

Gully erosion in southeast Nigeria: influence of land-use changes on gully catchment hydrology

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Abstract

Gully erosion leads to soil loss and poses significant threats to availability of land for cultivation, food security and development of infrastructure. Hydrological changes driven by land-use changes are often identified as drivers of gully erosion. The aims of this paper are to assess the influence of changes in land use on gully catchment hydrology and relate these changes to gully erosion. To achieve these aims, we used The Soil Water and Assessment Tool (SWAT, 2012 version) to assess hydrological changes driven by land-use changes in 22 gully catchments in the Orlu region of southeast Nigeria between 2009 and 2018. In the absence of measured hydrological data, we used a mixed-method approach to validate modelling results: literature review, field observations and focus group meetings. Increase in surface runoff estimates was observed in 21 catchments where reductions in fallow cover were observed. In one catchment where increased fallow was observed, we identified reduction in surface runoff. Surface runoff erosion was identified as a dominant process of gully expansion in the study area, but there was no significant relationship between changes in gullied area and changes in runoff volumes ($r^2 = 0.15$, $p = 0.08$). Within-catchment variations in land-use configuration influences surface runoff volumes and pathways, and by extension, gully erosion. This was evident in the slow gully expansion rate/gully reduction identified at gullies with vegetated adjacent lands as opposed to active runoff incision observed in gullies with bare adjacent lands. Therefore, the key finding of this study is that it is important to identify and incorporate the uniqueness of gully catchments in gully management as a successful management technique in a particular catchment may not work in another.

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