

# Sudden 'ecosystem flips' imperil world's poorest regions, say water experts

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Modern agriculture and land-use practices may lead to major disruptions of the world's water flows, with potentially sudden and dire consequences for regions least able to cope with them researchers at the Stockholm University-affiliated Stockholm Resilience Centre and McGill University have warned.

In a paper published April 1 in the journal *Trends in Ecology and Evolution*, Dr. Line J. Gordon of the Stockholm Resilience Centre and the Stockholm Environment Institute and Dr. Garry Peterson and Dr. Elena Bennett of McGill University argue that global water management has been focused too much on the “blue water” side of the hydrological cycle, neglecting the largely invisible changes humanity has had on so-called “green water.”

“Blue water is the part of the cycle we can see, like streams and rivers,” said Gordon, an assistant professor at the Stockholm Resilience Centre and the Stockholm Environment Institute. “This is as opposed to ‘green water’ in soil moisture, or evapotranspiration from plants, which agriculture can affect in significant ways.”

“Resilience” describes the capacity of social-ecological systems to withstand climactic or economic shocks, and to then rebuild and renew themselves. In their paper, the researchers look at the likelihood of that vital resilience being lost in the aftermath of catastrophic changes to the hydrological cycle that could be caused by agriculture and land-use practices.

“Our main point is that these effects aren’t necessarily going to result in gradual change,” explained Peterson, McGill’s Canada Research Chair in Social-Ecological Modelling, and assistant professor in the Department of Geography and the McGill School of Environment. “They can result in surprising, dramatic changes, what we call 'ecosystem flips' or 'ecosystem regime changes,' which can be very difficult or even impossible to reverse.”

According to Peterson, recent outbreaks of toxic algae blooms in Quebec lakes and off Sweden’s Baltic Sea coast are prime examples of ecosystem flips, the consequence of nutrients from fertilizers permeating the soil and running off into streams, lakes and oceans.

“As you get more and more nutrients in the soil you eventually get to a point where you can even completely stop farming and all the nutrients will still be there,” explained Bennett, an assistant professor at McGill's Department of Natural Resource Sciences and the School of Environment. “You go past a tipping point where it’s very difficult to reverse.”

Ecosystem flips can have significant and sometimes devastating effects on human well-being, as global populations suddenly lose resources they are dependent on, said the researchers. Some of the most vulnerable areas on Earth are places like the drylands of sub-Saharan Africa.

“In some of these regions we risk two types of ecosystem flips, one that causes rapid soil degradation with dramatic effects on yields and farmers' livelihoods, and another that affects rainfall and therefore also vegetation growth,” Gordon said.

“These are the places where populations are growing the fastest, people have the least amount of water per capita and are the poorest of any of the biomes of the world. They are also the regions most likely to be

affected by climate change,” Peterson added.

As global demands for agriculture and water continue to grow, concluded the authors, it is increasingly urgent for scientists and managers to develop new ways to build resilience by anticipating, analyzing and managing changes in agricultural landscapes. Managing the green water component of the hydrological cycle is also important, as well as encouraging more diverse agricultural practices.

Source: McGill University

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