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# Analysis of ephemeral gully erosion in small agricultural watersheds in Iowa (USA)

**Eduardo Luquin**[1], Richard M. Cruse[2], Karl R. Gesch[3], Matthew J. Helmers[4], Henrique G. Momm[5], Robert R. Wells[6], Miguel A. Campo[1], and Javier Casalí[1]

[1]Public University of Navarre, IS-FOOD, Dept. Engineering, Pamplona, Spain (eduardo.luquin@unavarra.es; miguel.campo@unavarra.es; jcs@unavarra.es)

[2]Dep. of Agronomy Iowa State Univ. 2104 Agronomy Hall Ames, IA 50011(rmc@iastate.edu)

[3]Iowa Soybean Association, Center for Farming Innovation, Ankeny, IA 50023 (KGesch@iasoybeans.com)

[4]Dep. of Agricultural and Biosystems Engineering, Iowa State Univ., Ames, IA 50011 (mhelmers@iastate.edu)

[5]Dep. of Geosciences Middle Tennessee State Univ. Kirksey Old Main 322G Murfreesboro, TN 37132 (Henrique.Momm@mtsu.edu)

[6]National Sedimentation Laboratory USDA-Agricultural Research Service 598 McElroy Dr. Oxford, MS 38655 (Robert.Wells@ARS.USDA.GOV)

Ephemeral gullies (EG) are linear erosion features located in swales where surface and/or subsurface runoff concentrate during or immediately after rainfall events. As its name states, EGs are temporary because they are easily filled by conventional machinery, but when filled they reform if the area is not appropriately managed. Downstream water quality issues and decreased soil productivity are the main environmental impacts. EGs are frequently identified as (the most) relevant sediment sources in agricultural areas but their dimensions and particular contribution to the total erosion under different temporal, spatial, climate and land use condition is still unknown. Therefore, the objective of this study is to obtain ephemeral gully erosion rates and estimate the main morphological characteristics of the ephemeral gullies (width, length and depth) and their evolution both in relation to time and position on the landscape.

The studied EGs, B6 with a 0.94 ha watershed and I3 with a 0.95 ha watershed formed in two fields located in the Walnut Creek watershed, Iowa (US). The field-sized watersheds are less than 1.5 Km apart and have similar topography and soils. The cropping system consists of a two-year corn-soybean rotation managed by one farmer using no-till and other standard management practices. EG were measured using close range photogrammetry techniques. In order to achieve a suitable characterization of the EG evolution over time and space, EGs were divided in three sections (bottom, middle and top) of equal length. Photographs were taken at least once in 2013, 2014 and 2018 (a total of five in I3 and three in B6). Cross section profiles along the EG perpendicular to the flow path direction were selected and their width, area and depth were determined from a graphical representation of the cross sections. EG volumes were estimated by the sum of interpolating sequential cross-section areas and multiplying by the distance between them.

Average EG erosion rates during 2013-2014 were 3.19 Mg ha$^{-1}$ year$^{-1}$ for B6 and 3.63 Mg ha$^{-1}$ year$^{-1}$

for I3. Values in agreement with rates estimated by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) of 0.49 to 5.18 Mg $ha^{-1}$ $year^{-1}$ across the USA and other simulated values of 4.00 ± 1.76 Mg $ha^{-1}$ $year^{-1}$ for no till systems in the state of Iowa. The current study shows evidences that EG in no till systems may not stabilize after their formation. EG dimensions (depth, width and length, thus volume) varied over time and space during the continuously monitored period. In general, volumes tend to increase in the middle position while depths decrease in the bottom position. When the EG was filled, it reformed again in approximately the same location showing similar dimensions to that which existed prior to filling.