

# **An experimental study of gully widening processes via cross-sectional gully analysis**

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## **Abstract**

Gully erosion causes severe soil loss on steep hillslopes on the Loess Plateau in northern Shaanxi Province of China. Therefore, understanding gully erosion processes is important for erosion modeling and control. Gully sidewall expansion is the result of the combined effects of gravitational erosion, water erosion, and a certain degree of randomness, leading to fluctuations in the gully sediment yield. The randomness of occurrence and measurement difficulties have limited further understanding of gully sidewall expansion mechanism. In this study, experiments in a soil flume were designed to analyze the gully widening process in association with gully slope and overland flow discharge by runoff scouring. For each experimental treatment, nine continuous experimental runs were performed and featured three different flow rates and three different slopes. The gully width changed with time and cross section for different slopes and flow rates, and the changes were recorded with a high-resolution camera. We calculated the maximum gully width in all cross sections from gully head to gully outlet with MATLAB code based on the recorded gully width. The results showed that the flow discharge and gully slope gradient are driving factors facilitating the process of gully widening, and the evolution of the maximum cross-sectional gully width exhibited an S-shaped curve. Based on the S-shaped curve fit, a predictive

equation for gully width change over time at the maximum cross-sectional was established and the form of the equation is simple and easy to apply.

**Keywords:** Soil erosion, Gully sidewall expansion, Gully cross-section, Loess plateau