# Intensive monoculture is putting water systems in peril

September 22 2020, by Beck Lockwood

Credit: CC0 Public Domain

The global spread of vast forest plantations and agricultural monocultures are turning once diverse landscapes into areas of land supporting single plant species, with profound implications for our terrestrial water cycle, according to new research.

A new paper published in *Nature Geoscience*, and written by a global

collaboration of interdisciplinary researchers studying ecohydrological systems, calls for policymakers and practitioners to consider these water-vegetation interactions in their land management decisions.

Professor David Hannah, who holds the UNESCO Chair in Water Sciences at the University of Birmingham, is a co-author of the paper. He said: "Scientists and policymakers need to work closely to translate scientific knowledge into action. We need to be designing forests and agricultural systems that embrace and enhance diversity. This approach is essential if we are to preserve the natural resilience of our water-dependent ecosystems and provide better stewardship of the Earth's finite water resources."

The authors of the paper argue that, while land-use cover change can be well intentioned—whether it is done to increase carbon sequestration or meet food, water, and energy demands—it can have unintended consequences that affect the water cycle.

Professor Irena Creed, co-lead author at the University of Saskatchewan, said: "There are hydrological consequences to consider when changing land cover types.People want to plant trees to help with carbon sequestration and climate change, but sometimes, when you do that and you plant a lot of fast-growing trees that are a uniform species and age, you're lowering the biodiversity and you're also homogenizing the water cycle. That basically means you're narrowing the range and response of the water cycle, and it makes it more susceptible to stressors like climate change."

Plant uniformity in highly managed landscapes that have replaced wetlands, for example, has been linked to increases in the frequency and severity of both floods and droughts, as well as the deterioration of water quality. Elsewhere, the growth of maize monocultures to produce ethanol and biodiesel in the United States are projected to increase areas at risk

of groundwater nitrate contamination. And tree plantations grown to meet the demand for wood can reduce or even eliminate streams, leading to soils becoming more acidic or salinated and with increased susceptibility to fire.

In contrast, a more biodiverse system has trees and plant with different architectures, both above and below the ground, leading to a robust, natural system.

Delphis Levia, co-lead author at the University of Delaware, explained: "Think of soil moisture and rooting depth. If there are a variety of different tree species, some send roots down kind of shallow, some intermediate and some deep. That means there's a lot more soil moisture available to some forest species than others. But if you're in a monoculture situation, as with many staple crops, the rooting depths are more uniform. They don't penetrate the soil to varying degrees like natural vegetation in forests. And so, they can be more susceptible to drought."

The research team argue that further research is needed to analyze fully the relationship between vegetative complexity and water use. This would be done to see how losses in plant diversity affect the water cycle and planetary resilience to global change, and how that can lead to increased susceptibility to disease, fire, and other extreme weather events such as hurricanes.

John Selker, professor at Oregon State University and a co-author on the paper, said that knowing how the change in the water cycle is occurring quantitatively would allow proper management practices to be put into place.

"It is fine to know the qualitative trends, but to put this into management practices, we need some numbers on the resilience as a function of

specific metrics of complexity," said Professor Selker.

The paper has its origins in the Ettersburg Ecohydrology Workshop funded by the University of Delaware and the UNIDEL Foundation. 29 experts and students from 11 countries gathered in Weimar, Germany to figure out how to start addressing the world's multifaceted water crisis. At the workshop, the experts worked together to identify the research needs that ecohydrologists must address so they can provide strategies and data to help mitigate some of the world's water crisis.

**More information:** Delphis F. Levia et al. Homogenization of the terrestrial water cycle, *Nature Geoscience* (2020). DOI: 10.1038/s41561-020-0641-y

Provided by University of Birmingham