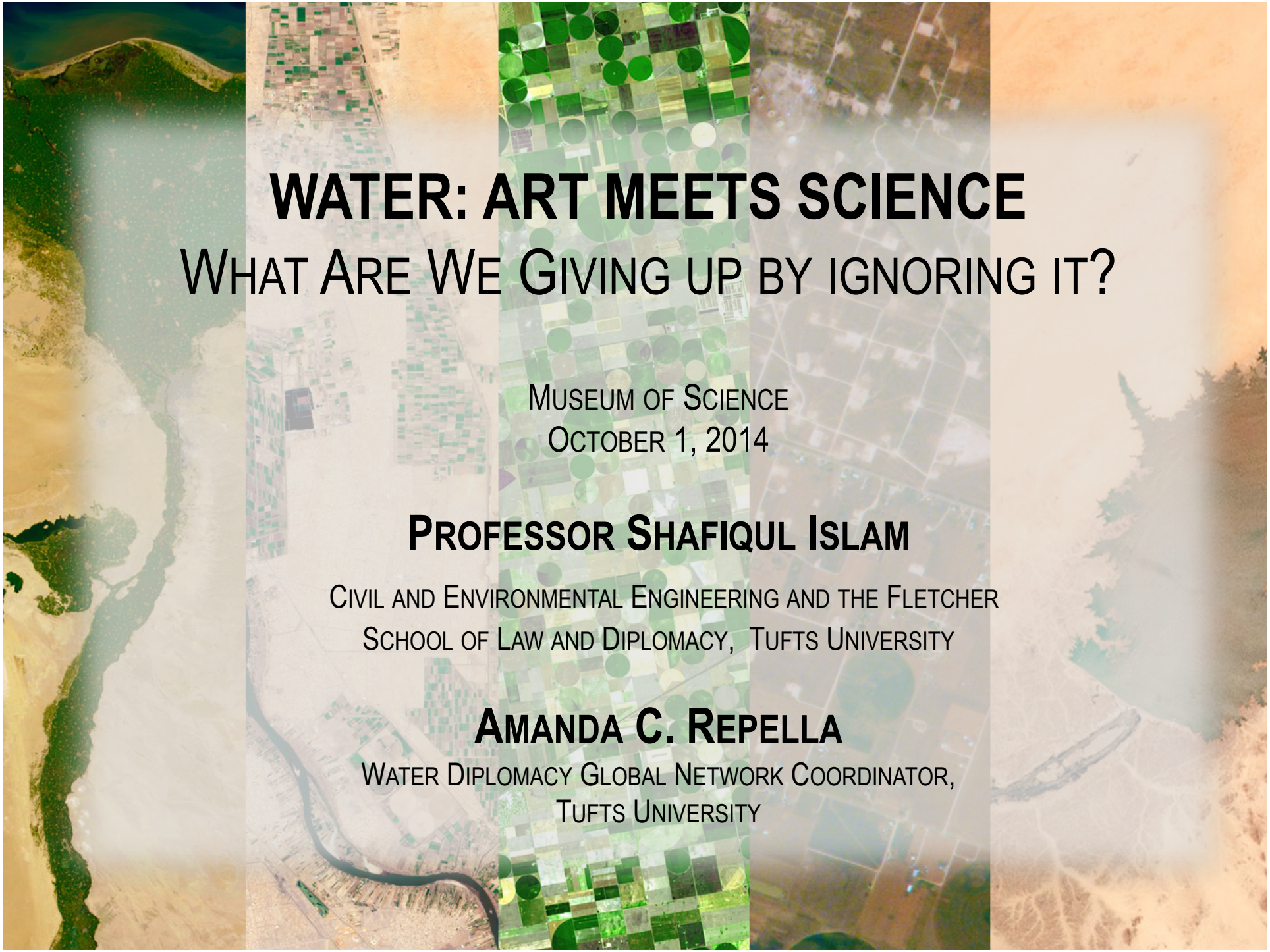

WATER: ART MEETS SCIENCE

WHAT ARE WE GIVING UP BY IGNORING IT?

MUSEUM OF SCIENCE
OCTOBER 1, 2014

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TUFTS UNIVERSITY

The Nile Delta

(False color MODIS, NASA Visible Earth)

A wealthy man willed his herd of camels to his three sons, allocating half for the first, one-third for the middle, and one-ninth for the youngest son. The man owned 17 camels.

How could they divide 17 camels according to the father's wishes?

Killing all the camels and dividing the meat may be an *optimal* solution that could meet the requirements of the will, but it is not a *desirable* one, as the live camels are more valuable than their meat. One of the sons could *concede* a portion of his own inheritance to his brothers, but that wouldn't meet his own *interests* and would *violate* his father's will.

A dispute started among brothers; the feud became heated; cousins were no longer playing with each other; the families were not talking to each other. They couldn't find a mathematical solution that would meet the requirements of the will and the positions of each brother to get their "fair" share. The problem was unsolvable.

In desperation, brothers visited a wise woman in the neighboring village. After hearing about the dispute, the woman agreed that it was a difficult problem; she would reflect on it, and advise them the next day.

The next morning, the woman told the brothers she could not solve the problem, but she would give them her own camel, in hopes that it could help them resolve their problem and end the feud.

The brothers were puzzled, but pleased to have an additional camel, and began to walk home. On the long walk home, they calculated how a herd of 18 camels might be divided…

Half, or nine, would go to the oldest, the middle would get a third (six), and after the youngest received his ninth (two), there was still one more camel.

To solve seemingly intractable water problems we have to find the 18th camel.

Many water management problems stem from competition, interconnection, and feedback among Natural and Societal processes within a Political Domain (NSPD).

A key goal of our work has been to create a framework to facilitate production and use of "actionable knowledge" for the characterization and management of complex water networks.

http://waterdiplomacy.org/framework

This photograph was taken in 2010, as the reservoir was filling for a dam completed in 2008. The primary goal for this project was to be a 1250 MW power plant that could provide electricity that supports water pumping for irrigated agriculture.

MEROWE DAM, NILE RIVER, REPUBLIC OF THE SUDAN

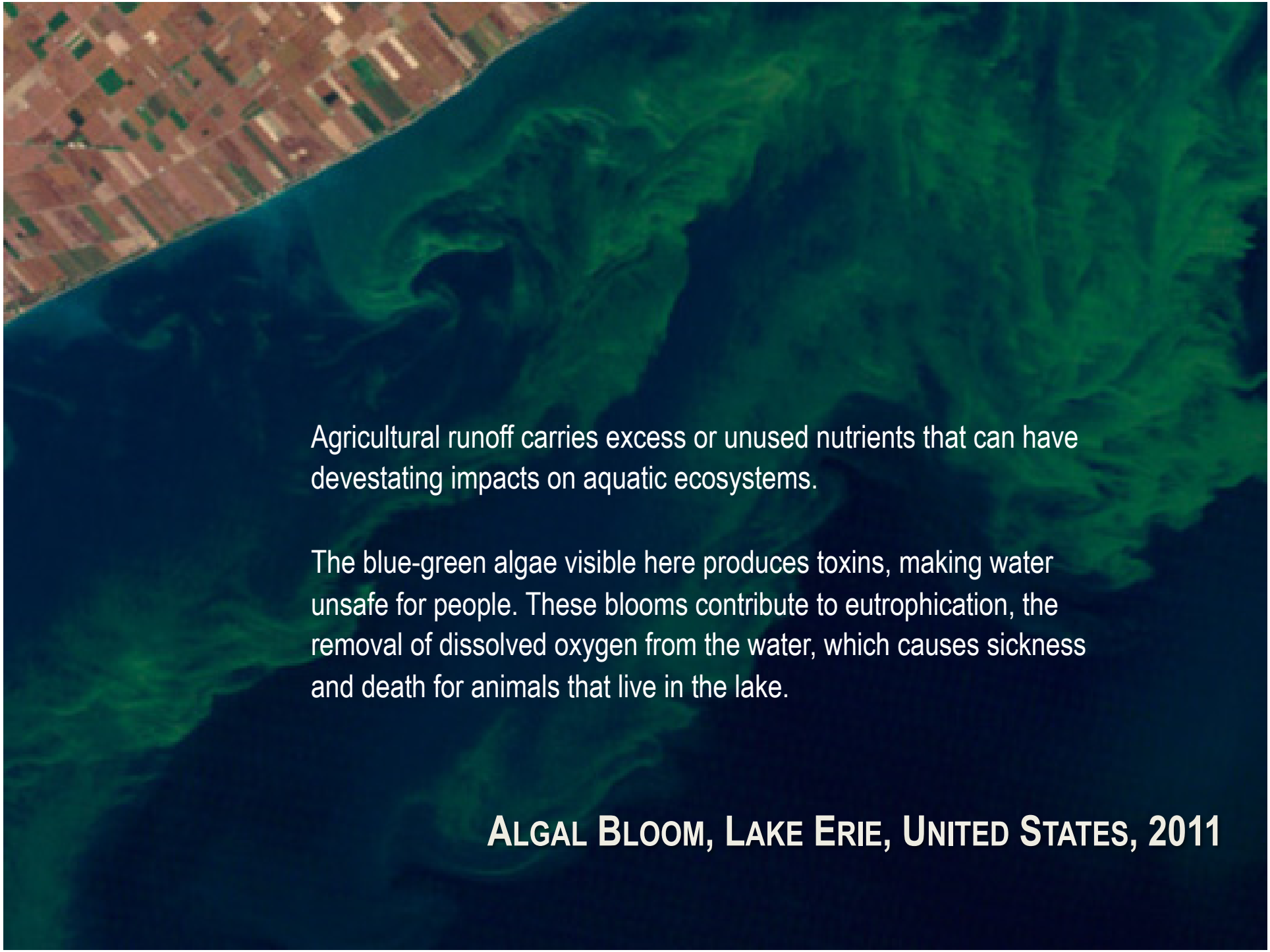
Irrigation can increase land productivity in relatively arid regions, feeding nations and improving economic outputs and individual livelihoods…

THE CONVERGENCE OF THE BLUE AND WHITE NILE, KHARTOUM REPUBLIC OF THE SUDAN


Irrigated agriculture produces food for people and livestock, but overdrawing groundwater resources can lead to disastrous consequences.
Irrigation is the largest user of groundwater in the United States.
FINNEY COUNTY, KANSAS, UNITED STATES, OGALLALA AQUIFER

Application of fertilizers – particularly phosphate and nitrate compounds dramatically improve yield – an important consideration for a planet that will need to feed nine billion people…

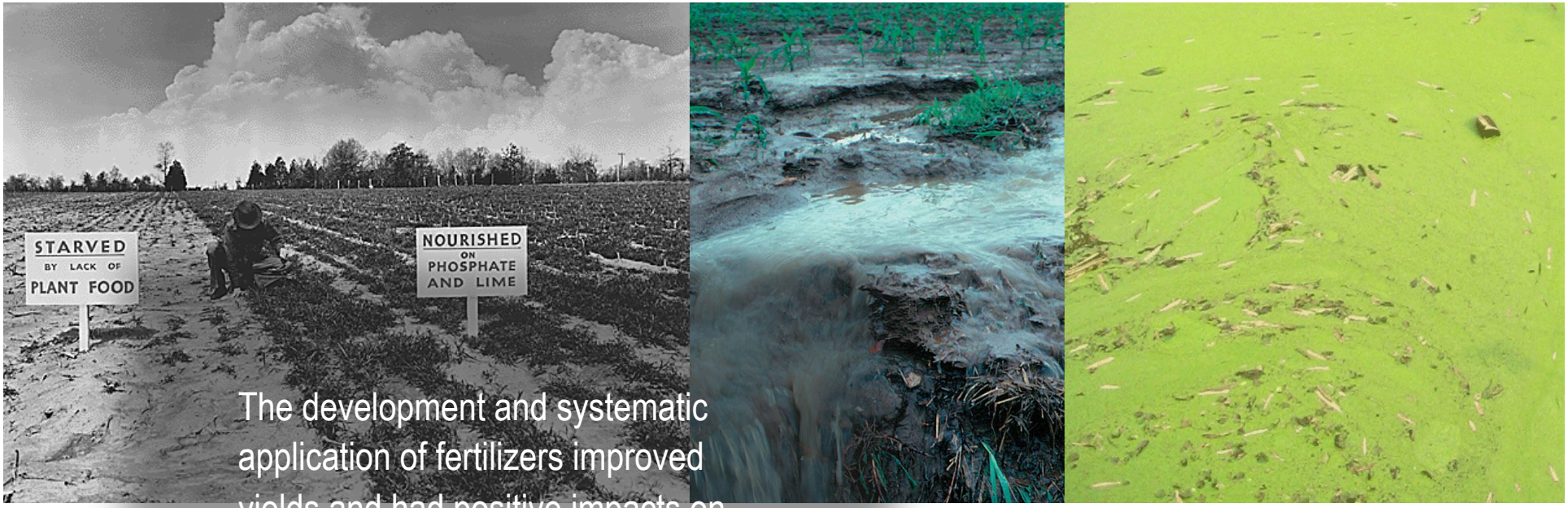
But fertilizer use includes questions of environmental outcomes, sustainability, economics, values and ethics.



Agricultural runoff carries excess or unused nutrients that can have devestating impacts on aquatic ecosystems.

The blue-green algae visible here produces toxins, making water unsafe for people. These blooms contribute to eutrophication, the removal of dissolved oxygen from the water, which causes sickness and death for animals that live in the lake.

ALGAL BLOOM, LAKE ERIE, UNITED STATES, 2011



The development and systematic application of fertilizers improved yields and had positive impacts on human nutrition, but we've also experienced negative outcomes.

And while the rate of application of fertilizers varies around the world, it is more closely tied with economics – the expense of fertilizer application – than to the environmental costs.

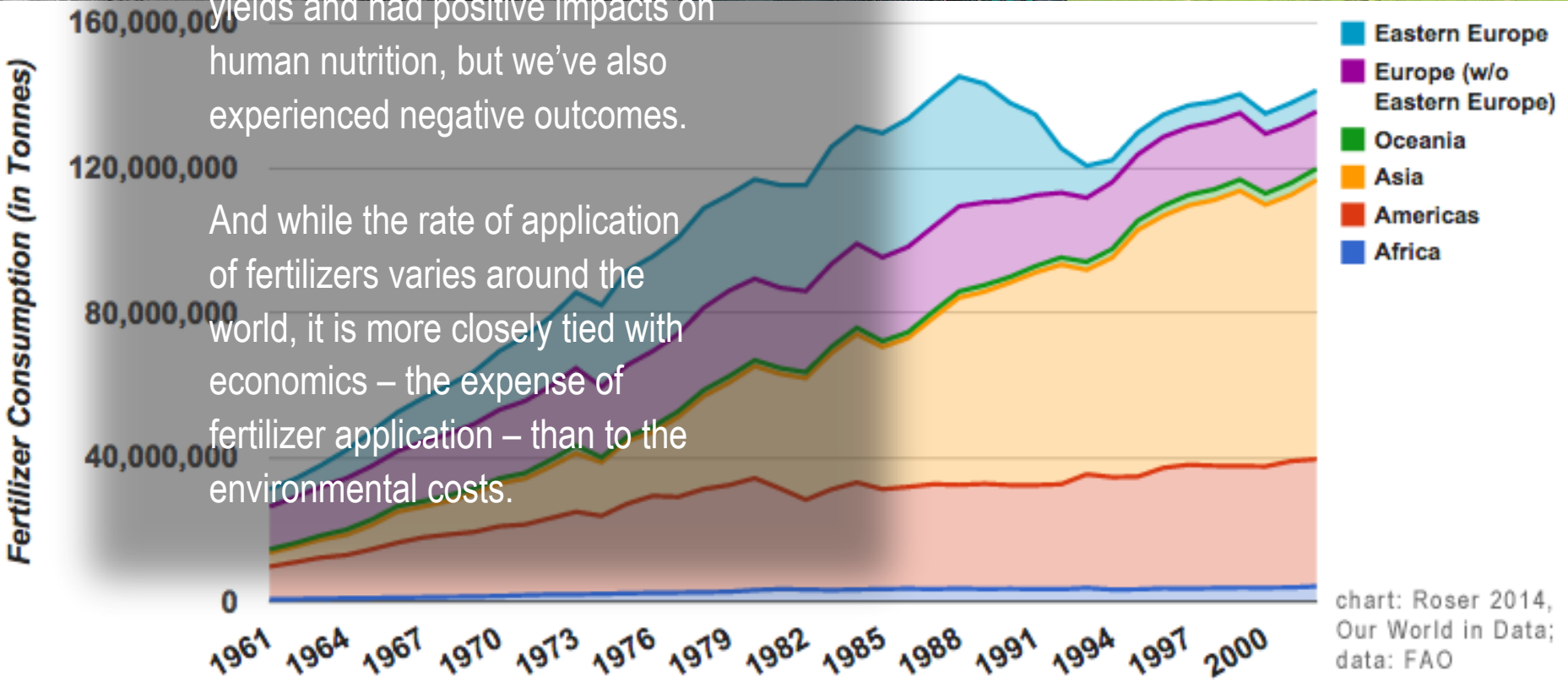
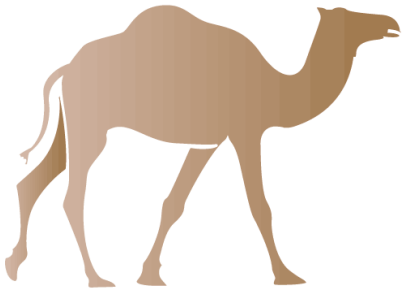


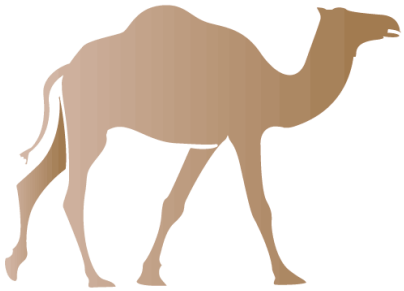
chart: Roser 2014, Our World in Data; data: FAO



Finding the 18th camel to address challenges like these requires many people and perspectives to come together.

This involves including stakeholders beyond scientists, industry leaders or politicians - such as people who live in the communities impacted by these problems and the consumers who purchase products that are grown using groundwater and synthetic fertilizer.

And it starts with broadening perspectives, gaining and sharing knowledge, and connecting to opportunities to learn, act, and produce measurable outcomes.



Water Diplomacy

WATERDIPLOMACY.ORG

AquaPedia Case Study Database

AQUAPEDIA.WATERDIPLOMACY.ORG

MIT Science Impact Collaborative

SCIENCEIMPACT.MIT.EDU

Charles River Watershed Association

WWW.CRWA.ORG

WATER DIPLOMACY

What is Water Diplomacy?

Rooted in the ideas of complexity theory and negotiation, water diplomacy is a theory and practice of adaptive water management being developed at Tufts, MIT, and Harvard.

1 2 3 4

IGERT PhD: Preparing the Next Generation of Water Scholars

The Water Diplomacy Graduate Program at Tufts University educates doctoral students who will become the next generation of teachers and scholars of water diplomacy. Supported by the Integrated Graduate Education and Research Traineeship (IGERT) of the National Science Foundation, this degree teaches interdisciplinary water professionals to think across boundaries, integrate explicit and tacit knowledge, and link knowledge and action from multiple perspectives to help resolve water issues through mutual-gains negotiations.

WDW: Building the Capacity of Reflective Water Professionals

The Water Diplomacy Workshop (WDW) is an annual "train-the-trainer" event that builds the capacity of senior water managers. Through highly interactive presentations and exercises, it helps participants master important water network management tools, and gain the skills needed to teach these tools to others. The 2012 WDW is scheduled for June 25-29 in Boston, Massachusetts, USA. **Read** about it or **apply**.

RCN: Bringing Together Research and Practitioner Communities

The Research Coordination Network (RCN) is a group of researchers and practitioners who will synthesize theory and practice to address complex water problems where natural, societal, and political elements cross multiple boundaries. Supported by the National Science Foundation, this global Water Diplomacy RCN explores ways to incorporate recent developments in complexity theory and negotiations, as well as advances in social networking technology, to generate actionable knowledge for adaptive water management.

Aquapedia: Gathering and Sharing Case Studies About Water

Aquapedia is a managed wiki that gathers case studies of water management and water conflict. It is meant to provide reliable, relevant, and readily available water information and wisdom from users and producers of explicit and tacit water knowledge. The potentially transformative and collaborative power of AquaPedia will, we hope, make water a flexible and expandable resource.

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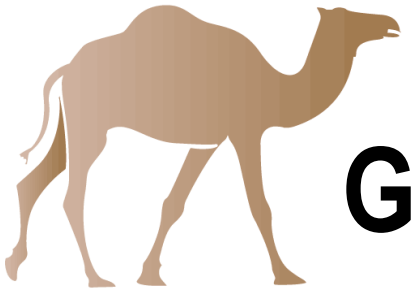
http://waterdiplomacy.org



GET INVOLVED - FIND THE 18TH CAMEL

CROWDSOURCING PUBLIC WATER FOUNTAINS

http://wetap.org/

AQUAPEDIA CASE STUDY DATABASE

http://aquapedia.waterdiplomacy.org

CITIZEN SCIENCE INITIATIVE FOR WATER PROJECTS

http://scistarter.com/

Remote sensing products and landscape images (public domain) are products from NASA (http://www.nasa.gov/multimedia/index.html) “TVA Results of Fertilizer” (public domain), “Blue Green Algae” (Felix Andrews, http://creativecommons.org/licenses/by-sa/3.0/deed.en) and “Runoff of soil and Fertilizer” (Public Domain) images from Wikimedia Commons. 18th camel illustrations and Water Diplomacy images courtesy of Water Diplomacy (waterdiplomacy.org)