

Gully erosion prediction tools can lead to better land management

November 23 2022, by Marianne Stein



Credit: Mick Lissone/public domain

Soil erosion is a significant problem for agricultural production,

impacting soil quality and causing pollutants to enter waterways. Among all stages of soil erosion, gully erosion is the most severe phase, where large channels are carved through the field. Once gullies develop, they are challenging to manage through tiling; they require a more comprehensive approach along the impacted area.

University of Illinois researchers developed a modeling framework that uses remote sensing [environmental data](#) to predict gully erosion susceptibility more accurately. This [predictive model](#) allows landowners and conservation agencies to direct management resources to the most vulnerable areas.

"Erosion processes are complicated to predict, because there are so many factors at play, including farmer activity, climate, rainfall, temperature, vegetation development, topography, and many other variables that are always changing over time. We wanted to incorporate more of these variabilities in space and time in our model to decrease the uncertainty of the prediction," says Jorge Guzman, research assistant professor in the Department of Agricultural and Biological Engineering (ABE) at the U of I and co-author on the paper, published in the *Journal of Hydrology: Regional Studies*.

The researchers conducted the study in Jefferson County, Illinois, where 59% of the land use is in [agricultural production](#), primarily corn and soybeans. The region is typical of row crop production in the Midwest.

"We predict the geospatial location of gully erosion based on high-resolution spatial and temporal data from satellite sensing," says Jeongho Han, a doctoral student in ABE and lead author of the paper.

"We used the maximum entropy model, or MaxEnt, to predict areas with a high probability of gully erosion. Typically, researchers have focused on static variables like soil, elevation, and slope, but we added temporal

variables like precipitation and vegetation because erosion is highly affected by crop growth, temperature, and rainfall intensity," Han says.

"For example, Illinois has a bimodal rain pattern, with heavier rainfall during the spring and fall seasons. We need to consider the temporal variability of these factors."

Adding dynamic variables helped the researchers create a modeling framework that more accurately represents the complexity of factors that affect erosion.

To confirm their modeling results with actual gully locations, Han and Guzman analyzed LiDAR data from the Illinois Geospatial Data Clearinghouse mapped at 2-meter [spatial resolution](#), which provides airborne surface light detection for all of Illinois. By comparing images from two different years, they could pinpoint changes in surface elevation that may indicate the formation of gullies. These identified locations were then filtered and processed to remove direct human intervention like mining, construction, and other activities, as well as to narrow the gully inference to the accuracy of the LiDAR.

Overall, the researchers found 7.4% of the [agricultural land](#) in the study area had an elevated risk of developing gully erosion.

Among all factors considered, the slope, [land use](#), seasonal daily maximum precipitation, and organic matter indicated the highest contribution in predicting the presence of gullies. The researchers also found that spatiotemporal changes in land cover and precipitation were crucial in predicting gully formation in agricultural areas.

Their approach can be applied across agricultural areas in the U.S. Midwest region that share similar land management and environmental variables.

"The main idea is that if we know where gullies are more likely to develop, we can start implementing land management practices," Guzman says. "Many tools and programs are available for [erosion](#) and nutrient management. The challenge is how to optimize these efforts more effectively. Landowners, communities, policymakers, and conservation agencies can use our tools to target programs and processes directing resources where they are most needed."

Study co-authors include Jeongho Han, Jorge Guzman, and Maria Chu.

More information: Jeongho Han et al, Gully erosion susceptibility considering spatiotemporal environmental variables: Midwest U.S. region, *Journal of Hydrology: Regional Studies* (2022). [DOI: 10.1016/j.ejrh.2022.101196](#)

Provided by University of Illinois at Urbana-Champaign

Citation: Gully erosion prediction tools can lead to better land management (2022, November 23) retrieved 29 May 2024 from <https://phys.org/news/2022-11-gully-erosion-tools.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--