

Effect of check dams in gullies on runoff response in the headwaters of Tekeze reservoir

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Abstract

In the Highlands of Northern Ethiopia soil and water conservation (SWC) practices, including construction of check dams in gullies, have been implemented for the last three decades. Despite this extensive installation of check dams; their effects on runoff response is not well understood as compared to other SWC practices. Hence, this study examines the effect of check dams on runoff response in gully channels. 90 degree V-notch flumes were installed to measure a wide range of discharges at the upper and lower sides of five gully reaches (two in sandstone lithology: a gully with check dams and vegetation (SCV) and an untreated gully (S); three in limestone: a gully with check dams and vegetation (LCV), a gully with check dams but no vegetation (LC) and an untreated gully (L)). Automatic e+ WATER 100L sensors were installed to monitor runoff depth from 29 August to 17 September 2014 at one min intervals. All gully reaches were standardized to have equal length (50 m) for analysis. In the sandstone area, the study shows longer lag times of runoff to reach the lower part of the channel in the treated gully (SCV) compared to the untreated gully: lag to production of runoff equals 43%, lag to peak runoff equals 57% and lag to end runoff equals 18%. In the limestone area, lag to production of runoff was greater by 29% and lag to end runoff by 52% at LCV than at LC. Check dams and the sediments deposited behind check dams are responsible for the delay of runoff to reach lower part of the gully channels. These delays also prove that the presence of vegetation in the gully channels retards runoff. The reduction of peak runoff discharge between the upper and lower sides of gullies was greater in the gullies with check dam and vegetation (12% – 24%) than in gullies without treatment (4% – 8%). Reduction of runoff volume was also greater in treated gullies than in untreated gullies. It was reduced by 16%, 10% and 9% in SCV, LCV and LC, respectively while it was only reduced by 7% in S and 4% in L gully. This study shows that implementation of check dams combined with vegetation considerably reduced peak discharge and volume of runoff as large portions of water infiltrated in the sediments accumulated behind the check dams. As check dams are implemented in a large part of the gullies in the Tekeze basin, this leads ultimately to improved baseflows and a better spreading of the river discharges into the Tekeze reservoir.

Keywords: Gully control, lag time, Northern Ethiopia, peak runoff discharge, runoff volume, Tekeze basin