Gully erosion assessment model with linear or areal development rate on the Loess Plateau

Zhen Li, Yan Zhang[*], Qingke Zhu, Song Yang, Hongjun Li, Huan Ma

Key Laboratory of Soil and Water Conservation and Desertification Combating, Ministry of Education, Beijing

Forestry University, 100083 Beijing, PR China

Gully erosion represents an important sediment source, and changes in gully volume show the contribution of gully erosion to sediment yield. A valid method to assess gully erosion at a large scale is needed. Based a 3-D scanner and QuickBird images with 0.61 m spatial resolution from 2007 and 2013 in one study areas and from 2004 and 2013 in another study area in the central Loess Plateau, this paper aims to characterize bank gully morphology, identify the factors affecting gully volume, and establish a model for assessing gully volume. The results showed that gully volume (V) for 44 bank gullies calculated with a 0.15×0.15 m digital elevation model was closely related to gully length (L) and gully area (A_g). The power function between V and L was of the form $V = aL^b$. The high R^2 value (0.78) indicated that gully length was a good predictor of gully volume; however, compared with the V–L relation, V could be better predicted by A_g by the form $V = 0.2762 A_g^{1.3971}$ ($R^2 = 0.91$), which had a lower mean error and higher Nash–Sutcliffe efficiency. The other advantage of the V–A_g model is that gully area can be easily measured from

[*] Corresponding author. Key Laboratory of Soil and Water Conservation and Desertification Combating, Ministry of Education, Beijing Forestry University, 100083 Beijing, PR China

Postal address: School of Soil and Water Conservation, Beijing Forestry University, No. 35 Tsinghua East Road Haidian District, Beijing, PR China. Tel.: +86 10 62336083. E-mail address: zhangyan9@bjfu.edu.cn.

high-resolution satellite images. Gully erosion on the Loess Plateau of China, accessed with the $V–A_g$ relation and parameters measured from QuickBird imagery, ranged from 0.41 to 36.76 m^3 yr^{-1} and averaged 10.32 m^3 yr^{-1}, which is equivalent to 15480kg yr^{-1}. This study presented a feasible method for assessing gully volume over a large scale with QuickBird images.